

Proceedings of the 22nd European Conference on e- Learning ECEL 2023



Hosted by the University of South Africa
26-27 October 2023

Edited by
Dr Sarah Jane Johnston
Dr Shawren Singh

Proceedings of the

22nd European Conference on e-Learning

ECEL 2023

Hosted by

University of South Africa

26- 27 October 2023

Copyright the authors, 2023. All Rights Reserved.

No reproduction, copy or transmission may be made without written permission from the individual authors.

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

ACIL 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/>

Self-Archiving and Paper Repositories

We actively encourage authors of papers in ACIL conference proceedings and journals to upload their published papers to university repositories and research bodies such as ResearchGate and Academic.edu. Full reference to the original publication should be provided.

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 <https://papers.academic-conferences.org/>

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

Electronic ISBN: 978-1-914587-91-7

Electronic ISSN: 2048-8645

Print version ISBN: 978-1-914587-90-0

Print Version ISSN: 2048-8637

Published by Academic Conferences International Limited

Reading, UK

www.academic-conferences.org

info@academic-conferences.org

Contents

<u>Preface</u>	v
<u>Committee</u>	vi
<u>Biographies</u>	ix
<u>Academic papers</u>	
<i>Soft Skills Demand and Supply Through the Lens of Higher Education Students</i> Naghmeah Aghaee, Thashmee Karunaratne	1-10
<i>Intelligent Adaptive E-Learning Systems: Current Approaches, Architectures, and Applications</i> Abbas Fadhil Aljuboori, Hala Al-lawati	11-16
<i>A Framework for Assessing the Complexity of Auto Generated Questions from Ontologies</i> Samah Alkhuzaey, Floriana Grasso, Terry Payne, Valentina Tamma	17-24
<i>Redesigning Professional Development on Digital Transformation Using Andragogy as a Theoretical Lens</i> Linda Bergkvist, Karin Ahlin, Niklas Humble, Peter Mozelius, John Johansson	25-32
<i>Impact of Digital Literacy on Cyberloafing and Compulsive Social Media Use Post-Kahramanmaraş Earthquake</i> Mehmet Ali Canbolat	33-38
<i>Preliminary Findings of the Needs Perceived and Expectations of Users of an Independent Learning Centre Survey in Hong Kong: What do They Tell Us?</i> Felix Chao, Yvonne Loong, Ocean Siu, Sharon Wong, Parker Chan	39-50
<i>Lasting Effects: What the Post Pandemic Return to In-person Teaching Tells Us About the State of e-Learning and its Future Trajectory</i> Paula Charbonneau-Gowdy, Mónica	51-60
<i>Analysing Gaming Behaviour: Insights on Personality Traits</i> Aikaterina Chatziavgeri, Maya Satratzemi	61-68
<i>Students' Acceptance Of Digital Exams: A Case Study In A Swedish University</i> Panagiota Chatzipetrou, Kristijan Majkic, Jonas Samuelsson, Oskar Åberg	69-77
<i>Are the Effects of COVID-19 on Inequality in Tertiary Education in Ghana Gendered?</i> Paul Nkegbe, Stanley Dary, Halidu Musah	78-87
<i>e-Learning Interactions and Academic Outcomes: an Analysis of Undergraduates in Sri Lanka</i> Tiloka de Silva, Buddhika Karunarathne, Vishaka Nanayakkara, Buddhika Karunarathne, Malik Ranasinghe, Eshana Ranasinghe	88-96
<i>Bridging contemporary theory with online practice: The sustained impact on student identities</i> Caroline Galdames, Paula Charbonneau-Gowdy	97-105
<i>Is this an e-School? e-Learning Using Information Communication Technologies in South Africa</i> Mandlenkosi Thwala, Leila Goosen	106-113
<i>Digital Addiction and Financial Literacy: A Study on University Students</i> ABDURRAHMAN GUMRAH, Hüseyin Karagöz	114-120

<i>ChatGPT-Proofing: Redesigning Assessment Practices for E-Learning</i> Tapiwa Gundu	121-130
<i>Challenges of Using Social Media as a Teaching Tool in Secondary Schools</i> Rafeeq Jaffer, Zane Davids, Lisa Seymour	131-138
<i>Analysis of the factors affecting successful completion of asynchronous online learning programs</i> Buddhika Karunaratne, Vishaka Nanayakkara, Eshana Ranasinghe, Malik Ranasinghe, Supunmali Ahangama, Sandareka Wickramanayake, Chathuranga Hettiarachchi	139-146
<i>Is it the new Google: Impact of ChatGPT on Students' Information Search Habits</i> Thashmee Karunaratne, Adenike Adesina	147-155
<i>Exploring the Student Perspective: Assessing Technology Readiness and Acceptance for Adopting Large Language Models in Higher Education</i> Claudia Lemke, Kathrin Kirchner, Liadan Anandarajah,	156-164
<i>Assessment of Academic ESL Writing in an Online Tutorial for Graduate Students</i> Zhi Li, Veronika Makarova, Zhengxiang Wang	165-173
<i>A Systematic Review: criteria and dimensions of learning experience</i> Ying-Dong LIU, Simon MORARD, Dina ADINDA, Eric SANCHEZ, Marc TRESTINI	174-182
<i>Online Modules Discussion Forums: A Pedagogical Platform Facilitating Learning in DE Environments</i> Dumisani Godfrey Mabasa	183-192
<i>Implementation of a Multilingual Booklet to Accommodate First-Year Students with Academic Work</i> Vuyokazi Mntuyedwa, Moeketsi Letseka, Johannes Cronje	193-201
<i>Robot-Assisted Language Education and Speech Therapy for Children with Cleft Lip and Palate</i> Aveen Najm, Eysin Chew, Barry Bentley	202-211
<i>Characteristics promoted in order to develop student's critical thinking disposition in online discussions during a fully online course</i> Minoru Nakayama, Satoru Kikuchi, Hiroh Yamamoto	212-218
<i>Student Perspectives on WhatsApp Support for Developing School Experience e-Portfolios on Google Sites</i> Professor Nkonki, Ms Tsipa-Booi , Ms Bongo Mqukuse	219-225
<i>Using Gamification to Develop Students As Strategic Thinkers – A Qualitative Perspective</i> Michael O'Brien, Yvonne Costin	226-233
<i>Challenges for implementing design thinking for social innovation: Case study during online learning</i> Fazlyn Petersen, Matthew Liam Killian	234-243
<i>Boosting Digital Entrepreneurship in European Union Higher Education</i> Ioana-Crina Pop-Cohuț, Anca-Otilia Dodescu	244-251
<i>Curriculum design in higher education: A reflection</i> Kemlall Ramsaroop Ramdass, Kgabo Mokgohloa	252-260
<i>Knowledge building through academic development</i> Kemlall Ramsaroop Ramdass	261-269

<i>A Comprehensive Analysis on the Student Behaviour in Open.uom.lk: A Large-scale Asynchronous Open Online Platform</i>	
Eshana Ranasinghe, Vishaka Nanayakkara, Buddhika Karunaratne, Malik Ranasinghe, Buddhini Gunarathna, Sumudu Jayathissa, Tiloka de Silva	270-279
<i>Does “one size” fit all? Comparing video-feedback in different courses</i>	
Tone Vold, Ole Jørgen Ranglund, Monica Lervik	280-285
<i>Impacts of COVID-19 on Higher Education in Developing Countries and the Strategy of Using ICTs for e-Teaching from Catholic University of Mozambique</i>	
Domingos Rhongo, Bianca Gerente	286-294
<i>Can Academic Librarians as Data Scientists Revolutionise User-Centric E-learning?</i>	
Hazia Sa'ari, Anne Goulding, Mohd Dasuki Sahak	295-304
<i>Meeting the demands of industry: A study on identifying and teaching emerging technologies in Engineering Education</i>	
Bronwyn Claudia Swartz, Sweta Patnaik	305-313
<i>What Have People Discussed about ChatGPT in Malaysian Education? A Qualitative Content Analysis of News Articles</i>	
Chun Meng Tang, Lee Yen Chaw	314-321
<i>Asynchronous e-learning: A collaborative, process-based solution for design and development challenges</i>	
Dilini Lakma Thoradeniya, Malik Ranasinghe, Vishaka Nanayakkara, Buddhika Karunaratne, Eshana Ranasinghe, Gaindu Saranga Jayathilaka, Niranjana Gunawardena	322-330
<i>Investigating Effective Ways to Use Artificial Intelligence in Teacher Education</i>	
Nyarai Tunjera, Agnes Chigona	331-340
<i>Exploring the Validity of Continuous Assessment in a First-Year Programming Course at a Comprehensive Open Distance e-Learning University</i>	
Dalize van Heerden, Mmafani Serote	341-347
<i>School Reading Lists and Understanding Written Information for Life and Work</i>	
Dana Vicherková, Veronika Murinová, Nela Nováková	348-357
<i>HyFlex learning as support for lifelong learning</i>	
Tone Vold, Linda V. Kiønig	358-363
<i>Using Video-Feedback to Support Learning Outcome and Work-life Relevance</i>	
Tone Vold, Ole Jørgen Ranglund, Linda V. Kiønig	364-368
<i>Facilitating Lifelong Learning for Mature Part-time Students: Findings from South Africa and Norway</i>	
Tone Vold, Ann Lourens, Linda V. Kiønig, Curwyn Mapaling	369-374
<i>A Review of Tools for the Design and Development of Online Interactive Gamified Content : A Simulation Study</i>	
Ludmila Walaszczyk	375-382

PhD Papers

Student Notetaking media in Higher Education
Colin Loughlin 384-389

Towards a brain-compatible approach for online programming education through CHAT
Vuyolwethu Mdunyelwa, Lynn Fitcher, Johan van Nierkerk 390-398

Masters Papers

Technology-Based Strategies Predicated on Self-Regulated Learning in a Flipped Computer Programming Classroom
Simphiwe Dayimani, Keshnee Padayachee 400-408

Late Submissions

Edtech Startups: Determining the factors involved in internationalisation
Keila Malca-Ramirez, Linda Marita Cruz-Pupuche, Franklin Cordova-Buiza 410-417

Empowering Deaf Learners: The Promise of Sign Language MOOCs
Paula Escudeiro Maria de Sá Escudeiro, Márcia Campos 418-421

Learning with Moodle and Google Drive: instrumental conflicts in question
zeller arnaud, Marquet Pascal 422-427

ECEL Preface

These proceedings represent the work of contributors to the 22nd European Conference on e-Learning (ECEL 2023), hosted by University of South Africa, Pretoria, South Africa on 26-27 October 2023. The Conference Co-Chairs Associate Professor Sarah Jane Johnston and Associate Professor Shawren Singh both from University of South Africa, Pretoria, South Africa.

ECEL is now a well-established event on the academic research calendar and now in its 22nd 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.

It is especially relevant that the conference is being hosted by UNISA this year as the university celebrates its 150th anniversary. UNISA has been a pioneer in first distance and now e-Learning. The conference will also host the final round of the 9th e-Learning Excellence Awards where innovative case histories will be presented.

The opening keynote presentation is given by Professor Thenjiwe Meyiwa, Vice Principal for the Research, Postgraduate Studies, Innovation and Commercialisation at University of South Africa who will speak on, “The Role of African Feminisms in Shaping a Sustainable Future of Being and Learning”. An afternoon keynote on Thursday will be made by Dr Zolile Martin Mguda, University of South Africa on the topic of “ChatGPT: The first year”. The second day of the conference will open with an address by Dr Isabel Tarling, MD, Limina, South Africa with the title “Developing Digital Standards for Learning and Teaching in South Africa’s Schools”.

With an initial submission of 100 abstracts, after the double blind, peer review process there are 45 Academic research papers, 3 PhD research papers and 1 Masters Research paper published in these Conference Proceedings. These papers represent research from Belgium, Canada, Chile, Czech Republic, France, Germany, Ghana, Greece, Hong Kong, Ireland, Japan, Malaysia, Mozambique, Norway, Oman, Perú, Poland, Portugal, Romania, Singapore, South Africa, Sri Lanka, Sweden, Switzerland, Turkey and the United Kingdom.

We hope you enjoy the conference.

Sarah Jane Johnston and Shawren Singh

University of South Africa,
Pretoria, South Africa
October 2023

ECEL Conference Committee

Prof Sara A. Abdoh, Faculty of Applied Arts, Benha university, Egypt, egypt; Dr Adrian Adascalitei, Technical University Gh. Asachi Iasi, Romania; Dr Dina Adinda, Paris Nanterre University, France; Dr Wilfried Admiraal, Leiden University, Leiden, The Netherlands; Prof Megha Ainapurkar, Padre Concicao College of engineering Goa, INDIA; Prof Hamid Alasadi, Iraq University College, Iraq; Dr Ali Alawneh, Philadelphia University, Jordan; Prof Abbas Aljuboori, University of Information Technology and Communications, Iraq; Prof Stephen Alstrup, Department of Computer Science, University of Copenhagen, Denmark; Paulo Alexandre Vara Alves, Instituto Politécnico de Bragança, Bragança, Portugal; René Holm Andersen, University College of Northern Denmark, Aalborg, Denmark; Prof Antonios Andreatos, Hellenic Air Force Academy, Greece; Prof Mohamed Arteimi, Libyan Academy of Graduate Studies, Libya; Marc Augier, SKEMA Business School, France; Prof Liz Bacon, University of Abertay, Dundee, UK; Prof Alina Badulescu, University of Oradea, Romania; Dr S.R. Balasundaram, NIT TIRUCHIRAPPALLI, INDIA; Dr Nimalathasan Balasundaram, University of Jaffna, Sri Lanka; Dr Joan Ballantine, University of Ulster, UK; Prof Gezani Baloyi, University of South Africa, South Africa; Dr Wendy Barber, University of Ontario Institute of Technology, Canada; Dr Trevor Barker, University of Hertfordshire, UK; 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; Dr Ivana Bogdanovic, University of Novi Sad, Serbia; 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; Mie Buhl, Aalborg University Copenhagen, Netherlands; Prof Carsten Busch, University of Applied Sciences HTW Berlin, Germany; Prof Kiyomet Caliyurt, Trakya University, Turkey; Dr Sancha Campanella, Instituto Superior de Administração e Línguas, Portugal; Prof Piedade Carvalho, ISEP, Porto; Dr Ivana Cechova, University of Defence, Czech Republic; Maria Celentano, University of Lecce, Italy; Felix Chao, The Chinese University of Hong Kong, New Territories, Hong Kong; Dr Valentina Chappell, Friends University, USA; Dr Paula Charbonneau-Gowdy, Universidad Andres Bello, Chile; Satyadhyam 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 Barbara Class, University of Geneva, Switzerland; Prof Dr Jürgen Cleve, Wismar University, Germany; 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 Sara Cruz, Polytechnic Institute of Cávado and Ave, Portugal; Dr Marija Cubric, University of Hertfordshire, UK; Ken Currie, CAPDM Ltd, UK; Dr Fisnik Dalipi, Linnaeus University, Sweden; Dr Susanne Dau, University College of Northern Denmark, Denmark; Dr Antonio de Castroavc, Instituto Superior de Engenharia do Porto (ISEP), Portugal; 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 Rajiv Dharaskar, GH Rasoni College of Engineering, Nagpur, India; 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 Elaïess, University of Benghazi, Libya; Khristin Fabian, Perth College UHI, UK; Dr Samson Fabiyi, University of Leeds, UK; Prof Gert Faustmann, Berlin School of Economics and Law, Germany; Prof Manuela Fernandes, Polytechnic Institute of Tomar, Portugal; Dr Rachel Fitzgerald, University of Queensland, Australia; Dr Panagiotis Fotaris, Brighton University, UK; Dr Michelle French, University of Toronto, Canada; Dr Václav Friedrich, VSB - Technical University of Ostrava, Czech Republic; Dr Vilas Gaikar, Smt. CHM. College, University of Mumbai, India, India; Thomas Goetz, Hokusei Gakuen University, Sapporo, Japan; 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; Dr Prakruthi Hareesh, Birla Institute of Technology and Science, Pilani, India; Muhammad Said Hasibuan, Institute Business and Informatics Darmajaya, Indonesia; Anita Hiralaal, Durban University of

Technology, South Africa; Dr Md. Fokhray Hossain, Daffodil International University (DIU), Bangladesh; Dr Maggie Hutchings, Bournemouth University, UK; Dr Maria Impedovo, Aix-Marseille Universite, France; Dr Ilknur Istifci, Anadolu University, Turkey; Dr Eunice Ndeti 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; Prof Aman Jatain, Amity University, India; Kanthi Jayasundera, Simon Fraser University, Canada; Amor Jebali, King Abdulaziz University, Saudi Arabia; Runa Jesmin, Global Heart Forum, UK; Prof Paul Jones, Swansea University, UK; Geraldine Jones, University of Bath, UK; Dr Jowati Juhary, National Defence University of Malaysia, Malaysia; Dr Dorela Kaçauni, Fan S. Noli University, Albania; Prof Leila Kajee, University of Johannesburg, South Africa; Dr Michail Kalogiannakis, University of Crete, Faculty of Education, Greece; Dr Elisabeth Katzlinger, Johannes Kepler University, Austria; Dr Andrea Kelz, University of Applied Sciences Burgenland, Campus Pinkafeld, Austria; Prof Jesuk Ko, Universidad Mayor de San Andres (UMSA), Bolivia; Blair Kuntz, University of Toronto, Canada; Iain Lambie, Glasgow Caledonian University, UK; 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; Eddy K. W. Li, Faculty of Education, University of Cambridge, UK; Dr Pinte Lin, University of Reading, United Kingdom; Prof Ana Paula Lopes, Polytechnic of Porto (P.Porto)/ISCAP, Portugal; Jenny Lorimer, University of Hertfordshire, UK; Ana Loureiro, Polytechnic Institute of Santarem - School of Education, Portugal; Prof Sam Lubbe, NWU, South Africa; Dr Robert Lucas, Keylink Computers Ltd, Kenilworth, UK; Dr Magdalena Maciaszczyk, Lublin University of Technology, Polska; 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; Dr Chittaranjan Mandal, Dept of Computer Sc & Engg, IIT Kharagpur, India; Dr Arianit Maraj, AAB College-Faculty of Computer Sciences, Kosovo; Tobi Mark, The Michener Institute of Education at UHN, Toronto, Canada; Dr Bertil P. Marques, GILT/ISEP, Portugal; Dr Lindsay Marshall, Newcastle University, UK; Dr JOSÉ ALBERTO MARTÍNEZ, UNIVERSIDAD DE LA LAGUNA, SPAIN; Dr Maria J Martinez-Arguelles, Universitat Oberta de Catalunya, Spain; Linda Joy Mesh, Università degli Studi di Siena, Italy; Bente Meyer, Aalborg University Copenhagen, Denmark; Julia Mingullon, Universitat oberta de catalunya, Spain; Prof Luisa Miranda, Polytechnic Institute of Bragança, Portugal; Dr Ali Moeini, Prague, Czech Republic, Iran; David Moffat, Glasgow Caledonian University, UK; Dr Begoña Montero-Fleta, Universitat Politècnica de Valencia, Spain; Prof Lina Morgado, Universidade Aberta, Portugal; Jolanda Morkel, Cape Peninsula University of Technology, South Africa; Peter Mozeliuss, Mid-Sweden University, Sweden; Ayanda Msomi, Nelson Mandela University, South Africa; Dr Minoru Nakayama, Tokoyo Institute of Technology, Japan; Dr Michaela Nettekoven, WU Vienna University of Economics and Business, Austria; Dr Annie W.Y. Ng, City University of Hong Kong, Hong Kong; Prof Dick Ng'ambi, University of Cape Town, South Africa; Prof Emanuela-Alisa Nica, Center for Ethics and Health Policy and Petre Andrei University from Iasi, Romania; Assc Nanuli Ninashvili, Tbilisi State Medical University, Georgia; Dr Susanna Nocchi, Dublin Institute of Technology, Ireland; Dr Chetsada Noknoi, Thaksin University, Songkhla, Thailand; Prof Jarmila Novotná, Charles University, Czech Republic; Dr Kamila Olševicová, Univeristy of Hradec Kralove, Czech Republic; Maria Osuna Alarcón, Salamanca University, Spain; Dr Abdul Jalil Othman, Faculty of Education, University of Malaya, Malaysia; 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; Dr Stamatis Papadakis, University of Crete, Greece; Prof Kyparisia Papanikolaou, School of Pedagogical and Technological Education, Greece; Dr Iraklis Paraskakis, South East European Research Centre (SEERC), Thessaloniki, Greece; Dr Marcello Passarelli, National Research Council of Italy, Italy; Dr Ayyub Patel, King Khalid University College of Medicine Biochemistry, 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 Didattiche-Consiglio Nazionale Ricerche, Genova, Italy; Dr Christopher Perumalla, University of Toronto, Canada; Dr Johan Petersson, Örebro University School of Business, Örebro, Sweden; Prof Nazanin Pilevari, Islamic Azad University, Iran; Prof Mário Pinto, Polytechnic

Institute of Porto, Portugal; Prof Selwyn Piramuthu, University of Florida, Gainesville, USA; Assc Isabel Pitacas, Polytechnic Institute of Tomar, Portugal; Dr Toomas Plank, University of Tartu, Institute of Physics, Estonia; Prof Maria Popescu, Carol I National Defense University, Romania; Dr Francesca Pozzi, ITD-CNR, Italy; Susannah Quinsee, City University, London, UK; Dr Bilba Radu, George Bacovia University, Romania; Abdul Rafay, Asia Pacific University College of Technology & Innovation, Malaysia; Dr Prasanna Ramakrisnan, Universiti Teknologi MARA (UiTM), Malaysia; Prof Kemlall Ramsaroop Ramdass, Unisa, South Africa; Prof Pongsak Rattanachaikunsopon, Ubon Ratchathani University, Thailand; Dr Liana Razmerita, Copenhagen Business School, Denmark; Prof Asmaa Retbi, Mohammadia School of Engineers, Mohammed V University in Rabat, Morocco; Prof Sandra Ribeiro, ISCAP-IPP, Portugal; Hugo Ribeiro, University of Porto, Portugal; Prof Cristina Rodrigues, University of Minho, Portugal; Sumowalt Roosevelt, Liberia Initiatives For Fostering Empowerment, Inc., Liberia; Dr Joanna Rosak-Szyrocka, Częstochowa University of Technology, Poland; Dr Eleni Rossiou, University of Macedonia, Greece; Dr Danguole Rutkauskiene, Kaunas University of Technology, Lithuania; Prof Abdel-Badeeh Salem, Ain Shams University, Cairo, Egypt; David Sammon, University College Cork, Ireland; Prof Vitor Santos, New University of Lisbon, Portugal; Dr Paulus Insap Santosa, Gadjah Mada University, Indonesia; Prof Maya Satratzemi, University of Macedonia, dept of Applied Informatics, Greece; 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 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 Susana Silva, School of Hospitality and Tourism, Institute Polytechnic of Porto, Portugal; Dr Gurmeet Singh, The University of The South Pacific, Suva, Fiji; Dr Deena Slockett, ADU (Adventist University of Health Sciences), USA; Dr Alisdair Smithies, Imperial College London, UK; Dr Keith Smyth, University of the Highlands and Islands, UK; Bent Soelberg, South Danish Education Center (SDE), Denmark; Dr Yeong-Tae Song, Towson University, Maryland, USA; Dr Michael Sonntag, FIM, Johannes Kepler University, Linz, Austria; Dr Sonia Sousa, Tallinn University, Estonia; Dr Rumen Stainov, University of Applied Sciences, Fulda, Germany; Martin Steinicke, University of Applied Sciences HTW Berlin, Germany; 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; Christopher Turner, University of Winchester, UK; Diane Tyczynski, Michener Institute of Education at UHN, Toronto, Canada; 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 Vleira, Polytechnic of Porto, Portugal; Dr Porawat Visutsak, Faculty of Applied Science, King Mongkut's University of Technology North Bangkok, Thailand; Elaine Walsh, University of Limerick, Ireland; Dr Philip Wilkinson-Blake, Loughborough University, UK; Dr Sheryl Williams, Loughborough University, UK; Dr Suzie Xiangping, University of Hertfordshire, Hatfield, UK; Dr Panagiotis Zaharias, Open University of Cyprus, Greece; Dr Justyna Żywiłek, Częstochowa University of Technology, Poland.

Biographies

Conference and Programme Chairs



South Africa (USAf) Community of Practice for Postgraduate Education and Scholarship (CoP PGES).

Associate Professor Sarah Jane Johnston is a mathematician with research interests in Orthogonal Polynomials and Special Functions. She joined the University of South Africa (Unisa) in 2012 as an Associate Professor after studying and working at the University of the Witwatersrand, Johannesburg and the University of Central Florida in the USA. She became the Chair of the Department of Mathematical Sciences at Unisa for four years and is now the Head of the office for Research and Graduate Studies for the College of Science, Engineering and Technology at Unisa. She is an active member of the South African Mathematical Society (SAMS), is also a HELTSA TAU Fellow and a member of the Universities



Computing at the University of South Africa.

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

Keynote Speakers



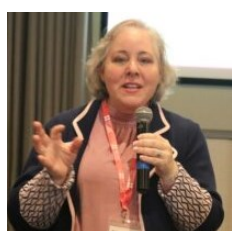
Department of Mathematical Sciences. He has a soft spot for educational outreach and particularly using Science to teach learners how to learn and how to think.

Zolile Martin Mguda was born in the then Port Elizabeth in the township of Kwazakhele. In his early years he moved around several towns in the Eastern Cape due to the riots of the early 80s. In his own words, “I went to 9 schools between the late 70s and 1990 and this, besides royally disrupting my education, taught me the importance of an education as the sacrifices made by my parents to ferret me out of rioting areas to the rural areas were consistently made to secure my educational future.” Zolile subsequently graduated with a BSc (Hons) in Applied Mathematics at the University of Fort Hare and a PhD in Astronomy from the University of Cape Town. He is currently lecturing in the University of South Africa’s



leadership and mentorship record with a strong focus on social science research in general and indigenous knowledge systems. Meyiwa has worked in South Africa and internationally with organisations and research teams ranging from government organisations, universities, and human rights NGOs. She has also served on the National Heritage Council and the South African National Heraldry Council as Chairperson.

Professor Thenjiwe Meyiwa, a feminist scholar, is part of the Executive Management of the University of South Africa, serving as Vice Principal for the Research, Postgraduate Studies, Innovation and Commercialisation portfolio. She has also served as a university registrar at DUT. Meyiwa has extensive experience in higher education, as a teacher, researcher and in administration. Prior to her appointment at UNISA she worked at various higher education institutions, including the Human Sciences Research Council (HSRC) as a senior manager and researcher. Meyiwa has an impeccable academic,



Councils across Africa and researchers in different countries with the skills to produce and evaluate excellence

Dr Isabel Tarling is a learning science scholar and digital learning specialist. She holds a PhD in Education Technologies and Teacher Professional Development from UCT, and is director of Limina Education Services. Since 2015, she has consulted on various local and international projects for UNESCO, the GIZ, common sense, GOPA and most recently the British Council. This has variously included developing web-based training courses, conducting research, and monitoring and evaluation of learning projects. In 2019 she started working with the Association of African Universities to empower Science Granting

in research. She is widely published in peer reviewed journals, books and other publications. She currently leads the research component of the Digital Standards Project, a co-creative collaboration between diverse stakeholders in education to develop digital standards for different role players in the sector. Dr Tarling is active on LinkedIn and Facebook under the handle @isabeltarling.

Mini-Track Chairs



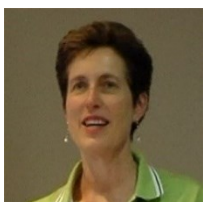
Prof. Dr. Abbas Fadhil Aljuboori is working currently at Al Zahra College for women, Information Technology Department, Muscat, Sultanate of Oman as a faculty Staff Member. He has a Ph.D. in Computer Science from Dongguk University, SOUTH KOREA. Fulbright Visiting scholar – University of Central Oklahoma – Edmond – USA –2017. International Advisory Board Member for CT University in India. His field of Interest are in Data Mining, Web Applications, Big Data, Data Security, Information Systems, Social Media Analysis, and Smart Applications. He is a Member of several of Academic and Professional Societies. He is an Editor-in-Chief, Editorial Board Member and Reviewer of many eminent International Journals and Conferences worldwide.



Dr Adrian A. Adascalitei is Professor at Technical "Gh. Asachi" University and at "Al. I. Cuza" University, Iasi, Romania. His specialist area is Blended STEM Teaching and Learning. He is a certified student teachers' trainer, reviewer in international journals and conference proceedings and member of scientific associations. He has authored and co-authored various papers in International and European conferences and journals. His research focuses on blended learning, use of virtual laboratories in STEM Education.



Dr Xiangping Du is a principal lecturer in Business Analytics and Systems and Deputy Associate Dean Postgraduate Student Experience at Hertfordshire Business School, University of Hertfordshire, UK. She received her PhD in education in 2005. Her current research focuses on learning and teaching pedagogy and student learning experience in higher education.



Dr Patricia M Gouws (PhD Information Systems) is a Senior Lecturer in the School of Computing (Department of Information Systems) at the University of South Africa. She has spent more than 20 years teaching and research programming. She is also the project leader for the Inspired towards Science, Engineering and Technology (I-SET) robotics project. The I-SET engaged scholarship flagship project has been using robotics to inspire science since 2009. The project is part of the Unisa Science Engagement Centre (USEC), a national accredited science center of South Africa, of which Dr Patricia M Gouws is the Director.



Dr Joanna Rosak-Szyrocka, is a Lecturer at Częstochowa University of Technology in Poland, the Vice President of the Qualitas Foundation and a member of the Polish ISO 9000 Forum Club. Joanna has authored/co-authored 221 scientific publications in prestigious journals, chapters in monographs and conference materials as well as co-authoring 20 scientific monographs. She has been a participant of the Erasmus + international exchange, during which she conducted a series of international lectures in England, Slovenia, Slovakia and Italy.



Dr Justyna Żywiołek is a doctor of engineering at the Faculty of Management of the Częstochowa University of Technology. She deals with the management of information and knowledge, and their security. Justyna is also a personal data protection inspector and an auditor of the ISO 27000 standard. She is interested in the use of Big Data, Internet of Things for security management systems. She is guest editor of many international magazines. Justyna is the co-author of over 150 publications, including articles published in peer-reviewed journals, book chapters, conference materials, and research reports.

Author Biographies

Dina Adinda holds a Ph.D. in Education Sciences. Associate professor of Education, she is also manager of an undergraduate online training program at the University Paris Nanterre. Her research interests include digital technology for teaching and learning, mentoring strategies, learners' self-direction, higher education and adult learning.

Naghmeh Aghaee, PhD., is a senior lecturer and researcher within information systems at the department of Informatics, at Lund University in Sweden. Naghmeh (Nam) is mainly teaching and conducting research in Designing and Managing Digitalisation and Digital Transformation, Modelling, IS design and management, UX design, and Educational Technology.

Samah AlKhuyaey is a PhD student of Computer Science at the University of Liverpool, UK. She works as a faculty member at the department of Computer Science at Umm Al-qura University, Saudi Arabia. She received her MSc in Web Science from the University of Southampton in 2019. Her main research areas are the application of Artificial Intelligence in Education.

Ahmet Burhan Çakıcı is a professor of individual and society problems at Karamanoglu Mehmetbey University, TURKEY. He received his PhD in management sciences from Selcuk University in 2012. He participated in many international meetings as a speaker and took part in many projects. His main research areas are organizational behavior, management and strategy.

Mehmet Ali Canbolat is a assist professor of management of organization at Karamanoglu Mehmetbey University, TURKEY. He received his PhD in management sciences from Selcuk University in 2022. He participated in many international meetings as a speaker and took part in many projects. His main research areas are organizational behaviour, strategic management and entrepreneurship.

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

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

Aikaterina Chatziavgeri received a B.Sc. in Applied Informatics from the University of Macedonia (UoM) in 2020. She is a M.Sc. student in Artificial Intelligence and Data Analytics in the University of Macedonia. She is primarily interested in game development, 3D graphics, serious games and data analytics.

Panagiota Chatzipetrou is an Associate professor at Department of Informatics, Örebro University School of Business, Sweden. Her research interests include applications of statistical methods to quality problems in software engineering. Moreover, she has been working with decision support systems, large-scale agile (and global) software development, and behavioural software engineering. Contact her at panagiota.chatzipetrou@oru.se

Stanley Kojo Dary is an Associate Professor of Agricultural and Applied Economics in the Department of Economics, Simon Diedong Dombo University of Business and Integrated Development Studies (SDD-UBIDS), Wa, Ghana. His research areas are in agricultural finance, agro-food industry innovation, agricultural cooperatives, and rural development and welfare.

Zane Davids is a lecturer in Information Systems at the University of Cape Town with over 10 years' experience in academia. His current research interest focuses on the use of digital technologies in education specifically e-learning strategies. Currently supervising several postgraduate candidates, and with several publications in both peer-reviewed journals and conference proceedings.

Simphiwe Dayimani is a dedicated Masters student at the University of South Africa (UNISA), working in Technical Vocational Education and Training with a research focus in Computing. Passionate about integrating technology into vocational education, Simphiwe explores innovative approaches to teaching computing skills and curriculum design.

Tiloka de Silva is a senior lecturer at the Department of Decision Sciences, University of Moratuwa, Sri Lanka. She received her PhD in economics from London School of Economics and Political Science in 2011. Her main research areas are learning analytics, education economics, and development economics.

Maria Denami is an Associate Professor in Education and Training Sciences. Interested in Higher Education Pedagogy, her main research topic is the process of professionalisation of students and their support to the development of professional skills. In this sense, her research objective is to understand how experiential learning combined with reflexivity support leads to the awareness/development of students' professional competences. She is a member of the Learning, Teaching and Education Practices team at LISEC. Maria Denami has worked for three years in the Student Success Unit and has designed and managed various projects to support integration and success.

Gregory Doyle is a PhD student in the School of Education and the E-Learning Manager at the University of Cape Town's Faculty of Health Sciences, with over a decade of service. A Rhodes University alumnus and former high school teacher, Greg specializes in educational technologies. He has published in various journals and presented at conferences focusing on staff development, open educational resources, and blended learning.

Xiangping Du is a principal lecturer and Deputy Associate Dean Postgraduate Student Experience at Hertfordshire Business School, University of Hertfordshire, UK. She received her PhD in education in 2005. Her current research focuses on learning and teaching pedagogies, blended learning, MOOCs, learning technologies, student engagement and learning experience in higher education.

Paula Escudeiro, Professor at the School of Engineering of Polytechnic University of Porto, Ph.D. in Computer Science/ Information Technology in Education. Director of the Research Unit GILT - Games Interaction & Learning Technologies. External Evaluator/Expert for the European Commission and associated agencies. Researcher and coordinator in the field of Learning Technology, with vast experience in project coordination and evaluation. Chair of several events to promote Learning and Inclusive Technology. Editor of several journals and Books. Author of over 100 scientific articles in the field of Education Technology. Author of Patent Bidirectional Translator of Sign Language

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

Leila Goosen is a professor at the University of South Africa. She received her PhD in computer sciences from North-West University in 2004. She has been involved in organising several regional and international conferences. Her main research areas are e-schools and e-learning, Information and Communication Technologies (ICTS) in education, as well as ICTs for Development.

Maike Grammens is currently working on her PhD project at the Department of Educational Studies at Ghent University and in function of the company d-teach. The main aim of her PhD project is to identify and measure the competences needed for teaching synchronously online through videoconferencing technology in order to support teachers' professional development.

Abdurrahman GÜmrah is an associate professor of accounting of organization at Selcuk University, TURKEY. He received his PhD in accounting and audit sciences from Nevsehir Haci Bektas Veli University in 2018. He participated in many international meetings as a speaker and took part in many projects. His main research areas are sustainability reporting, audit and cost accounting.

Tapiwa Gundu, a Senior Lecturer at Nelson Mandela University in Gqeberha, South Africa, specialises in Information Security. With a focus on the human dimension, he passionately lectures Information Security

related modules. His research delves into the intricate realm of information/cybersecurity, reflecting his commitment to safeguarding digital landscapes and the people within them.

Sumudu Jayathissa is an instructor at the Centre for Open and Distance Learning of the University of Moratuwa. She received her Bachelor of Science (BSc.) from Wayamba University of Sri Lanka

John Johansson has a Bachelor's degree in information systems from Karlstad University. In his work as lecturer at Karlstad University Johansson teaches advanced-level courses in project management and holds courses in Agile project management and practical pedagogy for the business community. Johansson is co-writer of two books, one on leadership and reflection, and one on recruitment.

Tomas Kaqinari is an educational scientist and scientific coordinator at the University of Basel. His research is focused on transformative online teaching practices in disruptive times, identifying individual and institutional factors that influence them. Concurrently, he's involved in strategic planning, program development, and quality assurance in higher education.

Buddhika Karunaratne is a senior lecturer at the Department of Computer Science and Engineering, University of Moratuwa Sri Lanka. He is also serving as the deputy director at the Centre for Open and Distance Learning (CODL), University of Moratuwa, Sri Lanka. His research interests include speech processing, voice biometrics and learning analytics.

Thashmee Karunaratne, PhD., is an associate professor and a project leader in the Department of Computer and Systems Sciences (DSV), Stockholm University and a researcher in the Department of Digital Learning in the Royal Institute of Technology (KTH), Sweden. Thashmee is conducting research mainly in Digital Transformation in Education, Learning Analytics and Technology Enhanced Learning.

Claudia Lemke is Professor of Business Information Systems in the field of Digital Transformation and Co-Director of the Master's Study Programme 'Digital Transformation' at the Berlin School of Economics and Law, Germany. She researches digital technologies' impact on economics and society, especially in higher education.

Zhi Li is an assistant professor in the Department of Linguistics at the University of Saskatchewan, Canada. He received his PhD in Applied Linguistics and Technology from Iowa State University in 2015. His research interests include language assessment, technology-supported language teaching and learning, and corpus linguistics.

Ying-Dong Liu is a Ph.D. candidate in Educational Sciences at the University of Strasbourg, France. Her primary research focus is on the design of learning experiences and the evaluation of these experiences in the context of serious educational games.

Colin Loughlin is a PhD student at Lund University's Department of Educational Sciences. His research interests are higher education curriculum theory and practice, relating to large-class lectures. He is also Head of Digital Education at Brunel University London, where his team support faculty in their effective use of educational technologies.

Dumisina G Mabasa completed his PHD studies with University of South Africa. He has attended and presented in some international conferences and published in the conference proceeding. His focus is on informal economy, entrepreneurship/business venturing and work engagement/positive psychology and well-being, and ODeL.

Vuyolwethu Mdunyelwa is a lecturer and a PhD candidate at the Nelson Mandela University in South Africa. He is a researcher at the Centre for Research in Information and Cyber Security, and his research focus is on secure software development. Vuyolwethu has authored and presented his work at national and international conferences.

Bongo Mqukuse is a Consultant in the Teaching and Learning Centre at the University of Fort Hare. In the Teaching and Learning Centre she heads up the Portfolio Development Team which is part of both staff and student development. She is also in the facilitation team where she is in charge of Tutor training in the institution as well as First Year Experience.

Nathunathi Mvunge is a Technology Enhanced Learning Consultant in the Teaching and Learning Centre at the University of Fort Hare. He is also the Associate Fellow of the Higher Education Academy - UK (AFHEA). His fields of interest include student development, technology integration and blended learning.

Aveen Najm is PhD researcher, an Associate Tutor at Cardiff School of Technologies and a Research Assistant in the [Healthcare Robotics as a Service](#). She completed the BSc in Computer Science – Robotics program at Cardiff Met in 2021, graduated 1st Class with Honours and received the Dave Leonard Rising Star Award in 2021.

Minoru Nakayama is a professor at Information and Communications Engineering, Tokyo Institute of Technology, Japan. He completed the Master of Education program in 1985 From Tokyo Gakugei University, and received a Doctor of Engineering degree from Tokyo Institute of Technology in 1990. His research concerns Human Visual Perception and Educational Technology.

Vishaka Nanayakkara is the Director of the Centre for Open and Distance Learning, and a Senior Lecturer at University of Moratuwa teaching in the fields of Computer, Electrical and Electronic Engineering. Her Research interests are Technology-based teaching, learning. She received her Technical Licentiate from the Department of Computer Engineering, Chalmers University of Technology and BSc. in Engineering from the Department of Computer Science and Engineering at the University of Moratuwa.

Jessica Nixon completed a M.S. in Governance and Public Policy from the TU Darmstadt. She has been a freelance consultant for the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH since 2017. Since 2021, she is employed at the Institute of Vocational Education and Training at TU Darmstadt. Her expertise lies on the future of work and digitalization in education.

Paul Kwame Nkegbe is an Associate Professor of Agricultural and Applied Economics at the Department of Applied Economics, University for Development Studies, Tamale, Ghana. His research interests are in applied microeconomic analysis, economics of development, and his recent work has concentrated on rural livelihoods and socio-economic development with emphasis on employment and inclusiveness.

Vuyisile Nkonki is an Associate Professor in Education and currently the Director of the Teaching and Learning Centre (TLC) at the University of Fort Hare. He is also the Senior Fellow of the Higher Education Academy (SFHEA).

Siyanda Ntlabathi is a Manager:Teaching and Learning Centre, East London Campus at the University of Fort Hare. Her work involves Leadership, Technology Enhanced Learning, Curriculum Development, Portfolio and e-Portfolios development, coordinating Foundation Provisioning (Extended Curriculum programmes) Support and advancing the HEA Fellowship CPD programme. This entails advising, capacity development and support of academics in teaching and learning and learning advancement support for students.

Michael P. O'Brien is an Associate Professor of 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.

Sweta Patnaik holds an MSc in Textile Science and a PhD in Textile Science from Nelson Mandela Metropolitan University, South Africa. Her quest for knowledge knows no bounds, as she also possesses a Master's degree in Fashion Management from NIFT Bangalore and a BTech in Textile Technology from CET Bhubaneswar in India.

Fazlyn Petersen is a Senior Information Systems Lecturer at the University of the Western Cape. Her research foci are Information Communication and Technology for Development (ICT4D) in health and education. Her research focuses on creating more inclusive online environments for students and patients, especially those with lower socioeconomic status.

Kemlall Ramdass is a process, performance and operations specialist with a driving passion for improving production, quality and competitiveness. He currently is heading numerous projects in quality management at different levels of the University of South Africa while responsible for modules in Industrial Engineering.

Eshana Ranasinghe is a Junior Quality Assurance Consultant at Centre for Open and Distance Learning of the University of Moratuwa. She received a MSc in Chemical and Process Engineering at the University of Moratuwa and a MChem in Chemistry from the University of Sheffield.

Domingos Rhongo is a PhD candidate in Information Sciences and Technologies. He has published several articles about e-Learning and e-Government. He was the Administrator in 2 Faculties at the Catholic University of Mozambique and at the moment he is the Pedagogical Director of the Faculty.

Haziah Sa'ari is a senior lecturer at School of Information Science, Universiti Teknologi MARA (UiTM) Malaysia. She is also a research fellow at the School of Information Management at Victoria University of Wellington in New Zealand. She spent several years as a librarian before joining the faculty. Her areas of interest include librarianship, knowledge management, entrepreneurial competencies, work ethics, and history.

Chun Meng Tang has been actively conducting research into the impact and applications of digital technology in education, including topics such as digital literacy, learning management systems, and learning environments. He has received research grants, published journal papers, conference papers, and book chapters, as well as edited various books.

Dilini Thoradeniya is a Senior Consultant at the Centre for Open and Distance Learning (CODL), University of Moratuwa, Sri Lanka, where she utilizes her academic and project management background to coordinate the development and implementation of the CODL's latest initiative: the "Project Management Programme" to be delivered online in asynchronous mode.

Nyarai Tunjera, an esteemed educational technologist researcher, is renowned for her expertise in integrating technology into learning environments. With a background in Education and Computer Science, her innovative approach has resulted in groundbreaking technology-enhanced teaching and learning strategies. Nyarai's insightful publications on educational technology continue to shape the future of education through transformative technology.

Dalize van Heerden is a lecturer in 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 has received numerous institutional awards for her innovative teaching and learning practices.

Dana Vicherková works as an assistant professor at the Department of Education and Adult Education, Faculty of Education, University of Ostrava. She deals with the issues of pedagogical communication, reading literacy of pupils, general didactics, pedagogical diagnostics, pedagogical practice.

Tone Vold lectures at The Inland Norway University of Applied Sciences, Norway, in courses within Digitalization of Workforms in Organization and Knowledge Management, and is particularly interested in knowledge management, e-learning and games for learning. Her PhD is about work relevance of higher education for innovative and entrepreneurial behavior in organizations.

Ludmiła Walaszczyk: Assistant professor and lecturer at Lukasiewicz Research Network – Institute for Sustainable Technologies in Radom (Poland). Head of Hybrid Learning and Behavioural Economics Lab. She received her PhD in Management at Warsaw University of Technology. Involved in research projects related to hybrid education (including gamification); behaviours of managers, and business models in companies.

Soft Skills Demand and Supply Through the Lens of Higher Education Students

Naghmeh Aghaee¹ and Thashmee Karunaratne²

¹Lund University, Lund, Sweden

²Royal Institute of Technology (KTH), Stockholm, Sweden

nam.agmaee@ics.lu.se

thashmee@kth.se

Abstract: Soft skills are becoming equally crucial as hard skills in today's labour market. In contrast to hard skills which are teachable typically through formal education, soft skills are non-technical and interpersonal, allowing individuals to be able to find and succeed in their studies, jobs, and professional life. Despite the increasing emphasis on soft skills, many university students are either unaware of or neglect enhancing them. Soft skills deficiency among university students has become a significant concern for employers, educators, and policymakers, as it negatively affects students' academic performance and future employment prospects. The purpose of this study is to investigate students' perceptions of the demand for soft skills and the possibility and availability of learning opportunities. The expected outcomes intend to provide insights about awareness of soft skills among students and pathways to reduce the soft skills gap through training provisions in higher education settings. Furthermore, it aims to find out how the young generation (mainly Generation Z) would perceive digitalisation and specifically gamification as a solution to facilitate soft skills training. This is a mixed method study, in which, an open survey was the data collection media. The survey was conducted during the spring semester of 2023 and analysed using visualisation and summarisation methods. Based on the outcome of 66 master's and bachelor's students attending the digitalisation courses in two classes in Sweden, over 50% of the students perceived a lack of soft skills in their curricula. They were also positive toward the use of gamification as an effective digital strategy, recognising it as a powerful tool to facilitate training and developing soft skills as a part of formal learning in higher education. As a suggested approach, gamifying soft skills training potentially creates simulations that mimic real-world situations to allow students to practice and develop their soft skills in a safe and low-stakes training environment. This facilitates training soft skills for better communication and collaboration during their academic journey and after their graduation and to prepare students for successful careers.

Keywords: Soft skills, Skills enhancement, Higher education, Gamification, Technology-enhanced learning

1. Introduction

In the millennium when smart technologies were introduced to general use, society, industry, education and citizens as individuals drifted towards technology abruption and smartphones became the new normal since then (Nasiri et al., 2020). Less than a year ago we experienced another digital paradigm. When the Large Language Models based Generative algorithms succeeded in generating acceptably accurate new knowledge, which was previously believed to be accomplished only by human experts, the academic and business world was shaken (Dwivedi et al., 2023). These are just only a couple of examples of the consequences of entering the digital era. Inevitably, more digital paradigms are yet to come, and probably we won't be able to predict them until they are already entered into reality. Hence, resilience to paradigm shifts is essential, and the competencies associated with it are indispensable and every individual should excel in it to thrive in the digital world. Skills such as adaptability, tenacity, problem-solving, leadership, communication, and so forth (Mobini & Karunaratne, 2019), named soft skills, allow sustaining the existence in the era, as shown by previous research (Laloti, 2019; Schislyaeva & Saychenko, 2022). In parallel with the digital transformation, the current labour market is rapidly changing to receive the maximum benefit of digitalisation. As recent literature (Börner et al., 2018; Patuzzi, 2021; Petritsopoulou et al., 2021; Susilawati et al., 2020), as well as reports on the labour market dynamics (EU, n.d.; Eurofound, 2017; Eurostat, n.d.), shows, the current and prospective employees may encounter great challenges in fulfilling the ever-changing job requirements (Smaldone et al., 2022), unless the employees are properly trained and skilful to thrive in the dynamic environment. In contrast to hard skills, such as computation, language learning and so forth, which are gained through learning and can be quantifiable and measurable, soft skills learning and assessment are associated with significant pedagogical challenges since the evaluation of the soft skills is not explicit and straightforward (Petritsopoulou et al., 2021; Schislyaeva & Saychenko, 2022). Although the value and the need for assessing and enhancing soft skills are recognised on many occasions from the reports of labour market demands (Glinos et al., 2020; Zhang et al., 2022) to European Commission recommendations (Andrews & Higson, 2008), soft skills learning and assessment is not explicitly embedded in the education programs or professional development programs to date (Admin, 2022; Börner et al., 2018; Cinque, 2016).

Previous studies about educators' and employers' perspectives on soft skills learning can be found in the contemporary literature (Ngang et al., 2015; Selvadurai et al., 2012; Susilawati et al., 2020). However, it is equally important to encompass the learner perspectives in this regard, which is an under-investigated and grey area in contemporary research. Specifically, university students are the mainstream task force in the prospective labour market who are being affected greatly by the dynamic job profiling (Petritsopoulou et al., 2021). Hence, how higher education students perceive the importance of learning soft skills is essentially a main requirement for bridging the knowledge gap in this domain of learning. In addition, despite the increasing emphasis on soft skills, university students often lack these essential abilities (Börner et al., 2018; Hanapi & Nordin, 2014). This deficiency in soft skills among university students has therefore become a significant concern for employers, educators, and policymakers (Mobini & Karunaratne, 2019), as it may negatively affect students' academic performance and future employment prospects (Malik & Ubaidillah, 2021; Salas-Velasco, 2021).

Technology-enhanced learning has become an integral part of today's formal education. Gamification is one of the advanced technologies that can be used to facilitate learning different skills, including soft skills (Adhiatma et al., 2019). Gamification, when it is embedded into game-based learning, supports and improves motivation and engagement in learning among students (Módné Takács et al., 2022) and develops different skills, including soft skills, as experimented in skill generator assessment game, for example (Dochie et al., 2017). In addition, Adhiatma, et al. (2019) reflects on gamification as a new concept for effective and targeted training to improve individual soft skills and motivate and facilitate soft skills development. Gamification in the digital age is a new way of involving students and motivating them to learn and train new concepts.

Higher education institutions possess a great responsibility in preparing their current students suitable to compete in the new job profiles and succeed in their professional lives (Brunello & Schlotter, n.d.; World Economic Forum, 2022; Cleary & Noy, 2014). However, the question is if the universities have recognised or, given attention to this need from the labour market and if their education programs help facilitate this need. The best stakeholder group if this need is supplied by the responsible entities is the university students. Hence, it is important to understand, firstly, if the students understand this need and, secondly, if they perceive the university to cater to the need for soft skills enhancement. Therefore, this study instruments an empirical study to systematically investigate the students' perception of soft skills demand and learning of soft skills. Accordingly, this study attempts to seek answers to research questions 1) How do higher education students perceive the need of learning and enhance soft skills 2) How can soft skills be learnt and assessed efficiently using a technology-enhanced learning approach of gamification.

The rest of the paper is organised as follows. The next chapter briefly describes the background and fundamentals of soft skills. Chapter 3 illustrates the methodological approach of this empirical study and chapter 4 analyses and summarises the main findings. Lastly, chapter 5 discusses the final concluding remarks including the potential way forward in the inclusion and application of soft skills learning into mainstream formal education.

2. Soft Skills Demand and Supply

Soft skills, also known as interpersonal or non-technical skills, have gained significant attention in scientific articles across various fields in many countries (Deep et al., 2019). Despite that the exact findings and discussions may vary depending on the specific context and the countries, several common themes and topics emerge when examining the existing literature on soft skills (Marin-Zapata et al., 2022). By definition, "a skill is defined as the ability to perform a certain physical or mental task that is functionally related to attaining a performance goal" (Marin-Zapata et al., 2022). Some key points to consider include the importance of soft skills in the new generation of learners and job seekers as well as the importance of soft skills training and development in educational settings (Andrews & Higson, 2008; Börner et al., 2018; Cinque, 2016; Marin-Zapata et al., 2022).

Different studies categorise soft skills differently and define the most important soft skills, from different perspectives (Böttcher et al., 2012; Mobini & Karunaratne, 2019). However, the prioritised skills and the expressed percentage of the importance of each component, and somehow their definition of each soft skill is different. For example, Robles (2012) discusses the business executives' perception of the 10 most important skills: integrity, communication, courtesy, responsibility, social skills, positive attitude, professionalism, flexibility, teamwork, and work ethic. Based on a literature review and different studies Susilawati et al. (2020) claim the need for 12 soft skills in science learning. These skills are critical thinking, teamwork, creativity and

innovation, communication, problem-solving, curiosity, rigour, integrity, analysis, research and inquiry, information literacy, and objective (Susilawati et al., 2020). From another perspective, Dell'Aquila (2017) defines the concept of soft skills, and the importance of different skills, based on various literature sources and highlights soft skills as a vital role player in students' performances and career advancements. This study also shows that employees greatly benefit from these skills as they enable effective interaction with customers and foster engagement with organisational objectives.

There have always been expectations and demands on graduates in their academic life, due to the increasing globalisation and digitalisation of professional careers. Students are compelled to excel academically and as well as to create and enhance their soft skills (Selvadurai et al., 2012). Unfortunately, the current academic system doesn't facilitate soft skills learning as mentioned above, but these skills are demanded by employers for graduates to be effective and efficient in their prospective occupations (Robles, 2012). Many of these soft skills are an essential part of employability and some even consider and place them more valuable than the subject matter in academic life. Though soft skills are described in our curriculum explicitly, they have been ignored for decades. The results are devastating and discouraging. Consequently, as a result, students happen to lack confidence, the ability to work as part of a team, have poorly written and oral communication, etc. (Deep et al., 2019).

3. Methodological Approach

The purpose of this study was to investigate the level of university student's knowledge and understanding of soft skills. It also intends to explore how students perceive the need and usefulness of soft skills and if technology-enhanced learning methods such as gamification would be a sufficient medium to facilitate soft skills training. Such research demands an instrument of explorative research strategy-based survey study. The data collection was based on a semi-structured questionnaire. A questionnaire is beneficial as a data collection instrument when the unit of measurement is drawn from a large sample where data is required to be collected and analysed through quantitative means (Jacobsen, 2000; Roni et al., 2020). As the focus of this study is on the general perspective and experiences of students, regarding the understanding of the concepts and training of soft skills in higher education, a representative data sample was needed to be able to make the study more transferable, through the survey results, and as mentioned by (Bryman, 2006), quantitative methods are appropriate when it comes to reflections on the current situation and trends, the relationships and patterns.

Due to the fact that awareness of soft skills may depend on several parameters (Glinos et al., 2020), including demographic variations (Andrews & Higson, 2008; Cinque, 2016), a case study was chosen for providing a deeper understanding of the unit of measurement in relation to specified characteristics. This study was done during the spring semester of 2023, and the case was conveniently chosen as the international students at LUSEM (Lund University School of Economics and Management), in Sweden. The questionnaire was distributed to international bachelor's and master's students, along with the informed consent and appreciations, during the digitalisation courses. There was a total of 66 students, in two classes, and the responses were received from almost 54-58 students (84.8% response rate). Composition of the questions includes, three segments, namely, 1) the awareness, definitions and understanding of the need for soft skills 2) availability and opportunities for learning soft skills 3) learning methods and if gamification could be a good approach to learn soft skills. Accordingly, a mixture of structured and open questions was used to define their perception and understanding of soft skills. This is followed by questions to rate the level of importance of each soft skills attributes specifically for them, in connection to the course concepts. The students were asked to answer only based on their own knowledge and understanding of these soft skills terms and not by refereeing to any resource. For structured questions, a Likert scale was used, while not for all questions, to avoid bias in scaling and rather to let the respondents choose among different options than just rating the skills. Half of the survey questions were open questions with qualitative data collection aimed to get students' understandings and reflections in their own words. However, the finding themes and the codes based on the open questions were also used in a quantitative way.

The respondents were divided into two groups: group 1, 28 participants from the master program, who answered almost all questions. The range of age among group 1 was from 1977-1999, with a larger weight of 2/3, belonging to birth years 1990-1999. Group 2, 40 participants from the bachelor programs, answered most of the questions, but less frequency of answers for open-ended questions. The range of age among group 2 was

1997-2004, with a larger weight on students born after the year 2000. Both groups of students were informed that their participation is fully voluntary, and this will not in any way have any influence on their course results and grades. An informed consent was shown to the participants to get their agreement, before starting the data collection. The respondents were given the option to stop at any time or skip any questions if they do not wish to answer any questions. Furthermore, none of the sensitive or personal information was collected through the questionnaire.

4. Results and Discussion

As stated above, the literature claims that soft skills have gained significant attention and are recognised by different educators and learners in the recent past (Marin-Zapata, et al., 2022; Selvadurai et al., 2012; Robles, 2012). The results revealed that among the respondents in this study, almost 41% of students were fully or partly unaware of what are soft skills (c.f. Figure 1).

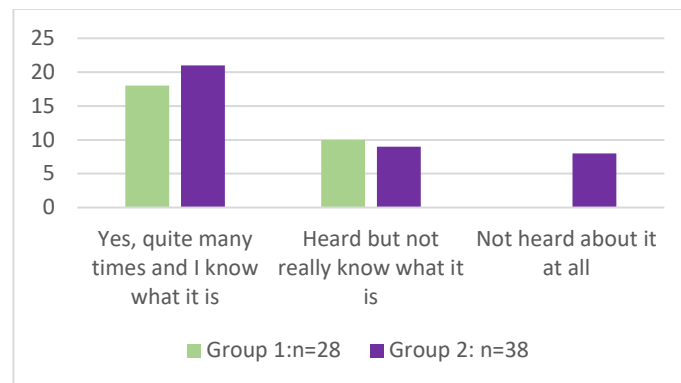


Figure 1: Awareness of soft skills among bachelor's and master's students.

Almost 70% of the students, who responded to the survey, have not had an opportunity to learn and practice the soft skills as a part or in concurrent with their formal education (c.f. Figure 2 -left). However, according to Figure 2 (right), most of the respondents (almost 76%) proclaim that training and education about soft skills in formal learning settings is missing or is quite poor. Furthermore, almost 84% showed interest and would like to have more soft skills training in their higher education.

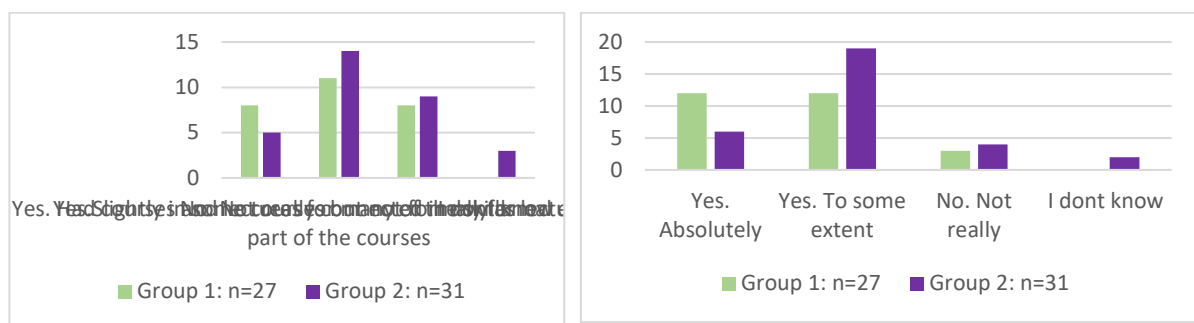


Figure 2: The distribution of the responses on the previous opportunity to learn soft skills (left), and if learning opportunities are missing or not in the current education system (right)

Previous studies define and describe soft skills, and also have prioritised (Robles, 2012; Aznam, 2020) skill sets that are important in general as well as specific to occupations in the job market (Mobini & Karunaratne, 2019). We defined a list of 10 skills based on the literature and asked the students about their knowledge for those skills. The responses were as in Figure 3. Accordingly, the majority of respondents know about communication and collaboration, problem-solving, and critical thinking as soft skills.

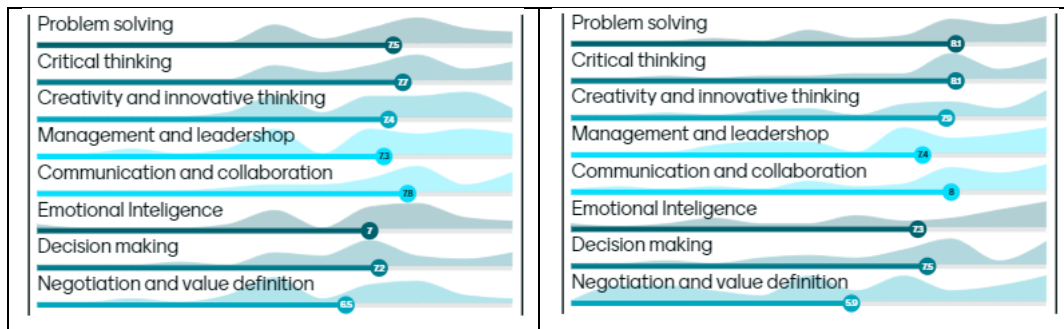


Figure 3: Students awareness of the soft skill types; masters' students n=25(left) and bachelors students n=31

As a follow up question, we asked students to prioritise the three most important skills that they wish to learn. As shown in the following word clouds, in Figure 4, the respondents in two separate groups, first indicated the soft skills they know and then defined their three highest prioritised soft skills, which they would like to learn. There is a slight difference between the BSc & MSc students. Accordingly, critical thinking, problem-solving and communication were picked as the known and the most important skills. These skills, as defined by previous studies, are essential for both managers and employees, as well as students and leaders, to facilitate the achievement of organisational missions, and the shaping of future directions and visions, as well as to guide teams towards achieving the shared goals through collaborations (Robles, 2012; Dell'Aquila, 2017). However, it should also be noted that when some known soft skills such as communication and problem-solving are listed, there is a higher probability that by default students may recognise them as important and pick them up, although they may not fully comprehend the need of the soft skills in the labour market.



Figure 4. Word Clouds indicate the soft skills they have heard before by masters' students (n=27 – top left) and bachelors students (n=32 – top right), the three most important soft skills among masters' students (n=27 – bottom left) and bachelor's students (n=36 – bottom right).

When defining soft skills based on previous knowledge and understanding or, based on the use of the skills in educational settings, most of the students responded that they have not learned about these skills, they did not have the training, and this kind of skills are more interpersonal and must have specific training than just being informed and get some theoretical teaching about them. For instance, one respondent described soft skills as *"Skills that are not formally taught, but that can be learned through experience whether in a professional environment, educational environment, or otherwise"*. According to another respondent *"Soft skills, from my*

point of view, is connected to more **personal characteristics**, rather than knowledge of tools". Another interesting response was "soft skills are those that can be **developed through practical experience** and have much to do with daily life and attitude". This mean that the students have no clear understanding of enhancing soft skills is a possibility irrespective of the evidence from literature about how soft skills can be enhanced and improved (Petritsopoulou et al., 2021). Not many respondents reflected on the definition of soft skills. However, the respondents reflected clearly on the usefulness of soft skills in educational settings and in connection to their future work and their interest in using technology support (in-line with Deep et al., 2019) and specifically gamification (in-line with Takács, et al., 2022; Dochie, 2017; Adhiatma, et al., 2019) for this kind of training in higher education. Figure 5 is the overview of the different themes that emerged from the texts that respondents used for defining and describing soft skills.

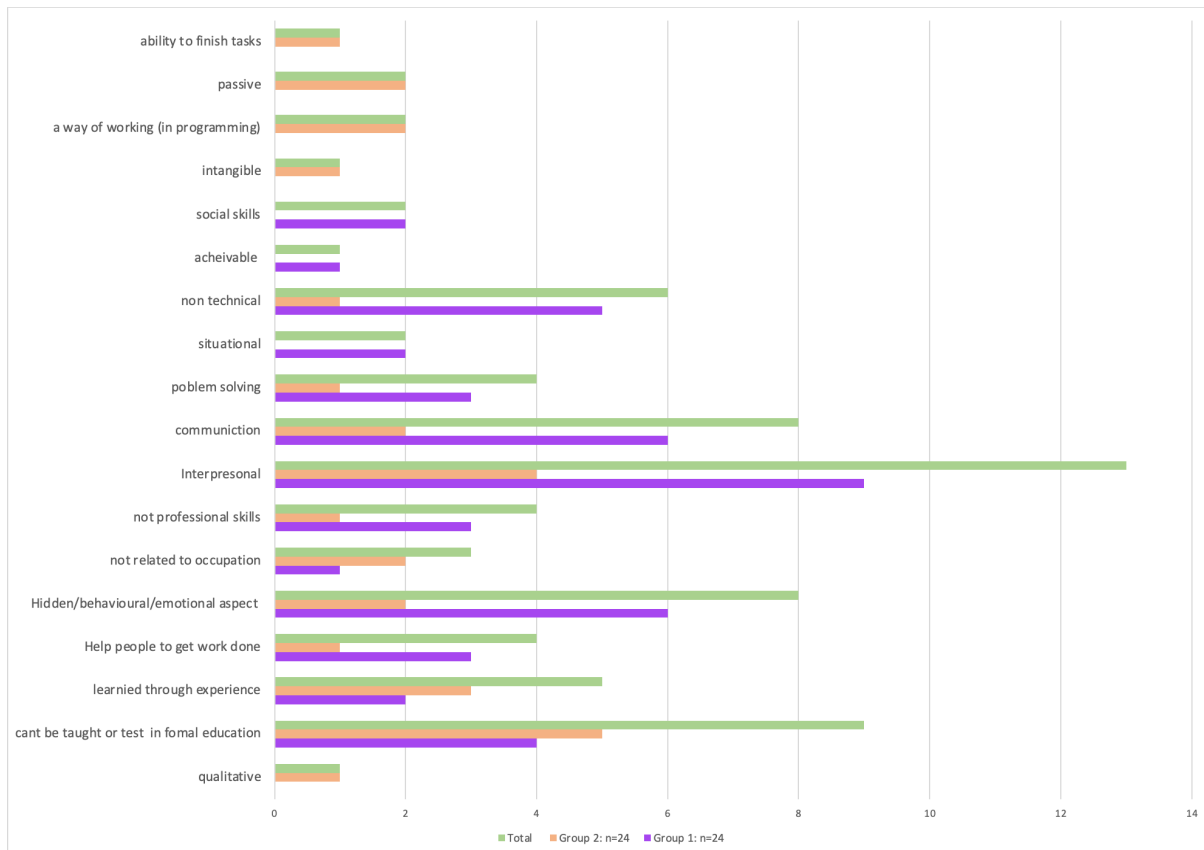


Figure 5: Definition and description of soft skills

It is interesting to see the breadth of the spectrum of the soft skills descriptions in Figure 5. There are many students who think that soft skills cannot be learnt (9), also some students think that soft skills do not impact on professional life, but it is just a way of dealing with the issues when one exists as a human being. Furthermore, according to some students' soft skills are just communication skills or skill of problem-solving. Many students assume it involves interpersonal skills; they, however, distinguish it from hard skills. Nevertheless, these outcomes comply with similar studies in other contexts, such as for unemployed adults (Petritsopoulou et al., 2021).

Using technology to train soft skills is examined and studied by different studies (Dell'Aquila, 2017; Aznam, 2020). Lack of soft skills and importance of it is also reflected by some previous studies (Hanapi & Nordin, 2014; Deep et al., 2019) The majority of respondents believe Technology enhanced solutions is mediating skills enhancement, e.g., "I think a lot of the tools we already have, do that - teamwork for group projects, class discussions, etc. I just think it needs to be clearer which educational activities are teaching which skills" according to one respondent. Figure 5 shows how students presume learning of soft skills.

The potential of Gamification in facilitating skills learning is positive as illustrated in Figure 6. Accordingly, majority of the respondents believe it is a good idea. In the attempt of capturing the perception of the students about gamification and game-based learning, it is found that all but five respondents knew or had experience

with it. They have been using game environments in the past, e.g., “*Language learning applications that use gamification techniques such as **reward systems** in order to encourage the user to continue using the app and in the process, learning a language*”, according to one respondent. “*Some teachers have used **classroom games** to get us to understand concepts. Online educational games intended to teach different subjects were also a large part of my childhood.*” according to another viewpoint. However, many respondents were referring to the tool (application) Duolingo as a good example that can be extended to use in the context of learning soft skills. Specific mentions of the features of the app were the “to-do” list, the game environment, badges, reward system, scoreboard of progress, and so forth. Virtual reality (VR) was highlighted as another potential application, where “*Business simulation or marketing simulation where it creates a virtual world that would act as how it would be in practice*” was a user story perceived by a respondent. Another participant thought as previous studies (Takács, et al., 2022; Dochie, 2017; Adhiatma, et al., 2019) also reflected “*It is (gamification) everywhere. A lot of apps use it to motivate you to use it more. Duolingo is a good example with a scoreboard*”.

When it comes to the question of how soft skills can be learnt and assessed efficiently, game-based learning was recognised as a potential methodology for formal training of soft skills. Gamification is adding game mechanisms into nongame environments, to facilitate learning. In reflection on this, it can be an option for learning about soft skills, based on the result of this study, which over 60% of the students reflected positively on the use of technology and specifically gamification in training soft skills; although, they have not been explicitly using game environments in their education.

Technology/Tools	Methods/Pedagogy	Mode/Medium
• Coursera • LinkedIn Learning • Machine Evaluation tools • Self-assessment • Visualisations • ChatGPT • Duolingo • Learning • Canva • Game applications • VR • Simulations	• Quizzes • Game-based learning • Learning Scaffolding • Technology enhanced learning • Group work • Case study • Writing/Pitch speech • Interactive/active learning • Problem/case-based learning • Role playing • Experience-based learning • Social learning • Scenarios • Class discussions	• Face to Face • Learning Management Systems • Coursera • LinkedIn Learning platform • Training at school • Online MOOCS • Zoom Lectures • Mobile applications

Figure 6: How can the soft skills be learnt?

A reflection is “*A learning platform where we were asked quiz questions and if we answered wrong, we got promoted to read on the material, if right we scored points to collect and reach a new level of questions*”. As shown in Figure 7, most students find the use of gamification relevant to soft skills training since the knowledge cannot be just gained theoretically, but rather through scenarios and gaming functions. However, again, this is the fact that some students have not had any experience with gamification in formal learning, and those who had, believed that gamification in formal learning could be a very good tool for training and gaining new skills.

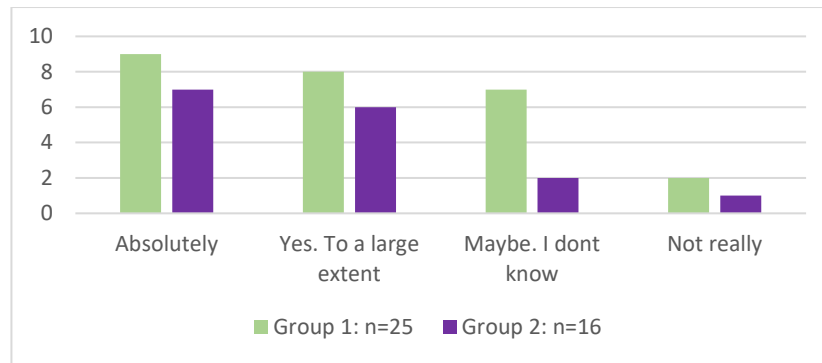


Figure 7: Can soft skills be learnt through gamification?

In summary, the students are recognising the need of learning soft skills, although in the beginning of the questionnaire a little less than half of the responder group was not aware about exactly what soft skills are. Moreover, the way and opportunities for learning soft skills in the frame of formal learning at the level of higher education is inadequate as perceived by the students. A need to have a clear structure and transparent process of inclusion learning and assessment of soft skills is raised. All in all, technology medication is recognised, and many methods, tools, and modes were named appropriate for the task according to students. Among those methods a specific focus was made on game-based learning, due to its potential in adapting to uncertain learning tasks, and ultimately students perceived it is a potential way of learning soft skills.

5. Concluding remarks

The purpose of this scientific paper is to investigate students' perception and understanding of soft skills and to reflect on how much they know about these skills, and how much they believe there is a lack or need for such skills training in higher education. The aim is to find out how technology and specifically game-based learning could be a solution for this filling in this gap of training, and, how the new generation (mainly focusing on Generation Z) would prefer to learn about these skills. We define Generation Z, as the demographic cohort succeeding Millennials and preceding Generation Alpha. By analysing the current literature and conducting original research through open surveys, this paper aims to provide insights into the strategies that can be used to improve the soft skills in university settings and to facilitate training soft skills for students and prepare them for successful careers and even better communication and collaboration during the academic journey.

Overall, the conclusion and contribution of this study is 1) training of soft skills is a lack of knowledge and practice among university students and 2) gamification can be an effective digital strategy and a powerful tool to facilitate training and development of soft skills among university students, as a part of formal learning in higher education. Gamification can provide an engaging and effective way to practice and develop the important soft skills attributes for academic and professional success among university students. By incorporating game-like elements into learning activities, such as points, levels, rewards, and badges, students can be motivated to engage with the material and practice their soft skills in a fun and engaging way.

As suggested by different students, as a part of the result in this study, one approach to gamifying soft skills training is to create simulations that mimic real-world situations in which these skills are needed, such as team collaboration, conflict resolution, and effective communication, to put students in real-life cases to learn from and handle the situation. These simulations can allow students to practice and develop their soft skills in a safe and low-stakes training environment. The system may also provide student-teacher communication possibilities, to facilitate receiving feedback and guidance along the way from the teacher team. Another approach is to use game-based assessments to measure students' soft skills and provide personalised training and feedback on areas for improvement. As some students mentioned, interactive communication and assessments, such as quizzes or scenario-based games can assess a student's ability to listen actively or demonstrate empathy in a certain situation and provide feedback and tips for improvement based on their performance. One point of caution is that skills learning elements must be transparent in terms of why, how, and which soft skills are learned and assessed during their academic courses. These conclusions of this research can feed forward to create learning solutions in higher education courses in the future.

References

- Adhiatma, A., Rahayu, T., & Fachrunnisa, O. (2019). Gamified training: A new concept to improve individual soft skills. *Jurnal Siasat Bisnis*, 127–141. <https://doi.org/10.20885/jsb.vol23.iss2.art5>
- Admin, S. (2022, August 18). Causes and Solutions To Soft Skills Gaps. *Upskillist Pro*. <https://www.upskillist.pro/blog/causes-and-solutions-to-soft-skills-gaps/>
- Andrews, J., & Higson, H. (2008). Graduate Employability, ‘Soft Skills’ Versus ‘Hard’ Business Knowledge: A European Study. *Higher Education in Europe*, 33(4), 411–422. <https://doi.org/10.1080/03797720802522627>
- Börner, K., Scrivner, O., Gallant, M., Ma, S., Liu, X., Chewning, K., Wu, L., & Evans, J. A. (2018). Skill discrepancies between research, education, and jobs reveal the critical need to supply soft skills for the data economy. *Proceedings of the National Academy of Sciences*, 115(50), 12630–12637. <https://doi.org/10.1073/pnas.1804247115>
- Böttcher, A., Thurner, V., & Winter, V. (2012). Soft Skill Development along the Education Path Evaluating expectations on and perceptions of student competencies in Software Engineering education. *International Journal of Engineering Pedagogy (IJEP)*, 2(3), Article 3.
- Brunello, G., & Schlotter, M. (n.d.). *Non Cognitive Skills and Personality Traits: Labour Market Relevance and their Development in Education & Training Systems*. 46.
- Bryman, A. (2006). Integrating quantitative and qualitative research: How is it done? *Qualitative Research*, 6(1), 97–113.
- Cinque, M. (2016). “Lost in translation”. Soft skills development in European countries. *Tuning Journal for Higher Education*, 3(2), Article 2. [https://doi.org/10.18543/tjhe-3\(2\)-2016pp389-427](https://doi.org/10.18543/tjhe-3(2)-2016pp389-427)
- Cleary, J., & Noy, M. V. (2014). A Framework for Higher Education Labor Market Alignment: Lessons and Future Directions in the Development of Jobs---Driven Strategies. Working Paper. *Undefined*. <https://www.semanticscholar.org/paper/A-Framework-for-Higher-Education-Labor-Market-and-Cleary-Noy/56967ddc71e75af2d561c6f25ddd798c48eada7a>
- Deep, S., Salleh, B. M., & Othman, H. (2019). Study on problem-based learning towards improving soft skills of students in effective communication class. *International Journal of Innovation and Learning*, 25(1), 17–34. <https://doi.org/10.1504/IJIL.2019.096512>
- Dochie, E., Herman, C., & Epure, C. (2017). Using gamification for the development of soft skills. Skill generator assessment game case study. *The International Scientific Conference ELearning and Software for Education*, 3, 610.
- Dwivedi, Y. K., Kshetri, N., Hughes, L., Slade, E. L., Jeyaraj, A., Kar, A. K., Baabdullah, A. M., Koohang, A., Raghavan, V., Ahuja, M., Albanna, H., Albashrawi, M. A., Al-Busaidi, A. S., Balakrishnan, J., Barlette, Y., Basu, S., Bose, I., Brooks, L., Buhalis, D., ... Wright, R. (2023). “So what if ChatGPT wrote it?” Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy. *International Journal of Information Management*, 71, 102642. <https://doi.org/10.1016/j.ijinfomgt.2023.102642>
- EU. (n.d.). *New Skills Agenda for Europe—Employment, Social Affairs & Inclusion—European Commission*. Retrieved April 13, 2020, from <https://ec.europa.eu/social/main.jsp?catId=1223>
- Eurofound. (2017). *EU Skills Panorama*. Eurofound. <https://www.eurofound.europa.eu/observatories/eurwork/industrial-relations-dictionary/eu-skills-panorama>
- Eurostat. (n.d.). *Skills—Experimental statistics—Eurostat*. Retrieved June 28, 2023, from <https://ec.europa.eu/eurostat/web/experimental-statistics/skills>
- Glinos, M., Petritsopoulou, M., & Karunaratne, T. (2020). The learner’s perceptions of an Integrated system for learning management of non-cognitive skills. *European Conference on E-Learning*.
- Jacobsen, D. I. (2000). *Vad, hur och varför? - Om metodval i företagsekonomi och andra samhällsvetenskapliga ämnen*. Bokus.com. <https://www.bokus.com/bok/9789144040967/vad-hur-och-varfor-om-metodval-i-foretagsekonomi-och-andra-samhallsvetenskapliga-amnen/>
- Lalioti, V. (2019). Strengthening the links between education and the labour market.: *Socio.Hu*, 70–90. <https://doi.org/10.18030/socio.hu.2019en.70>
- Malik, A., & Ubaidillah, M. (2021). Multiple Skill Laboratory Activities: How to Improve Students’ Scientific Communication and Collaboration Skills. *Jurnal Pendidikan IPA Indonesia*, 10(4), Article 4. <https://doi.org/10.15294/jpii.v10i4.31442>
- Marin-Zapata, S. I., Román-Calderón, J. P., Robledo-Ardila, C., & Jaramillo-Serna, M. A. (2022). Soft skills, do we know what we are talking about? *Review of Managerial Science*, 16(4), 969–1000. <https://doi.org/10.1007/s11846-021-00474-9>
- Mobini, P., & Karunaratne, T. (2019). Towards an ICT Enabler for Enhancing Non-Cognitive Skills in a Lifelong Learning Setting. *European Conference on E-Learning; Kidmore End*, 396-405,XIII,XV. <http://dx.doi.org.ezp.sub.su.se/10.34190/EEL.19.084>
- Módné Takács, J., Pogátsnik, M., & Kersánszki, T. (2022). Improving Soft Skills and Motivation with Gamification in Engineering Education. In M. E. Auer, H. Hortsch, O. Michler, & T. Köhler (Eds.), *Mobility for Smart Cities and Regional Development—Challenges for Higher Education* (pp. 823–834). Springer International Publishing. https://doi.org/10.1007/978-3-030-93904-5_81
- Nasiri, M., Ukko, J., Saunila, M., & Rantala, T. (2020). Managing the digital supply chain: The role of smart technologies. *Technovation*, 96–97, 102121. <https://doi.org/10.1016/j.technovation.2020.102121>
- Ngang, T. K., Chan, T. C., & Vettriveilmany, U. D. a/p. (2015). Critical Issues of Soft Skills Development in Teaching Professional Training: Educators’ Perspectives. *Procedia - Social and Behavioral Sciences*, 205, 128–133. <https://doi.org/10.1016/j.sbspro.2015.09.039>

- Patuzzi, L. (2021). Taking the Long View: Options for Inclusive Post-Pandemic Labour Markets. In *Migration Policy Institute*. Migration Policy Institute.
- Petritsopoulou, M., Karunaratne, T., & Glinos, M. (2021). Yes! I Want My Non-Cognitive Skills to Be Improved: Perceptions on an ICT-Enabled Learning Journey. *International Journal of Emerging Technologies in Learning (IJET)*, 16(22), Article 22. <https://doi.org/10.3991/ijet.v16i22.24665>
- Robles, M. M. (2012). Executive perceptions of the top 10 soft skills needed in today's workplace. *Business Communication Quarterly*, 75(4), 453–465.
- Roni, S. M., Merga, M. K., & Morris, J. E. (2020). *Conducting quantitative research in education*. Springer.
- Salas-Velasco, M. (2021). Mapping the (mis)match of university degrees in the graduate labor market. *Journal for Labour Market Research*, 55(1), 14. <https://doi.org/10.1186/s12651-021-00297-x>
- Schislyaeva, E. R., & Saychenko, O. A. (2022). Labor Market Soft Skills in the Context of Digitalization of the Economy. *Social Sciences*, 11(3), Article 3. <https://doi.org/10.3390/socsci11030091>
- Selvadurai, S., Choy, E. A., & Maros, M. (2012). Generic Skills of Prospective Graduates from the Employers' Perspectives. *Asian Social Science*, 8(12), Article 12. <https://doi.org/10.5539/ass.v8n12p295>
- Smaldone, F., Ippolito, A., Lagger, J., & Pellicano, M. (2022). Employability skills: Profiling data scientists in the digital labour market. *European Management Journal*, 40(5), 671–684. <https://doi.org/10.1016/j.emj.2022.05.005>
- Susilawati, Aznam, N., Paidi, & Ngadimin. (2020). Teachers' perspectives toward soft skills in science learning. *Journal of Physics: Conference Series*, 1460(1), 012111. <https://doi.org/10.1088/1742-6596/1460/1/012111>
- World Economic Forum. (2022). *4 trends that will shape the future of higher education*. World Economic Forum. <https://www.weforum.org/agenda/2022/02/four-trends-that-will-shape-the-future-of-higher-education/>
- Zhang, M., Jensen, K. N., Sonniks, S. D., & Plank, B. (2022). *SkillSpan: Hard and Soft Skill Extraction from English Job Postings* (arXiv:2204.12811). arXiv. <https://doi.org/10.48550/arXiv.2204.12811>

Intelligent Adaptive E-Learning Systems: Current Approaches, Architectures, and Applications

Abbas Fadhil Aljuboori¹ and Hala Jaffar Al-Lawati²

¹University of Information Technology and Communications, Baghdad, Iraq

²Al Zahra College for Women, Muscat, Oman

abbas.aljuboori@uoitc.edu.iq

hala_allawati@zcw.edu.om

Abstract: Considering the weakness of traditional e-learning, a multiple of e-learning systems attempt to get individualization into the process of learning by offering learner-centered instruction, the adaptive E-learning system(AES) is seen as one of the more famous models. An AES can tailor its response to different circumstances. Various types and platforms in E-Learning systems have been discussed and explained such as blended, adaptive, and educational e-learning. Architectures, functions, and challenges also illustrated in details in this paper. Mostly focused on the Adaptive e-learning concept and importance for the learners. AES concentrates on adaptively delivering learning materials. This paper discusses some studies that approved the importance of adaption in the e-learning system in the years (2018-2023), and introduced some challenges faced by this system.

Keywords: E-Learning, Blended, Adaptive, Intelligent, Education

1. E-Learning:

The term e-learning is a term that looks like a blending of the learning process with technology. It is well known that technology has become an integral part of many aspects of the personal and social life of everyone, including education and learning. E-learning concept evolved in the early nineties where it had a great impact in developing the educational process as it provided various technologies that facilitated communication, collaboration, resources sharing, and allowed providing education bypassing time and place constraints.

It appears from the research that there are several definitions of e-learning. Some like Keller and Cernerud (2002) defined e-learning as any learning that is based on using internet or implying learning by means of digital media such. Other researchers like Longmire (2001) expend the concept of e-learning as he stated “e-Learning covers a wide set of applications and processes such as computer-based learning systems, Web-based learning systems, virtual classrooms, and digital collaborative learning GroupWare packages. E-Learning content is mainly delivered via Internet, intranet/extranet, audiotape, and videotape; satellite broadcast, interactive TV, DVD and CD-ROM, and the still to emerge wireless application protocols (WAP)”.

Sangrà et al (2012) reviewed the definition of e-learning from literature published between 2005 and 2012 and as a result four general categories of definitions were identified:

1. Technology-driven: definitions of this category considered the use of technology as the most important characteristic of e-learning.
2. Delivery-system-oriented: this category focusses on the accessibility of resources
3. Communication-oriented: this includes definitions that expect interaction and collaboration as the most important part of e-learning.
4. Educational-paradigm oriented this type of definitions considers e-learning as an improvement to the existing educational models.

A. Pauline Chitra et al (2018) stated that “The term e-learning comprises a lot more than online learning, virtual learning, distributed learning, networked or web-based learning. As the letter “e” in e-learning stands for the word “electronic”, it would incorporate all educational activities that are carried out by individuals or groups working online or offline, and synchronously or asynchronously via networked or standalone computers and other electronic devices”.

Flora Amiti (2020) described two types of e-learning:

1. A synchronous learning which includes the environment or a specific online platform where the teacher and the students meet and communicate about a lesson.
2. Asynchronous e-learning which gives the students accessibility to the class material all the time and provide more flexibility in activities submission.

The increasing development in e-learning technologies and their widespread use is accompanied by the emergence of challenges summarized by Liu, M. and Yu, D (2022) in five reasons those are: The growing number of e-learners and course work, the huge amount of interactive information resulting from the exchange of information electronically, Resources are isolated due to their different types, Control methods and security policies are needed to handle personal and confidential information and the huge amount of data generated by e-learning must be well stored and managed. To meet these challenges, it is necessary to develop appropriate technologies that facilitate the collection, processing and analysis of the huge amount of data being collected from various sources, which led the e-learning applications developers to move toward some artificial intelligence techniques.

1.1 Blended – Learning

Many researchers defined blended learning over the last decades. The definitions vary where the old ones focus on adding helpful content stored on different medias to support learning at class. the widespread use of the Internet and the development of effective and safe e-learning environments, researchers have turned to a new concept of blended learning, which simply means to mix the face-to-face classroom learning with e-learning. The idea emerged in the early 2000s as a call to enable learners to make the most of online resources and tools in addition to classroom learning which makes it different from e-learning, in which the learner relies entirely on an online learning system. Allison Littejohn and Chris Pegler (2007) stated “The word ‘blended’ may refer to a blend within the ‘e-learning mix’ of media, or a blend of the e-learning with other approaches”.

The steady development of electronic technologies has contributed to raising the efficiency of blended learning as it is characterized by the peculiarity that any new technology can easily be integrated, providing the best individual learning experience.

Liu, M. and Yu, D (2022) classified three models of blended learning based on its aim: Skilled-driven let students to gain specific knowledge and skills based on teachers’ feedback and guidance, Attitude-driven model: enables learners to gain new behaviors or attitudes through learners-teachers interaction and collaboration, Competency-driven: In which the learner acquires knowledge implicitly by observing and interacting with experts at work.

1.2 Adaptive e-learning (AEL)

Contemporary educational studies tend to move from the unified learning style to in which a common content is delivered to all students in the same way to more personalized experience in which students' levels and their preferred learning styles are considered which enhance their performance. According to Luangrungruang, T. and Kokaew U (2022) the effective e-content of adaptive e-learning which is suitable for different learners’ styles and preference, would improve their skills acquisition, experiences, and critical thinking skills.

According to Kolekar et al (2018), adaptive learning is classified to macro and micro adaptive e-learning. The adaptive approach is the student profile to determine the e-learning process procedures. whereas in micro adaptive approach, students’ behavior is monitored and found from quantitative information in an e-learning system.

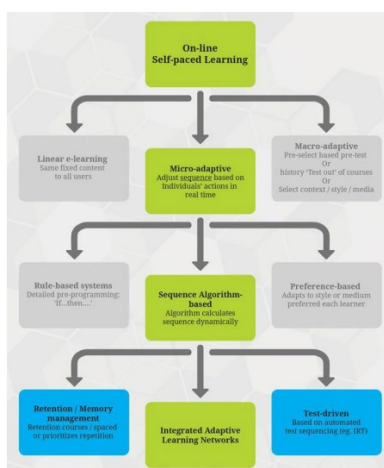


Figure 1: Type of E-learning

2. Literature Review

Yulia Vainshteina et al (2018) developed adaptation algorithm for the mathematical educational content by selecting an optimal edition of the material that best suits the individual characteristics of the student. the developed system uses three level adaptation algorithm: introductory content adaptation (an adaptation of the content of introductory materials of the discipline based on the initial level of students) - "current adaptation of the content" (an adaptation of the mathematical content based on current effective actions of students in the electronic course) - "appraisal-correcting adaptation" (an adaptation of normative parameters of the level of assimilation of materials, taking into account the results achieved by students). The proposed system allows implementing personal educational space of mathematical educational content for each student that adapts to its level of mastering the material.

Kolekar et al (2018) claimed that it is beneficial to provide a customized user interface for adaptive e-learning portal. They proposed a rule based adaptive user interface AUI. The proposed approach is based on Felder-Silverman Learning Style Model (FSLSM) which defines eight learning styles. There is a set of learning components provided through AUI. The idea is to decide users learning style dynamically by tracing his usage data. The learning components that are suitable for the users learning style are generated.

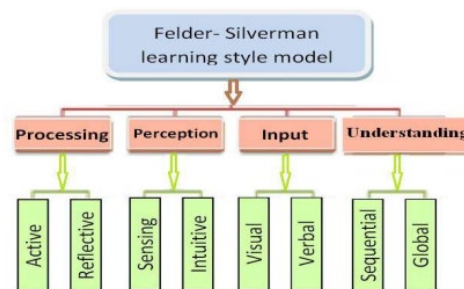


Figure 2: Feleder-Sliverman Learning Style Model

Bhawna Dhupia and Abdalla Alameen (2019) proposed a framework to implement an adaptive e-learning system that consists of three basic models:

1. Domain Model which contains course content and all related details.
2. Learner Model includes learner related information such as his level of knowledge, learning pattern .It also tracks learner records; learners' performance may also be measured through this model.
3. Adaptive Model this part is responsible for analyzing learner activities and behavior to identify his style. This will be done through a Predictive model and will allow the adaptive engine to offer the best learning technique and. The model also keeps reviewing learners' patterns for changes if any and updates the learning styles accordingly through an intervention engine.

Victoria Shershneva et al (2019) described an adaptive e-learning system considering basic principles:

- Allow students to have an individual learning experience and create personal educational material.
- Variability by presenting content in various forms.
- Automatic return to the studied topic content in different forms.
- Reduce the knowledge and skills gap.
- Student involvement in the learning process
- Focus on achieving learning outcomes.
- Build a comprehensive understanding of the discipline.
- The content should be suitable for learners and related to their future expected professional activities.
- The teacher's role is the learning process organizer and coordinator.

The applied system consists, as in the previous proposal of the content model, the learner model, the adaptation model and in addition an assessment model. The content model integrates the methods of Voishvillo's logical-and-gnoseological concept analysis with graph theory methods. Course concepts are structured hierarchically as the discipline's concepts tree. This allows visualizing the logical structure of the material, determining its study

sequence, and mastering the control over the results of course. The adaptive model then provides each term into three levels of details and presentations. The assessment model determines the level of subject competence development of the student by assessing all its components.

Mohamed Boussakssoua, Bader Hssinab and Mohammed Erritali (2020) a also developed an adaptive e-learning system. They used the Q-learning algorithm which is a reinforcement learning algorithm based on set of states with set of possible rewards were an agent passes from a state to another aiming to maximize the collected reward. The states and rewards of the suggested system were derived from the course content based on Bloom's taxonomy. List of actions was also created, as the agent pass from a state to another by performing an action. Reward matrix is constructed for the possible state-action combination from which the students best path to learn the course is known.

Some researchers have tried to study the effectiveness of using adaptive learning systems in different scientific fields. For example, Ali, N.A et al (2019) suggested using an adaptive approach in identifying learners learning styles to enhance their performance to get ICDL certificate without fail. The model was applied to a group of learners and the results compared to the results of another group whose members didn't use the model. The model used to provide the suitable learning objects based up on their identified learning style. The results approved that a high percentage of learners who used the adaptive system succeeded in achieving ICDL certificate without any fail compared with those who didn't use it.

Mathias Bauer, Jacqueline Schuldt and Heidi Krömker (2020) tested the effect of using adaptive e-learning platform in fostering students learning motivations. They compared the results of using a version of an existing e-learning platform for micro- and nanotechnologies with another version that was transformed into an adaptive e-learning system through multiple stages. The results of comparing the adaptive version to the non-adaptive version didn't identify a significant benefit.

A similar study was delivered by Nkemcho Ojeh et al (2020) who compared the usage of an online adaptive platform (Firecracker) to another assessment software. The objectives of this study were to determine: Firecracker usage rates, its formative quizzes performance, compare the performance of Firecracker with the performance at summative course assessments, and assess students' satisfaction with Firecracker usage. Data was collected and analyzed, and results were summarized as follows Most students welcomed the use of the Firecracker platform, as they considered it beneficial, and its use was associated with better academic performance. These findings suggest that the platform used could be useful in continuous monitoring of students' progress in other courses.

An approach by Mohammed Megahed, Ammar Mohammedcombines (2020) used convolutional neural network CNN and fuzzy logic. CNN model is used to detect a learner's facial expressions and fuzzy system is used to determine the next learning level based on the extracted facial expression states from the CNN and several response factors by the learner. Applying the proposed system to chosen groups showed suitable adaptive learning flows to the learning capabilities of all learners. Moreover, the approach allows decision makers to monitor the learning performance for each learner.

Hassan A. El-Sabagh (2021) conducted a study to investigate the impact of adopting adaptive e-learning environment on the students' engagement development. The developed platform is based on VARK learning styles shown in the figure below. Those styles were used to define four content paths in which all the learning objects fall.

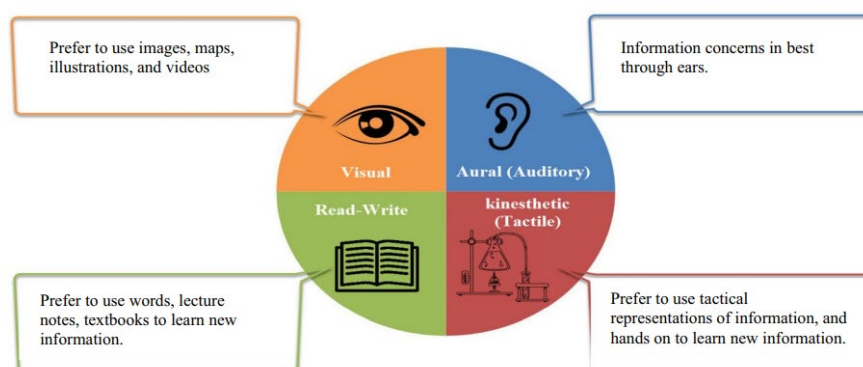


Figure 3: VARK Learning Styles

The proposed adaptive environment was used to measure student engagement in the “Learning Skills” course. A group of students used the proposed platform, and the results of the group were compared with the results of another group that did not use the mentioned environment. Results of this study revealed a significant difference in learning outcomes between the two groups with positive results for adaptive e-learning students, indicating that it may be helpful to adopt this technology in higher education.

Sayed S. Younes (2021) selected the students of the studies as a target group to know the impact of using this category to adaptive e-learning on the development of creative design skills for digital content. Research results concluded that, the proposed adaptive e-learning environment positively affected developing both cognitive achievement and practical performance of digital content creative design skills of students regardless of their learning styles whether global or sequential.

An adaptive e-learning approach based on learning style and knowledge level was proposed by ALBER S. AZIZ, REDA A. EL-KHORIBI and SHEREEN A. TAIE (2021). The model works in three phases. An English course material was selected and divided into units and then points. Each point was mapped to learning object and questions stored in a question bank. The learner starts the system and fills a dynamic questionnaire that determines his learning styles based on Felder-Silverman Learning Styles Model. Learning objects that match learners’ style are presented and he learns where his logs and activities are recorded. The learner then is required to take a pretest to determine his level of knowledge. This time the system will recommend suitable learning objects according to learning style and the updated level of knowledge. In the third phase the learner will take a post exam and his level of knowledge is updated. The results showed that using the proposed model increased the overall performance for the students significantly.

In addition to learning style and knowledge level, Oyuga Anne and Elizaphan Maina (2021) considered the learner’s affective state. they proposed a model that uses a questionnaire designed to extract learning style according to VARKs learning. An affective state extraction model was also designed, based on existing natural language processing libraries with several steps to identify, prepare, divide, train, classifying and training dataset. Q-learning reinforcement algorithm was followed to create adaptivity. The researchers claim that results show better adaptivity with models based on multiple learner characteristics rather than single characteristic. They recommend including more characteristics in further research.

Norah Dhafer Alqahtani (2021) reviewed several titles related to AES, such as the role of this type of system and its importance, in addition to the techniques used to enhance its performance and the most important challenges facing it. Four types of adaptivity were defined:

- Course content related: concerns providing the best content matching learner properties.
- Interaction related: in this type, adaptation appears in the interface where content is not changed.
- Collaborative Support: it supports communication between participants to achieve common goals.
- Implementing adaptive techniques to detect contents that matches the student's properties.

challenges like dealing with real data, trust and usability development and system scalability were also discussed.

A study conducted by Maha E. Attia, Mohamed A. Arteimi (2021) applied fuzzy logic to modify the domain model of an AES for computer programming language teaching as some topics are prerequisites for others. The proposed system manages learning material relationships through concept maps. It also measures students’ knowledge using fuzzy logic by converting student's grade to membership functions. the learning material is divided into concepts where a fuzzy Related-Concepts Network displays the knowledge relationships between them. This depicts the learning material's structure as well as the concepts' knowledge dependencies. This relates knowledge level of a connected topic to the knowledge level of a domain concept. meaning that if a topics level of knowledge increases the level of knowledge of the concept also increase and the other way around. The approach implemented as a plugin to MOODLE which resulted in improving student's learning and provided their satisfaction.

A new architecture for piloting and customizing adaptive learning paths was introduced in Sabeima, Massra and Lamolle, Myriam & Nanne, Mohamedade (2022). considering users’ profile, training domain and the available learning resources. It also includes synchronizing collaborative mode which allows learners to collaborate with each other. The proposed architecture is based on Semantic Web for knowledge representation and multi-agent system that manages the different events in the system.

3. Conclusion

E-learning is not just a technological development. Rather, it is a reason for changing the ways of transferring knowledge and the skills that the learner needs to receive knowledge. The involvement of more learners in various e-learning platforms, exceeding the constraints of space and time, led the designers on these platforms to work hard to improve their performance continuously, taking into account the needs and satisfaction of learners. Current trends in e-learning use adaptive technologies to provide a customized experience for each learner due to learners' differences in level, interests, cultural background, etc. in the past few years many approaches evolved proposing different ways to enhance adaptability in e-learning in terms of architectures, algorithms or characteristics used to identify learners needs. Studies performed between 2018 and 2023 has been demonstrated. This topic is vital and renewable, which makes it a target for more in-depth studies due to its great benefit associated with learning, which is a basic requirement on the one hand, and its reliance on artificial intelligence techniques, which are the latest technologies of the current era, on the other hand.

References

- Keller, C. and Cernerud, L. (2002) "Students' Perception of E-Learning in University Education", *Learning, Media and Technology*, 27, 55-67.
- Longmire, W. (2001) "A Primer on Learning Objects. Managing Web-Based Training", ASTD.
- Sangrà A, Vlachopoulos D, Cabrera N (2012) "Building an inclusive definition of e-learning: an approach to the conceptual framework", *Int Rev Res Open Distrib Learn* 13:145–159
- Liu, M., Yu, D. (2022) "Towards intelligent E-learning systems", *Educ Inf Technol*.
- Luangrungruang, T.; Kokaew U (2022) "E-Learning Model to Identify the Learning Styles of Hearing-Impaired Students" *Sustainability* 2022, 14, 13280. <https://doi.org/10.3390/su142013280>
- Yulia Vainshteina, Victoria Shershneva, Roman Esin, Gennady Tsibulsky, Konstantin Safonov (2018) "Adaptation algorithms of mathematical educational content in e-learning courses", *ERPA International Congresses on Education*
- Kolekar, Sucheta V.; Pai, Radhika M.; Manohara Pai, M. M. (2018) "Rule based adaptive user interface for adaptive E-learning system", *Education and Information Technologies*; Vol. 24, No. 1. pp. 613-641.
- Bhawna Dhupia and Abdalla Alameen (2019) "Adaptive eLearning System: Conceptual Framework for Personalized Study Environment", Springer Nature Singapore Pte Ltd.
- Victoria Shershneva, Yulia Vainshteina, Tatiana Kochetkova and Roman Esin (2019) "Technological approach to development of adaptive e-learning system" *EDP Sciences*
- Ali, N.A. & Eassa, Fathy & Hamed, Essam (2019) "Personalized Learning Style for Adaptive E-Learning System", *International Journal of Advanced Trends in Computer Science and Engineering*.
- Mohamed Boussakssoua, Bader Hssinab and Mohammed Erritali (2020) "Towards an Adaptive E-learning System Based on Q-Learning Algorithm" Elsevier B.V
- Mathias Bauer, Jacqueline Schuldt and Heidi Krömker (2020) "Evaluation of Learning Motivation within an Adaptive e-Learning Platform for Engineering Science", the 12th International Conference on Computer Supported Education (CSEDU 2020) - Volume 2, pages 64-73, SCITEPRESS – Science and Technology Publications
- Nkemcho Ojeh, Bidyadhar Sa, Md Anwarul Azim Majumder, Keerti Singh & Oswald Peter Adams (2020) "Use of an Adaptive e-Learning Platform as a Formative Assessment Tool in the Cardiovascular System Course Component of an MBBS Programme", *Advances in Medical Education and Practice*
- M. Megahed and A. Mohammed (2020) "Modeling adaptive E-Learning environment using facial expressions and fuzzy logic," *Expert Syst. Appl.*, vol. 157, p. 113460, 2020, doi: 10.1016/j.eswa.2020.113460
- Hassan A. El-Sabagh (2021) "Adaptive e-learning environment based on learning styles and its impact on development students' engagement", *International Journal of Educational Technology in Higher Education*
- Sayed S. Younes (2021) "Examining the Effectiveness of Using Adaptive AI-Enabled e-Learning during the Pandemic of COVID-19", *Journal of Healthcare Engineering*
- Alber S. Aziz, Redha A. El-Khoribi and Shereen A. Taie (2021) "Adaptive E-Learning Recommendation Model Based the Knowledge level and Learning Style, *Journal of Journal of Theoretical and Applied Information Technology*.
- Oyuga Anne & Elizaphan Maina (2021) "Reinforcement Learning Approach for Adaptive e-Learning Based on Multiple Learner Characteristics" *Open Journal for Information Technology*
- Norah Dhafer Alqahtani (2021) "Adaptation in the E-learning systems", **Technium Social Sciences Journal**
- Maha E. Attia, Mohamed A. Arteimi (2021) "Adaptive E-Learning System using Fuzzy Logic", *AI academia journal for Basic and Applied Sciences (AJBAS)*
- Sabeima, Massra & Lamolle, Myriam & Nanne, Mohamedade (2022) "Towards Personalized Adaptive Learning in e-Learning Recommender Systems" *International Journal of Advanced Computer Science and Applications*. 13. 10.14569/IJACSA.2022.0130803.

A Framework for Assessing the Complexity of Auto Generated Questions from Ontologies

Samah AlKhuyaey, Floriana Grasso, Terry R. Payne, and Valentina Tamma

University of Liverpool, Liverpool, United Kingdom

S.Alkhuyaey@liverpool.ac.uk

F.Grasso@liverpool.ac.uk

T.R.Payne@liverpool.ac.uk

V.Tamma@liverpool.ac.uk

Abstract: Automatic difficulty calibration (ADC) is the application of computational techniques to estimate the difficulty levels of assessment questions before administering them. Compared to traditional difficulty calibration approaches, ADC eliminates the need for pretesting, and minimises the time and efforts typically involved in manual calibration. In recent years, Ontology-based Automatic Question Generation (OAQG) has emerged as a powerful tool to generate assessment questions effortlessly and in massive numbers with minimal human intervention. Despite these benefits, not being able to control the characteristics of generated questions hinders their suitability to be used in pedagogical settings. However, much of the research up to now has tended to focus on the quantity of the questions rather than their quality. Indeed, most current automatic question generators produce simple questions which consist of a few facts, and simply test the recall of knowledge. Furthermore, the majority of existing frameworks are mostly technical and are not supported with a strong theoretical underpinning. In this paper, we propose a novel framework to assess the complexity of ontology-based, automatically generated questions. We discuss various aspects that are involved in determining the complexity of assessment questions, and attempt to quantify important characteristics of question complexity through the use of novel ontological metrics. To further support the plausibility of our computational framework, we shed light on its consistency with theories from education and cognitive psychology. This will provide us with a solid theoretical foundation which ensures that questions are generated according to principled methods that are grounded in theories of learning and cognition. The proposed approach is agnostic to different domains and independent of the question format, therefore, is highly general and applicable to a variety of contexts.

Keywords: Question Generation, Difficulty Estimation, Ontologies, Education, Question Complexity, Assessment.

1. Introduction

Automatic Question Generation (AQG) is a popular and challenging research area where technology-enabled solutions are used to automate assessment. It provides a scalable solution that can generate massive numbers of questions in a short time and with minimal human intervention. Various approaches have been proposed to generate questions from unstructured sources (e.g. text) with the help of Natural Language Processing (NLP) (Faizan and Lohman, 2018; Gao et al., 2018; Huang et al., 2017), or from structured sources such as ontologies and knowledge bases (Alsubait et al., 2016; Seyler et al., 2017; Vinu and Kumar, 2017). A small number of studies have explored the problem of controlling the characteristics of the generated questions to ensure their appropriateness for students' assessment. Some of them have also addressed the essential issue of controlling the level of difficulty of the generated questions. However, a desirable characteristic is the ability to differentiate between weak and competent students, through the design of questions with differing difficulty. This becomes even more important when moving toward the automatic generation of high quality and well-balanced exams. However, and despite the extensive literature on AQG, few studies have dealt with the task of difficulty estimation by developing computational frameworks to automate the process (Kurdi et al., 2020).

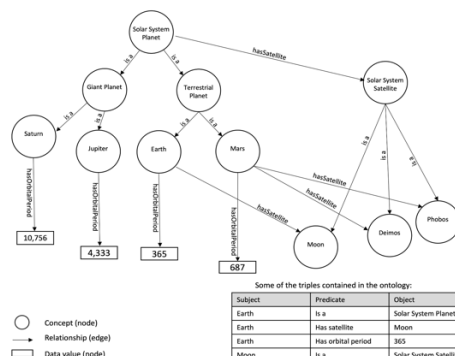


Figure 1: An example of an ontology describing some aspects of the solar system

Ontology-based Automatic Question Generation, OAQG, (Papasalouros et al., 2008) exploits domain specific knowledge bases (*ontologies*) as the main source of knowledge upon which question generation can be based. An ontology is a formal, explicit specification of a shared conceptualisation (Studer et al., 1998) that provides a representation vocabulary that can be used to describe the subject domain of interest in the form of a hierarchy or taxonomy of concepts that are connected to each other using different types of relationships. The taxonomic structure is typically modelled as a hierarchical classification, with more general concepts appearing higher within the taxonomy, and more specific concepts (connected by an *is-a* relationship) appearing lower down. In Figure 1, a small ontology fragment describes some of the concepts in the solar system; the concept “*Solar System Planet*” has two sub-concepts representing terrestrial and giant planets, whereas the concept “*Solar System Satellite*” has the sub-concepts (*Moon*, *Demios* and *Phobos*). These hierarchical relationships are represented by an “*is-a*” predicate. In addition, we have two other relationships: *hasOrbitalPeriod* and *hasSatellite*, which describe properties for the planets in our vocabulary. Thus, the triples (*Earth*, *hasOrbitalPeriod*, 365) and (*Earth*, *hasSatellite*, *Moon*) provide a knowledge-based description of the concept *Earth*.

Ontologies have a number of advantages over other forms of knowledge representation when generating questions with a controlled difficulty level. Ontologies have an inherent structure which can be complex (typically represented by a formally defined schema) and machine readable, making them more amenable to navigation and querying than unstructured forms of knowledge, such as natural language text. Not only does this eliminate the need to pre-process the input data, but also that existing ontologies can be readily reused, expanded and combined (Papasalouros et al., 2008). Furthermore, additional knowledge can be inferred from the ontology using rules or logics such as Description Logics (DLs) (Baader et al., 2017) which allow the specification of new knowledge that can be derived from the subject domain. From a cognitive perspective, the hierarchical architecture typically found within ontologies, coupled with their inferential techniques, resemble the way knowledge is represented in students’ memory as well as reflecting the way it is accessed. Indeed, research in the cognitive sciences has previously demonstrated that learners tend to represent subject knowledge in the form of a hierarchical structure where nodes represent units of information (concepts) that are connected to each other (Siew, 2020; Gobbo and Chi, 1986; Kalyuga, 2007). Furthermore, these studies have suggested a correlation between complex hierarchical knowledge structures and the actual time learners use to retrieve concepts from semantic memory to answer a question (Collins and Quillian, 1969). For example, Chang, (1986) argues that learners tend to respond faster when asked to verify if robins are birds compared to when asked if robins are animals. This is because the mental process of verifying that robins are animals would be consistent with having to traverse through an additional level on the hierarchy (i.e. robins are birds). This is exactly the case when considering ontology-generated questions, as we aim to capture the characteristics of knowledge that are tested by a question that was generated based on a hierarchical structure. In addition to all these advantages, semantic knowledge models have been found to be an effective tool that can produce *general* difficulty estimation frameworks. Indeed, ontology-based approaches were praised for being generalisable across different domains and questions formats (Alkhazaey et al., 2023). All these reasons support the argument that there is real value in using ontologies to generate difficulty-controllable educational questions.

In this paper, we propose a novel framework for assessing the complexity of automatically generated questions from domain ontologies. We underpin our framework by grounding it on pedagogical and psychological theories of learning and cognition. Before introducing our framework, we focus on discussing the fundamental issue of what makes a good question.

2. Assessment Quality: Background

Generally speaking, educational measurement refers to the process of gathering reliable information on the knowledge and skills of learners and assigning it a numerical value (Berry and Adamson, 2011). These properties are not necessarily directly observable, but can be hypothetical attributes that are complex, abstract, and/or not consistent across different learners. The fundamental purpose of assessment questions is to be used as a diagnostic tool to provide ongoing feedback to a learner on their understanding of the subject domain, and/or to measure the extent to which learners have met the learning objectives. A good quality assessment question should allow teachers and test developers to distinguish between high and low mastery students (i.e. weak vs. competent students). This is based on the premise that the characteristics of knowledge acquired by different level learners will differ with regard to its quantity and quality (Gobbo and Chi, 1986; Chi et al., 1981). Indeed, the characteristics of learning and performance differ significantly as knowledge increases (i.e. when there is the development of expertise) (Kalyuga, 2007). Thus, knowledge is considered to be an important property that, if

measured, can differentiate these two groups. However, knowledge is a property that is notoriously challenging to measure precisely. Any quantification of this feature must be an approximation that can vary based on the learner, test developer or the measurement method used. The definition of knowledge varies in the literature according to the research field considered. However, and despite the varying contexts, it is important to observe that these definitions often offer a simplification of what we mean by knowledge. This simplification is necessary, especially in pedagogical contexts, in order to facilitate the quantification of the term. One such simplification defines knowledge as a network structure of *nodes* and *edges* where nodes represent units of information (i.e. concepts) relevant to a specific domain, which are connected by edges that represent relations between concepts (Siew, 2020). We find that this definition of knowledge can be mapped to the way ontologies are structured.

An important criterion that is usually considered when designing high quality questions is *difficulty calibration*, which refers to the process of assigning a numerical or categorical score to represent the difficulty level of a question (Pelánek et al., 2021). This metric is crucial for test developers, as it allows them to design well-balanced tests with varying levels of difficulty in order to differentiate between different levels of achievement. Difficulty is a multi-faceted property that is affected by external and internal factors. External factors are influenced by variables such as students' background knowledge or the difficulty of the subject domain under consideration. Conversely, internal factors are derived from the intrinsic structure of the question itself and are commonly referred to as the *complexity* of the question. Hence, and despite being sometimes used as synonyms, difficulty and complexity are two distinct concepts (Pelánek et al., 2021). In this sense, complexity is one aspect that can indicate question difficulty. Indeed, among the ideal sources of difficulty are: 1) the underlying knowledge; and 2) the cognitive ability required to generate a correct answer (NRC, 2001). A question that entails more knowledge and requires cognitive processing is hence considered difficult. The latter source of difficulty is concerned with how learners understand and decompose a question before answering it correctly (also referred to as *the question-answering process*) (Ahmed and Pollitt, 1999; Hebel et al., 2017). If presented with a complex question, expert learners will be more able to decompose the question, identify relations and perform reasoning to arrive at the correct answer, whereas, given the limited abilities of low-knowledge learners, they will find the question more challenging. Based on this understanding of considering complexity as an *intrinsic* property of a question that is given by its internal structure, we use complexity as a proxy to calculate difficulty, meaning that complex questions (with complex internal structures) are also considered difficult. This assumption is supported by previous work which found that, when evaluating human-authored or automatically generated questions, estimating difficulty based on complexity is effective (Alkhazaey et al., 2023; Choi and Moon, 2020; Yaneva et al., 2019; Loukina et al., 2016).

3. Theoretical Foundation

In this section, we provide an overview of the pedagogical and psychological literature on which we ground our approach.

3.1 Question Complexity

Different points of view exist in the pedagogical literature regarding what makes a question complex. Complexity has been interpreted as a quantification of the cognitive demand that the question poses on the learner. In their investigation into what makes a question cognitively demanding, Ahmed and Pollitt (1999) proposed that question complexity was an important dimension that increases cognitive demands. According to their view, complexity was defined as the number of operations that must be carried out before generating a correct answer, or the number of ideas that must be brought together (as well as the nature of the relationships between these ideas) in order to determine a solution. Thus, low complexity questions involve simple ideas and operations without the need to link them together; whereas higher complexity questions would require the learner to identify and combine different operations and ideas, and then link them together. When considered on a cognitive scale, a complex question would require the learner to recall and evaluate their subject knowledge, whereas simple questions only require the recognition of knowledge (Ahmed and Pollitt, 1999). Complexity in this definition has been successfully used to rate exam questions in terms of their cognitive demand, in subjects such as Geography, History and Chemistry (Hughes et al., 1998).

This understanding of complexity is also shared by researchers from fields which share commonalities with the AQG community. For example, the question-answering community distinguishes between *simple* and *complex* questions in terms of the number of facts they include, and the need to infer inner relationships (Lan et al., 2021;

Etezadi and Shamsfard, 2023; Luo et al., 2018). Questions that have multiple facts and constraints, express compound relations, and/or include numerical operations, are considered complex questions that require the learner to infer intrinsic semantic components (i.e. understand the inner relationships). To illustrate, consider the question “Which terrestrial planet has the second highest orbital period?”. For a learner to answer this question correctly, they need to infer several semantic components: 1) that the answer is a member of the *terrestrial planet class*; 2) the answer has a numerical attribute presenting the orbital period value; and 3) the learner must choose the answer that is ranked as the second highest orbital period value amongst all *terrestrial planets*. Meanwhile, a question such as “What is the orbital period of Mars?” only requires the simple recall of one fact (i.e. The orbital period of Mars is 687 days).

3.2 The Gradual Progression towards Competence

According to theories from cognitive psychology, expert and novice learners differ considerably regarding the quantity and quality of knowledge they possess about a certain subject (Gobbo and Chi, 1986; Kalyuga, 2007; Chi et al., 1981; Chi and Koeske, 1983). Expert learners tend to be superior to novices in two knowledge related aspects: 1) they have a more integrated and cohesive knowledge structure of the subject; and 2) because their knowledge is well-organised, it allows them to perform higher cognitive tasks such as reasoning and deduction. In this context, knowledge cohesion is defined as the pattern of interrelations among the subject’s concepts through direct or indirect links. The latter aspect was found to be affected by the former one, meaning that the more complex the knowledge structure the students have, the more capable they will be in performing complex cognitive tasks. Studies have shown that more proficient learners are more capable of understanding complex structures of physics problems compared to novice learners who focus on surface structures (Chi et al., 1981). This unique distinction is consistent with the pedagogical point of view that considers a good quality question to be one that must account for these expert-novice differences. Furthermore, the National Research Council (NRC) (2001) report highlighted the need to develop assessment instruments that are informed by cognitive models of progression towards competence. The rationale for this recommendation is mostly based on research on cognitive expert-novice differences.

These two aspects of proficiency, degree of structure and the ability to perform reasoning, can be mapped to how well-connected concepts are in the ontology, and on the choice of logical formalism used to represent the ontology, which in turn determines the type of reasoning, and therefore the new knowledge that can be derived. To illustrate, refer to the example in Figure 2 which shows two questions generated from the example ontology in Figure 1. Figure 2 assumes that the example ontology in Figure 1 is expressed using the Resource Description Framework – RDF (W3C, 2014), which is a knowledge representation formalism for representing knowledge bases in a machine-readable format. An RDF document is composed of statements about concepts and their relationships. These statements are represented by triples in the form (*subject*, *predicate*, *object*) where a concept (the *subject*) has some property (the *predicate*) expressing the type of relation that exists with another concept (the *object*). A statement represents a portion of a graph where the subject and the object are vertices, and the predicate is the edge representing the relationship between them. RDF knowledge bases are queried through the SPARQL query language (W3C, 2013), that exploits the RDF graph data model and formulates queries ranging from simple graph pattern matching (in the form of triple patterns) to complex queries that can span across different knowledge bases.

We can see clear differences in the structure of these two questions when we consider the degree of complexity of the questions’ graph patterns. Question A is based on a simple triple pattern, that searches for the objects of triples that have :Earth as a subject and :hasSatellite as a predicate. Question B looks for entities that are of type :Planet and for the value for their property :hasOrbitalPeriod. SPARQL also allows the specification of solution modifiers (e.g ORDER BY, that orders results) and filters (conditions used to restrict solutions to those for which the condition evaluates to TRUE), which are used in Question B to return only the largest value of :hasOrbitalPeriod for each entity returned.

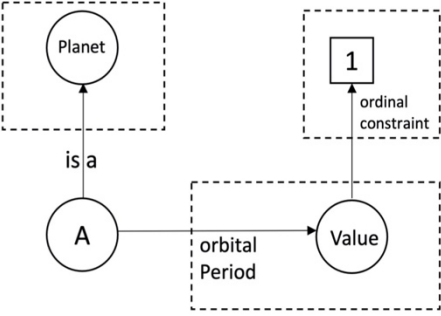
	A	B
Question	What is the satellite of Earth?	Which planet has the longest orbital period?
Graph Pattern		
SPARQL Query	<pre> SELEC ?object WHERE { :Earth :hasSatellite ?object. } </pre>	<pre> SELEC ?subject WHERE { ?subject rdf:type :Planet. ?subject :hasOrbitalPeriod :object. } ORDER BY DESC(?object)LIMIT 1 </pre>

Figure 2: Two examples of ontology-based auto-generated questions from ontologies (*A = answer*).

4. The Proposed Complexity Framework

The main goal of our framework is to be able to measure question complexity with ontological metrics to distinguish between students of different mastery levels. This assumes that questions are based on a knowledge base whose elements are expressed using the vocabulary and structure modelled by an ontology. Given that the gradual progression from novice to expert involves significant changes in *what* and, more importantly, *how* knowledge is represented in students' minds, we argue that these aspects are consistent with how ontologies are structured and accessed. This similarity in structure has motivated the development of our framework. In this paper, we adopt the understanding of complexity, where the cognitive demands are represented by the number of operations that must be carried out during the question-answering process, i.e. we propose to quantify these operations using ontological metrics. Therefore, we argue that in order to control the complexity of generated questions, we must be able to calculate an estimate for the knowledge structure required to answer the question (i.e. the complexity of the graph pattern) and the level of reasoning required during the question-answering process.

We introduce a metric that correlates the complexity of an ontology-generated question to the complexity of its underlying graph pattern. We define two categories of questions that can be generated from ontologies: *simple* and *complex* questions. Simple questions are questions which only require the recall of a single fact, whereas complex questions are those which require the integration of multiple facts and constraints, and that are subject to some level of reasoning (e.g. numerical operations). These two types of questions differ with respect to the volume of knowledge they test and the cognitive demand they require. The distinction between these two questions is consistent with how expert learners differ from novices with regard to their subject knowledge. Expert learners who can work with complex knowledge structures and in turn perform higher cognitive tasks are more capable of correctly answering complex questions. In contrast, novices' low ability to work with complex structures can compromise their ability to answer complex questions. This definition is useful and practical as it can be operationalised due to the structured nature of ontologies, which allows us to precisely and explicitly measure metrics such as the complexity of graph patterns.

We compute question complexity by considering the graph pattern which models the question. We define that a complex graph pattern is one that: 1) contains multiple facts; and 2) requires some level of reasoning. The first criterion can be measured by counting the number of triples that the question covers. For the second criterion, the presence of any semantic constraints that are expressed with restrictions such as filters or modifiers which restrict the number of possible answers can indicate a question which needs further reasoning. In contrast, simple questions have fewer triple patterns and only require the recall of the fact. Based on this assumption, we present the following definition to assess the complexity of ontology-based questions.

Definition. We define the complexity of a question Q as the level of complexity of its corresponding Graph Pattern GP . The complexity of a Graph Pattern C_{GP} is defined as the total number of TP , SM and F it contains, where a triple pattern TP_i is triple in which each element (the subject, predicate and object) can be a variable; a solution modifier, SM_i modifies the result set for a query, and more than one modifier can be specified in a query; and a filter F_i is a condition that restricts the results returned.

The definition illustrates that the increase in the number of triple patterns and the constraints posed on the answer set results in increasing the complexity of the generated question. To illustrate, consider our running example of a complex question in Figure 2. Question B is a complex question that entails the following triples “:Answer is_a :planet” and “:Answer :hasOrbitalPeriod :value”. When considering the SPARQL query for this question, we also notice that an additional ordinal constraint was carried out by using the ORDER BY and LIMIT modifiers to reason about the ontology and only return the planet with the highest orbital period. For a student to answer question B correctly, they must have knowledge of 1) all the planets in the solar system, and 2) the orbital period of each planet. In addition, the student needs to perform a ranking task to choose the highest planet in the ranked solar system planet set based on the length of its orbital period. This is to say that a student with a higher knowledge level and good reasoning abilities will likely be able to answer both questions (simple and complex). Consequently, this complexity framework will enable us to discriminate between students of different mastery levels.

5. Related Work

Rich semantic models such as ontologies and knowledge bases have been previously used to aid in the difficulty calibration of ontology-based questions. In this section, we discuss some of the previously proposed difficulty estimation frameworks.

Although an important deal of research effort has been made in the field of ontology-based automatic question generation, early studies did not directly tackle the problem of controlling the difficulty of the generated questions. In early studies such as Fischer (2001), Holohan et al. (2005) and Papasalouros et al. (2008), the aspect of difficulty estimation was only implicitly tackled by suggesting that semantic similarity (i.e. the distance between concepts in the hierarchical structure of the ontology) increases the learner’s effort to provide an answer. One of the earliest attempts to control the difficulty of Multiple-Choice Questions (MCQs) using ontological features was the work of Alsubait et al., (2013). They proposed a similarity-based theory to measure the *Concept similarity* between the key and distractors. They argued that semantically similar sets of options increase the cognitive demand on learners when trying to choose the correct answer. The underlying assumption was that identifying the correct answer would be more difficult if the distractors had a high semantic similarity to the answer. However, this approach is only applicable to MCQs, and the similarity-based measures only focus on distractors while neglecting the stem. This is problematic since it was found that the stem forms an important part of the question that can be a crucial deciding factor for its level of difficulty (Alkhuyaey et al., 2023). Seyler et al. (2017) proposed a difficulty estimation framework as a part of a question generator that employed Knowledge Graphs (KGs) such as DBpedia as an input source. Difficulty sources are extracted based on statistics computed from the knowledge graph, namely *entity popularity* and entity coherence (i.e. *the tendency of two entities to appear together*) as their difficulty metrics. However, given that their difficulty features are extracted from public KGs, this makes their approach less employable in specific educational contexts which utilise other types of knowledge sources. Vinu and Kumar (2015; 2016; 2017; 2020) have published several studies on ontology based AQG with various ontological metrics to control the difficulty of questions. Amongst the metrics they proposed were entities’ *popularity*, *selectivity* (i.e. the number of individuals that satisfy it), *coherence* (i.e. semantic relatedness of entities) and *specificity* (i.e. the depth of the entity within the ontology hierarchy). Faizan and Lohman also exploited the ontological class hierarchy to predict difficulty based on the depth of the correct answer in the class hierarchy. The underlying assumption is that deeper concepts require more knowledge as compared to surface or general concepts. The last two approaches indicate that the hierarchical structure of ontologies can be effectively employed to control the characteristics of the generated questions.

Some limitations were observed in existing ontology-based difficulty estimation models. All the approaches (except for Alsubait et al., 2013) are technical and lack a theoretical underpinning which guides the generation process. We have also observed that most current approaches focus on simple graph pattern matching when accessing the content of the ontology while dismissing advanced expressions that allow us to reason over the knowledge described by the ontology. These approaches start with a fixed linguistic construct that is instantiated with triples (or one part of a triple such as an object) from the input ontology. This method does not account for advanced constructs which capture the semantic relationship between the concepts. This limitation contributes to the simplicity of structure which was observed when comparing automatically generated questions to human-authored questions. Leo et al. (2019) have indeed noted that most of the current approaches are restricted in terms of their linguistic form. Another limitation of many of the current approaches is that the majority of questions generated are simple and only test the recall of knowledge (Khodeir et al, 2014). This has also been highlighted and addressed by Leo et al. (2019) who proposed an approach to control the difficulty of complex case-based MCQs in the medical domain. Although their model generates questions that test higher cognitive abilities (i.e. analysing knowledge), it is both domain- and source-specific as they only address medical case-based MCQs that are generated from one specific dataset, namely The Elsevier Merged Medical Taxonomy (EMMeT).

In this study, we focused on addressing the limitations of current approaches by proposing a generalisable framework which assesses the level of complexity based on ontological patterns to account for the underlying semantic structures. Our approach is employable in both generic and domain-specific contexts and is agnostic to the question format. Furthermore, it is grounded in principled theories of learning and cognition to increase its applicability in educational contexts.

6. Conclusion and Future Work

In this paper, we have proposed a framework to assess the complexity of ontology-based auto-generated questions. We have shown that our framework is practical, and consistent with well-established theories of learning and cognition. This work adds to the rapidly expanding field of AQG by providing researchers in the field with an evaluation framework that can help them to automatically calibrate the generated questions according to their complexity level. In future work, we aim to empirically validate our proposed approach by utilising it to practically assess automatically generated questions from domain ontologies.

References

- Ahmed, A. and Pollitt, A., (1999). Curriculum demands and question difficulty. In *IAEA conference*, Bled, Slovenia.
- AlKhuyaey, S., Grasso, F., Payne, T., Tamma, V. (2023) Text-based Question Difficulty Prediction: A Systematic Review of Automatic Approaches. *International Journal of Artificial Intelligence in Education*. <https://doi.org/10.1007/s40593-023-00362-1>
- Alsubait, T., Parsia, B., Sattler, U. (2016). Ontology-based multiple choice question generation. *KI-K unstliche Intelligenz*, 30 (2), 183–188.
- Alsubait, T., Parsia, B. and Sattler, U., (2013). A similarity-based theory of controlling MCQ difficulty. In *2013 second international conference on e-learning and e-technologies in education (ICEEE)*, 283-288. IEEE.
- Berry, R. and Adamson, B. eds., (2011). *Assessment reform in education: policy and practice*, 14. Springer Science & Business Media.
- Chang, T.M., (1986). Semantic memory: Facts and models. *Psychological Bulletin*, 99(2), p.199.
- Chi, M.T. and Koeske, R.D., 1983. Network representation of a child's dinosaur knowledge. *Developmental psychology*, 19(1), p.29.
- Chi, M.T., Feltovich, P.J. and Glaser, R., (1981). Categorization and representation of physics problems by experts and novices. *Cognitive science*, 5(2), 121-152.
- Choi, I.-C., & Moon, Y. (2020). Predicting the difficulty of EFL tests based on corpus linguistic features and expert judgment. *Language Assessment Quarterly*, 17 (1), 18–42.
- Collins, A.M. and Quillian, M.R., (1969). Retrieval time from semantic memory. *Journal of verbal learning and verbal behavior*, 8(2), 240-247.
- Etezadi, R. and Shamsfard, M., (2023). The state of the art in open domain complex question answering: a survey. *Applied Intelligence*, 53(4), 4124-4144.
- Faizan, A., & Lohmann, S. (2018). Automatic generation of multiple-choice questions from slide content using linked data. *Proceedings of the 8th international conference on web intelligence, mining and semantics*. 1–8.
- Fischer, S. (2001), Course and exercise sequencing using metadata in adaptive hypermedia learning systems. *Journal of Educational Resources in Computing*, 1(1), p. 5
- Gao, Y., Bing, L., Chen, W., Lyu, M.R., King, I. (2018). Difficulty controllable generation of reading comprehension questions. *arXiv preprint arXiv:1807.03586*.

- Gobbo, C. and Chi, M., (1986). How knowledge is structured and used by expert and novice children. *Cognitive development*, 1(3), 221-237.
- Holohan, E., Melia, M., McMullen, D. and Pahl, C. (2005), Adaptive E-learning content generation based on semantic web technology. *Proceedings of Workshop on Applications of Semantic Web Technologies for e-Learning*, Amsterdam, The Netherlands, 29-36.
- Huang, Z., Liu, Q., Chen, E., Zhao, H., Gao, M., Wei, S., . . . Hu, G. (2017). Question difficulty prediction for reading problems in standard tests. *Aaai*, 1352–1359.
- Hughes, S., Pollitt, A. and Ahmed, A., (1998). The development of a tool for gauging the demands of GCSE and A Level exam questions. BERA, Queen's University Belfast.
- Khodeir, N., Wanas, N., Darwish, N. and Hegazy, N., (2014). Bayesian based adaptive question generation technique. *Journal of Electrical Systems and Information Technology*, 1(1), 10-16.
- Kurdi, G., Leo, J., Parsia, B., Sattler, U. and Al-Emari, S., (2020). A systematic review of automatic question generation for educational purposes. *International Journal of Artificial Intelligence in Education*, 30, 121-204.
- Lan, Y., He, G., Jiang, J., Jiang, J., Zhao, W.X. and Wen, J.R., (2021). A survey on complex knowledge base question answering: Methods, challenges and solutions. *arXiv preprint arXiv:2105.11644*.
- Le Hebel, F., Montpied, P., Tiberghien, A. and Fontanieu, V., (2017). Sources of difficulty in assessment: example of PISA science items. *International Journal of Science Education*, 39(4), 468-487.
- Leo, J., Kurdi, G., Matentzoglou, N., Parsia, B., Sattler, U., Forge, S., Dowling, W. (2019). Ontology-based generation of medical, multiterm mcqs. *International Journal of Artificial Intelligence in Education*, 29 (2), 145–188.
- Loukina, A., Yoon, S.-Y., Sakano, J., Wei, Y., Sheehan, K. (2016). Textual complexity as a predictor of difficulty of listening items in language proficiency tests. *Proceedings of coling 2016, the 26th international conference on computational linguistics: Technical papers*, 3245–3253.
- Luo, K., Lin, F., Luo, X. and Zhu, K., (2018). Knowledge base question answering via encoding of complex query graphs. *In Proceedings of the 2018 conference on empirical methods in natural language processing*, 2185-2194.
- National Research Council (NRC), (2001). Knowing what students know: The science and design of educational assessment. *National Academies Press*.
- Papasalouros, A., Kanaris, K. and Kotis, K., (2008). Automatic Generation of Multiple-Choice Questions from Domain Ontologies. *e-Learning*, 1, 427-434.
- Pelánek, R., Effenberger, T. and Čechák, J., (2022). Complexity and difficulty of items in learning systems. *International Journal of Artificial Intelligence in Education*, 32(1), 196-232.
- Studer, R., Benjamins, V.R. and Fensel, D., (1998). Knowledge engineering: Principles and methods, *Data & Knowledge Engineering*, Volume 25, Issues 1–2, 1998, 161-197.
- Seyler, D., Yahya, M., Berberich, K. (2017). Knowledge questions from knowledge graphs. *Proceedings of the acm sigir international conference on theory of information retrieval*, 11–18.
- Siew, C.S., (2020). Applications of network science to education research: Quantifying knowledge and the development of expertise through network analysis. *Education Sciences*, 10(4), p.101.
- Vinu, E., & Kumar, P. (2020). Difficulty-level modeling of ontology-based factual questions. *Semantic Web*, 11 (6), 1023–1036.
- Vinu, E.V., & Kumar, P., (2017). Automated generation of assessment tests from domain ontologies. *Semantic Web*, 8 (6), 1023–1047.
- Vinu, E., Alsubait, T., Kumar, P. (2016). Modeling of item-difficulty for ontology-based MCQs. *arXiv preprint arXiv:1607.00869*
- Vinu, E.V., & Kumar, P. (2015). A novel approach to generate MCQs from domain ontology: Considering DL semantics and open-world assumption. *Journal of Web Semantics*, 34 , 40–54.
- World Wide Web Consortium, (2014). RDF 1.1 concepts and abstract syntax. Available at: <https://www.w3.org/TR/rdf12-concepts/#data-model> (Accessed: 11 Jun 2023).
- World Wide Web Consortium, (2013). SPARQL 1.1 Overview. Available at: <https://www.w3.org/TR/sparql11-overview/#:~:text=SPARQL%201.1%20is%20a%20set,A%20query%20language%20for%20RDF>. (Accessed: 11 Jun 2023).
- Yaneva, V., Baldwin, P., Mee, J., et al. (2019). Predicting the difficulty of multiple-choice questions in a high-stakes medical exam. *Proceedings of the fourteenth workshop on innovative use of NLP for building educational applications*, 11–20.

Redesigning Professional Development on Digital Transformation Using Andragogy as a Theoretical Lens

Linda Bergkvist¹, Karin Ahlin¹, Niklas Humble², Peter Mozelius³ and John Johansson¹

¹Karlstad Business School and Service Research Center (CTF), Karlstad University, Karlstad, Sweden

²Department of Computer and Geospatial Sciences, University of Gävle, Gävle, Sweden

³Department of Computer and Systems Sciences, Mid Sweden University, Östersund, Sweden

linda.bergkvist@kau.se

karin.ahlin@kau.se

niklas.humble@hig.se

peter.mozelius@miun.se

john.johansson@kau.se

Abstract: Regarding the ongoing digitalisation in the knowledge society, professional development seems more crucial than ever. The need for upskilling and reskilling is described as continuous lifelong learning, which must be combined and synchronised with the life of full-time working learners. Content, pedagogical models and instructional design in university courses are often created for students in Bachelor's and Master's programs instead of tailored for adults working full-time. This study describes and discusses andragogy as a potential knowledge base for redesigning professional development courses on digital transformation. Evaluations from two instances of a course for professionals on digital transformation showed that the course participants overall are satisfied with the course. However, only a few course participants take the exam to get credits. Therefore, the research question that guided this study was, "What redesign options for increased pass rates and learner satisfaction in professional development for adult learners can be identified using andragogy as a theoretical lens?" The course is on distance and contains four modules with synchronous and asynchronous learning activities, resulting in five European Credit Transfer System (ECTS). The empirical material consisted of course participants' check-in presentation before the course started, mid-term evaluation, final evaluations, and a learning diary containing 58 entries. The data was deductively analysed using the theory of andragogy as an analytical lens. The findings imply that instructors should put effort into how different parts of the course are connected, supporting learners' need to know. Further, to enhance the course participants' prior experience as a resource for learning by adding learning activities, they exchange experiences and examples with each other, adding to their learning process and networking. The pedagogic parts of understanding the theoretical course material could be split into pieces through exercises where the participants apply conceptual models and concepts to real-situation problems. The learning diary could help the participants align the new knowledge with their prior knowledge with a focus on professional roles and work situations. The identified redesign options create opportunities to increase pedagogical parts like readiness, orientation, and motivation to learn according to the current higher education system.

Keywords: Andragogy, Lifelong learning, Course redesign, Technology enhanced learning, Professional development

1. Introduction

In the contemporary knowledge society, the ongoing investment in upskilling and reskilling is an essential and continuous process across the human lifespan. Technology-enhanced learning has enabled new forms of professional development involving virtual learning environments and online conferencing tools for a more functional and flexible study design (Williams, 2020). At the same time, this requires higher education to rethink pedagogy and instructional design for an education tailored to working professionals (Mozelius, 2022). It is crucial to build on a pedagogical model that involves the needs of adult learners and opens up ideas such as experiential learning and work-integrated learning (Haddara and Skanes, 2007). Lifelong learning has a long history that can be traced back to Plato's 'The Republic' with his discussions on continuous learning to improve leadership (Williamson, 2008). This is still relevant today, but this is an elitist perspective that does not address the needs of the 21st-century knowledge society. In the 17th century, the philosopher and educationist Johann Amos Comenius outlined the broader and more democratic concept of lifelong learning for all. Both perspectives were combined by the French Enlightenment philosopher Nicolas de Condorcet with the still-modern idea of enabling lifelong learning for professional and personal development (Jaldemark, 2020). Lifelong learning in the 21st century should better be designed to stimulate self-determined learning and learner agency in a continuous and lifelong process (Blaschke, 2018; 2019).

In the discussions on education for adult working professionals, Knowles, Holton and Swanson (2015) have highlighted that Andragogy should be opposed to Pedagogy. On the other hand, Andragogy should rather be seen as a complementary extension to Pedagogy. This assumption could also be valid for Heutagogy in what has

been called a pedagogy–andragogy–heutagogy continuum (Blaschke, 2019; Moore, 2020). The individual learning journey could shift from traditional education to more self-directed and self-determined learning in this continuum. Course design in lifelong professional development should be related to this continuum, with variations depending on the group of participants and the assessment rules. In more traditionally graded university programmes, giving learners the same ownership over the assessment as in work-integrated professional development is impossible. In the context of higher education, this study belongs in the middle of the continuum, focusing on Andragogy. The research question that guided this study was: "What redesign options for increased pass rates and learner satisfaction in professional development for adult learners can be identified using andragogy as a theoretical lens?"

2. Theoretical framework

The concept of 'andragogy' has a long history and can be traced back to the Greek 'aner' and 'ageing', which would translate to 'leading men' or 'leading adults' (Loeng, 2018). Although the practice of adult learning and adult education has been around for a long time, the works of Malcolm Knowles have been highly influential on the concept and theory of andragogy (Loeng, 2018). Knowles's theory of andragogy has been widely used in prior research, for example, in studies on teacher professional development (Humble and Mozelius, 2021), the impact of COVID-19 on higher education (Sharaievska et al, 2022), and for reviewing the state-of-the-art literature on mobile learning (m-Learning) for adults (Sabri et al, 2022). In the theory of andragogy, Knowles, Holton, and Swanson (2015; 1998) present six core principles of adult learning, which are summarised in the listing below:

1. Learners need to know
 1. Why?
 2. What?
 3. How?
2. Self-concept of the learner
 1. Autonomous
 2. Self-directed
3. Prior experience of the learner
 1. Resource
 2. Mental models
4. Readiness to learn
 1. Life-related
 2. Developmental task
5. Orientation to learning
 1. Problem centred
 2. Contextual
6. Motivation to learn
 1. Intrinsic value
 2. Personal Payoff

The first principle highlights the importance of engaging adult learners in collaborative planning to share the control over learning and to make the learning more effective (Knowles, Holton and Swanson, 2015). Addressing how, what and why in the collaborative planning of learning is considered substantial (Knowles, Holton and Swanson, 2015). The second principle addresses learning mechanics and techniques and that adult learners are capable of taking control of these (Knowles, Holton and Swanson, 2015). Although there has been some discussion about whether this principle is a characteristic of adult learners and if it applies to all adult learners,

it is still emphasised that adult learning should be self-directed and autonomous (Knowles, Holton and Swanson, 2015).

The third principle has been highlighted as especially important for professional development (Knowles, Holton and Swanson, 2015). Prior research has also highlighted the importance of new learning and difficulties since they can challenge pre-existing mental models (Argyris, 1982; Knowles, Holton and Swanson, 2015; Schon, 1987). Instead, the recommendation is that adult learners' experiences be used as learning resources, which can also support them to more efficiently identify, test and change their own mental models (Knowles, Holton and Swanson, 2015). The fourth principle notes that changes in a life situation that creates a need for new knowledge often serve as readiness for learning among many adults (Knowles, Holton and Swanson, 2015). Therefore, teachers that understand adult learners' life situations can often be more effective (Knowles, Holton and Swanson, 2015).

Experiential learning, as defined by Kolb (1984), as "the process whereby knowledge is created through the transformation of experience", is considered a rooted practice in adult learning and highlighted in the fifth principle (Knowles, Holton and Swanson, 2015). They further state that learning should be contextual and problem-centred to suit adult learners' needs and preferences. The last core principle addresses adult learners' motivation to learn, where Knowles, Holton and Swanson (2015) state that internal payoffs and life-related problem-solving tend to motivate adults more. However, this should not lead to the misconception that payoffs of external nature (such as a raise in salary) are wasted on adult learners, but rather that intrinsic and personal satisfaction tend to be more motivating for adults (Knowles, Holton and Swanson, 2015).

Lastly, it should be noted that the core principles of adult learning in andragogy are located within 'goals and purposes for learning' and 'individual and situational differences' according to Knowles, Holton and Swanson (2015). Goals and purposes for adult learning are individual, institutional or societal and enclose and shape all other parts of the theory and the learning experience. In the next layer, enclosed by the goals and purposes, individual and situational differences comprise the middle part of andragogy and enclose the six core principles (Knowles, Holton and Swanson, 2015). These are described as variables and filters that shape the andragogy practice. These variables are categorised based on the type of difference they address subject-matter, situational, or individual learner.

In related research, Humble and Mozelius (2021) expand on Knowles, Holton and Swanson (2015) research to identify factors for learner satisfaction and pass rates in professional development courses. The research identifies eight crucial factors that could influence learners' satisfaction and increase course pass rates: 1) Exchange of experience, 2) Practical work, 3) Help and support, 4) Alignment to prior knowledge, 5) Required time and commitment, 6) Level of difficulty, 7) Clarity and structure, and 8) Participant expectation (Humble and Mozelius, 2021). In continuing professional development (CPD), Bennetts, Elliston and Maconachie (2012) highlight the importance of critical and active learners' involvement in ongoing professional development. Learners should take part in identifying their needs for development and training and formulating strategies and objectives that support them in addressing challenges in their professional practices (Bennetts, Elliston and Maconachie, 2012).

3. Research context

The existing distance course in this study is one course, among others, given by a research centre at a university in Sweden. The course 'Digitalisation and Digital Transformation in Organisations' has been designed and developed as part of a professional development initiative to offer flexible advanced-level courses for professionals. The requirements to apply for the course are 90 ECTS in Social or Natural Sciences and two years of work experience in digitalisation. The course runs for 15 weeks and is divided into four modules: Introduction to Digitalisation and Digital Transformation, Business Development through Digitalisation, Data-driven Organisations and Data Use, and Leadership and Organisations in the Age of Digital Transformation, resulting in five ECTS. The course aims to give the participant increased knowledge and understanding of central concepts, theories and models of digitalisation and digital transformation, which provides tools to lead and work systematically with digitalisation for improved efficiency and innovation in organisations.

The modules combine synchronous and asynchronous learning activities with three-hour weekly seminars, resulting in three or four seminars per module. Each module has a responsible teacher who has chosen research articles for the module and provided links to the articles on the learning management system (LMS). Besides that, the teachers record lectures and upload their film sequences on the LMS as they wish. The first seminar includes an introduction to the content of the course, a presentation of the teachers, and an introduction to the

LMS. Each module has at least one seminar with external professionals. Before the first seminar, the course participants are supposed to fill in a check-in template where they inform about their expectations, experiences of digitalisation, work roles, and industry. There are two internal course evaluations during the course, one formal course evaluation from the universities' side after the course, and the course participants are supposed to submit a learning diary to get their course ECTS.

So far, the course has been offered twice, and the overall impression is that the participants are satisfied. However, only a few take the examination to get the course credits. From an academic point of view, this is problematic since the pass rate is a quality measure in the higher education system in Sweden. In addition, allocating funds to the institution partly depends on the course participants passing the course. The course participants work with digitalisation in private or public organisations and occupy roles such as project leaders, business developers, managers, IT strategists and digitalisation coordinators. They have different backgrounds and experiences from digitalisation why their course expectations vary, bringing challenges concerning the course design and learning activities. Through this study, the idea is to investigate how an adult learning perspective on course design can help to address these problems and challenges.

4. Method

This study employs a design science research (DSR) approach. DSR is an appropriate methodological approach when the aim is to contribute with an artefact that helps to solve a practical problem (Johannesson and Perjons, 2021). In this study, the artefact is a master-level course for professionals designed and developed to address competence needs in digitalisation and digital transformation on a societal level and in the long run, contribute to lifelong learning. From evaluations of two course instances, problems and challenges regarding pass rate and course design surfaced, triggering a current state analysis to identify options for course redesign. Therefore, in this paper, the third step of the DSR process (Peppers et al, 2007) is focused on: options for redesigning the artefact (the course). Identifying options for redesign is based on the empirical material and the theory of andragogy (Knowles, Holton and Swanson, 2015). The identified options for redesign will constitute input to course (re-)design and development, implemented and evaluated during fall 2023.

4.1 Data collection and analysis

The empirical material for the study consists of five items: the course participants' check-in presentation, two internal course evaluations (mid-term and after course completion), one formal course evaluation from the university's side (after course completion), and a learning diary. The items have been designed with regard to the course curriculum, course objectives and course examination. Altogether the empirical material contains 58 entries, summarized in Table 1.

Table 1: Empirical material used in the study

Data items	Number of entries
Course participants' check-in	19
Internal mid-term evaluation	11
Internal evaluation (after course completion)	10
University-level evaluation (after course completion)	7
Learning diary	11

The empirical data has been deductively analysed using the theory of andragogy (Knowles, Holton and Swanson, 2015) as the theoretical lens. More specifically, the six core principles of adult learning guided the analysis and identification of course design and redesign options. Three authors have worked closely with the data, and two conducted the deductive data analysis. This was done iteratively and with recurrent discussions with the third author familiar with the data.

4.2 Ethical considerations

Course participants have been informed about the study and voluntarily consented that their material can be used. The study has been approved by an ethical advisor at Karlstad University (HS 2023/690).

5. Results

The results are categorised according to Knowles, Holton and Swanson (2015)'s previously presented principles for andragogy.

5.1 Learner's need to know

The course participants expressed their gratitude for the formality and administration related to the instance on the LMS. The information in the course instance is clearly announced on an overall level and for each of the four-course modules. The result is that it is easy to find information without too much effort. Some respondents want more rigid material to decrease the burden of returning to university studies. For example, support in how to get access to and read research articles. The information can be either in written words or in a recorded film. However, some prefer film since it can be listened to during a walk or other activities.

While the course participants saw the overall administration as satisfactory, they emphasised that they wanted all modules accessible at the course start. The reason was to schedule work assignments and prepare for course appointments. The total workload made the readings hard to squeeze into their schedule, and some participants expressed that it was difficult to find time for reflection. Another aspect related to the research articles was that the teachers handled them differently, affecting the understanding and how to use them in the learning diary. Individual assignments that included the application of theoretical concepts and models in their own business were viewed as introduced too late and, therefore, too harsh to handle in time.

Synthesising the empirical material, the professionals were satisfied with the information on what to learn and wanted us to continue in the same manner but increase the how and why already during the course introduction and then continuously.

5.2 Self-concept of the learner

Here, the empirical material focused on the design of the course and that the course material should be easily accessible via the LMS. The division of the course into four modules, the length of the course and the weekly meetings were especially appreciated. The course participants valued the provision of both recorded and written course material and that they could take part in it irrespective of time and place. Some participants expressed as missing one or two seminars did not affect the learning process, mainly because the seminars were recorded. The course participants appreciated the buffet of knowledge-acquiring resources and learning activities, but how to use them was, to some degree, handed over to the course participants.

To summarise, the empirical data shows that the course participants are satisfied with the course content, course length, and weekly meetings. Further, they want to spend their time on their learning process. Providing easily accessible course material in written and recorded form enables them to focus their learning process irrespective of time and place.

5.3 Prior experience of the learner

The learner's prior experience varies; some course participants are new to the area, and some are taking this course as one among others. The latter group of participants builds on previous knowledge and creates cutting-edge competence. Some have studied digitalisation previously, but more of the technical aspects. Therefore, they wish to add more social aspects, such as the organisational. Some describe themselves as "feeling rusty academically", expressed by the difficulty of reading scientific articles.

A central theme in the course participants' expectations of the course is that they want to learn from each other by sharing experiences and examples of digitalisation. The weekly seminars are highly appreciated as they constitute a forum for discussions and reflections on theoretical concepts and models based on their experiences and real-world examples. Since the course participants have different backgrounds and are occupied in different organisations, different perspectives on digitalisation are brought forward, which has greatly benefited the course participants.

For professional development, the prior experience of the learner is central. The empirical data also shows that professionals learn from each other, addressing the importance of designing learning activities where the learners can share and reflect on each other's experiences and lessons learned, thereby challenging their mental models.

5.4 Readiness to learn

The empirical material shows that all professionals are ready to learn more about digitalisation and look forward to developing their understanding. They emphasise that their professional role and curiosity are the driving forces, and for some professionals learning about digitalisation adds more business opportunities to entrepreneurs. Some professionals put forward communication skills for digitalisation to break a culture of needing to understand how to approach digital transformation in their organisation. They put hope and expectations in the course to solve existing problems and challenges.

The empirical material shows different incentives for why the course participants want to learn more about digitalisation. One is about increasing the theoretical and practical understanding of digitalisation, both from an individual and organisational perspective and another is about getting tools to advance the digital maturity in their organisations.

5.5 Orientation to learning

The course participants highlight the benefits of having a mixture of theoretical lectures, practical cases, and assignments to understand more about digitalisation and digital transformation. These activities add to their willingness to discuss and deepen their knowledge. The individual practical assignments between weekly seminars aim for the course participants to delve into the course literature and apply models in their work environment. This has been an appreciated task for some of the course participants, especially since it relates to their current work situation and helps them understand the models' benefits and how they can be used in practice. Further, it supports the writing of the learning diary.

The empirical material shows that the course participants want to iterate between theoretical and practical learning activities to promote their learning process. Theoretical learning activities should preferably be complemented with practical examples and cases and anchored in the course participants' life situations or practised through an exercise or assignment.

5.6 Motivation to learn

The motivation to learn is expressed as wanting to help their organisation and sometimes detailing it to specific work roles. They want the organisation to stay up-to-date and add to the pride and competitiveness of their organisation. They can benefit individually through personal development and organisationally in their work situation. Some professionals work as entrepreneurs and see opportunities to add more business possibilities. Thus, the motivation to learn is from an individual and organisational perspective.

6. Design and redesign options

The intention is to increase the course participants' satisfaction with the course and the number of participants graduating. Therefore, based on the findings and previous research, we present our perspectives on the results and ideas on design and redesign options.

The importance of the *learner's need to know* is based on the what, how, and why (Knowles, Holton and Swanson, 2015). Mainly discussed is the "what" and that easy accessibility is essential. The "what" is addressed in the course participants' feedback on the importance of course information, instructions, and access to learning material. We intend to increase the what by showing the learning objectives recurrently during the course and the how by establishing a format for article seminars used in all modules. Lemow (2015) describes that a similar format provides security and recognition, and clarity and structure are one of the factors for learner satisfaction found in the study by Humble and Mozelius (2021). Activities to keep are the mix of films, lectures, seminars, and assignments. We can add the why by reflecting on how the different parts are connected and how they help to reach the learning objectives. This supports the course participants in their learning process (cf. Humble and Mozelius, 2021).

The *self-concept of the learner* explains that the learning should be autonomous and self-directed by the adult learner (Knowles, Holton and Swanson, 2015). In the context of professional development and lifelong learning, the application to the course can be understood as a self-directed choice by the professionals based on their need to extend their knowledge in digitalisation. To provide a flexible and autonomous learning process, independent of time and place, we could provide easily accessible course material in written and recorded form. A theme in the empirical data is learning from each other by sharing experiences from different settings and

backgrounds. The exchange of experience for professional development has also been recognized in a previous study on the adult's learning process (Humble and Mozelius, 2021) and relate to the principle prior experience of the learner in the theory of andragogy (Knowles, Holton and Swanson, 2015). Therefore, we could clarify that the course participants should use their experiences to learn from each other and add learning activities such as an individual oral experience presentation during the introduction seminar. This activity also works as an icebreaker in adult learning contexts (Bowman, 2008).

Prior experiences of the learner suggest that the adult learner's mental models and prior experiences should be used as a resource for learning (Knowles, Holton and Swanson, 2015). Therefore, we should clarify that they should use their experience and that they will learn from each other (Bowman, 2008; Humble and Mozelius, 2021) and reinforce and add arenas to share previous knowledge and expectations. Further, we could design learning activities where the course participants reflect on what they have learnt in relation to previous knowledge and experiences and how the new knowledge can be applied in their professional work. This can help build a network and to realise they are part of a knowledgeable group. In the long run, this can support them to identify, test and even change their mental models (Knowles, Holton and Swanson, 2015).

Readiness to learn highlights the importance that adult learning should be life-related and that tasks conducted in this setting are developmental (Knowles, Holton and Swanson, 2015). The empirical material shows that the course participants expect to learn more about digitalisation from a theoretical and practical perspective (cf. Humble and Mozelius, 2021). Through research-based knowledge, they want to advance their knowledge in digitalisation and acquire tools to use in their organisational setting. Therefore, one suggestion is based on theories and models to help them argue for digitalisation or transformation in their contexts. Another suggestion is to add critical thinking and debate how and when digitalisation or digital transformation is out of range.

Orientation to learning points out that adult learning should be problem-centred and contextual (Knowles, Holton and Swanson, 2015). Here are interested in understanding how the learning has affected them and their organisation. An early assignment, as part of the check-in, where the course participants formulate their needs and how to involve their work in their development and training, could be one way forward (cf. Bennetts, Elliston and Maconachie, 2012). The assignments are designed so that they can adjust them to their specific needs and practical work, whereas the learning diary can be improved by designing it to help the participants align the new knowledge to their prior knowledge (cf. Humble and Mozelius, 2021) and transform the theoretical knowledge into their work situation.

Motivation to learn stresses that the learning should focus on intrinsic value and the personal payoff for the adult learner (Knowles, Holton and Swanson, 2015). We can therefore design learning activities where the course participants' new experiences and knowledge are related to prior experiences/knowledge, their professional development and how this will benefit the course participants on an individual and organisational level.

7. Conclusion

Higher education plays a crucial role in lifelong learning, but traditional academic structures and courses are not designed for full-time working adults. Therefore, higher education must rethink course design to meet the needs of working professionals. In this paper, the theory of andragogy has been used as a theoretical lens to identify redesign options for increased pass rate and learner satisfaction in professional development. The study reports on two instances of a master-level course aimed at professional development in digitalisation and digital transformation. The findings show the importance of designing learning activities where the course participants' experiences and prior knowledge are used as resources for learning. As an instructor, it becomes essential to clarify that the course participants should use their experiences to learn from each other. The material also shows that the adult learner wants to focus on their learning process, which can be supported by clear and structured information/instructions provided in written and recorded form and well in advance.

Further, the adult learner wants to integrate the new knowledge into their work environment. Tasks should be designed to help adult learners use the new knowledge in their professional roles and work. One way of supporting work-integrated learning is using problem-oriented tasks where research-based knowledge is applied in real work situations and designed to help the adult learner align the new knowledge with prior knowledge. The identified redesign options create opportunities to increase adult learner satisfaction and pass rate by addressing pedagogical parts like readiness, orientation, and motivation to learn according to the current higher education system.

Funding

The study was financed by KK-stiftelsen, the Knowledge Foundation (Grant No. 20200060).

References

- Argyris, C. 1982. *Reasoning, Learning and Action*, Jossey-Bass, San Francisco.
- Bennetts, C., Elliston, K. and Maconachie, M. 2012. Continuing professional development for public health: an andragogical approach, *Public Health*, Vol 126, No. 6, pp 541-545.
- Blaschke, L. M. 2018. Self-determined learning (heutagogy) and digital media creating integrated educational environments for developing lifelong learning skills, In D Kergel, B Heidkamp, P Kjærdsdam Telléus, T Rachwal, & S Nowakowski (eds), *The digital turn in higher education*, Wiesbaden, Springer VS, pp 129-140.
- Blaschke, L. M. 2019. The pedagogy–andragogy–heutagogy continuum and technology-supported personal learning environments. In I Jung (ed), *Open and distance education theory revisited*, Singapore, Springer, pp 75-84.
- Bowman, S. L. 2008. *Teaching from the back of the room: 65 ways to step aside and let them learn*. John Wiley & Sons Inc
- Haddara, M. and Skanes, H. 2007. A reflection on cooperative education: From experience to experiential learning, *International Journal of Work-Integrated Learning*, Vol 8, No. 1, p 67.
- Humble, N. and Mozelius, P. 2021. Enhancing Pedagogy to Andragogy in the Redesign of Teacher Training Courses on Programming, In *Proceedings of the European Conference on e-Learning (ECEL)*, Vol 2021, pp 210-217.
- Jaldemark, J. 2020. Formal and informal paths of lifelong learning: Hybrid distance educational settings for the digital era, In M. Cleveland-Innes & R. Garrison (eds.), *An introduction to distance education: Understanding teaching and learning in a new era*, 2nd edn, Routledge, New York, pp 25-42.
- Johannesson, P. and Perjons, E. 2021. *An Introduction to Design Science*, 2nd edn, Springer, Cham.
- Knowles, M. S., Holton III, E. F. and Swanson, R. A. 2015. *The adult learner: The definitive classic in adult education and human resource development*, 8th edn, Routledge, New York.
- Knowles, M. S., Holton III, E. F. and Swanson, R. A. 1998. *The adult learner: The definitive classic in adult education and human resource development*, 5th edn, Gulf Professional Publishing, Houston, TX..
- Kolb, D. A. 1984. *Experiential Learning: Experience as the Source of Learning and Development*, Prentice-Hall.
- Lemov, D. 2015. *Teach like a champion 2.0: 62 techniques that put students on the path to college*. John Wiley & Sons Inc
- Loeng, S. 2018. Various ways of understanding the concept of andragogy, *Cogent Education*, Vol 5, No. 1, 1496643.
- Moore, R. L. (2020) Developing lifelong learning with heutagogy: contexts, critiques, and challenges, *Distance Education*, Vol 41, No. 3, pp 381-401.
- Mozelius, P. (2022) With the Aim of Multi-directed and Work-integrated Professional Development, *The Electronic Journal of Knowledge Management*, Vol 20, No. 1, pp 52-62.
- Peffer, K., Tuunanen, T., Rothenberger, M. A. and Chatterjee, S. 2007. A design science research methodology for information systems research, *Journal of management information systems*, Vol 24, No. 3, pp. 45-77.
- Sabri, S., Gani, A., Yadegaridehkordi, E., Eke, C. I. and Shuib, L. 2022. A Survey on Mobile Learning for Adult Learners: State-of-the-Art, Taxonomy, and Challenges, *IEEE Access*. <https://doi.org/10.1109/ACCESS.2022.3195285>
- Sharaievska, I., McAnirlin, O., Browning, M. H., Larson, L. R., Mullenbach, L., Rigolon, A., ... and Reigner, N. 2022. Messy transitions”: Students’ perspectives on the impacts of the COVID-19 pandemic on higher education, *Higher education*, 1-18. <https://doi.org/10.1007/s10734-022-00843-7>
- Schon, D. A. 1987. *Educating the Reflective Practitioner*, Jossey-Bass, San Francisco.
- Williams, R.T. 2020. A Systematic Review of the Continuous Professional Development for Technology Enhanced Learning Literature, *Engineering International*, Vol 8, No. 2, pp 61-72.
- Williamson, T. 2008. The good society and the good soul: Plato's Republic on leadership, *The Leadership Quarterly*, Vol 19, No. 4, pp 397-408.

Impact of Digital Literacy on Cyberloafing and Compulsive Social Media Use Post-Kahramanmaraş Earthquake

Mehmet Ali Canbolat

Karamanoglu Mehmetbey University, Department of Management and Organization, Karaman, Turkey

mcanbolat@kmu.edu.tr

Abstract: In recent years, mass disasters have begun to occur in the world and the business world has been greatly affected by these disasters. Especially during the COVID-19 pandemic period, many processes have shifted to digitalization and people have increased their technology usage levels. It can be said that a similar situation was experienced in the Kahramanmaraş earthquake. From this point of view, within the scope of the research, the effects of digital literacy on cyberloafing and compulsory social media use were tried to be examined. The research was carried out with 244 participants aged between 18-30 working in any business line, in a quantitative research design. The data were collected using the questionnaire technique. The obtained data were subjected to descriptive statistics, correlation analysis, reliability analysis and simple regression analysis. According to the research findings, the digital literacy scale and its sub-dimensions are in a moderately and highly significant positive relationship with the cyberloafing scale and its sub-dimensions. However, the scale of compulsive social media use has a low level of positive and significant relationship with the scale of digital literacy and cyberloafing. According to the results of the regression analysis, it was determined that digital literacy has a statistically significant and positive effect on cyberloafing. In addition, it has been determined that digital literacy has a statistically significant and positive effect on compulsive social media use.

Keywords: Digital Literacy, Cyberloafing, Compulsive Social Media Use, CSMU

1. Introduction

Advances in technology continue to be rapidly integrated into almost every aspect of daily life. Although this integration is positive, in some cases, the misuse of software technologies brings with it a number of negativities. One of these negativities is the intensive use of internet technology. The COVID-19 pandemic in recent years has unexpectedly affected the education-teaching process around the world, forcing those concerned to switch to an online teaching and learning format (Li and Yu, 2022). This situation continued after the Kahramanmaraş earthquake. In the earthquake that took place on February 6, 2023, the epicenter of which was Turkey-Kahramanmaraş, more than 50 thousand people died and 13.5 million people were directly affected by this situation. In this process, life in 11 provinces has come to a standstill and education and training processes have passed to the online process, as in the pandemic. This situation has increased the tendency of young people who both work and study to be in the virtual environment. In other words, the education and training infrastructure used during the pandemic period was also used after the Kahramanmaraş earthquake. This situation has caused especially young people to spend more time in the virtual world. In this process, the level of technology use in the virtual world has increased, especially for people who want to communicate more with their relatives. Of course, not only the education sector, but almost all sectors were affected by this process (Peng and Yu, 2022).

Especially in times of crisis, misinformation with low credibility, unproven accuracy, and provocative misinformation can lead to misleading results for individuals and society (Hamutoğlu et al., 2017). New media, on the other hand, can trigger this situation by causing radical changes in the field of communication (Onursoy, 2018). In order to avoid these negative effects, the concept of digital literacy can be mentioned. Although the pioneer of the concept of digital literacy is Paul Gilster (1997), it can be said that digital literacy research has started to increase since 2013 (Tinmaz et al., 2022). Digital literacy refers to the competences related to the safe, legal and moral use of technologies that will contribute to personal development with these technologies, solve the problem in any context of life, and support social participation and production, while including the effective learning of information and communication technologies. In other words, digital literacy means effectively and seriously doing research on the internet, evaluating and collecting information by using various digital technologies (Özerbaş and Kuralbayeva, 2018). Digital literacy requires the right use of different technologies, as well as the ability to reach, produce and share the right information, and to have the skills to use technology in the learning-teaching processes (Hamutoğlu et al., 2017). Digital literacy, also called virtual learning, is a phenomenon that has the potential to improve lifelong learning (Khan et al., 2022). Digital literacy is also the ability to be aware of digital threats to one's own identity and to use digital tools to resist them and secure one's own identity (Martin et al., 2022). Digital literacy includes the complex cognitive, sociological and emotional skills required for users to work effectively in the digital environment (Karabacak and Sezgin, 2019). Williams et

al. (2022) found that digital literacy has a positive effect on people's online risk and self-control during the COVID-19 process.

Of course, heavy internet use can also pose a problem for the business world. Employees can use the internet for their personal business during working hours. At this point, the concept of cyberloafing emerges. Cyberloafing is the time employees spend for their personal needs through internet access during working hours (Lim, 2002). Cyberloafing means the use of computer and internet systems provided for business use for personal purposes (Örücü and Yıldız, 2014). Especially the addiction of the business world to the internet paved the way for cyberloafing (Mills et al., 2001). It is known that as internet addiction increases, cyberloafing tendency also increases (Lavoie, 2001). Organizations, on the other hand, are in an effort to restrict the use of the internet by their employees in various ways (Henle et al., 2009). The fact that not only in the business but also the mobile personnel use the internet for their personal purposes during working hours can be considered within the scope of cyberloafing (O'Neill et al., 2014). It is also reported that men engage in cyberloafing more than women (Baş, 2017). Candan and İnce (2016) found that there was no statistically significant relationship between employees' cyberloafing behaviours and their organizational commitment, and that there was a negative relationship between employees' service time and cyberloafing. Yıldırım (2018) determined that the level of burnout of employees will increase cyberloafing. According to Arslan Ayazlar et al. (2018), on the other hand, found that students frequently perform cyberloafing during their internship. Also, Arslantas et al. (2023) found that digital literacy has a positive effect on cyberloafing. According to Gönültaş et al. (2023) also found that gifted students have high levels of digital literacy and low levels of cyberloafing.

Finally, in line with these interactions, it can be said that people are faced with the use of compulsive social media. In addition to the positive results, especially regarding social networking sites, people may encounter negative consequences due to excessive use of social media (Fontes-Perryman and Spina, 2022). Compulsive social media use refers to the inability of the person to control himself/herself in social media use for fear of not receiving comments/likes or negative reactions in social media applications. The concept can sometimes be confused with problematic social media use. Problematic social media use is a form of use that occurs when a person spends a lot of time on social media together with developing technology (Keleş, 2020). This situation reduces face-to-face social sharing day by day and leads to the formation of a society in which compulsive behaviours are fed (Apaolaza et al., 2019). While social media applications are constantly evolving in terms of their features and functions, they have permeated many aspects of our lives. Compulsive social media use or social media addiction is becoming more common, especially among young people (Benson et al., 2019). Ali et al. (2021) tried to determine the relationships between social interaction anxiety, fear of negative evaluation, fear of rejection, and compulsive social media use. Aladwani and Almarzouq (2016), on the other hand, found that self-esteem had a negative effect on compulsive social media use, while interaction anxiety had a positive effect.

All three variables in the research are variables that develop due to digitalization. In this respect, it is expected that the variables may interact with each other. In addition, digital literacy can be considered a positive variable. However, the same cannot be said for other variables. Based on this, the problem of the research is to determine the effect of digital literacy on cyberloafing and compulsive social media use. The purpose of the research is to try to determine the possible effects of increased internet use, especially after crisis periods.

In line with all this information, the model of the research was determined as in Figure 1.

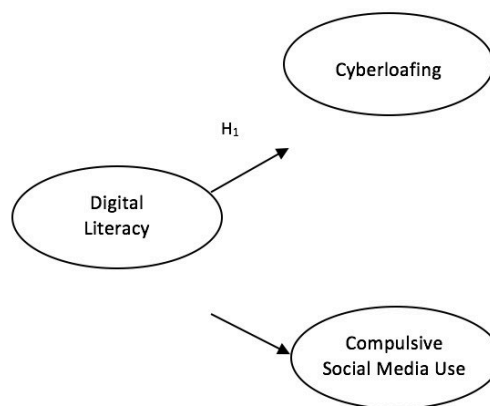


Figure 1: Model of the Study

The hypotheses put forward in line with the determined research model are as follows.

H₁: Digital literacy has an impact on cyberloafing.

H₂: Digital literacy has an impact on compulsive social media use.

2. Research Methods

The research was planned in a quantitative research design and cross-sectional type in order to determine the effect of digital literacy on cyberloafing and compulsive social media use. The research was carried out in March 2023 with 244 volunteer young people between the ages of 18-30 working in any business line. Data were obtained from the participants through the data collection form and online survey application. The data collection form consists of 4 parts. In the first part, there are 4 questions including demographic information, in the second part there is the digital literacy scale (17 items), in the third part there is the cyberloafing scale (14 items) and in the last part there is the compulsive social media use scale (8 items). The digital literacy scale was developed by Ng (2012). In the research, Hamutoğlu et al. (2017)'s Turkish validity and reliability scale was used. The scale consists of 4 sub-dimensions. For the cyberloafing scale, the scale developed by Örucü and Yıldız (2014) from various studies (Lim, 2002; Blanchard and Henle, 2008; Özkalp et al., 2012) was used. The scale consists of 2 sub-dimensions. For the scale of compulsive social media use, Okazaki et al. (2021) and the Turkish validity reliability of the scale was used by Çelik and Diker (2021). The scale consists of one dimension. The scales were used in a five-point Likert type between “strongly disagree” and “strongly agree”.

3. Findings

As a result of the frequency analysis performed first, the demographic characteristics of the participants were determined as in Table 1.

Table 1: Demographic Characteristics of the Participants

	Number	%		Number	%
Age			Gender		
18-23	185	75,8	Female	138	56,6
24-27	22	9,0	Male	106	43,4
28-30	37	15,2	Work Experience		
Education Level			Less than 1 year	118	48,4
High School	113	46,3	2-3 years	62	25,4
Bachelor	105	43,0	4-6 years	24	9,8
Graduate	26	10,7	7 years and above	40	16,4

As seen in Table 1, the majority of the participants (75.8%) were between the ages of 18-23, high school degree graduates (46.3%), female (56.6%), and their professional experience was less than 1 year (48.4%). has been done. After this stage, reliability analysis and correlation analysis were started. Table 2 shows the reliability and correlation coefficients of the scale and its sub-dimensions.

Table 2: Correlations

	1	2	3	4	5	6	7	8	9
Digital Literacy Scale	(,977)	,965**	,964**	,906**	,896**	,615**	,554**	,619**	,243**
Attitude		(,952)	,874**	,862**	,803**	,614**	,550**	,622**	,270**
Technical			(,955)	,837**	,883**	,573**	,520**	,571**	,205**
Cognitive				(,861)	,771**	,533**	,471**	,547**	,218**
Social					(,855)	,561**	,513**	,554**	,186**
Cyberloafing						(,934)	,957**	,940**	,339**
Significant Cyberloafing Scale							(,876)	,800**	,363**
Insignificant Cyberloafing								(,911)	,273**

	1	2	3	4	5	6	7	8	9
Compulsive Social Media Use Scale									(.861)

** . Correlation is significant at the 0.01 level (2-tailed). Values in parentheses are Cronbach's Alpha coefficients.

As can be seen in Table 2, the digital literacy scale and its sub-dimensions are in a moderately and highly significant positive relationship with the cyberloafing scale and its sub-dimensions. However, the scale of compulsive social media use has a low level of positive and significant relationship with the scale of digital literacy and cyberloafing. At the same time, it was observed that the scales had a high level of validity.

After this stage, regression analysis was used to test the research hypotheses. First, simple regression analysis was used to test the H₁ hypothesis. The findings are as in Table 3.

Table 3: Regression Analysis Findings on the Effect of Digital Literacy on Cyberloafing

Dependent Variable	Independent Variable	t	B	F	p	R ²
Cyberloafing	Constant	7.892	.567	147.009	.000	.378
	Digital Literacy	12.125				

As seen in Table 3, it was determined that digital literacy had a statistically significant and positive effect on cyberloafing ($R^2 = .378$; $p = .000$). In this case, the H₁ hypothesis was accepted. In Table 4, the results of the regression analysis performed to test the H₂ hypothesis of the research are given.

Table 4: Regression Analysis Findings on the Effect of Digital Literacy on Compulsive Social Media Use

Dependent Variable	Independent Variable	t	B	F	p	R ²
Compulsive Social Media Use	Constant	8.062	.218	15.237	.000	.059
	Digital Literacy	3.903				

As seen in Table 4, it has been determined that digital literacy has a statistically significant and positive effect on compulsory social media use ($R^2 = .059$; $p = .000$). However, it can be said that this effect is very low. In this case, the H₂ hypothesis was accepted.

4. Conclusion

The research was conducted with 244 young people between the ages of 18-30 working in any business line in order to determine the effect of digital literacy on cyberloafing and compulsive social media use. The majority of the participants are between the ages of 18-23, high school degree graduates, women and have less than 1 year of professional experience. According to the results of the correlation analysis, the digital literacy scale and its sub-dimensions are in a moderately and highly positive relationship with the cyberloafing scale and its sub-dimensions. However, the scale of compulsive social media use has a low level of positive and significant relationship with the scale of digital literacy and cyberloafing. According to the results of the regression analysis, it was determined that digital literacy has a statistically significant and positive effect on cyberloafing. In other words, as the digital literacy levels of young people increase, their cyberloafing levels also increase. In this case, the H₁ hypothesis of the research was accepted. In addition, it has been determined that digital literacy has a statistically significant and positive effect on compulsive social media use. In other words, as the digital literacy levels of young people increase, their compulsive social media use levels also increase. However, it can be said that this effect is very low. In this case, the H₂ hypothesis was accepted.

After the earthquake in Kahramanmaraş, people increased their social media usage levels especially in order to get more news from the region. It can be said that the social media usage levels of especially young people have increased in order to be able to respond to the calls for help and participate in the campaigns. Considering this point, it is expected that as the digital literacy levels of young people increase, the level of cyberloafing will also increase. In addition, although it has been determined that digital literacy has a positive effect on compulsive social media use, the fact that this effect remains at a very low level can be interpreted as an indication that people do not expect likes/comments during the earthquake period. In this context, in order to generalize the results of the research, it can be suggested to obtain comparative results by repeating the research in different sample groups and in different regions.

References

- Aladwani, A. M. and Almarzouq, M. (2016) "Understanding Compulsive Social Media Use: The Premise of Complementing Self-Conceptions Mismatch with Technology", *Computers in Human Behavior*, Vol 60, No. 2016, pp 575-581. <https://doi.org/http://dx.doi.org/10.1016/j.chb.2016.02.098>
- Ali, F., Ali, A., Iqbal, A. and Zafar, A. U. (2021) "How Socially Anxious People Become Compulsive Social Media Users: The Role of Fear of Negative Evaluation and Rejection", *Telematics and Informatics*, Vol 63, No., pp 1-12.
- Apaolaza, V., Hartmann, P., D'Souza, C. and Gilsanz, A. (2019) "Mindfulness, Compulsive Mobile Social Media Use, and Derived Stress: The Mediating Roles of Self-Esteem and Social Anxiety", *Cyberpsychology, Behavior, and Social Networking*, Vol 22, No. 6, pp 388-396. <https://doi.org/https://doi.org/10.1089/cyber.2018.0681>
- Arslan Ayazlar, R., Sayman, E. and Çınar, M. (2018) "Tourism Students' Cyberloafing Behavior in Their Training Courses", *Adnan Menderes University, Journal of Institute of Social Sciences*, Vol 5, No. 3, pp 24-37.
- Arslantas, T. K., Yaylacı, M. E. and Özkaya, M. (2023) "Association Between Digital Literacy, Internet Addiction, and Cyberloafing Among Higher Education Students: A Structural Equation Modeling", *E-Learning and Digital Media*, Vol 0, No. 0, pp. <https://doi.org/https://doi.org/10.1177/20427530231156180>
- Baş, M. (2017) "Cyberloafing Tendency in Applications of Students who have Tourism and Culinary Training", *Journal of Strategic Research in Social Science (JoSReSS)*, Vol 3, No. 4, pp 261-270.
- Benson, V., Hand, C. and Hartshorne, R. (2019) "How Compulsive Use of Social Media Affects Performance: Insights from the UK by Purpose of Use", *Behaviour & Information Technology*, Vol 38, No. 6, pp 549-563. <https://doi.org/https://doi.org/10.1080/0144929X.2018.1539518>
- Blanchard, A. L. and Henle, C. A. (2008) "Correlates of Different Forms of Cyberloafing: The Role of Norms and External Locus of Control", *Computers in Human Behavior*, Vol 24, No. 3, pp 1067-1084. <https://doi.org/https://doi.org/10.1016/j.chb.2007.03.008>
- Candan, H. and Ince, M. (2016) "A Research on the Relationship Between Cyberloafing and Organizational Commitment of Police Department Personnel", *Niğde Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, Vol 9, No. 1, pp 229-235.
- Çelik, F. and Diker, E. (2021) "Covid-19 Sürecinde Depresyon, Stres, Gelişmeleri Kaçırma Korkusu ve Zorlayıcı Sosyal Medya Kullanımı Arasındaki İlişkiler", *AYNA Klinik Psikoloji Dergisi*, Vol 8, No. 1, pp 17-43.
- Fontes-Perryman, E. and Spina, R. (2022) "Fear of Missing Out and Compulsive Social Media Use as Mediators Between OCD Symptoms and Social Media Fatigue", *Psychology of Popular Media*, Vol 11, No. 2, pp 173-182. <https://doi.org/https://doi.org/10.1037/ppm0000356>
- Gilster, P. (1997). *Dijital Literacy*. John Wiley, New York.
- Gönültaş, A., Avcu, Y. E., Taşdelen, A. S. and Hünerli, S. (2023) "Examination of the Relationship Between Digital Literacy and Cyberloafing Levels of Gifted Students", *Eğitim Teknolojisi Kuram ve Uygulama*, Vol 13, No. 2, pp 415-439.
- Hamutoğlu, N. B., Canan Güngören, Ö., Kaya Uyanık, G. and Gür Erdoğan, D. (2017) "Adapting Digital Literacy Scale into Turkish", *Ege Journal of Education*, Vol 18, No. 1, pp 408-429. <https://doi.org/https://doi.org/10.12984/egeefd.295306>
- Henle, C. A., Kohut, G. and Booth, R. (2009) "Designing Electronic Use Policies to Enhance Employee Perceptions of Fairness and to Reduce Cyberloafing: An Empirical Test of Justice Theory", *Computers in Human Behavior*, Vol 25, No. 4, pp 902-910. <https://doi.org/https://doi.org/10.1016/j.chb.2009.03.005>
- Karabacak, Z. İ. and Sezgin, A. A. (2019) "Digital Transformation and Digital Literacy in Turkey", *Türk İdare Dergisi*, Vol 1, No. 488, pp 319-343.
- Keleş, O. (2020). *Investigation of the Relationship Between High School Students Problematic Social Media Use and Cognitive Distortions in Terms of Various Variables*. Unpublished Master's Thesis, Bayburt University Graduate Education, Bayburt.
- Khan, N., Sarwar, A., Chen, T. B. and Khan, S. (2022) "Connecting Digital Literacy in Higher Education to the 21st Century Workforce", *Knowledge Management & E-Learning*, Vol 14, No. 1, pp 46-61. <https://doi.org/https://doi.org/10.34105/j.kmel.2022.14.004>
- Lavoie, J. A. A. (2001) "Cyberslacking and the Procrastination Superhighway: A Web-Based Survey of Online Procrastination, Attitudes, and Emotion", *Social Science Computer Review*, Vol 19, No. 4, pp 431-444.
- Li, M. and Yu, Z. (2022) "Teachers' Satisfaction, Role, and Digital Literacy during the COVID-19 Pandemic", *Sustainability*, Vol 14, No. 3, pp 1-19. <https://doi.org/https://doi.org/10.3390/su14031121>
- Lim, V. K. G. (2002) "The IT Way of Loafing on the Job: Cyberloafing, Neutralizing and Organizational Justice", *Journal of Organizational Behavior*, Vol 23, No. 5, pp 675-694. <https://doi.org/https://doi.org/10.1002/job.161>
- Martin, L., Hauret, L. and Fuhrer, C. (2022) "Digitally transformed home office impacts on job satisfaction, job stress and job productivity. COVID-19 findings", *PLoS ONE*, Vol 17, No. 3, pp 1-23. <https://doi.org/https://doi.org/10.1371/journal.pone.0265131>
- Mills, J. E., Hu, B., Beldona, S. and Clay, J. (2001) "Cyberslacking! A Liability Issue oor Wired Workplaces", *Cornell Hotel and Restaurant Administration Quarterly*, Vol 42, No. 5, pp 34-47.
- Ng, W. (2012) "Can We Teach Digital Natives Digital Literacy?", *Computers & Education*, Vol 59, No. 3, pp 1065-1078. <https://doi.org/https://doi.org/10.1016/j.compedu.2012.04.016>
- O'Neill, T. A., Hambley, L. A. and Chatellier, G. S. (2014) "Cyberslacking, Engagement, and Personality in Distributed Work Environments", *Computers in Human Behavior*, Vol 40, No., pp 152-160. <https://doi.org/http://dx.doi.org/10.1016/j.chb.2014.08.005>

- Okazaki, S., Schuberth, F., Tagashira, T. and Andrade, V. (2021) "Sneaking the Dark Side of Brand Engagement Into Instagram: The Dual Theory of Passion", *Journal of Business Research*, Vol 130, No., pp 493-505.
<https://doi.org/https://doi.org/10.1016/j.jbusres.2019.11.028>
- Onursoy, S. (2018) "Digital Literacy Levels of University Youth: A Research on the Students of Anadolu University", *Gumushane University e-Journal of Faculty of Communication*, Vol 6, No. 2, pp 989-1013.
<https://doi.org/https://doi.org/10.19145/e-gifder.422671>
- Örücü, E. and Yıldız, H. (2014) "The Personal Internet and Technology Usage at the Workplace: Cyberslacking", *Ege Academic Review*, Vol 14, No. 1, pp 99-114.
- Özerbaş, M. A. and Kuralbayeva, A. (2018) "A Review of Digital Literacy Levels of Future Primary-School and Secondary-School Teachers in Turkey and Kazakhstan", *MSKU Journal of Education*, Vol 5, No. 1, pp 16-25.
<https://doi.org/https://doi.org/10.21666/muefd.314761>
- Özkalp, E., Aydın, U. and Tekeli, S. (2012) "Sapkın Örgütsel Davranışlar ve Çalışma Yaşamında Yeni Bir Olgu: Sanal Kaytarma (Cyberloafing) ve İş İlişkilerine Etkileri", *Çimento İşveren Sendikası Dergisi*, Vol 26, No. 2, pp 18-33.
- Peng, D. and Yu, Z. (2022) "A Literature Review of Digital Literacy over Two Decades", *Education Research International*, Vol 2022, No., pp 1-8. <https://doi.org/https://doi.org/10.1155/2022/2533413>
- Tinmaz, H., Lee, Y.-T., Fanea-Ivanovici, M. and Baber, H. (2022) "A Systematic Review on Digital Literacy", *Smart Learning Environments*, Vol 9, No. 21, pp 1-18. <https://doi.org/https://doi.org/10.1186/s40561-022-00204-y>
- Williams, A., Bangun, C. S. and Shino, Y. (2022) "The Urgency of Digital Literacy in Indonesia on COVID-19 Pandemic", *Startupreneur Business Digital (SABDA)*, Vol 1, No. 2, pp 183-190.
<https://doi.org/https://doi.org/10.34306/sabda.v1i2.143>
- Yıldırım, F. (2018) "The Mediating Role of Job Satisfaction in The Effect of Burnout Level on Cyberloafing", *Gazi Üniversitesi Sosyal Bilimler Dergisi*, Vol 5, No. 13, pp 302-313.

Preliminary Findings of the Needs Perceived and Expectations of Users of an Independent Learning Centre Survey in Hong Kong: What do They Tell Us?

Felix Chao, Yvonne Loong, Ocean Siu, Sharon Wong and Parker Chan

The Independent Learning Centre, The Chinese University of Hong Kong, Hong Kong

felixchao@cuhk.edu.hk

loongycw@cuhk.edu.hk

oceansiu@cuhk.edu.hk

swong@cuhk.edu.hk

parker.chan@cuhk.edu.hk

Abstract: The Independent Learning Centre (ILC) has a long history in the Chinese University of Hong Kong (CUHK). Being unique in many ways, both within the university and in Hong Kong as an independent support unit on campus, we support all students, namely undergrads and postgrads, in their academic pursuit, career preparation, as well as whole-person and global awareness development through non-formal education. In other words, the ILC does not touch students' grade point average (GPA) directly, but has an undeniable and direct impact on CUHK students' learning experiences and well-being by complementing their formal education and supporting their language and communication skills both in English and Chinese in the context of Hong Kong. We offer both academic and work-related workshops (2 hours long), conduct individual and group consultations, and we develop online learning resources on our own or in collaboration with colleagues from other units such as the University Library, and the Office of Student Affairs to address students' diverse learning needs. Evaluation of our services and resources is conducted after every student encounter face-to-face, and through the online means. In general, students are very satisfied with what we have been offering, and think our Centre is an important piece of puzzle in their learning jigsaw. But despite this, no formal survey on students' views about independent learning has been conducted since our inception. The ILC, therefore, conducted our very first survey in 2022 among all students in the CUHK on their perception of the learning needs, and their expectations of independent learning support that the university should provide in face of the challenges, both local and global, ahead of them. Our paper will present both our quantitative and qualitative survey results, students' comments, as well as the implications for a centre like ours, and other similar centres in the region and across the world.

Keywords: Independent Learning, Higher Education, Independent Learning Effectiveness, Education in Hong Kong, Learning Support

1. Introduction

University education is never spoon-fed education. It fosters critical thinking and encourages independent learning. However, there has not been consensus in literature regarding the definition of independent learning (Mckendry & Boyd, 2012), thus there is a need to first define the term if we are to discuss the provision of quality university education.

Gow & Kember (1990) investigated whether higher education in Hong Kong promotes independent learning, and summarised independent learning as students' capacity to learn through acquiring analytical skills and ability to process new information as well as to draw meaningful conclusions on their own. We tend to agree with the general direction of this summary, but argue that a more comprehensive definition is needed so as to also address the following points.

First, independent learning does not necessarily mean learning entirely independently. Stewart (2002, p. 23) suggested that the future of higher education in Hong Kong should encompass both teaching and learning, meaning that neither one should be given insufficient value in quality education, even in the independent learning context. Carroll (1987, p. 224) also pointed out that teachers should explain the purpose and methodology of self-directed learning so that students will not be overwhelmed by frustration and anxiety.

Second, the effects assessments have on teaching and learning should also be reconsidered. This is because good assessments that are nicely integrated within the teaching and learning process could serve as a positive lever (Brown, 2015, p. 127); and formative assessments could help enhance students' independent learning abilities (Blayney & Freeman, 2008).

Therefore, the working definition of independent learning we propose is the ability to acquire new knowledge and accomplish learning goals by making use of one's critical thinking and problem-solving skills coupled with appropriate assessments and teachers' support.

Universities in Hong Kong generally promote independent learning, but most of them associate independent learning only to the acquisition of language. Some local examples are to provide self-access language learning materials (e.g. Hong Kong Baptist University¹ and Education University of Hong Kong²) or one-to-one language learning support (e.g. Hong Kong Polytechnic University³ and Hong Kong University of Science and Technology⁴). Only the CUHK supports students in a wider spectrum instead of framing independent learning merely within the language learning scope.

Established 30 years ago at the CUHK, the Independent Learning Centre (ILC) plays a unique role in providing all students at both undergraduate and postgraduate levels with language and communication skills support in both Chinese and English in their academic pursuit, career preparation, as well as whole-person and global awareness development. Our mission is fulfilled in mainly two ways, namely (1) by offering support through co-curricular non-credit bearing ILC activities on our own with our full-time staff at the ILC and (2) in collaboration with other academic programmes or service units on campus through the formal curriculum. For the former, students register voluntarily based on their own needs and availability in our ILC workshops, individual consultations and small study groups. A typical ILC workshop, usually two hours long, would involve input in a specific academic or career-related topic, ample practice opportunities, and practical takeaways so students can conduct independent learning on their own afterwards. On the other hand, consultations, usually 30 minutes long, would involve teacher-led discussions of a topic initiated by students based on their learning needs. Common discussion topics include outline of a term paper, preparation of a language or government exam, or ways to sharpen communication skills. Should a few students share a common learning target, they can form a small study group and learn with a teacher for a few sessions. To assist students to conduct independent learning successfully, goal setting and evaluation of learning outcomes are emphasised. Feedback is collected at the end of each in-person or virtual workshop and consultation session for quality assurance purpose, and it is also through such means that we collect information about students' fast-changing learning needs so we can address them quickly.

Furthermore, to cater to students' personalised learning goals, different study pace, and diverse study preferences, we provide as well as develop our very own online learning resources so students can learn anywhere and at any time they like. For instance, seeing an increasing number of local and international students who want/ need to learn Chinese with various levels of prior knowledge in the language, a Self-Learning Chinese Resource Platform with written Chinese grammar, spoken Chinese, and Chinese Culture was developed, so all students can study at their own pace and achieve their respective learning goals. Another example is ARCTAPS – Active Reading, Critical Thinking, Academic Publication Skills - three independent yet inter-related online learning series were developed specifically to address the increasing pressure to read fast, think critically and publish before graduation among postgraduates from different disciplines. Examples, exercises, as well as e-resources both within and beyond the university are included to strengthen students' academic and communication skills in higher education.

To facilitate the whole-person development among our students, the Centre, for instance, also organises events and talks to promote the appreciation of writing and literature in both English and Chinese on campus through "The Power of Words" project. To nurture students into responsible citizens in a globalised world and to strengthen their intercultural communication skills, we developed an online learning series called "Interacting Across Cultures" so they can communicate with people of different nationalities more effectively. As mentioned before, the ILC also collaborates with other academic units to support credit-bearing programmes in, for example, reflective journal, literature review and term paper writing at undergraduate level. To support our postgraduate students, the ILC also collaborates with the CUHK library in offering workshops in dissertation writing, poster presentation, and oral defence. In collaboration with the Graduate School as well, a Research

¹ See <https://lcsystem.hkbu.edu.hk/newmain/self-learning/>. Accessed 05 August 2023.

² See <https://www.eduhk.hk/cle/en/asllc/welcome>. Accessed 05 August 2023.

³ See https://www.polyu.edu.hk/clc/self-learning-unit/consultation-service/?sc_lang=en. Accessed 05 August 2023.

⁴ See <https://cle.hkust.edu.hk/extracurricular/advising>. Accessed 05 August 2023.

Poster Exhibition is organized for the postgraduates to both showcase their work and exchange their research ideas with peers within the university community.

Based on our feedback and user rate of the online learning resources, students in general are satisfied with our work. Nevertheless, no formal survey on students' views about independent learning has been conducted since our inception. The ILC, therefore, conducted our very first survey in 2022 among all students in the CUHK on their perception of the learning needs, and their expectations of independent learning support that the university should provide in face of the challenges, both local and global, ahead of them.

2. The design and content of the questionnaire regarding independent learning effectiveness at the CUHK

The questions of this questionnaire survey were formulated jointly by all the teachers of the ILC. For the convenience of respondents, we set the total number of questions to 10, and it is estimated that each questionnaire will only take about 10 minutes to complete. In order to save administrative work, there is no printed copy of the questionnaire. Students only need to log in to a specific link with their student account to complete the questionnaire online.

In terms of the form of the questionnaire, closed questions accounted for 9 questions. This is because some scholars pointed out that under the premise of receiving several expected answers, open questions often have problems that are difficult to interpret text responses or cause data loss (Reja, Manfreda, Hlebec & Vehovar, 2003, p.169-p.172). However, considering that the answers to the survey topics may not only lead to a single answer, the 9 questions are all designed to allow more than one option to be selected, and some of them even have "others" options for the respondents to provide supplementary explanations.

For the remaining question, we choose an open-ended question design, as this design is more suitable when the responses the respondents will provide cannot be expected (Krosnick, 2018, p.445). To avoid confusion among respondents, we place this question at the end of the entire questionnaire.

As for the content of the questionnaire, we follow the general principles of questionnaire design, that is, arrange the questions in a logical manner and strive for brevity (Burgess, 2001, p.7). Specifically, the questionnaire can be divided into three parts: the first part consists of questions 1 to 3, mainly to understand how the respondents define independent learning and successful independent learners, and what characteristics a successful independent learner should possess; the second part consists of questions 4 and 5, which are composed to collect respondents' opinions on the independent learning atmosphere of the CUHK and what support measures the university should provide to help students enhance their independent learning ability; the third part consists of questions 6 to 10, which are expected to understand the respondents' perception of the ILC, which activities or learning resources organised by the centre they have participated in or used, and their views on the future development of the ILC.

We arrange the questions from the whole to the part. First, we invite the respondents to think about their own understanding of independent learning. Then, we introduce the actual scene of the CUHK to guide the respondents to be aware of their identity as a CUHK student, so as to evaluate the university's current situation of independent learning. Finally, we bring out the ILC, the learning support unit most directly related to independent learning in the CUHK, in order to further explore the independent learning effectiveness of the CUHK students.

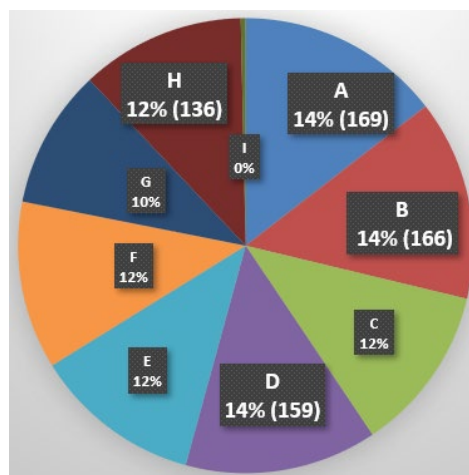
It should also be noted that in order to determine the validity of this questionnaire survey, we collected opinions from a review team, which is composed of external experts⁵ and calculated the scale-level content validity index (S-CVI). After calculation, we get the questionnaire's SCVI based on the average calculation method (SCVI/Ave) is 0.975, and SCVI based on the universal agreement method (SCVI/UA) is 0.9, both are in the range of acceptable content validity (Polit & Beck, p.496).

⁵ All members of the review team have more than 15 years of teaching or assessment experience, and are invited to rate the effectiveness of all the questions in the questionnaire with a four-point scale.

3. The result of the questionnaire regarding independent learning effectiveness at the CUHK

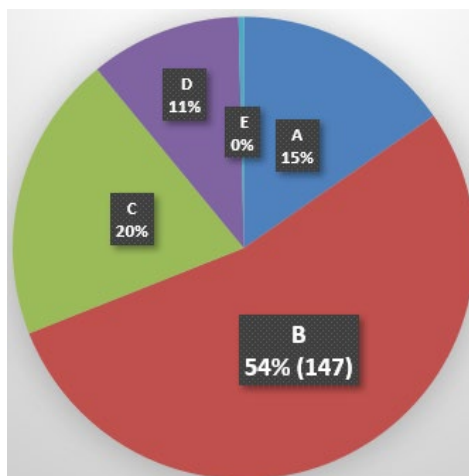
There are 10 questions in the online survey (*please see **Appendix 1** for the questions). Personal information such as name, degree, year of study, and contact details was also gathered. Two hundred and twenty-three students participated in the survey, but 2 were excluded from the study because they did not finish the survey. Based on the data from 221 participants (142 undergraduate students; 79 postgraduate students), we report the total number of hits, the options with most hits, the options with most hits accounting in percentage to the question's total hits of all questions, and important comments or suggestions.

"What is Independent Learning?" is the first question, with a total of 1,165 hits for the 9 options (From A to I) provided. The three options: "Able to identify one's own learning needs" (A), "Able to set one's own learning goal(s)"(B) and "Able to decide one's own learning strategies" (D) have garnered the most hits, accounting for over 42% of the question's total number of hits (See Figure 1). Students from post-graduate diploma and PhD programmes seem to believe that the option: "Able to locate suitable resources or seek help when necessary"(H) should also be considered a major element of independent learning when comparing the preferences of undergraduate students with those of post-graduate students.



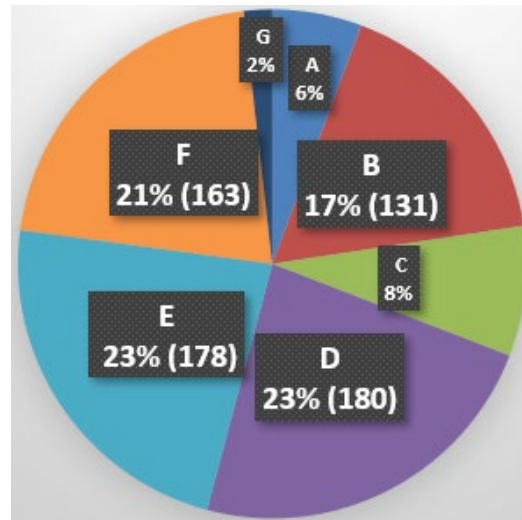
(Figure 1. First Question: "What is Independent Learning?")

The second question "Which of the following statement(s) best describe(s) you as an independent learner?" has 274 hits for the 5 options (From A to E) provided. The option: "I have had successful independent learning experience" (B) has garnered the most hits, accounting to over 50% of the question's total number of hits (See Figure 2).



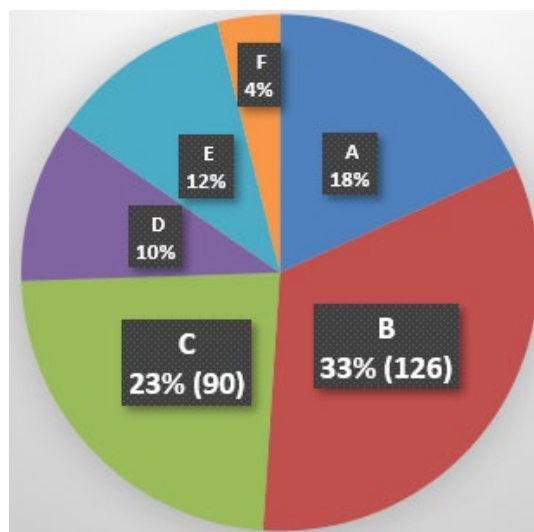
(Figure 2. Second Question: "Which of the following statement(s) best describe(s) you as an independent learner?")

The third question “What quality/qualities do you think a successful independent learner should possess?” has 774 hits for the 7 options (from A to G) provided. The four options: “Logical thinking skills” (B), “High motivation” (D), “Having clear goals” (E) and “Good time management skills” (F) have garnered the most hits, accounting to over 84% of the question’s total number of hits (See Figure 3). The option “Others” has received 14 written comments and 6 of them are the word “Self-discipline” or the equivalent.



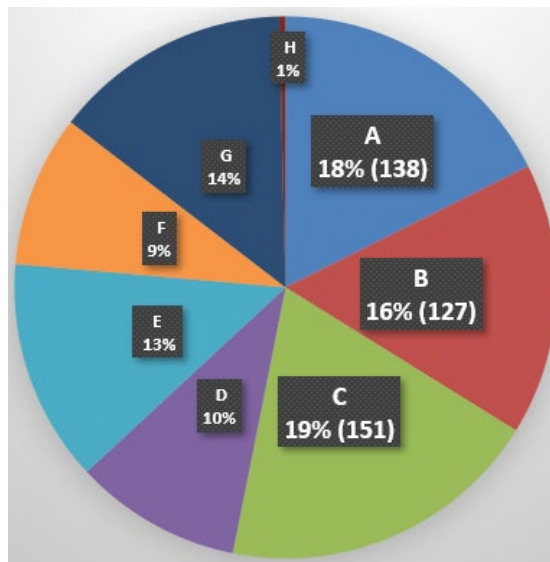
(Figure 3. Third Question: “What quality/qualities do you think a successful independent learner should possess?”)

“How would you describe the independent learning style of most CUHK students and the learning atmosphere in general?” is the fourth question. It has 384 hits for the 6 options (from A to F) provided. The two options: Participants have given “Most CUHK students have experience in independent learning” (B) and “Most CUHK students know they can seek help in independent learning from the University” (C) has garnered the most hits, accounting to over 56% of the question’s total number of hits (See Figure 4).



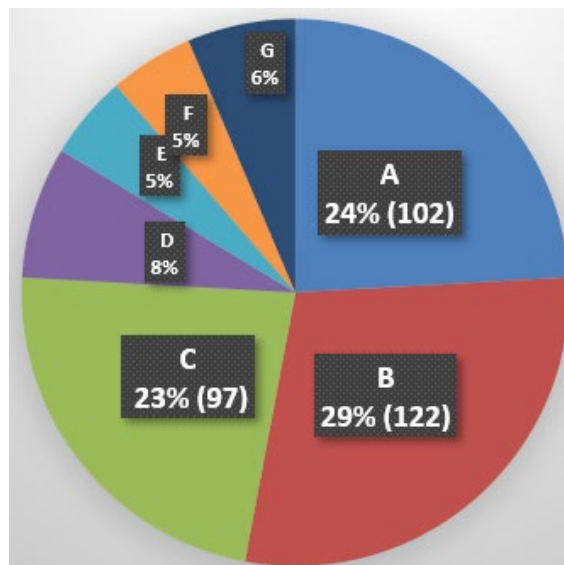
(Figure 4. Fourth Question: “How would you describe the independent learning style of most CUHK students and the learning atmosphere in general?”)

The fifth question “What kind of learning support do you think CUHK should offer to further enhance student’s independent learning skills?” has 783 hits for the 8 options (from A to H) provided. The three options: “Face-to-face learning activities (e.g. workshops, seminars, consultations)” (A), “Online learning activities (e.g. workshops, seminars, consultations)” (B), and “E-resources for independent learning” (C) have garnered the most hits, accounting to over 53% of the question’s total number of hits (See Figure 5).



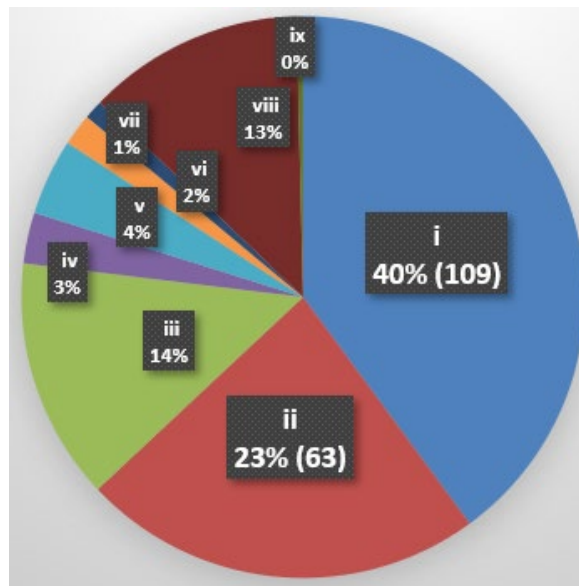
(Figure 5. Fifth Question: “What kind of learning support do you think CUHK should offer to further enhance student’s independent learning skills?”)

The next question coming up is “Which of the following(s) can be used to describe your experience with the Independent Learning Centre (ILC) at CUHK?”. It has 423 hits for the 7 options (from A to G) provided. The three options: Participant have given “I have visited the ILC in UC Library before” (A), “I have used the learning support (workshops or consultations) offered by the ILC before” (B), and “I have used the learning resources (print or e-resources) developed or recommended by the ILC before” (C) have garnered the most hits, accounting to over 75% of the question’s total number of hits (See Figure 6).



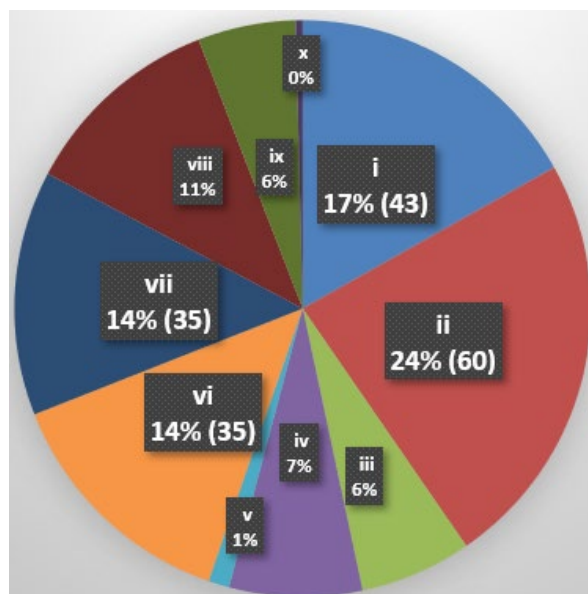
(Figure 6. Sixth Question: “Which of the following(s) can be used to describe your experience with the Independent Learning Centre (ILC) at CUHK?”)

In the seventh question, participants were asked “Have you ever used any following learning support provided/ participated in any activities/ programmes organised by the ILC?”. 147 participants have answered yes and given total 273 hits for the 9 options (from I to IX) provided. The two options: “Workshop(s)” (i), and “Consultation(s)” (ii) have garnered the most hits, accounting to over 63% of the question’s total number of hits (see Figure 7).



(Figure 7. Seventh Question: “Have you ever used any following learning support provided/ participated in any activities/ programmes organised by the ILC?”)

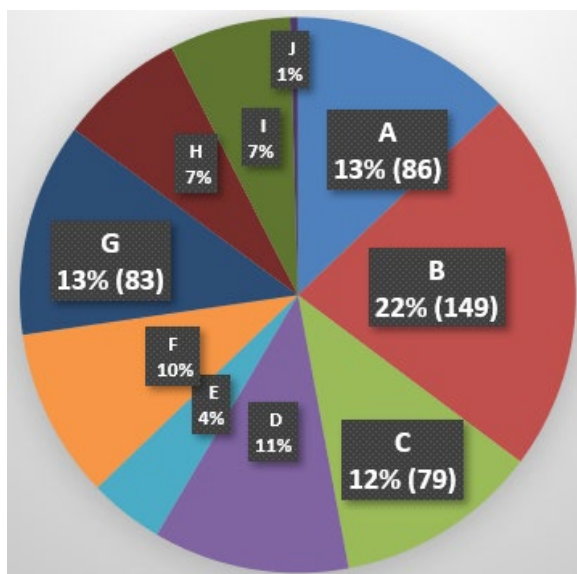
“Have you ever consulted any following learning resources (print or online) developed or offered by the ILC?” is the eighth question. 119 participants have answered yes and given total 255 hits for the 10 options (from I to X) provided. The four options: “Citation style resources (e.g. “A User Guide to Chinese Citation Styles”)", “Academic writing resources (e.g. “GE Reflective Journal Micro-Modules” (i), “GE Chinese Reflective Journal Writing” or “Academic Writing”))” (ii), “Job search and interviews resources (e.g. “Interview Skills Development System (ISDS)”, “ISDS Ex” or “Career Development” page)” (vi), and “Language learning resources (e.g. “Online Platform for Successful Chinese Learning”, “Cantonese Romanisation Express”, “Online Cantonese”, “Pulewang”, “Self-Learning Chinese”, “Chinese Grammar”, “Tense Buster” or “Clear Pronunciation”))” (vii) have garnered the most hits, accounting to over 69% of the question’s total number of hits (See Figure 8).



(Figure 8. Eighth Question: “Have you ever consulted any following learning resources (print or online) developed or offered by the ILC?”)

“Which of the following area(s) would you like to see more support in?” is the ninth questions that has total 667 hits for the 10 options (from A to I) provided were recorded for the ninth question “Which of the following area(s) would you like to see more support in?”. The four options: “GE assignments (e.g. reflective journals or term papers)” (A), “Academic writing (e.g. final-year projects or final-year papers)” (B), “Online leaning support

(e.g. online consultations, e-resources)" (G) and "Academic support for postgraduate students (e.g. research proposals, thesis writing, oral presentations and oral defense)" (C) have garnered the most hits, accounting to over 59% of the question's total number of hits (See Figure 9).



(Figure 9. Ninth Question: "Which of the following area(s) would you like to see more support in?")

The last question asked "Do you have any suggestions for the future development of the ILC at CUHK?" and it received 29 written answers. 10 types of suggestions can be generated from the answers. To display all the suggestions in order of popularity (1 is the most popular) : 1. Provide more writing training workshops, 2. Provide small group or individual learning supports, 3. ILC should gain publicity and visibility, 4. Provide workshop's material, learning guidelines and online services, 5. Provides videos of workshops, 6. Offer different modes of teaching (online, hybrid etc.), 7. Develop and provided special workshops and new workshops, 8. Provide more activities, 9. Provide trainings for public examination and examination related skills, 10. Have a better location (Venue).

4. Preliminary findings on the result of the questionnaire

Students believe that independent learning entails active reflection and systematic achievement of one's learning objectives. Based on the results of first and third question, students believe that a successful independent learner should be extremely motivated to reflect on one's own learning needs. Only when the learner's learning needs have been recognized will they be able to formulate specific learning goals and formulate efficient learning strategies in line with their preferred learning style. The students have also emphasized other traits like logical thinking and time management that could aid in making effective reflections or advancement. Furthermore, Hagger & Hamilton (2019, p.336-337) have noted that self-discipline can help people achieve long-term goals and resolve immediate problems with their learning; which helps to explain why students also see it as a crucial trait for a successful independent learner.

More than half of the students have successful independent learning experience and they believe the university has a good independent learning atmosphere. Based on the result of second and sixth question, more than half of the students have actively sought our learning support or have used online learning resources provided or recommended by ILC or libraries, and they seem to regard this as a successful experience of independent learning. Successful learning experiences are crucial because they can help build self-efficacy. Students with strong self-efficacy tend to have good performance, have good metacognition and be able to use deep-processing learning styles when compared with students with weak self-efficacy (Coutinho & Neuman 2008, p.137). We can therefore safely assume that a positive independent learning experience can increase a student's self-confidence in managing their own learning to achieve the learning goal. Additionally, according to the results of fourth question, more than half of the participants think that most of the university students have independent learning experiences or know how to seek help, which means they believe the general independent learning atmosphere is good.

Students believe independent learning should be self-directed learning with instructor guidance. Based on the result of the fifth question, more than half of the students believe that CUHK should provide students with face-to-face learning activities (such as workshops, seminars, and consultations), online learning activities (such as workshops, seminars, and consultations), and e-resources for independent learning. The first two options are distinct modes of teacher-guided learning activities. Combining this result with the result of tenth question, where almost all suggestions are about teacher-guided learning activities, such as new workshops, videos of the workshops, study groups, etc, we can conclude that students believe independent learning should be a highly motivated form of self-directed learning with instructor guidance which meets the definition of independent learning in the introduction section of this paper, and that technology should be an aid in this setting.

Academic writing and language learning are the two areas where students have sought the most assistance for independent learning. Based on the result from the eighth to tenth question, academic writing and language learning are the most popular independent learning activities. This outcome aligns well with the statistics we gathered, i.e. . most students attended the ILC workshops or sought consultations because they want to improve in their academic writing and language learning⁶. For ILC online resources, many of which are related to these 2 areas. A total hit number as high as 18,201,490 has been recorded between December 2019 and March 2022. However, despite the high usage rate and all the available resources, students continue to expect more support or new development in these 2 areas in the future.

5. Further developments: focus group study and publications

A series of focus group discussions will be conducted by ILC in addition to the questionnaire survey. We aim to better understand the independent learning efficacy at the CUHK by utilising a qualitative study approach that gathers data through group interaction on a topic chosen by the researcher (Atkinson, 2017, p. 65 and Morgan, 1996, p. 130). The approach can be used to evaluate people's knowledge and experiences as well as their thoughts, including how and why they believe the way they do (Kitzinger, 1995, p. 299). This approach may be used to interview a wide variety of students (Goss, 1996, p. 113).

Around 60 students will be invited to participate in the study. Every session will last for 90 minutes with three to six participants, including both undergraduate and graduate students. Two lecturers, one from the Chinese team and one from the English team, will moderate each session. A member of the administrative team will be there to do video recording and offer technical assistance. The discussion data will be transcribed verbatim.

The three primary themes of the focus group discussions are: (1) understanding of independent learning; (2) independent learning at CUHK; and (3) the present and future of the ILC. Participants will be encouraged to address the questions in any way and to interact with other respondents. The discussion has no set structure, and neither the moderators nor the students are obligated to cover or avoid any topics or inquiries.

The study's design and findings will be presented at conferences, workshops, and in scholarly publications.

6. Conclusion

To conclude, as the first of its kind in the history of the Independent Learning Centre at the Chinese University of Hong Kong, this study investigates users' perceived needs and expectations as well as their self-efficacy within the scope of independent learning. Among the 221 valid responses from undergraduate and postgraduate students, more than half of them agreed that the University has a good independent learning atmosphere and expressed that they have had successful independent learning experience. Participants also rated the Independent Learning Centre positively—not only have they joined the workshops offered and the consultation sessions, they have also used the resources designed and/or recommended by the Centre to assist their independent learning.

Apart from providing an example of how independent learning could be facilitated in higher education institutions, this study also has pedagogical implications. First, from the survey, we understand how university students in the 21st century perceive independent learning and what it means to be a successful independent learner. Participants attribute success to the ability to formulate learning goals and strategies, then achieve them progressively with persistent self-motivation and appropriate teachers' guidance. The findings fit well into

⁶ Every year, 3000 to 4000 attendants were recorded for ILC workshops, in which, many of them are attending academic writing or language learning related workshops.

how we initially defined independent learning, and thus could serve as empirical evidence to support the proposed definition. Pedagogically, independent learning today should encompass appropriate assessment and teacher support. Second, this study reveals that independent learning at the university level could go beyond language learning. Traditional language topics, such as pronunciation and vocabulary, are certainly of students' interests, but we found that students, especially postgraduate ones, are also fond of undertaking independent learning in skills related to public examinations and specific aspects in academic writing. Therefore, in addition to offering support merely in language learning, universities should consider extending the concepts of independent learning to other learning aspects, which certainly entails a more promising and sustainable future of independent learning.

This article presents the quantitative data of the survey. To triangulate the quantitative data with qualitative ones, we will analyse the focus group discussion data in the next step and publish it in order to help portrait a fuller picture of the topic.

References

- Atkinson, J. D. (2017). *Journey into social activism: Qualitative approaches*. Fordham University Press.
- Blayney, P. & Freeman, M. (2008). Individualised interactive formative assessments to promote independent learning. *Journal of Accounting Education*, 26, 155-165. <https://doi.org/10.1016/j.jaccedu.2008.01.001>
- Brown, S. (2015) *Learning, teaching and assessment in higher education global perspectives*. Macmillan Education.
- Burgess, T. F. (2001). *A general introduction to the design of questionnaires for survey research*. University of Leeds.
- Coutinho, S. A. & Neuman, G. (2008) A model of metacognition, achievement goal orientation, learning style and self-efficacy. *Learning Environments Research*, 11(2), 131-151. <http://doi.org/10.1007/s10984-008-9042-7>
- Goss, J. D. (1996). Introduction to focus groups. *Area*, 28(2), 113-114.
- Gow, L. & Kember, D. (1990). Does higher education promote independent learning? *Higher Education*, 19(3), 307-322.
- Hagger, M. S. & Hamilton, K. (2019) Grit and self-discipline as predictors of effort and academic attainment. *British Journal of Educational Psychology*, 89, 324-342. <http://doi.org/10.1111/bjep.12241>
- Iwasiw, C. L. (1987). The role of the teacher in self-directed learning. *Nurse Education Today*, 7, 222-227. [https://doi.org/10.1016/0260-6917\(87\)90005-0](https://doi.org/10.1016/0260-6917(87)90005-0)
- Kitzinger, J. (1995). Qualitative research: Introducing focus groups. *British Medical Journal*, 311, 299-302. <https://doi.org/10.1136/bmj.311.7000.299>
- Krosnick, J.A. (2018). Questionnaire design. In D. Vannette & J. Krosnick (eds), *The Palgrave handbook of survey research*. Palgrave Macmillan Cham. <https://doi.org/10.1007/978-3-319-54395-6>
- Mckendry, S. & Boyd, V. (2012). Defining the "independent learner" in UK higher education: Staff and students' understanding of the concept. *International Journal of Teaching and Learning in Higher Education*, 24(2), 209-220.
- Morgan, D. L. (1996). Focus groups. *Annual Review of Sociology*, 22, 129-152. <https://doi.org/10.1146/annurev.soc.22.1.129>
- Polit, D. F., & Beck, C. T., (2006). The content validity index: Are you sure you know what's being reported? Critique and recommendations. *Research in Nursing & Health*, 29, 489-497. <https://doi.org/10.1002/nur.20147>
- Reja, U., Manfreda, K.L., Hlebec, V., & Vehovar, V. (2003). Open-ended vs. close-ended questions in web questionnaires. *Developments in Applied Statistics*, 159-177.
- Stewart, R. S. (2002) *Higher education in Hong Kong, report of the University Grants Committee*. <https://www.ugc.edu.hk/doc/eng/ugc/publication/report/her/herreport.pdf>

Appendix 1: Survey Questions

1. What is independent learning?
 - A. Able to identify one's own learning needs
 - B. Able to set one's own learning goal(s)
 - C. Able to determine one's own learning content
 - D. Able to decide one's own learning strategies
 - E. Able to follow one's own learning pace
 - F. Able to choose suitable learning materials by oneself
 - G. Able to evaluate one's own learning outcome(s)
 - H. Able to locate suitable resources or seek help when necessary
 - I. Others (please specify):
2. Which of the following statement(s) best describe(s) you as an independent learner?
 - A. I am a mature and experienced independent learner
 - B. I have had successful independent learning experience
 - C. I have tried independent learning before, but it was unsuccessful
 - D. I want to try, but don't know how to put independent learning into practice

- E. I have never tried independent learning before
3. What quality/qualities do you think a successful independent learner should possess?
 - A. High degree of creativity
 - B. Logical thinking skills
 - C. Good language proficiency
 - D. High motivation
 - E. Having clear goals
 - F. Good time management skills
 - G. Others (please specify):
4. How would you describe the independent learning style of most CUHK students and the learning atmosphere in general?
 - A. Most CUHK students are motivated independent learners
 - B. Most CUHK students have experience in independent learning
 - C. Most CUHK students know they can seek help in independent learning from the University
 - D. Most CUHK students believe independent learning have nothing to do with their formal education
 - E. Most CUHK students rarely attend any independent learning activities organised by the university
 - F. Most CUHK students are not interested in independent learning
5. What kind of learning support do you think CUHK should offer to further enhance student's independent learning skills?
 - A. Face-to-face learning activities (e.g. workshops, seminars, consultations)
 - B. Online learning activities (e.g. workshops, seminars, consultations)
 - C. E-resources for independent learning
 - D. Guidelines or handbooks for independent learning
 - E. Venue for independent learning
 - F. Hardware for independent learning (e.g. laptop)
 - G. Incentives for independent learning efforts (e.g. certificates, awards)
 - H. Others (please specify):
6. Which of the following(s) can be used to describe your experience with the Independent Learning Centre (ILC) at CUHK?
 - A. I have visited the ILC in UC Library before
 - B. I have used the learning support (workshops or consultations) offered by the ILC before
 - C. I have used the learning resources (print or e-resources) developed or recommended by the ILC before
 - D. I have heard of but never visited the ILC in UC Library before
 - E. I have never attended any workshops or consultations offered by the ILC before
 - F. I have never used any resources offered by the ILC before
 - G. I am not aware of the ILC at CUHK
7. Have you ever used any following learning support provided/ participated in any activities/ programmes organized by the ILC?
 - A. Yes.
 - i. Workshop(s)
 - ii. Consultation(s)
 - iii. ILC materials (books or examination practice papers) in UC library
 - iv. Guided Study Plan (GSP)
 - v. Language Exchange Program (LEP)
 - vi. Peer Mentoring Program (PMP)
 - vii. The Power of Words (TPOW) (Glass Wall and Black Board Poem activity or seminars)
 - viii. The ILC Area (1/F of UC Library)
 - ix. Others (please specify):
 - B. No.
8. Have you ever consulted any following learning resources (print or online) developed or offered by the ILC?
 - A. Yes. I have used:
 - i. Citation style resources (e.g. "A User Guide to Chinese Citation Styles")
 - ii. Academic writing resources (e.g. "GE Reflective Journal Micro-Modules", "GE Chinese Reflective Journal Writing" or "Academic Writing")
 - iii. Argumentative writing resources (e.g. "Argumentative Writing")

- iv. Critical thinking resources
 - v. Intercultural communication resources (e.g. "Interacting Across Cultures")
 - vi. Job search and interviews resources (e.g. "Interview Skills Development System (ISDS)", "ISDS Ex" or "Career Development" page)
 - vii. Language learning resources (e.g. "Online Platform for Successful Chinese Learning", "Cantonese Romanisation Express", "Online Cantonese", "Pulewang", "Self-Learning Chinese", "Chinese Grammar", "Tense Buster" or "Clear Pronunciation")
 - viii. Public examinations resources (e.g. CRE /JRE or IELTS/TOEFL materials)
 - ix. Study skills resources ("Learning Apps", "PG Corner" or "Study Skills Success")
 - x. Others (please specify):
- B. No.
9. Which of the following area(s) would you like to see more support in?
- A. GE assignments (e.g. reflective journals or term papers)
 - B. Academic writing (e.g. final-year projects or final-year papers)
 - C. Academic support for postgraduate students (e.g. research proposals, thesis writing, oral presentations and oral defense)
 - D. Learning support in collaboration with your programmes (e.g. Writing for Life Sciences)
 - E. Learning support in collaboration with your college
 - F. Activities in collaboration with overseas universities or institutions (e.g. online or face-to-face activities)
 - G. Online leaning support (e.g. online consultations, e-resources)
 - H. Cultural activities (e.g. seminars, sharing sessions)
 - I. Group learning support (e.g. "Guided Study Plan")
 - J. Others (please specify):
- 9b. Generally speaking, are you satisfied with the learning support provided by the ILC? (only for those completed 7b and 8b)
- A. Very satisfied
 - B. Satisfied
 - C. Somewhat satisfied
 - D. Not very satisfied
 - E. Not satisfied at all
10. Do you have any suggestions for the future development of the ILC at CUHK?

Lasting Effects: What the Post Pandemic Return to In-person Teaching Tells Us About the State of e-Learning and its Future Trajectory

Paula Charbonneau-Gowdy and Mónica Frenzel

Faculty of Education and Social Sciences, Universidad Andres Bello, Santiago, Chile

paula.charbonneau@unab.cl

mfrenzel@unab.cl

Abstract: An outpouring of studies on the forced move to distance learning during the COVID-19 pandemic has revealed deep concerns with teaching and learning online. Yet, now that most learning is returning to pre-pandemic environments, it seems naive to assume that teachers and learners in these settings, are, or will ever be, the same. A deeper understanding of the impact of those online experiences on teachers and learners before, during and immediately after the pandemic can provide insight into how to move forward in our educational systems, where technology is increasingly implicated. The conceptual framework of the study was based on the three key features of contemporary e-learning theory: learner-centred, community-based, constructivist-driven. We mapped this framework against course design, teaching approach and the use of technology to conceptualize the conditions that existed in returning to in-person teaching in a blended learning setting. This framework uncovers the developments, constraints, openness, and fears of a group of Higher Education (HE) EFL Chilean teachers in leading students into technology-enhanced, 21st century learning environments. A qualitative case study methodology was employed. Findings are based on written responses to an 8-item open questionnaire ($n=32$) and individual, oral-based ($n=13$) interviews along with field notes. Evidence of a significant advancement in digital literacy skills on the part of teachers, and indeed students was uncovered. Untypical in the Chilean educational context, a strong shift towards valuing more social constructivist teaching practices and an awareness of the importance of fostering relationship-building in learning ecologies, both in person and online, was also revealed. Changes attributed to both positive experiences online and reactions to negative ones, bode well for those long seeking a shift away from a traditional educational mindset that existed prior to the pandemic. At the same time, the findings that reveal hesitancy and in some cases fear of the rapidly encroaching new technologies, especially Artificial Intelligence (AI) tools, indicate that for some teachers the embrace of technology has its limits. We discuss both encouraging and more concerning results in terms of the insight they offer and their implications for further e-learning research and for educational stakeholders operating in increasingly technology-dependent learning spaces.

Keywords: Higher Education; Contemporary E-Learning Theories; Post Pandemic; AI Tools and Affordances; Agency; Identity

1. Introduction and Background

The deep shift in ways to practice teaching and learning that many educational stakeholders at all levels of the system were called upon to adopt during the COVID-19 pandemic could easily, and perhaps purposely, be forgotten. Yet now that the pandemic period is behind us, increasing numbers of scholars are asking what we can learn from these experiences. Can we simply go back to our pre-COVID ways? To our previous conventional epistemological and ontological assumptions that defined our perspectives on learning and learners? To our established mindsets about student and teacher roles? About the value, or lack of value we place on digital spaces and e-learning? Or having lived through such a period of profound challenges, do we now question with more determination than ever how we practice education?

The global proliferation of studies documenting the COVID-19 challenges in education have raised many such questions that are now preoccupying researchers globally. Recent reviews of this scholarship are pointing especially to teachers and the vital role they were called upon to play in the unanticipated need to practice remote teaching during the pandemic years (Martin et al., 2023). Calls for more post pandemic research into teachers and their practices is a common theme in these reviews. Gaps cited in these reviews call, for example, more research connected to teachers' professional development opportunities to teach in online spaces (Wright et al., 2023; Doo et al., 2023), to the roles teachers assume when it comes to developing successful course designs, measuring outcomes and dealing with discord (Ahlf and McNeil, 2023), research into teacher agency (Dennen, 2022), into teachers' practices in the areas of assessment (Heil and Ifenthaler, 2023), into their innovative practices in the use of technologies (Zhang et al, 2022) to promote intersubjectivity and engagement (Dennen et al., 2023).

Our study was aimed at responding to these collective teacher-focused calls. Our focus was on a group of Chilean HE English as a foreign language (EFL) teachers and their experiences teaching during the pandemic online and in the academic year of 2022 when they returned to "regular" blended teaching. By collecting and analyzing

their stories and perspectives, we hoped to gain insight into their e-learning practices, and indirectly those of their students. Importantly, we also sought to uncover a deeper understanding of how they were moving forward in terms of their use of technology in the “new reality”. Indeed, many of the topics raised in these accounts match the gaps in e-learning research highlighted in the reviews of e-learning scholarship listed above. In initiating this inquiry, we were keenly aware that our focus on this group of Chilean educators and giving voice to their experiences with technology-mediated learning could help serve to address concern raised in recent literature about the imbalance that exists in e-learning scholarship, between research emanating from the global north and south (Zhang et al., 2022).

The following questions guided the inquiry:

1. How did a group of Chilean HE educators experience online learning during the pandemic? What were their challenges and reactions to these challenges?
2. In their view, what changes, if any, did they make in their roles and teaching practices after the return to hybrid learning?
3. From their perspectives, what has been the impact of the pandemic on their views of the use of technology, on their practices and on their identities as teachers?

In the next sections, we discuss the theory and relevant literature that informed and framed our study, followed by a description of our methodological choices, including details about the research design, the context and participants. We then provide an analysis of the data we collected and conclude the report with the results of the inquiry, its limitations and implications.

2. Theory and Literature Underpinnings

2.1 Ideal Conditions for Teaching and Learning Online

Few educators would dispute that for many in their positions, conditions for learning online during the pandemic were far from ideal. Scholars who have studied ways to promote such ideal conditions and to help support teachers to connect theory to effective practice have pointed to the alignment of design, pedagogy, and technology as essential. Based on accounts of online learning challenges experienced by many during the pandemic (Vlachopoulos et al., 2021), in far too many contexts these conditions were absent. Yet as Adinda et al. (2020) have shown, it is in the epistemological conformity of instructional design, pedagogical practice, and the use of technology with contemporary learning theories and 21st century goals that quality learning can be achieved (See Figure 1).

Essentially, these theories and goals i) place learners and their agency at the centre of the learning; ii) are based on an understanding that learning is a complex social interactive phenomenon; iii) involve learners in communities collaborating on co-constructing knowledge based on their individual social contexts and experiences; and iv) have important implications for learners’ competencies and identities in a highly dynamic, technology-driven society (Charbonneau-Gowdy and Chavez, 2019). Of course, implied in creating these kinds of scenarios in learning contexts presumes that teachers’ roles, identities, and the agency they assume are collectively and substantially different than those of teachers in conventional teaching contexts.

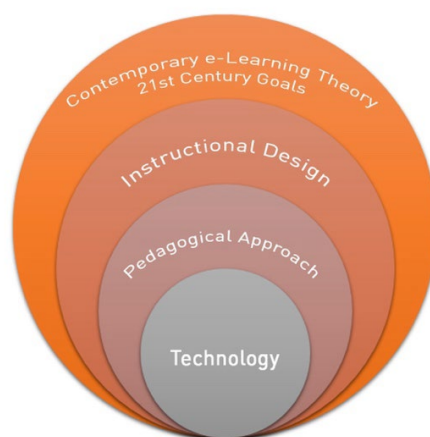


Figure 1: Model of effective online learning conditions.

2.2 Connecting Teachers' Roles with Agency and Identity

In an effort to gain inroads into actually applying contemporary learning theories and 21st century goals so that learning contexts reflect the characteristics listed above, attention in scholarship has primarily been on learners and finding ways to increase their active agentive roles in their learning process. At the same time, these trajectories towards change have altered in a profound way not only learners' roles but those of teachers' as well. From long-held expectations to be content experts and transmitters of information in typical conventional teaching settings, teachers are asked to take on facilitator roles in contemporary learning ones. Of the many skills implied in assuming roles as guides, teachers are compelled to create learner-centred designs, engaging group projects, to promote and manage class communities and experiment with innovative assessment practices, not to mention be models of care and support. For many teachers, this transition has brought with it serious challenges. Not the least of these challenges has been how to embrace change, and simultaneously not relinquish the last remains of agency they consider having in the oftentimes hierarchal spaces they inhabit in educational settings (Charbonneau-Gowdy and Chavez, 2019). As Ashton (2022, p.2) points out: "there is still much to learn about the complex ways in which individual teachers exercise their agency in their day-to-day teaching practice, particularly when these routines are disrupted".

There is little doubt that COVID-19 led to such a disruption. The breakdown in routines caused by the emergency move to online teaching during the pandemic left many teachers worldwide questioning their roles and re-examining their professional agency (Ashton, 2022). According to Leijen et al. (2020), from an ecological perspective this reflective process involves teachers looking at their past experiences, considering future plans and goals, evaluating them in order to make decisions and taking appropriate action, i.e. making changes, in the present. In this contextually dependent process, reflection and evaluation are key to teachers exercising their agency. Importantly, acts of resistance to change are also forms of exercising agency. Still, in situations where a teacher views that there are little or no options available but to adhere to the status quo, their agency can be considered severely limited.

Adapting to educational changes, as teachers experienced in the pivot to online learning during COVID, are closely connected to changes in their professional identities. By identity, we reference Norton (Darvin and Norton, 2015, p. 4) who defines the construct as "the way a person understands their relationship with the world, how that relationship is built across time and space, and how the person understands the possibilities for the future". When teachers confront changes in their working worlds, they are required to re-negotiate their professional identities which impacts their response to change (Ashton, 2022). Vähäsantanen (2015) posits that how teachers see themselves or aspire to see themselves as teachers is key to understanding their agency and decision making. The author also underlines the importance of teachers being able to act according to their present or imagined professional identities. When a conflict arises between what teachers see as acting according to their professional identities and an identity expected of them on the part of a global pandemic, an institution, or students for example, as in the case of teaching online for the first time, teachers will attempt to 'meet in the middle' (Vähäsantanen, 2011). Scholars argue that in those situations where agency is limited, in other words where 'meeting in the middle' is not an option, emotional reactions that influence teachers' motivation and well-being can be impacted negatively. Comas-Quin's (2011) call echoes our own (Charbonneau-Gowdy and Galdames, 2023) for more research into the connection between teachers' agency and their identity in confronting deep educational change especially in digital environments as many educators faced during the pandemic, including the participants in the present study.

3. Methodology

A qualitative case study research methodology was chosen for the study for several reasons: i) its suitability for investigating complex human activity and for uncovering participant voices (Denizen et al. 2005,); ii) its underlining goal to study real-life contemporary systems in-depth and over time (Creswell, 2013b, Da Costa, 2016); iii) the potential within a case to develop theory, evaluate programs, and develop interventions (Baxter, 2008); iv)); iii) the connection the case study assumes between the researcher(s) and participants. In this case for example, one researcher is a colleague of the participants while the other leads the program in which the teacher participants teach. Ethical guidelines established by the institution to protect the rights and privacy of the participants, were strictly adhered to throughout the case study process including informed and signed written consent collected from each participant who was interviewed.

3.1 Context and Participants

The study was carried out in a HE institution in Chile, a South American country located on the western edge of the continent. Politically, Chile is a presidential republic. Until 2021, the country had experienced significant economic growth and had been recognized as one of the most developed nations in Latin America. Since then, growth has slowed, which has brought about less productivity and progress in equity. Chile also faces social and economic inequalities, which have led to ongoing discussions and protests regarding social plus educational issues and demands for reforms (The World Bank, 2023). These issues weigh heavily on the minds of all Chileans.

Chile has a well-established HE system. Numerous universities and institutions offer a wide range of academic programs and degrees. The country has made efforts to improve access to HE, and a significant proportion of the population enrolls in tertiary education. Particularly due to the COVID-19 pandemic, online learning has been adopted with varying degrees of success, representing a considerable challenge for institutions, faculty, and students (Montero et al, 2022). Chile has invested in technological infrastructure and initiatives to support online learning, including the provision of internet access to remote areas. Although most people have access to the internet, its quality depends on family income (Yeomens Cabrera and Silva Fuentes, 2022). The digital divide is evident in the level of technological resources available in various Chilean households. For example, in 2020, 76% of higher income families had a personal computer, laptop or tablet, whereas only 45% of lower income families had one, and 16% had none (Milesi, 2022). Despite such challenges, and to provide wider access to education, universities and other educational institutions have implemented virtual learning platforms and tools to deliver courses and facilitate remote collaboration. A few institutions offer fully online programmes for working adults, making it possible for this sector to obtain a first or second professional degree and to promote their lifelong learning.

The participants in this study are EFL instructors who at the time were employed by the largest private university in Chile. The teaching staff consists of about 90 instructors, who are mostly Chilean EFL instructors, having obtained their EFL teaching qualifications at a Chilean HE institution, and holding a Master's degree in the areas of Education, Linguistics, or TESOL (Teaching English to speakers of other languages). Regarding gender, 70% of teachers are female and 30% male. Over 90% of the EFL instructors at this institution have a part-time contract. Such contract work is typical among Chilean private HE institutions which do not receive public funding, posing several challenges. Among teachers' employment challenges are uncertainty about their employment status, limited or no benefits and heavy teaching workloads, as they often juggle multiple teaching positions across different HE institutions to earn sufficient income (Simbürger and Neary, 2016).

Teachers in Chile also face pedagogical challenges. Teaching students with varying proficiency levels of English that may require differentiated instruction and additional support can be particularly demanding for part-time instructors without sufficient resources or training (Lombardi, 2018). Part-time instructors might have limited autonomy in designing their curriculum and assessment methods. Often, they need to follow predetermined syllabi or teaching guidelines, which may or may not match their teaching approach or their students' needs (Nehrbass et al, 2022). EFL instructors employed in the institution where the study took place deliver English courses that are mandatory in all undergraduate curricula. In view of globalisation, this requirement responds to a government initiative to promote English learning to its population. The official language, spoken by 99,5% of the population in Chile, is Spanish. Reportedly, only 10,2% can communicate in English (The World Factbook, 2023). Students enrolled in those courses have varying proficiency levels of English and are often not motivated enough to learn English since they do not perceive it as a necessary tool for their academic and future professional development. Thus, EFL instructors often face continuing challenges in teaching such HE courses.

3.2 Research Design

The research design consisted of three overlapping phases (Table 1). In the first phase, access to the research site was gained through the agreement of the director of the English Language Learning (ELL) program, herself a researcher and co-author of the report, who was also able to provide access to the teachers' contact information. Having the director involved in the research provided insight into valuable background for the study both institutionally and from the greater educational context in Chile. Also, research into effective educational institutional change has shown the importance of multi-level – *macro*, *meso* and *micro* involvement (Charbonneau-Gowdy and Chavez, 2019). Since one of the main drivers for the study was based on making changes to the online teaching programs at the site, the implication of the meso-level director seemed an obvious advantage.

Table 1: Phases of the Study and Data Collection

Phase	Type of Data	Description
Phase 1: Gaining access December 2022 – January 2023	Field notes	Collaborative discussions with director about challenges being faced in the ELL Program. Agreement to collaborate on the inquiry gained. Contact information of teachers shared and e-mails sent to all faculty members in the Program ($n=89$).
Phase 2: Seeking support from faculty January to March 2023	Online questionnaire	Teachers' support solicited and response given through completion of Online Google Form ($n=32$).
Phase 3: Follow-up teacher support. January to March, 2023	Teacher interviews	Recorded ZOOM sessions held, consisting of 40 to 60-minute follow-up conversations with teachers ($n=13$) describing in-depth experiences with the use of technology, both their own and those of students, pre, during and post pandemic.

In the second phase, January to March 2023, individual teachers in the ELL program ($n=89$) were solicited by e-mail, for their consent to participate in the study. Teachers who volunteered ($n=32$) responded in text-based written format to a questionnaire which included 8 open-ended items. Essentially, these items requested their views on their online teaching experiences in the period 2020 and 2021, and also when they returned to f2f classrooms in the context of blended courses in 2022.

In phase three, March to April 2023, interviews were conducted with a self-selected group of the ELL teachers ($n=13$) who had indicated their willingness to participate in response to the questionnaire. The individual, 40 to 60-minute, open-ended interviews were conducted as a follow-up to the emerging data from the questionnaires and to gain deeper insight into teachers' educational experiences teaching in the ELL program during three periods: i) in blended courses *prior* to the pandemic, ii) fully online *during* the pandemic and iii) in both semesters of the first year, March 2022 to July and August to December 2022 when teachers were back teaching in a blended learning scenario.

The analysis of the extensive data collected through all three phases in this design led to a deep understanding of the evolving roles, practices, and identities of these teachers online pre, during and post Pandemic and their aspirations for and hesitations about teaching with technology in the ensuing years.

3.3 Data Collection and Analysis

Data was collected using the various qualitative tools listed in Table 1. We position our analysis of this data within a social constructionist epistemology. The data corpus was analyzed using grounded qualitative coding methods involving a combined inductive-deductive process (Miles et al., 2014). After establishing a conceptual framework rooted in agency and identity elements within the sociocultural contexts of teaching pre, during and post pandemic, a series of iterative steps were taken. These steps included: i) inspecting the data sets for data that shed light on the various kinds of experiences participants had during the pandemic, on the changes to their roles and the impact they felt that this period had on their views of themselves as educators; ii) multiple readings and considerations of the data sets looking for similarities and differences in the stories that were being recounted and comparing these stories with other sources of data; iii) condensing and coding the data for key concepts and ideas that related to the theoretical concepts of identity and agency and comparing this data with findings from other studies during and post pandemic; iv) actively identifying and refining salient or common patterns or themes as well as selecting representative data extracts to support these themes from the coded data; v) forming a conceptual framework that could be corroborated by the findings that were uncovered. Through this rigorous process, we sought to ensure the reliability of our findings.

4. Analysis and Discussion of Findings

There is a famous musical lyric suggesting that in life we should never take more than we give. Yet, it seems that educational systems, in Chile at least, in many ways have built their institutional operations on the assumption that teachers are prepared to give *far* more than they are ever offered or receive in return. During the years of the pandemic, the demands on teachers globally, and no less so in Chile, could be considered unprecedented. Not only were most teachers dealing with their personal situations in the midst of a global pandemic, but also with the responsibility of assuring that effective learning continued for the multitude of students for whom their job was "to educate". While the impact of those years uncovered in the accounts of the teacher participants in

our inquiry are diverse and complex, two major themes surfaced in the analysis that shed light on what those demands have meant in terms of their practices and professional teacher identities in the aftermath of COVID. We label these two themes that are discussed in the following sections as: 1) Negative impact of pandemic teaching on teachers' roles, agency and identities and 2) Positive impact of pandemic teaching on teachers' roles, agency and identities.

4.1 Negative Impact of the Pandemic on Teachers' Roles, Agency, and Identities

Table 2: Negative impact of the pandemic on teachers

Negative Impact	Representative Excerpt from the Data
Teachers lose agency over decision making	"I don't know what happened and why they [administration] did that decision, but we just have to follow." (Interview, March 2023)
Teachers forced to revert to conventional teaching practices	"No, I can't [couldn't] talk to students, so it was only presenting." (Interview, March 2023) "You can't do much...And it becomes this kind of radio show" (Interview, March 2023)
Teachers find little incentive to building community in their classrooms	"I didn't have much time to create that student-teacher relationship, so attendance was super low, very, very low." (Interview, March 2023)
Teachers lose control over assessment practices and results	"We couldn't ask that much from them...Lots of students ended up passing the courses even though they did not have the competencies". (Interview, March 2023)
Teachers regarded as service providers by students and institution"	"...that is the way now that students are more than students, they are customers, they want a service and they want to learn without suffering." (Interview, March 2023)
Teachers suffer emotionally, in terms of confidence and motivation	"I had a gray wall...and there were no answers [from students [online]] so I started to feel frustrated and not motivated at all." (Interview, March 2023)
Teachers face a change in their role - no longer viewed as information experts	"...this idea of traditional education in the sense that this guy, this professional that needs... to have information like handy, is changing." (Interview, March 2023)
Teachers forced to accept lower standards	We were not able to ask that much [of students] ... because we were not able to be demanding like we couldn't ask that much from them...we couldn't be so demanding or strict about anything." (Interview, March 2023)
Teachers lose satisfaction of being effective promoters of learning	I worked hard for students...to feel comfortable and confident... but I think I wasn't, I wouldn't say very successful." (Interview, March 2023)
Teachers are forced to assume changes to their natural teacher identities	"I love to improve my own teaching experience... but then I feel nobody cares." (Interview, March 2023)

Many of participants in the study were well aware that the sudden transition to online learning had a profound impact on what transpired in their classrooms. They also revealed how changes that occurred in those spaces impacted their roles as teachers, their practices, the agency they felt they had and their views of themselves as professionals. Of course, most of these changes were inextricably tied to the actions of students who were adapting themselves to a new way of learning entirely in virtual spaces. Table 1 summarizes what the data revealed in terms of these conditions. For some, the loss of decision-making power over materials, assessment, student behaviours and attendance, the change in status from being considered a content expert and effective promoter of learning, the feelings of being forced to assume untypical roles, such as non-dynamic and strict enforcers of rules, as well as the assuming of a lack of confidence about teaching online left these teachers feeling lonely, unmotivated, and questioning the value of their profession. In these situations, many found themselves re-negotiating their long-held identities (Ashton, 2022). For example, Francisco explains: "This idea of traditional education...that this guy, this professional that needs to have information...is changing". Many shared that they became frustrated and saw little hope online in trying to build community or to engage students in interactive behaviours. Maria poignantly remarks: "I didn't have much time to create that student-teacher relationship" and as a result student attendance severely suffered in her class. In this unfulfilling setting, several participants spoke of a lack of drive to encourage self-directedness, learner centred practices, and critical thinking among their students – practices discussed above that underline contemporary e-learning theories, 21st century goals leading to quality online learning results (Zhang et al. 2022; Charbonneau-Gowdy and Galdames, 2022). Maria reveals: "We couldn't ask that much from them [students]". And Fernanda adds: "... nobody cares" when describing the extra effort that she was making online. It's little wonder that in the wake of such circumstances, many of these teachers lost their confidence and passion for teaching post pandemic. Fernanda expresses the losses she felt in her typical empowered identity as a teacher in her words: "I worked hard for students... to feel comfortable and confident, but I think I wasn't...very successful." In her testimony, as from others, it was clear that the pandemic was a turning point for many in the ways they viewed themselves as professionals and their roles as leaders in guiding students' learning processes.

4.2 Positive Impact of the Pandemic on Teachers' Roles, Agency and Identities

Table 3: Positive impact of the pandemic on teachers

Positive impact	Representative Excerpt from the Data
Teachers feel empowered and confident in their digital literacy skills	"It [online teaching] had a great influence since the return to f2f classes helped me improve my teaching practice, incorporating more technology to carry out a more active teaching practice." (Questionnaire, January 2023).
Teachers recognize more than ever the importance of building community with technology	"We need it [building community] because we cannot work on our lessons without sharing." (Interview, March 2023) I find learning is a relationship and if you don't have that strong relationship students don't really not only engage in the class...(Interview, March 2023)
Teachers regain control over their classroom practices	"The freedom of teaching is just the class...not the evaluation. "
Teachers acknowledge the need to exploit their students' increased use of technology for learning	"Flip ... [the app]...you can generate your video doc.. It's just great! You can give an opinion using video or audio. I have used it a lot...because it helped me with my students [in] using technology." (Interview, March 2023).
Teachers take on role as data miner for appropriate learner-centred digital materials and tools	"I became more skillful surfing the internet and finding useful material for my classes." (Questionnaire 2023)
Teachers appreciate the value of using technology for engaging learners in active interaction for learning	"[With the podcast], they were all so engaged and enjoying the discussions...They spontaneously told me that they loved it and that they spoke from the heart. " (Interview, March 2023)
Teachers rethink their perspectives on assessment practices	"I now use technology to assess." (Questionnaire, January 2023). "Some evaluations are easier to apply [using technology] and feedback can be also easily administered and recorded on these platforms." (Questionnaire, January 2023).
Teachers are more critical in terms of the agency they need from their institutions to be effective	"Then we receive everything and then we have to explore how to teach and how to incorporate things that are on the platform...but just follow the platform. Everything is done and you cannot modify." (Interview, March 2023)
Teachers have renewed enthusiasm for teaching	"What I can say is that in 2022 my passion for teaching was reignited." (Questionnaire, January 2023). "I felt enchanted again with my profession." (Interview, March 2023)
Teachers become partners with students in promoting self-directed learning behaviours	"More students than ever before asked me for extra work or additional activities...asking me about specific websites where they could practice their grammar. " (Interview, March 2023)
Teachers see their roles as leaders in directing learners in the use of powerful AI technologies	"I'm beginning to use Chat GBT with students and to embrace it, yet be critical" (Questionnaire, January 2023).

Without denying the long-term impact of what occurred during the pandemic pivot to online learning, many of the participants were able to see some advantages to their teaching from the challenges they had faced during the pandemic. In Table 2, we summarize these findings with support from the data. Analysis of the various data sets revealed that in their return to blended programming and thus f2f teaching, there were teachers who felt comfortable and indeed excited to incorporate technology into their daily teaching practices (Engeness, 2020). As Marco, one of the teachers remarks: "I felt enchanted again with my profession." Another participant, Stefano, shares that his passion for teaching was reignited because of all that he had learned online and that he was able to apply that knowledge post pandemic. Many recognized that their students had become far savvier and indeed interested in the use of technology. They observed their students beginning to acknowledge that technology served not only their social media interests but that they could benefit from its powerful potential for learning. It was obvious to many of these teachers that the climate had changed in terms of implicating digital tools actively in their practices. Indeed, some participants reported taking a leadership role in working with their students to critically investigate the uncharted use of AI tools for learning (Godwin-Jones, 2022). As Carlos, one of the teachers reveals: "I feel we have to embrace it [AI] somehow. It's... it's there. No point in trying to fight it. There's no going back...I know that's the road we must travel" (Interview, March 2023). In his testimony, Carlos is recognizing, as did others although not all, that teachers will need to assume a clear stand on AI tools and embrace their advantages instead of fearing their power over the way individuals learn.

Another major impact of the pivot to online learning on teachers was the realization on the part of many participants not only of the powers of technology but the advantages of combining these tools with course designs and pedagogical practices that result in access to quality learning (Charbonneau-Gowdy and Galdames, 2022). Most revealed suffering both emotionally and professionally through the period of the pandemic with virtually little or no engagement from students online and daily facing a "grey wall" (Consuelo, Interview, March 2023). Yet, once back in f2f classrooms and a return to blended learning, several teachers reported feeling enthusiastic about developing learner-centred practices, engaging students in constructivist learning, developing strategies to promote student group work, self-directed learning and especially to build community. Some spoke excitedly about employing strategic and emerging technology resources for both learning and assessment – all further evidence of their aligning design, pedagogy and technology resources that are proven to lead to quality learning results. Some teachers predicted that the experiences online during the pandemic were leading to a major transition in education.

While all teachers acknowledged the after-effects of the pandemic, their responses to the “new reality” were mixed. Some saw students’ lackluster attitudes, their emotional instability, and their unwillingness to adopt to the online learning side of their blended courses as further challenges. Others saw it as an exciting time - a time to not only raise standards but also to rethink standards about assessment, about efficient ways of learning, and about the value to learning in engaging with others. Some shared their view of this post pandemic period as a time to re-ignite the spirit of being together in an active learning community, supported by technology tools where learning is experienced as fun and worthwhile. Rosario comments about introducing game-based learning strategies: “Yeah they got excited...That’s what we want as teachers, not only in terms of students being engaged in class and interacting in a very positive way...I felt more satisfied because I felt they were also enjoying their learning more...We want that affirmation that our students want to learn.” (March, 2023). Through her students’ enthusiasm, Rosario mediates her identity as a teacher as fulfilled and empowered, confident that she is being an effective educator.

These extracts as well as others cited above attest to the changing times teachers are facing in their post pandemic professional lives. For some, the impact of what they had experienced online during the two years of the pandemic resulted in their being skeptical and wary of what lay ahead. According to several participants, angst about how to navigate their students’ emotional states, distant attitudes, the lack of importance students were placing on grades and succeeding, left teachers accepting the fact that things would never be the same – that they were facing a “revolution” as Marco puts it and that AI would help kindle that revolution further. Others saw their online experiences and the return to classroom teaching as an opportunity to take a more active role in introducing deep changes to their approaches in their blended learning practices and how they promote learning that will have 21st century benefits for their students’ skills in the immediate and long term. Referring to the inevitability of the presence of AI in these spaces, with conviction Leona shares: “We need to do things differently.” (March 2023).

5. Conclusion

Reflection is essential to change. As one teacher participant Carlos remarked: “If there is no reflection, we won’t be able to see the mistakes we’ve made and improve.” (Interview, March 2023). Our study is an effort to incite reflection. We believe this reflection is not just limited to Chile where educational change has been slow to materialize despite government efforts. Reflection is needed more extensively in the other global contexts that have shared and are facing similar and new challenges as they migrate to a variety of spaces, virtual and otherwise. Given the understandings we have uncovered, it seems obvious to us that the pandemic has had a deep impact, on teachers, their roles, their identities, and their practices that will ultimately influence learning in the next decade in ways that would have been unimaginable just a few years ago. Marco observes: “I probably changed for ever. I don’t think it will ever(sic) be the same.” (Interview, March, 2023). We strongly believe that the implications for learning from the pandemic’s impact will be seen in teachers i) expertly guiding students to rethink the use of powerful emerging technologies in more critical ways, ii) partnering with students in learning how to exploit technologies for their most positive benefits, iii) strongly encouraging students to assume the direction of their own learning in novel, exciting and life-long ways and supported by technology, iv) having more collaborative control over decision-making with regard to theoretically aligning the materials, designs and technologies they use and v) being able to access the professional support they need to be leaders in learning - whatever that entails as the century progresses. While we acknowledge the limitations in terms of the size of our study and the context-specific nature perhaps of some of the conditions, we believe these results add a powerful incentive to others in the research community to add much needed empirical evidence. This evidence is critical for our global society to emerge from these difficult years with renewed enthusiasm for valuing and supporting teachers at this key moment in history to use the best technology has to offer for improving education opportunities for all.

References

- Adinda, D. and Mohib, N. (2020) “Teaching and Instructional Design Approaches to Enhance Students’ Self-Directed Learning in Blended Learning Environments”, *The Electronic Journal of e-Learning*, Vol 18, No. 2, pp. 162-174.
- Ahlf, M., and McNeil, S. (2023) “A Systematic Review of Research on Moderators in Asynchronous Online Discussions”, *Online Learning*, Vol. 27, No. 1, pp. 219 – 262. DOI: 10.24059/olj.v27i1.3381
- Ashton, K. (2022) “Language Teachers Agency in Emergency Online Teaching”, *Systems*, Vol. 105, pp. 1-12. <https://doi.org/10.1016/j.system.2021.102713>
- Baxter, P. and Jack, S. (2008) “Qualitative Case Study Methodology: Study Design and Implementation for Novice

- Researchers", *The Qualitative Report*, Vol 13, No. 4, pp. 544-559.
<https://doi.org/10.46743/2160-3715/2008.1573>
- Charbonneau-Gowdy, P. and Galdames, C. (2023) "About Change: How Institutionally Aligning Online Pedagogy, Design and Technology Impacts Higher Education Teachers. *Proceedings of the 9th International Conference on Education Advances (HEAd 2023)*, 1467 -1476, DOI: <https://dx.doi.org/10.4995/HEAD23.2023.16871>
- Charbonneau-Gowdy, P. and Galdames, C. (2022) "The Impact on Learners' Identities of Aligning Pedagogy, Design and Technologies with Theory in Online Courses. *Proceedings of the 21st European Conference on e-Learning (ECEL)*, pp. 51-60. DOI: <https://doi.org/10.34190/ecel.21.1.899>
- 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*, Vol. 17, No.3, pp. 131-143.
- Comas-Quinn, A. (2011) "Learning to Teach Online or Learning to Become an Online Teacher: An Exploration of Teachers' Experiences in a Blended Learning Course", *ReCALL*, Vol 23, No. 3, pp. 218–232.
<https://doi.org/10.1017/S0958344011000152>
- Creswell, J. W. (2013b) *Qualitative Inquiry and Research Design: Choosing Among Five Approaches* (3rd ed). Sage, Thousand Oaks, CA
- da Costa, R. B., Hall, S. M. and Spear, A. (2016) "Whose Reality? A Meta-analysis of Qualitative Research in International and Comparative Education", *The Qualitative Report*, Vol. 21, No. 4, pp. 661-676. <https://doi.org/10.46743/2160-3715/2016.2252>
- Denzin, N.K., and Lincoln, Y.S. (2005) Introduction: The Discipline and Practice of Qualitative Research. In N.K. Denzin and Y.S. Lincoln (Eds.), *The Sage Handbook of Qualitative Research* (2011 ed.). Thousand Oaks, CA: Sage.
- Dennen, V. P. and Jones, M. K. (2022) The Role of the Online Instructor: A Nexus of Skills, Activities, and Values That Support Learning" In O. Zawacki-Richter and I. Jung (Eds.) *Handbook of Open, Distance and Digital Education*. Springer. https://doi.org/10.1007/978-981-19-0351-9_62-1
- Dennen, V. P., Hall, B. M. and Hedquist, A. (2023) "A Systematic Review of Research on Intersubjectivity in Online Learning: Illuminating Opportunities for Cohesion and Mutual Understanding in the Research Conversation" *Online Learning*, Vol. 27, No.1, pp. 158-186. DOI: 10.24059/olj.v27i1.3430
- Doo, M. Y., Zhu, M., & Bonk, C. J. (2023) "A Systematic Review of the Research Trends in Online Learning During COVID-19: Documenting the Sudden Shift" *Online Learning*, Vol 27, No. 1, pp. 15-45. DOI: 10.24059/olj.v27i1.3405
- Engeness, I. (2021) "Developing Teachers' Digital Identity: Towards the Pedagogic Design Principles of Digital Environments to Enhance Students' Learning in the 21st century" *European Journal of Teacher Education*, Vol 44, No. 1, pp. 96-114. DOI: 10.1080/02619768.2020.1849129
- Godwin-Jones, R., (2022) "Partnering with AI: Intelligent Writing Assistance and Instructed Language Learning" *Language Learning & Technology*, Vol. 26, No. 2, pp. 5–24. <http://doi.org/10125/73474>
- Heil, J. and Ifenthaler, D. (2023) "Online Assessment for Supporting Learning and Teaching in Higher Education: A Systematic Review" *Online Learning*, Vol 27, No.1, pp. 187-201. DOI: 10.24059/olj.v27i1.3398
- Leijen, A., Pedaste, M. and Lepp, L. (2020) "Teacher Agency Following the Ecological Model: How it is Achieved and How it Could be Strengthened by Different Types of Reflection" *British Journal of Educational Studies*, Vol 68, No. 3, pp. 295–310. <https://doi.org/10.1080/00071005.2019.1672855>
- Martin, F., Dennen, V.P., and Bonk, C.J. (2023) "Systematic Review of Research on Online Learning: An Introductory Look and Review" *Online Learning Journal*, Vol 27, No. 1, pp. 1-14.
- Miles, M. B., Huberman, A. M., and Saldaña, J. (2014) *Qualitative Data Analysis: A Methods Sourcebook* (3rd ed.), Sage, London.
- Milesi, O. (2022, July 1) "The Digital Divide, a Pending Issue in Chile's Educational System" *Global Issues*, July 2022. <https://www.globalissues.org/news/2022/07/01/31282>
- Montero R., Gemp R., and Vargas M. (2022) "Chilean University Students' Satisfaction with Online Learning During COVID-19 Pandemic: Demonstrating the Two-Layer Methodology" *Frontiers in Psychology*, Vol 13. <https://doi.org/10.3389/fpsyg.2022.887891>
- Nehrbass, K., Murcray, T., and Morris, E. (2022) "Flexibility Within Structure: Factors Contributing to Faculty Perceptions of Autonomy and Standardization in Course Design and Delivery" *The Journal of Applied Instructional Design*, Vol 11, No. 3., pp. 25-40. https://edtechbooks.org/jaid_11_3/flexibility_within_s
- Simbürger, E. and Neary, M. (2016) "Taxi Professors: Academic Labour in Chile, a Critical-practical Response to the Politics of Worker Identity", *Workplace*, Vol 28, pp. 48-73. <https://doi.org/10.14288/workplace.v0i28.186212>
- The World Bank (2023, April 3) The World Bank in Chile. <https://www.worldbank.org/en/country/chile/overview>
- The World Factbook (2023, June 9) Explore All Countries - Chile. <https://www.cia.gov/the-world-factbook/countries/chile/>
- Wright, A. C, Carley, T. C, Jivani, R, and Nizamuddin, S. (2023) "Features of High-quality Online Courses in Higher Education: A Scoping Review" *Online Learning*, Vol 27, No.1, pp. 336-355. DOI: 10.24059/olj.v27i1.3411
- Vähäsantanen, K. (2015) "Professional Agency in the Stream of Change: Understanding Educational Change and

Teachers' Professional Identities" *Teaching and Teacher Education*, Vol 47, pp. 1–12.

<https://doi.org/10.1016/j.tate.2014.11.006>

Vlachopoulos, D. and Makri, A. (2021) "Quality Teaching in Online Higher Education: The Perspectives of 250 online Tutors on Technology and Pedagogy" *International Journal of Emerging Technologies in Learning*, Vol 16, No. 06, pp.40-56.
DOI: 10.3991/ijet.v16i06.20173

Yeomans Cabrera, M. M. and Silva Fuentes, A. (2022) "Non-cost Proposal to Reduce Educational-technological Inequity During Confinement in Chile" *Revista de Estudios y Experiencias en Educación [REXE]*, Vol. 21, No. 45, pp. 70-86.

<https://doi.org/10.21703/0718-5162.v21.n45.2022.004>

Zhang, L., Carter, R. A. Jr., Qian, X., Yang, S., Rujimora, J. and Wen, S. (2022) "Academia's Responses to Crisis: A Bibliometric Analysis of Literature on Online learning in Higher Education During COVID-19", *British Journal of Educational Technology*, Vol 53, pp. 620–646. <https://doi.org/10.1111/bjet.13191>

Analysing Gaming Behaviour: Insights on Personality Traits

Aikaterina Chatziavgeri and Satratzemi Maya

Department of Applied Informatics, University of Macedonia, Thessaloniki, Greece

aid21007@uom.edu.gr

maya@uom.edu.gr

Abstract Educational games have become an integral part of the educational process at various levels, with their usage rapidly increasing as innovative e-learning methods. These games have proven to be highly engaging and effective in knowledge retention. Previous research primarily focused on the impact of violent video games on behaviour and the correlation between game behaviour and personality. Traditionally personality assessment relies on psychometric questionnaires, with the Big Five Inventory (BFI) being a widely used tool. However, these approaches often have certain drawbacks as respondents tend to carefully consider their answers, prioritizing correctness over authenticity. To address these limitations, novel approaches are being developed that incorporate gaming elements to indirectly measure personality. Therefore, an intriguing question arises: Can the subconscious moves, choices, and behaviours exhibited during gameplay serve as indicators of players' personality? In this case study, we developed an educational game focused on Databases courses for university students. The game aims to capture everyday life experiences at the university such as social connections and curiosity or willingness to try new things, based on the Five-Factor Model (OCEAN). The educational content is presented in the form of a quiz with four possible answers, providing appropriate feedback based on the selected responses. The objectives were to strengthen the knowledge and comprehension of Databases subject and also to gather information about players' gaming behaviour and thus predict their scores on two personality traits: Extraversion and Openness to Experience, based on the Five-Factor Model. A total of 149 computer science students of the University of Macedonia participated in the study by playing the game and completing the BFI questionnaire. We utilized classification algorithms to develop a model to predict student's personality. The goodness of the model was assessed using different metrics and the results showed that it is effective to model both the extraversion and openness personality dimensions using serious games instead of questionnaires. These findings can be used by educators and game designers to develop personalized educational games taking into account learner's personality and thus provide valuable insights for future research in this domain.

Keywords: Educational Game, Gaming Behaviour, Gameplay, Personality, Data Analysis

1. Introduction

Educational games are constantly becoming more and more popular. Serious games have significant training potential as they affect the learning process of users in a positive way. The main objective of serious games is to strike a balance between entertainment and interactive education (Noemí and Máximo, 2014). Although assessing the efficiency of an educational game can be quite challenging, recent research findings are notably encouraging regarding the effectiveness of games as educational tools (de Freitas, 2018). Video games have several benefits, for instance, players learn to focus on a desired target and handle situations where multiple events occur simultaneously (Prensky, 2003). Playing games also enhances skills like effectively assimilating information from various sources (Prensky, 2003). In addition, playing educational games increases players' motivation and involvement, leading to enhanced learning outcomes and overall satisfaction (Machado et al., 2018). According to teachers who participated in a survey, student learning is enhanced when educational games are integrated in the school environment (e.g., playing and developing games) (Huizenga et al., 2017). The study highlights essential factors observed by teachers that have an impact on cognitive learning outcomes, including the provision of direct feedback and the facilitation of active learning through discovery. These factors were considered for our game design and development, with personality assessment being the ultimate goal of the study. A common way to measure personality is through questionnaires in a self-report form. The Big Five Inventory (BFI) (John, Naumann and Soto, 2008) is probably one of the most popular questionnaires for personality. However, some questions are arisen regarding their validity as tools for assessing personality. The limitation of these methods is the potential of hiding information on purpose when the respondent will not benefit from answering sincerely (Chen and Lin, 2017). Tlili et al (2016) noted that long questionnaires can sometimes stress the respondents and lead to lack of motivation. These reasons lead to alternative approaches for personality assessment in a subconscious way. At the same time, concerns have arisen regarding the potential impact of e-learning methods on the authenticity of the student-teacher relationship. In their study, (Kim, Lee and Ryu, 2013) investigated the impact of personality on e-learning performance and proposed a user framework to enhance adaptable e-learning systems. Their findings suggest that extraversion may affect the ease to perform a learning task in an e-learning environment. In previous studies, a personalized game lead in reduction of cognitive load and mental effort within the game (Tlili et al, 2019), also learning motivation can be

enhanced if personality type is taken into account in the game (Hwang et al, 2012). In our study we developed an educational game as an approach to gather data such as subconscious moves, choices, and behaviors exhibited during the gameplay and then utilize data classification algorithms to measure the players' personality. An extension of this approach would involve providing this valuable data to game designers and educators for more personalized instruction.

The rest of the paper is structured as follows: Next section presents the background and related work to the current study. In Section 3 the educational game is described and the conducted experiment to evaluate it is presented. In Section 4, the methodology used is explained. Section 5 details the classification algorithms and the results, and finally, Section 6 concludes with limitations and future directions.

2. Background and Related Work

Several studies have explored whether individuals with similar personalities tend to exhibit similar preferences for game genres such as adventure, shooting, puzzle, and simulation games (Fang and Zhu, 2011; Peever, Johnson and Gardner, 2012; Dewanto and Tiatri, 2021). Fang and Zhu (2011) assume that it is likely that players choose games that align with their own extraverted personality traits. Additionally, research conducted by Tlili et al (2019) has examined whether a personalized game based on the players' personality may impact their engagement and cognitive load. Various game mechanisms such as scoring, feedback and difficulty, have been investigated for their influence on players' motivation. This study also examined the influence of this game personalization on technology acceptance. Players who used the personalized game expressed more positive feedback regarding its perceived usefulness and their intention to continue using the game in the future (Tlili et al, 2019).

Prior studies also examined the violent behaviours in video games and the potential to indicate violent personality. It appears that the players having more aggressive personality, act more violent while playing as well (shooting, kicking etc)(Peng, Liu and Mou, 2008). A meta-analysis showed that the exposure to violence in video games is related with aggressive behaviour, desensitization, and dearth of empathy (Anderson et al, 2010). While numerous studies have centred on game genres or violent video games, our research takes a distinct approach by focusing on investigating individual player behaviours and choices within games as potential indicators of personality characteristics.

The OCEAN Big Five Model (John, Naumann and Soto, 2008) is a popular model that assesses five personality traits that is also known as Five Factor Model. The OCEAN is an acronym that represents the five personality factors: Openness to experience, Conscientiousness, Extraversion, Agreeableness and Neuroticism. According to the model, people scoring high on extraversion are more likely to exhibit sociability and are driven with positive emotions and energy. On the other hand, individuals with high Openness to Experience tend to be curious, imaginative, and have artistic interests. The Big Five Inventory (BFI) questionnaire (John et al, 2008), is a widely used self-report assessment that consists of 44 questions. The statements of the questionnaire are referring to a specific trait. The respondents are asked to choose how much they relate to each statement by rating in a Likeart scale. According to the given rates a score is calculated and the respondent's personality is determined.

In the past years, research has been conducted to model personality with games as an alternative method. Denden et al (2018) developed a computer architecture educational game to measure learners' personality and ran an experiment with thirty-four University students. The BFI and TAM models were employed to measure personality and technology acceptance respectively (Denden et al, 2018). By utilizing the Naive Bayes classifier and collecting gameplay data, the researchers modelled personality traits. This study focused on extraversion and openness to experience and the predictions for both factors had high accuracy compared to the respective BFI scores. Afroza et al (2021) developed a 3D game that serves as a psychometric tool measuring extraversion, neuroticism, and conscientiousness. Pearson's correlation was used between the scores of the BFI and predicting values. The results showed that neuroticism had a moderate correlation while the extraversion and conscientiousness results were not satisfactory. In addition, a study that aimed to identify the conscientiousness trait using an Item Response Theory system (Palhano, Machado and Almeida, 2020) gave encouraging results. Specifically, the variables of the game regarding the conscientiousness were related with the respective variables of the BFI. Finally, research by Shen et al (2012) used text analysis, behavioural and social network data to infer personality. The study involved more than one thousand participants and the results indicated that the character and guild names hide valuable personality information.

3. The Case Study

3.1 The Game Development

The game was developed in Unity, a free, strong, and well-known tool for game development. In Unity both 2D and 3D games can be developed while it is also widely used in 3D animations (VR and AR development). It allows the development of serious games running in multiple platforms (mobile devices, desktops) concurrently. This game targets Windows and Linux Operating Systems for desktop usage, ensuring a user-friendly downloading and installation process. Scripting in C# helps in building stable and custom applications. The game's design, development, and testing process lasted approximately four months.

3.2 The Game Concept

Designed as an interactive quiz experience, UniGame aims to strengthen the knowledge and comprehension of Databases subject among university students. The Database course is a mandatory component of the curriculum. The game presents a virtual university environment where players freely navigate through different rooms as shown in Figure 1, asking a task to the user. When the task is completed, a quiz question related to Databases is showing up in Greek. Greek is selected as the native language of the students for better comprehension. Since feedback is an essential characteristic of the learning process, a positive or negative feedback is given, based on the answer given for the specific quiz question. Figure 2 depicts the positive feedback provided when players select the correct answer. The primary objective of the game is to collect valuable behavioural data in order to model the learner's personality. The game gathers additional data regarding the learning process and student responses to the game questions. Future data analysis took place to assess whether the gathered data are sufficient to provide meaningful insights about user personality traits. The data gathering is restricted to two personality traits: Extraversion and Openness to Experience. The data collected from the game regarding the Databases course can be analysed to identify patterns in student responses and areas of weakness.

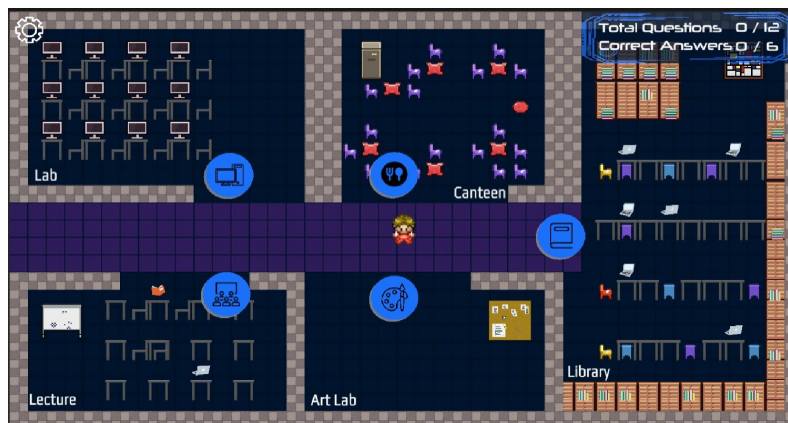


Figure 1: Screenshot of the map of the game

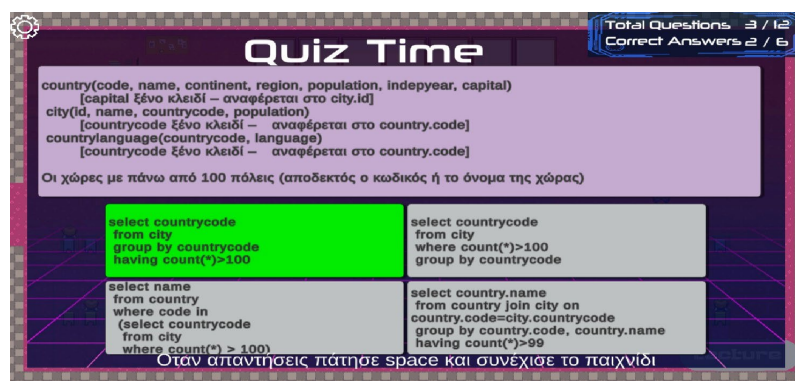


Figure 2: Screenshot of the quiz game when the selected answer was correct.

3.3 The Game Design

The primary objective behind designing the educational game was to collect relevant data effectively. The selection of the game environment along with the details of every room are all important indices of the personality. All the freedom given to the player, the user interface, and the game functionality were designed to be used in the predictions. The rooms and the map of the game are tile-based with multiple levels of tiles. The educational quiz component was designed to offer an optimal user experience and gain high knowledge retention. As mentioned above the player could freely navigate in the university and choose the rooms they wanted to visit as many times as they wanted. This gives them freedom and gives us information about the room visits.

Sociability and enjoyment of social interactions serve as indicators of extraversion, while feelings of loneliness are often associated with introversion (John, Naumann and Soto, 2008). In two rooms of the university the player is asked to choose where they will take the class. The two choices were: a chair surrounded by other students and a chair to sit alone. Additionally, since individuals high in openness to experience are driven by curiosity and a desire for novel experiences, exploring different locations within a game can be used as a measure of this trait (John, Naumann and Soto, 2008). Curiosity and desire to explore new areas is measured by the players' visiting choices. Extraversion is measured with colour preferences for avatar and selections in the game. According to research conducted in the USA, extraverts tend to prefer warm colours while introverted people tend to prefer cool colours (Choungourian, 1967). While Jia et al (2016) suggest that extraverts are more likely to find leaderboards enjoyable and beneficial as compared to introverts. This is why the leaderboard was also added to the initial game settings. Since studies found that there is a significant correlation between openness to experience and academic results, knowledge, and overall school performance (Ackerman and Heggestad, 1997; Farsides and Woodfield, 2003), the final score of the quiz is a trace too. Research suggests that individuals with introverted personalities are more susceptible to distraction when it comes to music and background noises, particularly during cognitive activities or work (Furnham and Bradley, 1997; Dobbs, Furnham and McClelland, 2011). Music and sound effects were integrated into the initial settings of the game to measure extraversion. Last but not least, people with low openness to experience are less likely to prefer art and in particular abstract art compared to the high openness individuals, who exhibit greater artistic and aesthetic inclinations (Feist and Brady, 2004; Chamorro-Premuzic et al, 2009). Thus, visiting the art room multiple times may be a trace indicating high openness and the painting they choose could also be a predictor.

3.4 The Participants

The study was conducted at a Computer Science Department offering an opportunity for all enrolled students in the database course to participate. The study aimed to include students from various academic levels. To encourage participation, a 0.5 bonus motivation was offered to those successfully passing the final exams. Out of the 174 students who initially expressed interest in participating, a total of 149 students actively engaged in the survey and completed all required procedures.

3.5 The Procedure

Throughout the procedure, a Zoom call was conducted to supervise and assist the participants. Any queries or difficulties encountered during the game installation and execution were addressed and resolved. The students were required to download and play the game, and then upload the generated files to the University's e-learning platform. The final step involved completing the BFI questionnaire in Greek.

4. Methodology

The behavioural data along with the BFI questionnaire for each student were pre-processed and merged into two datasets, each aimed at predicting a specific personality trait. The resulting datasets were formatted to be compatible with Pandas Library to run the classification algorithms in Python. The Pandas library was utilized to handle the dataset, while the scikit-learn library was employed for machine learning algorithms and metrics. The dataset consisted of a total of 21 variables, as shown in Table 1.

Table 1: The Variable values | Opposite Variable values of the dataset

Variable value	Opposite Variable value	Type
Blue avatar	Red Avatar	Numerical integer
Leaderboard Enabled	Leaderboard Disabled	Numerical integer
Music On	Music Off	Numerical integer
Sound Effects On	Sound Effects Off	Numerical integer
Canteen blue chair selected	Canteen red chair selected	Numerical integer
Lab Alone	Lab with others	Numerical integer
Lecture Alone	Lecture with others	Numerical integer
Visited Lib	-	Numerical integer
Art Room Abstract Painting	Art Room Classic Painting	Numerical integer
Visited All Rooms	-	Boolean
Successful game	Game Over	Numerical integer
Final score	-	Decimal number

The “Visited all rooms” becomes true when the player has visited all the rooms within the game environment. Game run is considered as successful when six or more questions are answered correctly. The “Final score” indicates the score achieved in the last played game. The remaining variables mentioned above are integers, representing the total count of occurrences for each variable within the different runs. The 22nd variable was the class of each personality trait (Extraversion or Openness to experience) that we aimed to predict. The scores served as Ground truth. The BFI score is calculated by reversing the scores of the negative questions and then averaging the scores of the questions related to each personality trait. The resulting mean falls within a range of 1 to 5, with values between 1 and 3 categorized as “low” and those between 3 and 5 classified as “high.” For extraversion 69 students were categorized as having a “low” score and the remaining students were labelled as “high”. As for openness to experience, 73 students were labelled as “low” and 76 as “high”.

5. Results

The generated datasets of the collected and pre-processed data were utilized to run the classification algorithms and predict the class for Extraversion and Openness to Experience. For model evaluation, a 20-80% test-train split was employed on the data. The train set was used to run the classification algorithms and make predictions on the test set. Experiments with four algorithms: Naive Bayes Classifier, Decision Trees, k-Nearest Neighbour (k-NN) and Logistic Regression for 15 different seeds were conducted. Their performance was evaluated using Accuracy, Cohen's-Kappa, F1 score and AUC-ROC curve metrics. The accuracy metric is defined as the proportion of the instances that were correctly classified out of the overall instances. The Cohen's-Kappa measure is evaluating the agreement between two raters considering the factor of chance. F1 score (also known as F-score) evaluates the model performance by combining the precision and recall values. Finally, a high AUC ROC metric suggests that the classifier performs well at distinguishing between the classes. The optimal algorithm, along with the respective results of all metrics, is detailed in Table 2.

During the game, continuous music played in the background, while the sound effects provided positive or negative feedback to the player. These audio elements were collected for their potential impact on extraversion. As noted above, previous research has shown that music may distract individuals during cognitive activities. However, the sound effects are used to notify the players about the correction of their responses. The majority of the players retained the sound effects on during gameplay, minimizing their potential impact on extraversion. In addition, after several runs it was observed that certain variables had a negative impact on the results, leading to lower scores in the evaluation metrics. This happened specifically for the extraversion predictions, this is why the “Game Over”, “Sound-on”, and “Sound-off” variables were excluded from the dataset in the final experiments.

In our study, we evaluated the performance of our model in predicting the Extraversion, achieving an accuracy score of 0.7 and a Cohen's Kappa agreement of 0.4 (as shown in Table 2). A similar study conducted by Danden et al (2018), where they worked with forty four participants, including 34 learners who played the game and completed the BFI questionnaires. In their study, the BFI scores were categorized into "low", "balanced" and "high" classes for both Extraversion and Openness to Experience personality traits. Due to a limited number of observations in the "balanced" category (2 for Extraversion and none for Openness to Experience), we decided to simplify our analysis to two classes, as discussed in Section 4.

Danden et al achieved a score of 0.79 in accuracy and a Kappa agreement of 0.65 using the Naive Bayes algorithm. While this accuracy is higher compared to our model, it can be attributed to the disparity in sample sizes. The above findings identify areas of improvement in our model, for instance we acknowledge the need to collect additional traces, such as risk factor and players' emotional states as done in Danden's study.

When it comes to Openness, our model achieved an accuracy of 0.73 and a Cohen's agreement of 0.45 using the Naïve Bayes algorithm. Notably, our accuracy is slightly higher than that on Danden's et al study (0.70) when using the same algorithm. This result is encouraging, particularly considering the broader sample size of 149 players in our study, enhancing its generalizability. However, it's worth noting that there is room for improvement in terms of the Cohen's Kappa value. The values of F1 score and AUC-ROC are satisfactory across both personality traits. The results of the Afroza's et al (2021) study on extraversion did not show correlation with the ground truth data; this is why we do not proceed to comparisons.

Table 2: The evaluation metrics of the classification algorithms for each personality trait

Personality Trait	Classifier	Accuracy	Cohen's-Kappa	F1 score	AUC-ROC
Extraversion	Logistic-Regression	0.7	0.4	0.76	0.64
Openness	Naive Bayes	0.73	0.45	0.64	0.76

6. Conclusion, Limitations, and Future Directions

In recent days, educational games have gained recognition and are widely used, while personalized games based on personality or educational level are a subject of research that shows great promise. Our game offers the potential to collect data in a subconscious way, to identify some personality traits. The moves, choices and behaviours exhibited in a game can be used as indicators to model personality. A future direction is to adapt the game to match the individual's personality. In this way, the educational process can be optimized, resulting in improved knowledge retention. Our model performs effectively on extraversion and openness traits, but further enhancements are required, particularly in improving the Cohen's Kappa metric. In related studies, a smaller number of participants were involved, and they utilized only a single algorithm. The difference between the values of the previous studies and our model may lay in the difference in the size and motivation of the sample.

Several limitations emerged during the study that could have influenced the results concerning the gameplay procedure. It should be noted that during the zoom call students frequently asked questions about the gameplay, indicating a lack of caution to the game guidelines. It can be inferred that the students' primary motivation was to complete the process to receive the bonus for the course. Additionally, it was observed that many students were unexpectedly quitting the game before reaching its conclusion, without any reason for doing so. This possibly indicates a lack of thorough reading of the instructions or unfamiliarity with the quiz questions. At the same time, some students appeared determined to continue playing until they successfully completed the game, disregarding the instruction to play it only once. All the above may have a negative influence on the reliability of the gathered data.

Future research contains the data analysis of the quiz answers, the identification of patterns in the responses. An area that holds significant interest is the expansion of this educational game in personalized educational game. Through this extension we would aim to explore the relationship between learning outcomes in higher education and two distinct types of quizzes: personalized game quizzes and non-game quizzes. The relationship of educational data analysis with personality is an area of particular interest. Since the psychological part of the game is based on literature research, future research in collaboration with psychologists for the collected data is required to optimize the results.

Acknowledgements

This paper is a result of research conducted within the “MSc in Artificial Intelligence and Data Analytics” of the Department of Applied Informatics of University of Macedonia. The presentation of the paper is funded by the University of Macedonia Research Committee

References

- Ackerman, P. and Heggstad, E. (1997) ‘Intelligence, Personality, and Interests: Evidence for Overlapping Traits’, *Psychological bulletin*, 121, pp. 219–45. Available at: <https://doi.org/10.1037//0033-2909.121.2.219>.
- Afroza, A. et al. (2021) ‘Who am I? - Development and Analysis of an Interactive 3D Game for Psychometric Testing’, in *Proceedings of the 2021 Australasian Computer Science Week Multiconference*. New York, NY, USA: Association for Computing Machinery (ACSW ’21), pp. 1–10. Available at: <https://doi.org/10.1145/3437378.3442688>.
- Anderson, C.A. et al. (2010) ‘Violent video game effects on aggression, empathy, and prosocial behavior in Eastern and Western countries: A meta-analytic review.’, *Psychological Bulletin*, 136(2), pp. 151–173. Available at: <https://doi.org/10.1037/a0018251>.
- Chamorro-Premuzic, T. et al. (2009) ‘Who art thou? Personality predictors of artistic preferences in a large UK sample: the importance of openness’, *British Journal of Psychology (London, England: 1953)*, 100(Pt 3), pp. 501–516. Available at: <https://doi.org/10.1348/000712608X366867>.
- Chen, Z. and Lin, T. (2017) ‘Automatic personality identification using writing behaviours: An exploratory study’, *Behaviour & Information Technology*, 36(8), pp. 839–845. Available at: <https://doi.org/10.1080/0144929X.2017.1304994>.
- Choungourian, A. (1967) ‘Introversion--extraversion and color preferences’, *Journal of Projective Techniques & Personality Assessment*, 31(4), pp. 92–94. Available at: <https://doi.org/10.1080/0091651X.1967.10120401>.
- Denden, M. et al. (2018) ‘Implicit modeling of learners’ personalities in a game-based learning environment using their gaming behaviors’, *Smart Learning Environments*, 5(1), p. 29. Available at: <https://doi.org/10.1186/s40561-018-0078-6>.
- Dewanto, G.W. and Tiatri, S. (2021) ‘Attitude Towards Video Game Genre and Five-Trait Personality’., in *International Conference on Economics, Business, Social, and Humanities (ICEBSH 2021)*, Jakarta, Indonesia. Available at: <https://doi.org/10.2991/assehr.k.210805.147>.
- Dobbs, S., Furnham, A. and McClelland, A. (2011) ‘The Effect of Background Music and Noise on the Cognitive Test Performance of Introverts and Extraverts’, *Applied Cognitive Psychology*, 25, pp. 307–313. Available at: <https://doi.org/10.1002/acp.1692>.
- Fang, X. and Zhu, M. (2011) ‘Extraversion and Computer Game Play: Who Plays What Games?’, in J.A. Jacko (ed.) *Human-Computer Interaction. Users and Applications*. Berlin, Heidelberg: Springer (Lecture Notes in Computer Science), pp. 659–667. Available at: https://doi.org/10.1007/978-3-642-21619-0_78.
- Farsides, T. and Woodfield, R. (2003) ‘Individual differences and undergraduate academic success: the roles of personality, intelligence, and application’, *Personality and Individual Differences*, 34(7), pp. 1225–1243. Available at: [https://doi.org/10.1016/S0191-8869\(02\)00111-3](https://doi.org/10.1016/S0191-8869(02)00111-3).
- Feist, G. and Brady, T. (2004) ‘Openness To Experience, Non-Conformity, And The Preference For Abstract Art.’, *Empirical Studies of The Arts*, 22, pp. 77–89. Available at: <https://doi.org/10.2190/Y7CA-TBY6-V7LR-76GK>.
- de Freitas, S. (2018) ‘Are Games Effective Learning Tools? A Review of Educational Games’, *Journal of Educational Technology & Society*, 21(2), pp. 74–84.
- Furnham, A. and Bradley, A. (1997) ‘Music while you work: The differential distraction of background music on the cognitive test performance of introverts and extroverts’, *Applied Cognitive Psychology*, 11, pp. 445–455. Available at: [https://doi.org/10.1002/\(SICI\)1099-0720\(199710\)11:5<445::AID-ACP472>3.0.CO;2-R](https://doi.org/10.1002/(SICI)1099-0720(199710)11:5<445::AID-ACP472>3.0.CO;2-R).
- Huizenga, J.C. et al. (2017) ‘Teacher perceptions of the value of game-based learning in secondary education’, *Computers & Education*, 110, pp. 105–115. Available at: <https://doi.org/10.1016/j.compedu.2017.03.008>.
- Hwang, G.-J. et al. (2012) ‘Development of a personalized educational computer game based on students’ learning styles’, *Educational Technology Research and Development*, 60(4), pp. 623–638. Available at: <https://doi.org/10.1007/s11423-012-9241-x>.
- Jia, Y. et al. (2016) ‘Personality-targeted Gamification: A Survey Study on Personality Traits and Motivational Affordances’, in pp. 2001–2013. Available at: <https://doi.org/10.1145/2858036.2858515>.
- John, O.P., Naumann, L.P. and Soto, C.J. (2008) ‘Paradigm shift to the integrative Big Five trait taxonomy: History, measurement, and conceptual issues’, in *Handbook of personality: Theory and research*, 3rd ed. New York, NY, US: The Guilford Press, pp. 114–158.
- Kim, J., Lee, A. and Ryu, H. (2013) ‘Personality and its effects on learning performance: Design guidelines for an adaptive e-learning system based on a user model’, *International Journal of Industrial Ergonomics*, 43, pp. 450–461. Available at: <https://doi.org/10.1016/j.ergon.2013.03.001>.
- Machado, R.S. et al. (2018) ‘The membrane potential puzzle: a new educational game to use in physiology teaching’, *Advances in Physiology Education*, 42(1), pp. 79–83. Available at: <https://doi.org/10.1152/advan.00100.2017>.
- Noemí, P.-M. and Máximo, S.H. (2014) ‘Educational Games for Learning’, *Universal Journal of Educational Research*, 2(3), pp. 230–238. Available at: <https://doi.org/10.13189/ujer.2014.020305>.

- Palhano, D., Machado, L. and Almeida, A. (2020) 'Paki Mirabolandia: A Serious Game to Identify Player Personality', in, pp. 1–5. Available at: <https://doi.org/10.1109/SeGAH49190.2020.9201759>.
- Peever, N., Johnson, D. and Gardner, J. (2012) 'Personality & video game genre preferences | Proceedings of The 8th Australasian Conference on Interactive Entertainment: Playing the System', in. Available at: <https://doi.org/10.1145/2336727.2336747>.
- Peng, W., Liu, M. and Mou, Y. (2008) 'Do Aggressive People Play Violent Computer Games in a More Aggressive Way? Individual Difference and Idiosyncratic Game-Playing Experience', *CyberPsychology & Behavior*, 11(2), pp. 157–161. Available at: <https://doi.org/10.1089/cpb.2007.0026>.
- Prensky, M. (2003) 'DON'T BOTHER ME, MOM — I'M LEARNING'.
- Shen, J. *et al.* (2012) 'Inferring Personality of Online Gamers by Fusing Multiple-View Predictions', in J. Masthoff *et al.* (eds) *User Modeling, Adaptation, and Personalization*. Berlin, Heidelberg: Springer (Lecture Notes in Computer Science), pp. 261–273. Available at: https://doi.org/10.1007/978-3-642-31454-4_22.
- Tlili, A. *et al.* (2016) 'Role of personality in computer based learning', *Computers in Human Behavior*, 64, pp. 805–813. Available at: <https://doi.org/10.1016/j.chb.2016.07.043>.
- Tlili, A. *et al.* (2019) 'Does Providing a Personalized Educational Game Based on Personality Matter? A Case Study', *IEEE Access*, 7, pp. 119566–119575. Available at: <https://doi.org/10.1109/ACCESS.2019.2936384>.

Students' Acceptance Of Digital Exams: A Case Study In A Swedish University

Panagiota Chatzipetrou, Kristijan Majkic, Jonas Samuelsson and Oskar Åberg
Örebro University, Sweden

Panagiota.chatzipetrou@oru.se
majkickristijan12@gmail.com
josa@tuta.io
oskar.aberg96@gmail.com

Abstract: In this paper we present the results of a case study in a Swedish university regarding students' acceptance of digital exams. Technology Acceptance Model (TAM), which has been widely used in research concerning technology acceptance, was used to measure the level of students' acceptance of digital exams. The aim of the study is to investigate students' acceptance of digital exams and if there are any factors that are responsible for this behavior. A survey based on the two main factors of TAM, perceived ease of use and perceived usefulness, was conducted. The survey was targeting the degree of acceptance along with students' demographic characteristics. The results showed that the students demonstrated a high degree of acceptance of digital exams, with students in their second and third year having a more positive perception rather than students in their first year. However, other factors, such as gender, subject, and age did not appear to have a strong impact on the overall acceptance of digital exams but did show a moderate impact on external factors such as perceived accessibility and computer self-efficacy, which work as predictors for perceived ease of use for a system. Overall, the knowledge about the level of acceptance of the students is valuable since we can highlight strengths and weaknesses associated with digital exams. This can be a useful tool in deciding upon a suitable digital solution for digital exams, as well as in learning how to increase the level of acceptance among the students in the future.

Keywords: Technological Acceptance, Digital Exams, Technology Acceptance Model (TAM), Higher Education

1. Introduction

Coronavirus pandemic has brought with it a tremendous shift in how learning, assessments, and examinations take place in the field of higher education. Restrictions concerning in-person activities have forced educational institutions to shift to a primarily digital, or digital-only, approach. Many universities introduced taking digital exams at home as an alternative campus-based exams (Liebherr et al., 2022). Digital exams offer some advantages over traditional methods, such as increased accessibility, faster feedback, and flexible scheduling (Dreher et al., 2011). Despite these advantages, there are still reservations among teachers towards the concept of digital exams, both concerning academic dishonesty (Eltahir et al., 2022) as well as the well-being of students (Dayananda et al., 2021). Therefore, given the current context, it is likely that digital exams will remain an option at many universities in the future.

In this paper we present the results of a case study in a Swedish university regarding students' acceptance of digital exams and if there are any factors that are responsible for this behavior. For that reason, the results are oriented along with students' demographic characteristics. The knowledge about the level of acceptance of the students is valuable and it can be a useful tool in deciding upon a suitable digital solution for digital exams, especially on emergency situations, such as pandemics. It also can be helpful in learning how to increase the level of acceptance among the students in the future solutions and in choosing the right solution for our students. In particular, from our study we learned that "older" students demonstrated a high degree of acceptance of digital exams in comparison with "younger" students which did not have such positive perception towards digital exams.

To measure the level of students' acceptance of digital exams, we have used Technology Acceptance Model (TAM). TAM has been widely used in research concerning technology acceptance. For this study, we focused on the two main factors of TAM, perceived ease of use and perceived usefulness. Towards that direction we have conducted a survey targeting the degree of acceptance along with students' demographic characteristics.

The remainder of the paper is structured as follows: Section 2 provides an outline of the related work. Section 3 provides a brief description of the theoretical framework that was used in the study. Section 4 presents the research methodology of our work. Section 5 presents the results of the analysis. Finally, in Section 6 discussion and conclusions are provided.

2. Background

Digital exams are administered electronically, typically through a computer, tablet, or other electronic device. They may involve a combination of assorted questions including multiple choice, true or false, matching, arrangement, fill in the blank, or essay questions. They typically require students to type or select their answers, and those answers are then graded and scored manually or automatically, depending on the type of assessment. According to Awad Ahmed et al. (2021), digital exams enable the provision of new kinds of questions with the use of multimedia as well as easy ways to gather feedback, instant support, assistance, aid during the examination, distribution of results, easy use of data, and flexibility of examination timing.

2.1 Benefits:

Digital exams provide a number of benefits, both for the teachers as well as the students; it constitutes a fully integrated system, which increases the validity of its evaluations (Alsalhi et al., 2019); it improves the reliability of the performance and the robustness of the test, as well as providing quicker feedback (Dreher et al., 2011); it decreases the workload of teachers, and significantly reduces the burden of monitoring while examining bigger student populations (Hodgson and Pang, 2012); as well as being cheaper as it saves effort, time, money, and can be more environmentally friendly (James, 2016). Additionally, Eltahir et al. (2022) states that studies have shown that digital exams improve learning amongst students when compared to paper exams. Studies show that students seem to prefer digital exams over traditional exams because they have the choice of where to take it, can obtain feedback and results quicker, are quick and easy to use, saves time, and are more environmentally friendly (Alyahya and Almutairi, 2019; Challis et al., 2004; Uchenna, 2021). Ryan et al. (2014) summarises digital exams in comparison to traditional paper-based examinations as possessing six characteristics: interactivity, instant feedback, flexibility, timesaving, recordkeeping, and reduced resource use.

2.2 Challenges:

However, there are reported some challenges regarding digital exams. According to Eltahir et al. (2022) five categories of challenges with implementing digital exams have been identified. These are: (1) *risks of technical failure*, where potential problems can arise from insufficient servers or lack of internet connection amongst faculty members and students (2) *academic student dishonesty*, which refers to the risk of plagiarism and cheating connected with digital exams (3) *ensuring fairness*, which refers to the various working conditions on an individual level amongst students when taking a digital exam, since they do not offer the same environment for every student, while on-campus exams do (4) *assessing practical skills, and knowledge*, which refers which refer to the problem of not being able to evaluate a student's practical ability to complete a certain task and (5) *lack of experience amongst undergraduate students in regard to digital exams* which highlights the problem of insufficient knowledge of how digital exams are performed and thus the need of familiarising undergraduate students with digital exams and how they are done so that they can perform them on their own.

The COVID-19 pandemic has caused an unprecedented crisis. Worldwide, teachers in all educational levels were invited to develop the students' learning experience in a new digital environment for their teaching (Lavidas et al, 2022, a)). Empirical studies have been conducted to investigate the potential effects of social desirability on students' self-reports in different social contexts (Lavidas et al, 2022, b)). Towards to that direction, we have noticed that in the last decade, there has been increased use of eLearning tools. Platforms and ecosystems supporting digital learning generate a vast amount of data and information in various forms and formats (Papadakis et al, 2022). Overall, the knowledge about the level of acceptance of the students is valuable since we can highlight strengths and weaknesses associated with digital exams, but also to choose the best digital tool for our students.

3. Theoretical Framework

Technology Acceptance Model (TAM) (Salloum et al., 2019) is widely used to measure the level of acceptance of technologies. In our case we used TAM to measure the level of students' acceptance of digital exams. In TAM (Figure 1, Salloum et al., 2019) there are two main factors that contribute to the level of acceptance concerning technologies. These are *perceived ease of use* and *perceived usefulness*. As a result of these two factors an attitude towards use of the specific technology is created which in turn showcases the behavioural intent to use the technology which ultimately predicts the actual use of the technology.

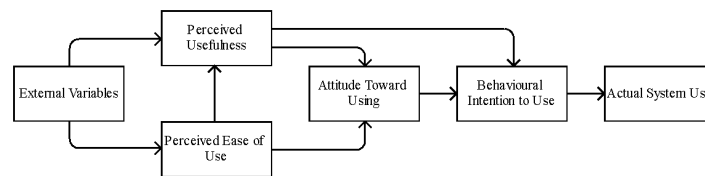


Figure 1: Technology Acceptance Model (TAM)

TAM (Figure 1) has been proven to be effective in measuring technology acceptance when it was compared with other similar models. However, when it comes to applying TAM in the context of digital exams and e-learning, a new comprehensive version of TAM (Figure 2) has been created which further describes the external variables that affect *perceived ease of use* and the *perceived usefulness*. These factors have been identified into two categories: *System Characteristics* (which contain system, content, and information quality) and *Individual Factors* (which contain computer self-efficacy, subjective norm, perceived enjoyment, perceived accessibility, and computer playfulness) (Salloum et al., 2019). Table 1 contains all the TAM specific constructs, System Characteristics, and Individual Factors with their acronyms and a short term (Salloum et al., 2019), as they were used in this work.

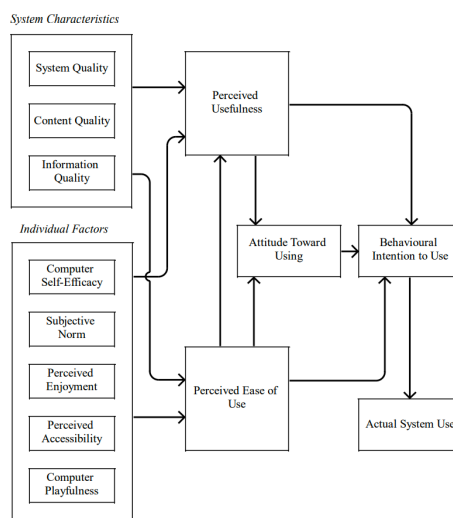


Figure 2: Comprehensive TAM

Table 1

TAM specific constructs		
PU	Perceived usefulness	The degree of belief that implementation of a new technology can enhance work performance amongst individuals
PEOU	Perceived ease of use	The level of how uncomplicated a system is to use, according to an individual
ATT	Attitude towards use	The level of negative or positive feelings an individual internalises in regard to an e-learning system, i.e., digital exams
BIU	Behavioural intention to use	The intent a user has regarding the use of an e-learning system
System characteristics		
CQ	Content quality	The depth of the content as well as the frequency at which it is updated
IQ	Information quality	The degree to which a user receives precise, well-timed, and complete information
SQ	System quality	Refers to the system characteristics such as adaptability, availability, usability and reliability and how they affect the view users have of the system in question
Individual factors		
CP	Computer playfulness	Refers to the degree of cognitive spontaneity in interacting with a system
AC	Accessibility	Describes how easy it is for users to use and access information from the system
CSE	Computer self-efficacy	Refers to an individual's confidence in their ability to take steps needed to deal with future situations.
PE	Perceived enjoyment	Is described as the enjoyment that comes from using a system, rather than from the enjoyment that manifests itself because of the intended system outcome
SN	Subjective/social norm	Refers to the social pressure an individual perceives when it comes to engaging or not engaging in a certain type of behaviour

4. Research Methodology

4.1 Research Euestion

Our work is driven by the following research questions:

RQ1: To what degree do students accept digital exams as a viable option?

RQ2: Is the degree of acceptance of digital exams affected by the students' demographic characteristics i.e., age, academic year, subject or gender?

4.2 Survey Design

The questionnaire consisted of 15 closed-ended Likert scale questions. The questions are referred to as Q1-Q15 and are available in Table 2. The questionnaire contained three sections targeting TAM specific constructs, System Characteristics, and Individual Factors (Table 1). The overview of the questionnaire is available in Figure 3 and Table 2. For collecting our data, we have used the *Simple Random Sampling* technique. The simple random sample means that every case of the population has an equal probability of inclusion in sample. (Taherdoost, 2016).

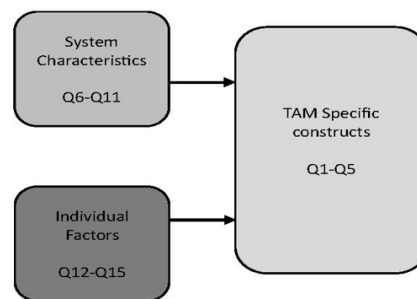


Figure 3: Overview of the questionnaire

Table 2: The questionnaire questions

Questions	
Q1	I find it to be easy to reach the digital exams
Q2	I like using digital exam tools
Q3	I use digital exam tools without issues
Q4	I think digital exam tools are easy to use
Q5	I think digital exam tools are a good replacement for written classroom exams
Q6	The digital exam tool provides me with the information I need
Q7	Information on digital exams is current
Q8	I am satisfied with my interaction with digital exam tools
Q9	Digital exams provide me with clear information
Q10	I am satisfied with the functions that digital exam tools offer
Q11	I trust digital exam tools to give me information that is true
Q12	I find it more comfortable to use a digital tool than to take a written classroom exam
Q13	Digital exams were accessible according to my own capabilities
Q14	I feel I have enough knowledge to use digital exam tools
Q15	I feel confident in my use of digital exam tools, even when there is no one nearby to help me

4.3 Description of the Data Set

The data were gathered from a Swedish University in particular, from the Business school. We evaluated the effect of the digital exams through a survey. We performed the survey under the academical year 2022 where the students still used digital exams for the examination of all their courses. In total we collected 103 responses from the survey.

Regarding the demographic characteristics of the students, we took into consideration 4 different factors: The subject of their study, the age, the gender, and the semester study. Since the survey was conducted to a business school, the students came from 4 different subjects: civil economics (36%), economics (21%), informatics (40%) and only 1% came from statistics, an expected result since the statistic department in the university where the survey was conducted, has a few number of students. Regarding the age of the students, most of the students (74%) are between 20-24 years old. 16% are between 25-29 years old, where almost 10% was over 30 years old. Regarding gender, the sample was equally distributed with 50% male and 50% female students. Furthermore, regarding the semester they are studying, only 2% were new students (1st semester), 9% from 2nd semester, 16,5% from 3rd semester, 20% from 4th semester, 32 from 5th semester, 10% from 6th semester and a 10% were in order semester than 6th.

4.4 Data Analysis

In order to identify to what degree, do students accept digital exams as a viable option (RQ1), we used descriptive measurements. The descriptive measurements we used were Mean value and Standard Deviation. Moreover, to investigate the degree of acceptance of digital exams and if it is affected by the students' demographic characteristics i.e., age, academic year, subject or gender (RQ2), we used the Chi-Square Test of Association. The Chi-Square Test of Association determines whether there is an association between categorical variables (i.e., whether the variables are independent or related) and it is a nonparametric test. To examine the strength of associations we use Cramer's V test. Cramer's V is a measure of the strength of association of a nominal-by-nominal relationship. Cramer's V ranges in value from 0 to +1 with a value of 0 indicating no association to a value of 1 indicating complete association. Cohen (1988) suggested the following guidelines for interpreting Cramer's V: describes the association as weak for values from 0.1 to 0.3, moderate for values from 0.3 to 0.5 and strong for values over 0.5.

Finding an association, however, did not provide us with further details about this association (e.g., which cases are 'responsible' for this association). Therefore, following up our statistically significant results, we performed post hoc testing using adjusted standardized residuals (Agresti 2013), (Siegel and Castellan, 1988). By analysing these values, we had a cell-by-cell comparison of the expected versus observed frequencies which helped us understand which cases were deviated from the independence. We consider an adjusted residual significant if the absolute value is above 1.96, as suggested by Agresti, (2013). The analysis was conducted in the statistical package SPSS.

4.5 Validity Threats

The population under study, i.e., students at the Business school, is large and highly heterogeneous. Consequently, we assume that the size of the population could be regarded as infinite. Under these circumstances, the importance of determining the appropriate sample size for our study is dwarfed by the importance of selecting a representative sample. Our survey was not designed to make strong quantitative conclusions about all the students belonging to the Business school, but rather to identify larger trends.

Next we discuss four aspects of validity according to (Runeson and Höst, 2009):

Construct validity reflects the extent to which the operational measures represent study subject. All our data were quantitative responses of the students, thus representing objective measures. No subjective measures were used, such as data through interviews.

Internal validity refers to the examination of causal relations. In our study, we focused on descriptive statistics and on the preliminary results from the differences between the demographic characteristics of the students. Our results are preliminary and further study of potential impact factors is needed to build the resulting prediction model.

Regarding *external validity*, the study is empirical and by no means can the findings be generalized to an isolated department or university.

Regarding *reliability*, this aspect is concerned with to what extent the data and the analysis are dependent on the specific researchers. Again, the data gathered are quantitative and independent from the influence of different research subjects or researchers' interpretation.

5. Results

5.1 Descriptive Results

Regarding RQ1, we wanted to identify to what degree do students accept digital exams as a viable option. To answer this RQ we used a descriptive measurement and calculated the mean value of the responses. The mean value of all the 15 questions is quite high i.e., 4.3 which indicates that the students showed a very high level of acceptance of digital exams. From Table 3 we can claim that the questions related to System Characteristics and Individual factors tend to attract very higher values from the students (mean value: 4.32/5), in addition, the questions related to TAM Specific constructs seem to attract again high values (mean value: 4.32/5).

Taking into consideration the different question items we can claim that Q11 (*"I trust digital exam tools to give me information that is true"*) and Q14 (*"I feel I have enough knowledge to use digital exam tools"*) have the highest mean values (4.62 and 4.61 accordingly). This indicates that computer self-efficacy and information quality are highly rated, which according to the comprehensive TAM model, are both strong predictors for perceived ease of use.

Q13 (*"Digital exams were accessible according to my own capabilities"*) attracted also a very high score (4.53). This indicates that the perceived accessibility of the system is highly valued, which works as a predictor for both perceived usefulness as well as perceived ease of use, with a slight leaning toward perceived usefulness. Q6 (*"The digital exam tool provides me with the information I need"*) and Q3 (*"I use digital exam tools without issues"*) were again rated high, with the respective mean values of 4.43 and 4.40. This confirms previous findings that perceived accessibility and information quality are important constructs for the acceptance of e-exams.

Q1 (*"I find it to be easy to reach the digital exams"*) was rated again very high (4.35), which furthermore expounds on the importance of perceived accessibility. Q7, Q8 and Q9 were rated quite high. These questions refer to the quality of a specific part of the implementation and to the quality of the system, which predicts perceived ease of use. Q2 (*"I like using digital exam tools"*) received the lowest mean (3.93). However, even though this question has the lowest score it is still regarded as a high score, indicating that the students, in general, accept digital exams as a viable solution.

Table 3: Descriptive results for RQ1

TAM Specific constructs		System characteristics		Individual factors	
Question	Mean	Question	Mean	Question	Mean
Q1	4.35	Q6	4.40	Q12	4.03
Q2	3.93	Q7	4.24	Q13	4.53
Q3	4.43	Q8	4.28	Q14	4.61
Q4	4.39	Q9	4.22	Q15	4.12
Q5	4.24	Q10	4.17		
		Q11	4.62		

Mean: 4.23

Mean: 4.32

Mean: 4.32

5.2 Validity of Association

Regarding RQ2, we were interesting into investigating the degree of acceptance of digital exams affected by the students' demographic characteristics i.e., age, academic year, subject or gender. Thus, after the descriptive statistics, a chi-square test of independence was conducted between the mean score of each question and the 4 demographic characteristics of the students, i.e., age, gender, study subject and academic semester. The null and the alternative hypothesis of our study were:

Ho: There is no association between Q1-Q15 and demographic characteristics, and

H1: There is an association between Q1-Q15 and demographic characteristics.

The Chi-Square test of association provides further evidence against the null hypothesis (i.e., the p-value for this test describes the strength of evidence against the null hypothesis of independence). We used this result to determine whether there is an association between our variables. We have found a number of statistically significant associations and we tested also the strength of the association with Cramer's V. However, to test which categories deviate from independence, we follow up our statistically significant results with Post hoc testing using Adjusted Standardized Residuals. The results are available in Table 4 where we report the p-value of the test for each question along with the Cramer's V results. The questions with significant differences (p-value < 0.05) are written in bold.

Q	Age	Gender	Subject	Semester
	Sig (Cramer's V)	Sig (Cramer's V)	Sig (Cramer's V)	Sig (Cramer's V)
Q1	0.441 (0.198)	0.387 (0.203)	0.544 (0.187)	0.006 (0.331)
Q2	0.056 (0.250)	<0.001 (0.435)	0.145 (0.235)	0.238 (0.263)
Q3	<0.001 (0.408)	0.007 (0.298)	0.002 (0.317)	<0.001 (0.404)
Q4	0.005 (0.302)	0.100 (0.218)	0.072 (0.226)	0.009 (0.338)
Q5	0.387 (0.203)	<0.001 (0.427)	0.015 (0.285)	0.064 (0.293)
Q6	0.091 (0.247)	0.730 (0.141)	0.063 (0.229)	<0.001 (0.392)
Q7	0.029 (0.288)	0.404 (0.173)	0.686 (0.138)	0.115 (0.296)
Q8	0.062 (0.269)	0.507 (0.160)	0.472 (0.165)	0.045 (0.322)
Q9	<0.001 (0.408)	0.006 (0.274)	0.039 (0.239)	0.038 (0.311)
Q10	0.105 (0.244)	0.263 (0.190)	0.045 (0.236)	0.040 (0.310)
Q11	0.002 (0.320)	0.001 (0.299)	0.550 (0.159)	<0.001 (0.388)
Q12	0.425 (0.200)	0.292 (0.214)	0.486 (0.193)	0.174 (0.271)
Q13	0.004 (0.332)	0.104 (0.226)	0.085 (0.232)	0.002 (0.386)
Q14	0.004 (0.306)	0.270 (0.189)	<0.001 (0.318)	<0.001 (0.490)
Q15	0.236 (0.218)	0.043 (0.264)	0.315 (0.211)	0.006 (0.330)

Age seems to play a significant role related to constructs of perceived accessibility and information quality (Q13, Q14 and Q7, Q9). In order to identify which age categories of the students deviate from independence, we follow up our statistically significant results with post hoc testing and the results revealed that the students aged 20-24 were more in favour of digital exams, displaying a significantly higher perceived ease of use of the technology than students aged 30 and higher.

Regarding gender, a statistically significant association was found for many of the questions that are related with TAM specific constraints and more specifically towards perceived usefulness and information quality. The questions concerning information quality show a significant difference between men and women, where male respondents tend to be more neutral while female respondents are more positive. However, both groups lean towards a positive sentiment.

Regarding subject, again the results showed that there is a statistically significant association with the questions that are related with TAM specific constraints and more specifically towards perceived usefulness and information quality. However, from the post hoc test, no important deviations were found between the students from different departments.

Finally, regarding semester, many of the questions related with System characteristics and individual factors were found to have statistical difference in relation to the semester the students were. The post hoc results indicate that students in their second to third academic year were more in favour of digital exams.

6. Discussion and Conclusions

According to our RQ1, our study aimed to investigate to what degree do the students accept digital exams as a viable solution. Thus, we aimed to determine the level of acceptance of digital exams among undergraduate students at a Swedish University. The results on the degree of acceptance of digital exams indicate that, from purely the students' own perspective, the degree of acceptance of digital exams was at a very high level, with a general mean of 4.304/5. This result might indicate that the majority of the students have accepted the implementation of digital exams, while only a small minority of students still prefer traditional paper-based examinations. Moreover, it is noted that some of their responses indicated positive attitudes towards the implementation of digital exams, particularly regarding Q2. The reason for this might be a perceived ease of use and a perceived usability as indicated by the results of the questionnaire, as well as other factors inherent to digital exams, such as quicker feedback, saving time and money, being environmentally friendly, being more accessible and clearer, and giving students the ability to take exam wherever they want.

Furthermore, regarding our RQ2, we were interested into investigating if the degree of acceptance of digital exams is affected by the students' demographic characteristics. The results showed that the demographic characteristics of the students seems to also affect their acceptance of the digital exams. Younger students seem to be keener to digital exams, rather than older students. On the other hand, students on the later exams seem to be more acceptive towards digital exams. In any case, those results by no means can be generalized and further research is necessary to understand the factors contributing to these variations and to determine if similar patterns of acceptance exist at other universities.

As mentioned before, one difficulty with implementing digital exams is the lack of experience and familiarisation among undergraduate students when it comes to how digital exams are conducted. This lack of familiarisation and experience makes it more difficult for students to perform digital exams on their own which potentially affects the grade of acceptance of digital exams among the students. The results showed that undergraduate students in their second to third academic year had the highest level of acceptance for digital exams. One potential reason behind this is the need for more experience and familiarisation with digital exams. According to Bashitialshaaer et al. (2021), studies have shown that a resistance or unwillingness to accept a more digital learning environment might stem from a familiarity with traditional education and learning systems. Thus, according to Liu et al. (2015), unfamiliarity with e-exams may indicate a resistance to change. A possible implication of this is that universities should aim to introduce digital exams early, to garner familiarity with digital exams faster in order to increase the likelihood of a higher acceptance.

The results of this study cannot be applied to create new insight into the difficulties with implementing digital exams, aside from the lack of experience and familiarisation regarding digital exams, as this study has not focused on cheating, environmental factors, technical difficulties, or anxiety levels connected to e-exams. These difficulties are essential to take into consideration when considering digital exams as a viable solution in situations that require it, such as a pandemic.

References

- Agresti, A. 2013. Categorical data analysis. John Wiley & Sons.
- Alsalmi, N. R., Eltahir, M. E., & Al-Qatawneh, S. S. (2019). The effect of blended learning on the achievement of ninth grade students in science and their attitudes towards its use. *Heliyon*, 5(9).
- Alyahya, D., & Almutairi, N. (2019). The Impact of Electronic Tests on Students' Performance Assessment. *International Education Studies*, 12(5), 109.
- Awad Ahmed, F. R., Ahmed, T. E., Saeed, R. A., Alhumyani, H., Abdel-Khalek, S., & Abu-Zinadah, H. (2021). Analysis and challenges of robust E-exams performance under COVID-19. *Results in Physics*, 23, 103987.
- Bashitialshaaer, R., Alhendawi, M., & Avery, H. (2021b). Obstacles to Applying Electronic Exams amidst the COVID-19 Pandemic: An Exploratory Study in the Palestinian Universities in Gaza. *Information*, 12(6), Article 6.
- Challis, D., Clarkson, P., Hughes, J., & Abendstern, M. (2004). A Systematic Evaluation of the Development and Impact of the Single Assessment Process in England Stage 1-Literature review: Key issues in implementation. Volume 1.
- Cohen, J. 1988. Statistical power analysis for the behavioral sciences 2nd edn.
- Dayananda, D. P. D., Vasanthapriyan, S., Chathumini, K. G. L., & Fernando, M. A. C. S. S. (2021). A Systematic Literature Review on Online Exams in COVID-19 Pandemic: Assessment Methods, Students' Preferences, Dishonest Behaviors and Challenges in Online Exams. 2021 From Innovation To Impact (FITI), 1, 1–6.
- Dreher, C., Reiners, T., & Dreher, H. (2011). Investigating Factors Affecting the Uptake of Automated Assessment Technology. *Journal of Information Technology Education*, 10, 161–181.
- Eltahir, Mohd. E., Alsalmi, N. R., & Al-Qatawneh, S. S. (2022). Implementation of E-exams during the COVID-19 pandemic: A quantitative study in higher education. *PLoS ONE*, 17(5).

- Hodgson, P., & Pang, M. (2012). Effective formative e-assessment of student learning: A study on a statistics course. *Assessment & Evaluation in Higher Education*, 37, 215–225.
- James, R. (2016). Tertiary student attitudes to invigilated, online summative examinations. *International Journal of Educational Technology in Higher Education*, 13.
- Lavidas, K., Apostolou, Z., & Papadakis, S. (2022). a) Challenges and opportunities of mathematics in digital times: Preschool teachers' views. *Education Sciences*, 12(7), 459.
- Lavidas, K., Papadakis, S., Manesis, D., Grigoriadou, A. S., & Gialamas, V. (2022). b) The Effects of Social Desirability on Students' Self-Reports in Two Social Contexts: Lectures vs. Lectures and Lab Classes. *Information*, 13(10), 491.
- Liebherr, Martin, R. J., Boumann M., Schweig R., Kracht S., F. E., & Schramm, D. (2022, August). Digital, Online, Take-Home–University Students' Attitude towards Different Examination Formats. In *2022 IEEE German Education Conference (GeCon)*(pp. 1-5). IEEE.
- Liu, I.-F., Chen, R.-S., & Lu, H.-C. (2015). An Exploration into Improving Examinees' Acceptance of Participation in an Online Exam. *Educational Technology & Society*, 18(2), 153–165.
- Papadakis, A., Barianos, A., Kalogiannakis, M., Papadakis, S., & Vidakis, N. (2022). ARION: A Digital eLearning Educational Tool Library for Synchronization Composition & Orchestration of Learning Session Data. *Applied Sciences*, 12(17), 8722.
- Runeson, P. & Höst, M. 2009. Guidelines for conducting and reporting case study research in software engineering. *Empirical software engineering*, 14, 131.
- S Castellan Siegel and Jr Castellan. [n. d.]. NJ (1988). Nonparametric statistics for the behavioural sciences. New York, McGraw-Hill ([n. d.]).
- Salloum, S. A., Qasim Mohammad Alhamad, A., Al-Emran, M., Abdel Monem, A., & Shaalan, K. (2019). Exploring Students' Acceptance of E-Learning Through the Development of a Comprehensive Technology Acceptance Model. *IEEE Access*, 7, 128445–128462.
- Taherdoost, H. (2016), Sampling Methods in Research Methodology; How to Choose a Sampling Technique for Research. *International Journal of Academic Research in Management (IJARM)*, 5, 2, 18-27, ISSN: 2296-1747
- Uchenna, S. A. O. (2012). The use of e-assessments in the Nigerian higher education system. *The Turkish Online Journal of Distance Education*, 13, 140–152.

Are the Effects of COVID-19 on Inequality in Tertiary Education in Ghana Gendered?

Paul Kwame Nkegbe¹, Stanley Kojo Dary² and Halidu Musah²

¹ University for Development Studies (UDS), Tamale, Ghana

² Simon Diedong Dombo University of Business and Integrated Development Studies, Wa, Ghana

Abstract: Educational institutions around the world were hit hard by the COVID-19 pandemic as there were nationwide closures of educational institutions around the world to contain the spread of the virus, resulting in the migration of teaching and learning to online platforms. This study examines the effects of the COVID-19 pandemic on inequality in tertiary education in Ghana, focusing on the gendered effects. Primary data were collected from 371 students from six selected public universities in Ghana mainly online using KoboCollect. Binary logistic regression was employed in the data analysis. The results show that the COVID-19 induced universities' closure and migration of teaching and learning to online platforms accentuated inequalities in learning opportunities by university students in Ghana, just that its effects are not gendered. Location significantly explained the observed inequalities experienced during the period of the universities' closure and online teaching and learning. It is recommended that universities should embrace online systems as part of their teaching and learning practices.

Keywords: COVID-19, Inequality, Tertiary Education, Ghana

1. Introduction

The coronavirus disease 2019 (COVID-19) outbreak has been the greatest global pandemic since the beginning of the 21st century. The COVID-19 pandemic contracted the demand for goods and services both spontaneously and forcibly by official orders and lockdowns (Kikuchi, Kitao & Mikoshiba, 2020). The education, economic, social, health, and other sectors have all been thwarted by the novel virus. The education systems of both developing and developed countries could not withstand the uncertainties of this virus. All schools, no matter the level, around the world faced closures to limit the spread of the virus. As of May 14, 2020, UNESCO statistics showed that there were 160 country-wide closures of educational institutions around the world. In Ghana, all educational institutions were closed on March 16, 2020. School closure is a non-pharmaceutical measure during pandemics (Doyle, 2020). The closure of the educational institutions disrupted learning, examinations schedules, academic calendars, and other planned educational events.

Essentially, the closure of schools shifted education from the classroom to the home and parents were required to play a great role, at least at the lower education level (Doyle, 2020). At the tertiary level, the universities resorted to online teaching and learning platforms to minimise the disruption to academic work and calendars. Both lecturers and students were expected to use these online platforms for teaching and learning, examinations, and assessments. However, the shift in education platforms was challenging for both lecturers and students, especially in universities/ colleges that introduced online platforms for the first time due to COVID-19 and school closures. These online platforms were untested and both students and lecturers had challenges with access and use. Also, to use the online platforms, students needed devices such as computers, laptops/smartphones, reliable internet connection, large amount of internet data, and physical space at home. Gyampoh et al. (2020) found in Ghana that, tutors were challenged with their inability to confidently use the digital teaching and learning platforms. The online platforms posed serious challenges to the universities and have disproportionately affected students. Hence, it was not surprising that, in all Ghanaian public universities, the Student Representative Councils (SRCs) called for the abrogation of the online platforms for teaching, examinations, and assessments due to unequal access to the platforms as well as the malfunctioning of some of the platforms. Even in advanced nations, concerns were raised about the fairness of online teaching and assessment since students require technology and suitable space for work (Montacute, 2020). Also, some students will be engaged in family responsibilities during the crisis, thus reducing the time available for online studies and assessments (Montacute, 2020).

The shift to online platforms in universities, the associated challenges, and the general hold-up of academic work caused by the COVID-19 pandemic can accentuate inequality in education. There is some level of existing inequality in tertiary education, more especially in the developing world. According to Doyle (2020), widening inequalities and skills in education are a potential outcome of school closures due to COVID-19. Thus, the interruptions in academic work and schedules can worsen inequality in the short- and long-term (Burgess & Sievertsen, 2020). The critical empirical research question is, did COVID-19 promote inequality in tertiary education and are the effects gendered? This study was designed to answer this question by examining the

effect of the COVID-19 pandemic on inequality in tertiary education in Ghana. Related studies have largely concentrated on basic education and, to some extent, secondary education. Ghana provides a good scenario for understanding the effects of the COVID-19 pandemic on tertiary education and tertiary education inequality due to the serious challenges it posed to the universities, lecturers, and students. The study can inform policy and practice post the COVID-19 crisis for governments and universities as well as the work and policies of international education and development organisations on reducing education inequality and enhancing inclusive education. Understanding the distributional impact of COVID-19 on education can enable targeted education and investment.

2. Literature Review

Existing inequalities can drive the spread and effects of COVID-19 and COVID-19 can also aggravate existing inequalities. The **UNDP (2020) states that the economic consequences of the COVID-19 pandemic will be far-reaching and will deepen existing inequalities, including gender inequalities. Some studies have examined the effects of COVID-19 on economic and social outcomes and have concluded a worsening effect of COVID-19 on inequality [e.g., widening food insecurity** (Van Lancker & Parolin, 2020; Kikuchi, Kitao & Mikoshiba, 2020), inequality in employment and earning for low-educated, low-skilled, and low-income groups (Doyle, 2020; Kikuchi, Kitao & Mikoshiba, 2020; Adams-Prassl et al., 2020), and inequality in employment and earnings for women (Alon et al., 2020; Kikuchi, Kitao & Mikoshiba, 2020; Adams-Prassl et al., 2020)]. Gender inequality may increase during and post COVID-19 as sectors with high female employment share are hit harder and working mothers may be more burdened with childcare with the closure of schools (Alon et al., 2020; Bick & Blandin, 2020). Adams-Prassl et al.'s (2020) study in the United Kingdom, United States, and Germany has shown that the impacts of the COVID-19 crisis are large and unequal within and across countries.

On the education front, though the literature on the effects of the COVID-19 pandemic on education inequality is limited, the few existing theoretical and empirical studies have concluded that education inequality will increase (e.g., Doyle, 2020; Van Lancker & Parolin, 2020; Burgess & Sievertsen, 2020; Bick & Blandin, 2020). The COVID-19 related school closures and migration of learning to homes and online platforms will likely widen the learning gap between students from high and low socioeconomic backgrounds and hence worsen educational outcome inequality (Van Lancker & Parolin, 2020). Students from low socioeconomic backgrounds are more likely to be adversely affected by the COVID-19 pandemic (Doyle, 2020) and several reasons may account for this: lack of a conducive environment at home that supports learning (Van Lancker & Parolin, 2020; Bol, 2020; Montacute, 2020); lack of access to resources such as computers and internet connectivity for remote learning (Van Lancker & Parolin, 2020; Bol, 2020; Montacute, 2020); inability of poorer households to invest in education due to the COVID-19 induced economic recession (Van Lancker & Parolin, 2020; Bol, 2020); and the inability of uneducated or lowly-educated parents to supervise and support their children's studies at home (Lee & Bowen, 2006; Bol, 2020).

Bania and Banerjee (2020) noted that the socioeconomic aspects of unequal access to the new online learning have their bearing from age, race, education, and most importantly gender. In Brazil, Marinoni and van't Land (2020) identified unequal access to information and communication technology in the Amazon area with a greater percentage of students with limited or no access to online teaching and learning. In Nepal, Tulza (2020) indicated that all attempts at online teaching and learning were crushed due to the inaccessibility on the part of poor students residing in remote parts of the country. Bania and Banerjee's (2020) study in India revealed that only 8.5% of females in rural areas are internet literate, pointing out that the digital divide with its embedded gender divide is widening the inequality gap in India. In Ghana, Demuyakor (2021) revealed that some students were challenged with unstable electricity, unreliable internet service, expensive learning technologies, and high cost of internet access. The geographical location of students renders such students more susceptible to the challenges identified (Demuyakor, 2021). Furthermore, an assessment of COVID-19's effects on Ghanaian households and living standards proved that females and rural communities are disadvantaged (Bukari et al., 2021). Conversely, a few studies have recorded no negative impact of the COVID-19 pandemic on education. For instance, a comparative study in South Africa, Wales, and Hungary by Cranfield et al. (2021) highlighted that most students had better experiences with their online teaching and learning sessions.

3. Conceptual Framework

The conceptual framework developed for the study is presented in Figure 1. In the framework, there are several channels through which the COVID-19 pandemic causes education inequality. COVID-19 has led to public policy

changes including social distancing and lockdowns, which have also led to (i) university closures, and (ii) contributing to economic repression. The university closures have denied students the space, on-campus internet access, and use of computer labs for learning. The migration of teaching and learning to online platforms requires resources such as computers, internet, time, and learning space at home. That is, additional investment is required on learning resources and space as well as time. However, the economic repression leading to job losses and reduced incomes directly affects the ability to invest in additional resources for learning at home. Public policy changes are also affecting access to learning resources. In general, students from higher socio-economic backgrounds will have access to the resources, time, and space for learning at home. The COVID-19 will worsen education inequality among university students.

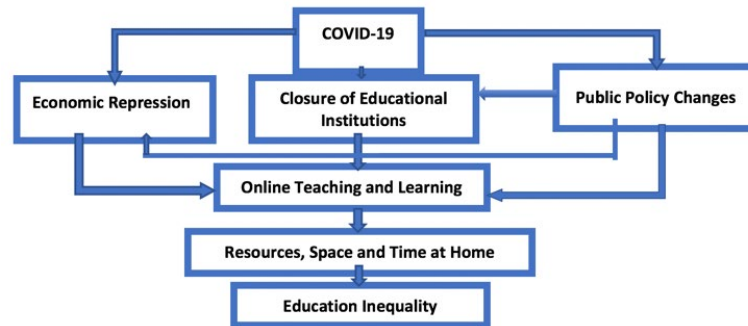


Figure 1: Conceptual framework

Source: Authors' Construct (2022)

4. Materials and Methods

4.1 Data

The study adopted a mixed research approach, employing both quantitative and qualitative methods. The study population comprised students from six selected public universities in Ghana, namely, the University of Ghana (UG), Kwame Nkrumah University of Science and Technology (KNUST), University for Development Studies (UDS), University of Cape Coast (UCC), University of Environment and Natural Resources (UENR), and the University of Education, Winneba (UEW). Data collection was mainly online due to the social and physical distancing policy in Ghana, with limited personal interviews conducted by enumerators on the university campuses due to the low responses to the online survey. The data collection thus spanned May to September 2022. The questionnaire was designed and transferred to KoboCollect and made available online. The link to the survey was also sent via students' university emails and WhatsApp platforms. Due to the online survey methodology, sampling was not practicable. As a result, the complete response cases from students stood at 372 after data cleaning. Also, data were collected from 10 university teachers via Key Informant Interviews.

4.2 Variables

Education inequality was measured in terms of access to education during the COVID-19 school closures. Access to education was measured in terms of: (i) physical space for learning at home, (ii) internet access for learning at home, (iii) data access, (iv) ease of use of online platforms while at home, and (v) access to computers for learning at home. The independent variables relate to the socio-economic characteristics of students and university characteristics. The socio-economic characteristics of students include age, gender, level of education, household size, employment status, parents' level of education, urban/rural home location, region of residence, type of home (home quality), and programme of study. Data were collected on teaching and learning innovations and platforms, and challenges to access and use for both students and lecturers. The specific variables used in our models are defined in Table 1.

Table 1: Variables and measurement

Variable	Definition	Measurement
<i>Dependent variables</i>		
Study_space	Access to a convenient place to study at home during the COVID-19-induced universities' closure	1 if access to a convenient place to study and 0 otherwise
InternetAccess	Student's access to internet at home	1 if yes and 0 otherwise

Variable	Definition	Measurement
DataAccess	Ease of student's acquisition of internet data for online learning	1 if easily accessible/acquired and 0 otherwise
EasyOnlineP	Easy access to online platform	1 if yes and 0 otherwise
COMP_LAPTOP	Access to a computer or laptop	1 if student has access to a computer or laptop and 0 otherwise
<i>Explanatory variables</i>		
Gender	Gender of the student	1 if female and 0 if male
LnHHSIZE	Natural log of household size	Number
LnAge	Natural log of age of the student	Completed years
Marital_status	Marital status of student	1 if married and 0 otherwise
FatherEdu	Father's education status	1 if formal education and 0 otherwise
MotherEdu	Mother's education status	1 if formal education and 0 otherwise
Workingstudent	If a student is working (private or public)	1 if a student worker and 0 otherwise
ComputerLiterate	Self-reported indicator for computer literacy	1 if student is computer literate and 0 otherwise
PMScience	Major field of study of student	1 if the field of study is physical, biological, engineering, and medical sciences and 0 otherwise
UrbanLoc	Locality lived by student during the COVID-19-induced schools' closure	1 if urban or peri-urban location and 0 otherwise
Universities	University attended by student	Dummies created for six universities with UCC and UEW, from the same region, as the base
Regions	Regions stayed during the COVID-19-induced schools' closure	Dummies created for the 16 regions of Ghana, with NE region serving as the base

4.3 Data Analysis

The analytical methods ranged from descriptive statistics such as frequencies, means, t-tests, and Chi-square tests, to regression analysis. For determinants of education inequality, the study employed a generalised model of the form:

$$(1) \quad Y_i = \beta'X_i + \varepsilon$$

where Y is education inequality, measured in terms of access to physical space, internet, data, online platforms, and computers/laptops for learning at home. Each of these dimensions is modelled and estimated using a binary logit model (Hill, Griffiths & Lim, 2018; Greene, 2018). Also, X is a vector of independent variables affecting education inequality, including gender, β is a vector of parameters corresponding to X to be estimated, and ε is the error term.

5. Results and Discussion

5.1 Online Learning Platforms, Effectiveness and Challenges

Various online teaching and learning platforms were used by lecturers and students during the COVID-19-induced schools' closures (Marinoni, van't Land & Jensen, 2020; Toquero, 2020). The Zoom platform was the most used platform during the period, with about 45% of the respondents indicating its use (Table 2). The availability of free Zoom versions and the ease of use of the platform may have accounted for its high use during the period. However, the free versions have shorter time limits for lectures/meetings. Often, the system closes when the time limit is reached with more than two participants. Some universities have acquired Zoom platforms with unlimited time for the delivery of lectures. WhatsApp and Microsoft Teams were also important platforms used during the period. The WhatsApp platform is convenient for sharing documents, video, and audio recordings, as well as giving information and receiving information in real-time via a smart phone. The 'others' category includes the use of YouTube, Google Classroom, Sakai, and Google Meet.

Table 2: Online Learning Platforms Employed

Platform	Frequency	Percent Frequency
Moodle	51	10.08
Zoom	228	45.06
Microsoft Teams	62	12.25
WhatsApp	70	13.83
Others	95	18.77
Total	506	100.00

The results on students' assessment of online learning effectiveness are presented in Table 3 by gender and location. In terms of differences in responses, the Chi-square test results show that there is no significant difference between male and female students in their assessment of online teaching and learning effectiveness. However, there is a significant difference between students who stayed in rural and urban locations during the schools' closure in their assessment of online teaching and learning effectiveness. This finding is synchronous with that of Bukari et al. (2021) and Demuyakor (2021), who observed that even though COVID-19 affected virtually everyone, its damaging effects on those living in rural areas will be far greater than those in urban areas. Of course, such inequalities are driven by the absence of or ineffective online platforms in rural areas, among others.

Table 3: Assessment of Online Learning Effectiveness by Gender and Location

Category	Gender		Location	
	Male (n=224)	Female (n=146)	Rural (n=85)	Urban (n=285)
Effectiveness				
Ineffective	44	31	24	51
Fairly effective	66	39	28	77
Effective	75	55	26	104
Very effective	34	18	7	45
Excellent	5	3	0	8
Pearson χ^2		1.3112		9.9571**

Note: ** represents $p < 0.05$.

From Table 4, the most common problem experienced by students with the online learning system was unreliable internet access, whether viewed based on gender or location. This reflects the experience in Afghanistan as told by Noori (2021), but it is symptomatic of developing countries' circumstances during the pandemic. Indeed, Henaku (2020) and Owusu-Fordjour, Koomson and Hanson (2020) reported similar results for Ghana. The other challenges students faced in order of importance were family distractions, inaccessibility to lecturers, internet data problems, inaccessibility to laptops/smartphones, psychological stress, and power outages. The challenges faced by both male and female students are similar as shown in Table 4. This is especially so because a test of the difference between the challenges faced by males and females returned no significant result even at the 0.10 level, as revealed by the reported Chi-square statistic. In terms of locality, those living in rural and urban areas face significantly different challenges as shown in the table.

Table 4: Descriptive Statistics of the Challenges of Students

Challenges	Gender			Location		
	Male	Female	Test of diff. (χ^2)	Rural	Urban	Test of diff. (χ^2)
Family distractions	45(20.09)	43(29.25)		23(27.06)	65(22.73)	
Intermittent internet access	71(31.70)	38(25.85)		31(36.47)	78(27.27)	
Access to lecturers	36(16.07)	28(19.05)	8.97	13(15.29)	51(17.83)	24.29***
Psychological	17(7.59)	8(5.44)		6(7.06)	19(6.64)	
Data purchase	15(6.70)	7(4.76)		2(2.35)	20(6.99)	
Laptop/phone	5(2.23)	6(4.08)		7(0.24)	4(1.40)	
Power outage	3(1.34)	3(2.04)		-	6(2.10)	
No challenge	28(12.50)	13(8.84)		3(3.53)	38(13.29)	
Don't Know	4(1.79)	1(0.68)		-	5(1.75)	
Total	224(100)	147(100)		85(100)	286(100)	

Note: *** represents $p < 0.01$; figures in parentheses are percentages.

Lecturers also faced challenges in delivering their lectures during the migration of teaching and learning to online platforms. The lecturers, as key informants, enumerated challenges they faced as unstable internet connectivity

leading to frequent breakdowns during lectures, expensive internet data, and generally unfriendly nature of the online platforms. Indeed, a lecturer key informant had this to say:

Unfortunately, everyone was caught unawares so no well-planned training took place before lectures were migrated onto the online platforms. Even though some of us were lucky to have received a bit of training before the commencement of the online lectures, some lecturers have indicated they did not undergo any training. Fact is that even those who went through some form of training needed some more time to imbibe the process and procedure well (Lecturer/Key Informant, June 2022).

The sentiments expressed in the above quote reflect those highlighted by Adom (2020) and Gyampo et al. (2020), who noted that among other problems associated with online teaching and learning in Ghana, lecturers were not properly trained and so lacked critical technical knowledge for smooth virtual teaching and learning. Given the challenges the lecturers indicated they faced, they were asked if they appreciated the fact students might also face similar or even more challenging situations. All lecturer key informants indicated they were aware students would face challenges and so they had adopted very flexible regimes to be able to assist the students. They mentioned some of the assistance they offered to students as accepting late submissions of answers to assignments and/or examinations, rescheduling lectures where it is not possible to have a given lecture, arranging to deliver hard copies of materials to students located in hard-to-reach areas, and discussing with students to settle on what works best for them.

5.2 Effects of COVID-19 Pandemic on Inequality in Tertiary Education

The majority of the sampled students (ranging from 61.54 to 84.71%) have indicated from their experience that the COVID-19-induced universities' closure and online learning created inequality in access to teaching and learning among students in their classes. In their opinion, such inequalities come in access to study space, online platforms, internet access, data bundle, and access to equipment such as computer/laptop and phone/tablet as reported in Table 5. Except in phone/tablet access, they indicated inequality in accessing all other items meant to facilitate their learning as shown in Table 5. This finding reflects that revealed by Bick and Blandin (2020), Burgess and Sievertsen (2020), Doyle (2020), and Van Lancker and Parolin (2020) to the effect that education inequality will increase with COVID-19. However, while the responses of male and female students did not show any statistically significant differences, locality does on all fronts except in computer/laptop and phone/tablet (Table 5). For example, while 84.7 percent of students located in rural areas during the COVID-19-induced online learning perceived inequality in learning opportunities, those in urban/peri-urban areas with this perception is 61.5 percent. This implies that even though all sampled students perceive inequality because of the migration of learning online, those located in rural areas might suffer this more than those in urban areas. Lecturer key informants held a similar view. They revealed that the COVID-19-induced school closures and the subsequent migration to online learning had brought about serious inequality in learning opportunities. They maintained that such inequalities emanated from unstable internet access, especially for those located in rural areas, and the inability of students to buy data, especially those with 'humble' socio-economic backgrounds. The opinions of the lecturer key informants thus corroborated those of the students.

Table 5: Descriptive Statistics of Inequalities Faced by Students

Inequality	Gender		Test of diff. (χ^2)	Location		
	Male (n=224)	Female (n=147)		Rural (n=85)	Urban (n=286)	Test of diff. (χ^2)
<i>Perception of inequality</i>						
No	80(35.71)	43(29.25)	1.67	13(15.29)	110(38.46)	1.86***
Yes	144(64.29)	104(70.75)		72(84.71)	176(61.54)	
<i>Study space</i>						
Otherwise (No)	126(56.25)	85(57.82)	0.09	57(67.06)	155(54.20)	4.66**
Convenient (Yes)	98(43.75)	62(42.18)		28(32.94)	131(45.80)	
<i>Ease of use of online platforms</i>						
Not easy at all	32(14.29)	21(14.38)	2.02	24(28.24)	29(10.18)	30.60***

Inequality	Gender		Test of diff. (χ^2)	Location		Test of diff. (χ^2)
	Male (n=224)	Female (n=147)		Rural (n=85)	Urban (n=286)	
Fairly easy	66(29.46)	49(33.56)		35(41.18)	80(28.07)	
Easy	78(34.82)	53(36.30)		15(17.65)	116(40.70)	
Very easy	48(21.43)	23(15.75)		11(12.94)	60(21.05)	
<i>Internet problem</i>						
Otherwise	83(37.05)	60(40.82)		9(10.59)	134(46.85)	
Internet problem	141(62.95)	87(59.18)	0.53	76(89.41)	152(53.15)	36.38***
<i>Internet data</i>						
Otherwise	83(37.05)	50(34.01)		16(18.82)	117(40.91)	
Internet data	141(62.95)	97(65.99)	0.36	69(81.18)	169(59.09)	13.90***
<i>Computer/laptop</i>						
No	105(46.88)	75(51.02)		38(44.71)	142(49.65)	
Yes	119(53.12)	72(48.98)	0.61	47(55.29)	144(50.35)	0.64
<i>Phone/tablet</i>						
No	2(0.89)	2(1.36)		-	4(1.40)	
Yes	222(99.11)	145(98.64)	0.18	85(100.00)	282(98.60)	1.20

Note: ** and *** represent $p < 0.05$ and $p < 0.01$, respectively; figures in parentheses are percentages.

Things were taken further to examine what factors might be contributing to the inequalities students faced in their studies during the COVID-induced schools' closure. We measured inequalities in education during the closure using five items, viz. access to study space, access to internet, access to internet data, ease of access to online platforms, and access to a computer or laptop at home. These are cast in a positive light, as defined in Table 1, so that factors that negatively affect each of these will be considered as contributing to inequality in access to education during the period of schools' closure. For each of these, individual binary logit models were estimated, and the results are shown in Table 6. Two basic models were estimated for each where the control variables include regional fixed effects in the first model and then the same model re-estimated without controlling for regional fixed effects. It should be noted that we controlled for university-specific fixed effects in all the models.

From the results, age has mixed effects on inequality. While increasing age increases access to study space at home thereby reducing inequality to study space, it reduces access to data for online purposes implying that it increases inequality in access to data. It is very likely that while older students might have relatively well-established and spacious homes, their spending might be directed to other things rather than financing data for lectures. Household size is consistent in reducing access in all the models in which it appears. Increasing household membership reduces study space at home and reduces data access. It is also negative in the computer/laptop access model even though it is not significant in this model. The implication of this result on household size is that the variable increases inequality in terms of study space and internet data. Mother's education reduces inequality in educational opportunity at least during the period of schools' closure. For example, relative to not having formal education, a mother's formal education status increases the probability of having study space at home by 21.7 to 24.1 percent depending on whether regional fixed effects have been controlled for or not. The results so far are in consonance with those of Aristovnik et al. (2020), and Bania and Banerjee (2020) who observed that household socioeconomics (including age, race, and household size among others) drive inequality in learning opportunities during the COVID-induced schools' closure.

Being in urban or peri-urban areas during the time of school closures drives increased access to study space, internet access, data access, and ease of use of online platforms. This implies that those in rural areas have reduced access than their urban and peri-urban counterparts. Location thus plays an important role in inequality to learning opportunities in periods of pandemics. This result resonates with that of Bania and Banerjee (2020) who observed that students located in rural India were especially impacted negatively in their studies during the COVID-induced migration of teaching and learning to online platforms. Demuyakor (2021) made a similar observation for Ghana. Indeed, infrastructural development, especially technological infrastructure, in rural Ghana leaves much to be desired thereby leaving those located in such areas without access to the technology

that will allow them to follow the online lectures. Other studies that found similar results are Marinoni and van't Land (2020) in Brazil and Tulza (2020) in Nepal. A student on a job or in work and computer literacy both reduce inequality through increasing access to educational opportunities during the COVID-induced schools' closure. Specifically, being in work increases the probability of access to study space by between 12.0 and 14.4 percent depending on whether regional fixed effects have been controlled for. Computer literacy increases the probability of use of online platforms by over 23.0 percent, and this increases to about 28.0 percent when regional fixed effects are controlled for.

To answer the question regarding gender dimensions in the effects of COVID-19 on educational inequality, we used Chi-square tests, and the results in Table 5 show no differences in the perception of males and females in inequality in learning opportunities during the period of migration of teaching and learning to online platforms in Ghana. This result is confirmed across all the models in Table 6 where the gender variable does not determine access to any of the facilitating conditions of learning opportunities in the period of the schools' closure. Even though this finding runs counter to our expectation and contradicts that of Aristovnik et al. (2020) and Bukari et al. (2021) who observed gender-accentuated differences in the effects of COVID-19 among their respective samples, our sample simply does not show any gender differences in the outcomes.

Table 6: Binary Logit Models of Determinants of Inequality in Access to Education

Variable	Study space		Internet access		Data access		Use of online platforms		Computer/Laptop access	
	Model 1 Marginal effect	Model 2 Marginal effect	Model 1 Marginal effect	Model 2 Marginal effect	Model 1 Marginal effect	Model 2 Marginal effect	Model 1 Marginal effect	Model 2 Marginal effect	Model 1 Marginal effect	Model 2 Marginal effect
Constant										
Gender	0.0205 (0.0497)	0.0319 (0.0495)	0.0574 (0.0515)	0.0461 (0.0482)	-0.0169 (0.0476)	-0.0243 (0.0467)	-0.0351 (0.0524)	-0.0311 (0.0520)	0.0209 (0.0471)	0.0214 (0.0475)
LnAge	0.4186** (.2041)	0.4733** (0.2177)	0.1175 (0.2182)	0.1313 (0.2100)	-0.2993* (0.1808)	-0.3310* (0.1921)	0.1297 (0.2203)	0.1210 (0.2238)	0.1021 (0.2142)	0.1157 (0.2091)
Marital_status	-0.1157 (0.0903)	-0.0957 (0.0926)	-0.1332 (0.1001)	-0.1797* (0.0971)	0.1179 (0.0936)	0.0787 (0.0951)	-0.0012 (0.1009)	-0.0414 (0.1020)	-0.2704*** (0.0911)	-0.2462*** (0.0930)
LnHHSIZE	-0.1442*** (0.0516)	-0.1344*** (0.0505)			-0.1960*** (0.0455)	-0.2161*** (0.0487)			-0.0382 (0.0463)	-0.0342 (0.0457)
FatherEdu	0.0338 (0.0737)	0.0440 (0.0775)	0.0820 (0.0752)	0.1050 (0.0713)	0.0894 (0.0686)	0.1195* (0.0704)			-0.0327 (.0770)	-0.0611 (0.0735)
MotherEdu	0.2409*** (0.0692)	0.2170*** (0.0703)	-0.0496 (0.0637)	-0.0714 (0.0613)	-0.0575 (0.0562)	-0.0399 (0.0581)			-0.0460 (0.0724)	-0.0474 (0.0686)
UrbanLoc	0.0531 (0.0565)	0.0987* (0.0533)	0.4283*** (0.0773)	0.4213*** (0.0645)	0.1661*** (0.0643)	0.2172*** (0.0632)	0.2414*** (0.0654)	0.2683*** (0.0565)	-0.0232 (0.0574)	-0.0250 (0.0569)
Workingstudent	0.1439*** (0.0544)	0.1197** (0.0555)	0.0152 (0.0614)	0.0085 (0.0577)	0.0150 (0.0506)	0.0102 (0.0532)	0.0321 (0.0584)	0.0371 (0.0595)	0.0883 (0.0543)	0.0777 (0.0553)
ComputerLiterate							0.2784*** (0.0886)	0.2356*** (0.0914)		
UDS	-0.3375*** (0.1151)	-0.3007*** (0.1038)	0.0737 (0.1295)	0.0481 (0.1146)	0.1270 (0.1319)	0.0261 (0.1288)	0.1052 (0.1262)	0.1185 (0.1134)	-0.1152 (0.1114)	-0.0829 (0.1020)
UG_Legon	-0.1304 (0.1292)	-0.0981 (0.1195)	-0.2160 (0.1427)	-0.2471* (0.1329)	0.0767 (0.1316)	0.1087 (0.1335)	-0.0256 (0.1337)	0.0996 (0.1255)	0.0207 (0.1191)	0.0340 (0.1127)
KNUST	-0.3005*** (0.1097)	-0.3085*** (0.1056)	0.2163* (.1212)	0.2074* (0.1113)	0.3062*** (0.1222)	0.2897 (0.1235)	0.2703*** (0.1168)	0.2663*** (0.1145)	-0.4955*** (0.1051)	-0.4927*** (0.0951)
UENR	0.0840 (0.1565)	0.0680 (0.1479)	0.0872 (0.1612)	0.0733 (0.1540)	0.2131 (0.1566)	0.1930 (0.1562)	0.2067 (0.1565)	0.2337 (0.1458)	-0.0246 (0.1303)	-0.0088 (0.1237)
Regional fixed effects	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Model diagnostics										
Wald χ^2	283.3***	72.4***	68.0***	54.7***	90.9***	53.1***	51.2***	38.5***	87.9***	77.9***
Pseudo R ²	0.246	0.203	0.223	0.177	0.243	0.167	0.141	0.094	0.233	0.209

6. Conclusion and Policy Implications

This study was undertaken to examine the effects of the COVID-19 pandemic on inequality in tertiary education in Ghana, focusing on the gendered effects. The study concludes that the COVID-19 pandemic and its induced closure of universities and migration of teaching and learning online have adversely affected lecturers and tertiary students. It worsened inequality in tertiary education, just that its effects are not gendered. In all the estimated binary models for the various dimensions of inequality in access to education, gender was not a significant explanatory variable. Therefore, the effects of COVID-19 on tertiary education inequality during the universities' closure are not gendered. Location rather significantly explained the observed inequalities experienced during the period of the universities' closure and online teaching and learning. The study also concludes that Ghanaian universities, students, and lecturers were not adequately prepared in terms of infrastructure, equipment, training, and other logistics for effective online teaching and learning, and hence several challenges were encountered with the online teaching and learning approach. That notwithstanding, lecturers and students were exposed to online teaching and learning platforms. Both lecturers and students acquired knowledge and developed valuable skills which are essential for future online teaching and learning endeavours. The study further concludes that the COVID-induced universities' closure accentuated inequalities

in learning opportunities for university students in Ghana. The study recommends that universities should embrace online systems as part of their teaching and learning policy. This will require the universities to invest in IT infrastructure, equipment, and online platforms, maintain workable online systems, and enhance the training of students, lecturers, and staff on the use of online learning platforms. It will help the universities to be well prepared in the event of future pandemics that can lead to universities' closure. Investment in infrastructure that will improve internet coverage and strong internet connectivity in rural areas is required. This will enable students who are back home in rural areas to access information and participate in online teaching and learning. The non-gendered effects of the COVID-19 pandemic on tertiary education inequality suggest that efforts aimed at improving learning and hence students' performance should target both males and females.

Acknowledgement

The authors wish to sincerely thank the Agence Universitaire de la Francophonie/Francophone University Agency (AUF) Africa Region Team based in Senegal and their funding partners for their financial and technical support in a project that has led to the production of this paper.

References

- Adams-Prassl, A., Boneva, T., Golin, M., & Rauh, C. (2020). Inequality in the Impact of the Coronavirus Shock: Evidence from Real Time Surveys. *IZA Discussion Papers*, No. 13183, Institute of Labor Economics (IZA), Bonn. Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3594297
- Adom, D. (2020). Cultural and educational implications of the COVID-19 global pandemic in Ghana. *International and Multidisciplinary Journal of Social Sciences*, 9(3): 202-229.
- Alon, T. M., Doepke, M., Olmstead-Rumsey, J., & Tertilt, M. (2020). *The impact of COVID-19 on gender equality*. NIBER working paper, No. w26947. Available at: <https://www.nber.org/papers/w26947>
- Aristovnik, A., Keržič, D., Ravšelj, D., Tomaževič, N., & Umek, L. (2020). Impacts of the COVID-19 pandemic on life of higher education students: A global perspective. *Sustainability*, 12(20): 8438. <https://doi.org/10.3390/su12208438>
- Bania, J., & Banerjee, I. (2020). Impact of Covid-19 pandemic on higher education: A critical review. Global University Network for Innovation Publication, 1-12. <https://www.guninetwork.org/report/impact-covid-19-pandemic-higher-education-critical-review>
- Bick, A., & A. Blandin (2020). Real time labor market estimates during the 2020 coronavirus outbreak. Vox. Available at: <https://voxeu.org/article/real-time-labour-market-estimates-during-2020-coronavirus-outbreak>.
- Bol, T. (2020). *Inequality in homeschooling during the Corona crisis in the Netherlands. First results from the LISS Panel*. Available at <https://osf.io/preprints/socarxiv/hf32q/>
- Bukari, C., Essilfie, G., Aning-Agyei, M. A., Otoo, I. C., Kyeremeh, C., Owusu, A. A., Amuquandoh, K. F. & Bukari, K. I., (2021). Impact of COVID-19 on poverty and living standards in Ghana: A micro-perspective. *Cogent Economics & Finance*, 9(1): 1879716.
- Burgess, S., & Sievertsen, H. H. (2020). *Schools, skills, and learning: The impact of COVID-19 on education*. Vox. Available at: <https://voxeu.org/article/impact-covid-19-education>.
- Cranfield, D. J., Tick, A., Venter, I. M., Blignaut, R. J., & Renaud, K. (2021). Higher education students' perceptions of online learning during COVID-19—A comparative study. *Education Sciences*, 11(8), 403.
- Demuyakor, J. (2021). COVID-19 Pandemic and Higher Education: Leveraging on Digital Technologies and Mobile Applications for Online Learning in Ghana. *Shanlax International Journal of Education*, 9(3): 26-38.
- Doyle, O. COVID-19: Exacerbating Educational Inequalities? Available at: <http://publicpolicy.ie/papers/covid-19-exacerbating-educational-inequalities/>
- Greene, W. H. (2018). *Econometric Analysis* (8th ed.). Pearson Education Inc., New York.
- Gyampoh, A. O., Ayitey, H. K., Fosu-Ayarkwah, C., Ntow, S. A., Akossah, J., Gavor, M., & Vlachopoulos, D. (2020). Tutor perception on personal and institutional preparedness for online teaching-learning during the COVID-19 crisis: The case of Ghanaian Colleges of Education. *African Educational Research Journal*, 8(3): 511-518.
- Henaku, E. A. (2020). COVID-19: Online learning experience of college students: The Case of Ghana. *International Journal of Multidisciplinary Sciences and Advanced Technology*, 1(2): 54-62.
- Hill, R. C., Griffiths, W. E., and Lim, G. C. (2018). *Principles of Econometrics* (5th edition). New Jersey: John Wiley & Sons, Inc.
- Kikuchi, S., Kitao, S., & Mikoshiba, M. (2020). *Heterogeneous Vulnerability to the COVID-19 Crisis and Implications for Inequality in Japan*. Available at: <http://www.crepe.e.u-tokyo.ac.jp/results/2020/CREPEDP71.pdf>.
- Lee, J. S., & Bowen, N. K. (2006). Parent involvement, cultural capital, and the achievement gap among elementary school children. *American Educational Research Journal*, 43(2), 193-218.
- Marinoni, G., van't Land, H., & Jensen, T. (2020). The impact of Covid-19 on higher education around the world. IAU Global Survey Report, 23.
- Marinoni, G. & van't Land (2020). The Impact of COVID-19 on Global Higher Education. *International Higher Education*, 102 (Special issue).

- Montacute, R. (2020). Social Mobility and Covid-19: implications of the Covid-19 crisis for educational inequality. The Sutton Trust. Available at: <https://dera.ioe.ac.uk/35323/2/COVID-19-and-Social-Mobility-1.pdf>
- Noori, A. Q. (2021). The impact of COVID-19 pandemic on students' learning in higher education in Afghanistan. *Heliyon* 7(10): e08113. <https://doi.org/10.1016/j.heliyon.2021.e08113>
- Rashid, S. & Yadav, S. S. (2020). Impact of Covid-19 Pandemic on Higher Education and Research. *Indian Journal of Human Development*, 14(2): 340-343.
- Toquero, C. M. (2020). Challenges and opportunities for higher education amid the COVID-19 pandemic: The Philippine context. *Pedagogical Research*, 5(4): em0063.
- Tulza, K. C. (2020). Impact of COVID-19 on university education, Nepal. *Tribhuvan University Journal*, 35(2): 34-46.
- UNDP (2020). The economic impacts of covid-19 and gender inequality recommendations for Policymakers. <https://www.undp.org/content/dam/rblac/docs/UNDP-RBLAC-PNUD%20GENEROCOVID19ENGFINAL.pdf>
- Van Lancker, W., & Parolin, Z. (2020). COVID-19, school closures, and child poverty: a social crisis in the making. *The Lancet Public Health*, 5(5), e243-e244.

e-Learning Interactions and Academic Outcomes: an Analysis of Undergraduates in Sri Lanka

Tiloka de Silva, Vishaka Nanayakkara, Buddhika Karunaratne, Malik Ranasinghe, Eshana Ranasinghe

University of Moratuwa, Sri Lanka

tilokad@uom.lk

vishaka@cse.mrt.ac.lk

buddhika@cse.mrt.ac.lk

malik@uom.lk

enranasinghe1@gmail.com

Abstract: The shift to online teaching and learning following the onset of the COVID-19 pandemic resulted in a large increase in the usage of online learning platforms. Student interactions with these platforms provide an important source of information on student progress on a course during periods of distance learning. However, in resource constrained settings where students face difficulties in accessing stable and quality internet, it is unclear to what extent interactions with the learning platform influence academic outcomes, especially for programmes that were not originally intended to be delivered online. This study makes use of data on four cohorts of undergraduate students at the University of Moratuwa, where each cohort was exposed to different periods of online teaching and learning. The data covers interactions with Moodle course pages and assessment marks for multiple courses with diverse subject contents offered in two faculties. Interactions with the learning platform are measured using clicks on different types of objects on the course page as well as the distribution of clicks over the course of semester. To account for the confounding effect of prior ability on the relationship between learning platform interactions and academic outcomes, we also use results from courses that the students have taken a priori. We find that while the switch to online teaching and learning led to a dramatic increase in the level of student interactions with the learning platform, the level of interaction has remained above the pre-COVID levels even after resuming on-site, face-to-face delivery. While differences among the subjects and cohorts exist, results from a multiple regression model suggest that the association with certain types of learning platform interactions and academic outcomes are significant even after controlling for prior ability and differences in course design. Specifically, the volume and consistency of access both improve outcomes with the timing of clicks more strongly associated with the final examination mark whereas the type of content clicked on is more associated with continuous assessment marks. The findings have important implications for the continued adoption of blended learning methods and course design for the programmes under study.

Keywords: e-Learning Interactions, Student Behaviour, Learning Analytics, Online Learning

1. Introduction

The shift to online teaching and learning following the onset of the COVID-19 pandemic resulted in a large increase in the usage of online learning platforms within the higher education sector. Education providers who had previously made little or no use of learning management systems (LMS) were forced to switch to online delivery within relatively short periods. The transitions ranged from merely changing the delivery of a lecture from on-site to a video-conferencing tool to redesigning courses to encourage more interactive learning in an online environment (Brancaccio-Taras et al, 2021; Pagoto et al, 2021; Lee et al, 2021; Means and Neisler, 2020; Rapanta et al, 2020).

The Sri Lankan state higher education sector was no exception. While all educational institutions closed on 12 March 2020, it is estimated that by June 2020, almost all universities had switched to online education (Hayashi et al, 2020). This is despite substantial challenges faced in terms of lack of adequate infrastructure (including devices and internet connectivity) among students and limited prior exposure to online education among both staff and students (World bank, 2020). Key measures taken to facilitate the transition included the provision of free access to university web servers by internet service providers and free access to a video-conferencing solution via university web servers.

Despite the rapid transition to online teaching and learning, it has been more challenging to ensure the continuous engagement and achievement of learning outcomes for courses that were not originally designed for online delivery among students who were not prepared for this mode of learning. Student interactions with learning management platforms provide an important source of information on student progress on a course during periods of distance learning. However, in resource constrained settings where students and courses were not prepared for online delivery, it is unclear as to how well these student interactions can predict learning outcomes. For instance, all learning activities cannot be monitored through the LMS even for activities

implemented through the system (for example, if students share resources shared on the LMS with each other using other means such as social media or email).

Indeed, while there is a body of work on education and learning analytics, much of this work focuses on courses that were designed for online learning (for example, Ruipérez-Valiente, Munoz-Merino and Kloos (2018), Grandzol and Grandzol (2010)). The experience of the Sri Lankan state universities (and possibly many others internationally) following the onset of the pandemic was different, essentially following a form of blended learning with face-to-face synchronous interactions with the lecturer (via video conferencing) as the key instructional element supplemented (in some cases) with additional learning resources and activities on the LMS. Three years on, we are now well-placed to take stock of the unprecedented transition brought on by the pandemic and assess the teaching and learning experience taking place during this period.

As such, this paper studies the relationship between student interactions with the LMS and academic outcomes based on the experiences of one of the state universities in Sri Lanka. This study makes use of data on four cohorts of undergraduate students at the University of Moratuwa, where each cohort was exposed to different periods of online teaching and learning. The data covers interactions with the Moodle course pages and assessment marks for four first- and second-year courses with diverse subject contents offered in two different faculties. By using data on cohorts taking the subjects online as well as on-site, we can see both how interactions with the LMS changed following the switch to online education as well as identify if there are differences in the way that these interactions influenced academic outcomes in the two periods.

The rest of the paper is organized as follows: Section 2 discusses some of the related literature. Section 3 describes the data and methods used. Section 4 presents the results and the final section discusses the implications of the results and concludes.

2. Related Work

The adoption of learning management systems like Moodle and Blackboard to facilitate learning has generated a vast amount of data resulting in the emergence of the field of learning analytics (Ferguson and Shum, 2012). While there is also a growing body of work based on the experience of the switch to online teaching and learning as a consequence of the Covid-19 pandemic, much of this work, which examines the use of online teaching and learning as an emergency tool, is based on survey data or qualitative research methods to analyse student and faculty perspectives on this transition (see Lee et al (2021) for a review of this literature). However, given the quantitative nature of this study, in this section we review the learning analytics literature most relevant to this paper.

LMS usage statistics provide a wealth of insights about student learning behaviours including logs containing detailed information on when a student accessed the LMS and which components they interacted with. Commonly constructed variables for measuring LMS usage include total time spent on the LMS, frequency of access, total visits to the LMS, etc. Several studies have found that even such simple measures can help predict student performance (Ulfa and Fatawi, 2021; Damianov et al, 2009; Vengross and Bourbeau, 2006,). Other researchers have also considered the consistency with which a student may access the LMS and find that hit consistency is a strong (if not stronger) predictor of student success (Bitkimirov and Klassen, 2008; Baugher, Varanelli and Weisbord, 2003). Crampton, Ragusa and Cavanagh (2012) take the analysis a step further to also find that the diversity of resources accessed by students also has a positive impact on grades.

However, LMS logs allow for more nuanced insights than just total clicks or time spent on the system. It is also possible to identify the types of tools that encourage the most interactivity among the students, which could be very informative in the process of improving course design. For instance, reading and posting of messages on course forums have been found to be significant in predicting student outcomes by Coldwell et al. (2008), MacFayden and Dawson (2010) and Zacharis (2015). More recent work by Ruipérez-Valiente et al (2018) uses the learning analytics support provided by the Khan Academy to consider an array of more sophisticated student behaviour-related variables into a multiple regression model to predict learning gains. These variables include the percentage of videos completed, the time spent on solving exercises or watching videos, the number of optional activities accessed etc. While several of these variables are found to be important, the authors highlight that the pre-test score is a key predictor of learning gains.

A related strand of research examines the importance of different types of interactions in influencing student outcomes, including learner-learner, learner-instructor and learner-content interactions. Li et al (2022) use a quasi-experimental design to assign students to two groups with varying types of interactions in an online

environment and find that learner-learner and learner-content interactions were the most significant predictors of student performance and student satisfaction. Other studies make use of ex-post evaluations to assess the role of different types of interactions by classifying user interactions recorded in the LMS logs (Agudo-Peregrina et al., 2014; Grandzol and Grandzol, 2010). However, the ability to measure inter-personal interactions between students or students and teachers using only the LMS logs is limited, especially in contexts where students and teachers may communicate in other ways such as email, mobile phones or social media (or even face to face if courses are offered in a blended learning mode).

While the scope for the type of information that can be extracted from LMS logs is huge, many studies are constrained in terms of the sample of students studied, limiting the number of variables that can be included in their statistical models. Moreover, the literature is predominantly based on courses that were designed for online or blended learning, an important distinction in the context of this paper where the switch to online learning was an emergency response to the Covid-19 closures of the universities. As such, this paper builds on the available literature to evaluate the effectiveness of LMS-user interactions for understanding student outcomes in this current context, making use of a variety of different courses and multiple cohorts of students.

3. Data and Methods

3.1 Selected Cohorts and Subjects

The study considers four 1st and 2nd year courses followed by four consecutive undergraduate cohorts (intake 2017 to 2020) from two different Faculties in the University. Specifically, the study uses two statistics related subjects offered to 2nd year business students and two subjects (one related to communication skills and the other related to computer operating systems) offered to 1st and 2nd year engineering students. The differences in the nature of the subjects and background of the students (and staff) in terms of readiness for online learning allow us to explore differences in student interactions with the learning platform in greater detail.

The combinations of selected cohorts and courses cover different levels of exposure to online teaching and learning - the earliest cohort considered followed the selected (and all preceding) subjects on-site whereas the later cohorts had followed most of their courses online. It should be noted that even in the earlier periods of on-site delivery, the selected course pages on the learning platform were already being made use of though at different levels, with Moodle being available in both desktop and mobile app versions. For instance, for the earliest cohort of Business students, the Moodle pages were used primarily to share resources such as lecture slides, tutorials and references. Most assessments, formative and summative, were administered physically with hard copy submissions. After the shift to online delivery, the Moodle pages were utilized for much more including submission of assignments, participation in quizzes and interactive learning content, and scheduling of online lectures and discussions. Table 1 summarizes the modes of delivery of the four subjects and cohorts considered for the analysis.

Table 1: Mode of delivery

Faculty	Semester	Cohort			
		2017	2018	2019	2020
Business	3	F2F	F2F	Online	Online
	4	F2F	Online*	Online	F2F
Engineering	2	F2F	F2F	Online	Online
	3	F2F	Online*	Online	Hybrid

Note: F2F refers to face-to-face, on-site delivery

*A few lectures held on-site but mainly (including all assessments) online

The total sample consists of four subjects and 1,010 students (429 business students and 581 engineering students), most of whom are followed for two subjects each.

3.2 Learner interactions with the Moodle pages

For each of the courses offered to each cohort, we use course logs taken from the Moodle course pages to measure student interactions with the learning platform. An alternative source of information is the activity completion log of a course page. However, given that for some of the courses there were no Moodle activities carried out during periods of on-site delivery we do not use this source of information.

We draw from the literature to construct measures of total access frequency and consistency as well as measures of access for specific types of content. Specifically, alongside the count of total clicks, we construct separately the share of clicks made on static (e.g. lecture slides or references) and interactive (e.g. quizzes, assignments, etc.) content, where the remainder consists of clicks made to view the course page or announcements. To study the consistency of access over the course of the Semester, we use the standard deviation of clicks observed during each month of the Semester for each student - a lower standard deviation suggests that the student consistently accesses the course over the entire duration of the Semester. We also compute separately the share of clicks made during the first half and second half of the Semester, where the remainder consists of clicks taking place after the Semester has ended but before the final Examination.

The number of clicks made by students are clearly linked to the design of the Moodle course page; for instance, the number of activities to be completed via the Moodle page. Moreover, the design of the course page could be geared towards encouraging asynchronous learning which would also affect student learning outcomes. Accordingly, the number of activities conducted via the Moodle page is also included as a variable moderating the relationship between learner interactions and academic outcomes.

3.3 Academic outcomes

This study makes use of the continuous assessment (CA) and written examination (WE) marks obtained for the course as the measures of academic outcomes. The CA mark is the aggregate mark from all summative assessments carried out during the semester, while the WE is conducted at the end of the semester.

An additional confounding effect that may be important to this analysis is the ability of the student. Student ability will influence marks obtained on assessments but also influence learning behaviour and interactions with the learning platform. As such, we use results from related courses that students have taken a priori, in a semester preceding the course being studied, to control for this effect.

3.4 Methods

The relationship between learner interactions and academic outcomes are studied using the following model:

$$y_{isft} = \alpha + \beta X_{isft} + \gamma \text{PriorAbility}_i + \theta_{st} + \delta_{tf} + u_{isft} \quad (1)$$

where the dependent variables considered, y_{isft} , are the CA and WE marks obtained on subject s by student i belonging to cohort t in Faculty f . X_{isft} is the vector of learner interaction variables for each student. To control for differences between subjects, cohorts and faculties, we include θ_{st} , which refers to fixed effects related to a subject offered to a given cohort (including the number of Moodle activities conducted on the Moodle page) and δ_{tf} , which accounts for fixed effects related to a cohort in a given Faculty. u_{isft} refers to an idiosyncratic error term.

4. Results

4.1 Descriptive analysis

Figure 1 shows the distribution of total clicks by mode of delivery across the four subjects using a box plot.

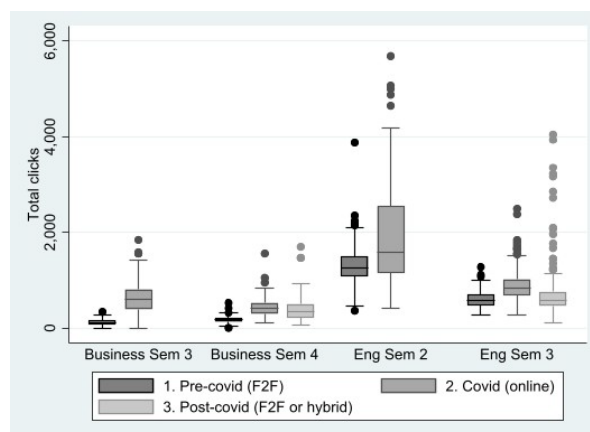


Figure 1: Total clicks by mode of delivery and subject

Note: The Figure shows the box plots of total clicks across the faculties and mode of delivery. The three horizontal lines that form a box in each plot refer to the 25th, 50th, and 75th percentile values; the two horizontal lines appearing at the end of the vertical lines are the adjacent values (most extreme values within 1.5 times the interquartile range of the nearest quartile); the dots refer to any outside values that are higher (lower) than the upper (lower) adjacent value.

The Figure provides several insights. First, the number of clicks in the pre-Covid era is much lower for the courses offered to Business students (in terms of median and quartiles) given that the course pages were primarily used to supplement face-to-face delivery through sharing of additional resources. Among the courses offered to the engineering students, total clicks are much higher, especially for the 2nd semester communication skills subject that had a course page already designed for active online learning. Second, we see the expected increase in clicks during the period of online delivery, across all courses. Third, for the two subjects that we observe in the post-covid return to onsite or hybrid delivery, we see that total clicks remain above the pre-Covid level. This is particularly true for the Business faculty subject where the LMS course page was not heavily utilized pre-Covid. Given the clear differences between the courses from the two faculties, the regression models are computed for the total sample as well as for the two faculties separately.

Figures 2 and 3 present the correlation matrices for the variables considered in the analysis, looking separately at subjects taught on-site and online. The two graphs show some differences in magnitude of correlations for onsite and online delivery but the results are qualitatively very similar. Performance in the assessment (CA, WE or final mark) is positively correlated with clicks of all types and negatively correlated with the standard deviation of clicks. For instance, the correlation coefficient between final mark and total clicks is 0.29 for onsite delivery and 0.43 for online delivery, while the correlation between final mark and the standard deviation of monthly clicks is -0.24 and -0.31 for onsite and online delivery, respectively. The latter result shows that greater consistency is associated with better academic outcomes. We also see a strong positive correlation between the mark obtained in the pre-requisite course and that this mark is also positively associated with LMS interactions (e.g. correlation between marks in the considered course and pre-requisite is 0.7 for onsite delivery, while the correlation between pre-requisite mark and total clicks in the considered course is 0.09). The same is true for the number of activities included in the LMS course page, motivating the use of these two variables as confounders in the regression analysis. Given the similarities of the correlation matrices for online and onsite delivery, the regression analysis considers the full sample of subjects together after allowing for differences in the mean assessment marks before, during and after the period of online teaching and learning.

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Total clicks	(1)	1.00										
Click distribution	(2)	-0.27	1.00									
Clicks at start of semester	(3)	0.76	0.08	1.00								
Clicks in middle of semester	(4)	0.94	-0.35	0.54	1.00							
Clicks on static content	(5)	0.40	0.03	0.33	0.43	1.00						
Clicks on interactive content	(6)	0.70	-0.09	0.83	0.50	0.14	1.00					
Number of activities	(7)	0.61	-0.06	0.82	0.41	0.12	0.90	1.00				
Prior ability	(8)	0.09	-0.21	-0.04	0.09	0.02	0.04	-0.01	1.00			
WE mark	(9)	0.17	-0.07	0.20	0.09	0.05	0.23	0.18	0.65	1.00		
CA mark	(10)	0.20	-0.28	0.02	0.22	0.06	0.08	0.01	0.64	0.56	1.00	
Final mark	(11)	0.29	-0.24	0.17	0.26	0.07	0.28	0.20	0.70	0.84	0.83	1.00

Figure 2: Correlation matrix – onsite delivery

Figure 3: Correlation matrix - online delivery**4.2 Regression Results**

The regression analysis examines how the different measures of LMS interaction are associated with student outcomes after controlling for differences in subjects, cohorts and prior ability. Table 2 shows the results of the regression estimated on the entire sample students, as well as for the business and engineering students separately. Robust standard errors are reported in brackets.

As Table 2 shows, there are both similarities and differences in how the selected explanatory variables are associated with academic outcomes among the two sets of students and two types of assessment considered. The first two columns report the results from estimating the model on the full sample of students. The results suggest that total clicks significantly improve both CA and WE marks, as do prior ability and the share of clicks on static content. The timing and consistency of clicks as well as the share of clicks on interactive content are relatively more important for improving CA marks. However, these results mask considerable differences between the students and subjects in the two faculties. Accordingly, the rest of the section will discuss these disaggregated results in more detail.

Table 2: Relationship between LMS interactions and academic outcomes

	WE mark (Full sample)	CA mark (Full sample)	WE mark		CA mark	
			Business	Eng	Business	Eng
	(1)	(2)	(3)	(4)	(5)	(6)
Total clicks	0.002**	0.001*	0.006**	0.003***	-0.012**	0.004***
	[0.001]	[0.001]	[0.003]	[0.001]	[0.005]	[0.001]
Distribution of clicks	-12.351	-38.247***	-38.007***	-16.296	-34.624*	-74.977***
	[9.122]	[11.840]	[14.318]	[15.074]	[17.785]	[16.372]
Share of clicks in 1st half of Sem	-18.500***	-37.796***	-34.311***	7.569	-66.294***	10.514
	[3.693]	[4.207]	[5.668]	[5.753]	[6.874]	[6.409]
Share of clicks in latter half of Sem	0.344	14.660**	-9.264	11.666**	8.782	10.409
	[4.426]	[5.764]	[6.305]	[5.257]	[8.981]	[6.376]
Share of clicks on static content	14.608**	31.280***	16.999	4.68	45.718***	2.997
	[6.826]	[7.864]	[10.394]	[6.482]	[13.246]	[6.422]
Share of clicks on activities	-8.621*	14.411***	1.753	9.676*	16.610*	17.520***
	[4.416]	[5.288]	[6.958]	[5.463]	[9.551]	[4.751]
	-0.166**	1.297***	-0.268**	-0.159	2.269***	0.567***

	WE mark (Full sample)	CA mark (Full sample)	WE mark		CA mark	
			Business	Eng	Business	Eng
	(1)	(2)	(3)	(4)	(5)	(6)
Number activities of	[0.080]	[0.086]	[0.121]	[0.109]	[0.160]	[0.108]
Prior ability	0.626***	0.437***	0.863***	0.372***	0.594***	0.333***
	[0.031]	[0.031]	[0.038]	[0.034]	[0.050]	[0.036]
N	1792	1790	764	1028	764	1026
R-square	0.507	0.549	0.536	0.374	0.645	0.375

*Note: All regressions control for subject fixed effects and faculty-cohort fixed effects. Robust standard errors in brackets. Significance levels: * 10%, ** 5%, *** 1%*

Among the considered explanatory variables, prior ability has the most consistent impact on academic outcomes, with a larger, positive impact among Business students. For instance, an increase in the mark of the pre-requisite subject by 1, results in an increase of WE marks by 0.8, holding constant the effect of LMS interactions. Among engineering students, the increase is 0.4. Indeed, prior ability is a key confounder in the analysis, increasing the regression r-square by around 20 percentage points and changing the estimated coefficients on LMS interactions significantly (additional results available on request).

The estimated coefficients on the LMS interactions show more variation across the two groups of students and type of assessment considered. Total clicks are significantly and positively associated with both CA and WE marks among the engineering students, and for WE marks among the business students. For example, an additional 100 clicks on the LMS course page is associated with an increase of 0.6 marks in the WE and 1.2 marks in the CA for business students. However, total clicks are negatively associated with CA marks for the business students. The distribution of clicks across the semester (our measure of consistency) is also statistically significant across faculties, with marks decreasing for students with a higher standard deviation in clicks over the semester. In other words, students who access the LMS more consistently record better academic outcomes on average.

In terms of timing of the clicks, having a higher share of clicks at the start of the semester (compared to closer to the written examination) significantly reduces both WE and CA marks among business students, after controlling for consistency of access and other confounders. The timing matters less for the engineering students where the continuous assessments are spread over the entirety of the semester – consequently, the effect of consistency of clicks is also largest for CA marks among these students. On the other hand, the clicks by type of content accessed have a stronger effect on engineering students. More clicks on activities and interactive content significantly increases both CA and WE marks for these students whereas for the business students, it is only the CA mark which is improved. The latter result may point to differences in the type of learning outcomes measured by the CA and WE for these subjects.

The estimated regression models vary in terms of predictive power, depending on the group of students considered - the model can explain more than 50 percent of the variation in WE marks among business students and close to two-thirds of their CA marks. The explanatory power of the model is much lower for the engineering students, just over one third of variation in both CA and WE marks are explained by the model.

5. Conclusion

This paper makes use of data on four undergraduate cohorts from two faculties in the University of Moratuwa, Sri Lanka, to study the relationship between student interactions with the LMS and learning outcomes. The data spans the pre-Covid period of on-site teaching and learning, the Covid period of exclusively online delivery and the post-Covid period where subjects were delivered on-site or through a hybrid model. By considering subjects that were not originally designed for (purely) online delivery and students who may not have been prepared for the same, we are able to add to the literature on the use of online teaching and learning for emergency purposes as well as online learning in general.

The analysis finds that, while the Covid-19 related closures resulted in increased levels of interaction with the LMS, the levels of interaction remain higher than in the pre-Covid period, reflecting an increased level of comfort with online tools for teaching and learning among both staff and students. We also find, consistent with the

literature, that there are strong associations between student interactions with the LMS and their learning outcomes. In particular, both the volume and consistency of clicks significantly predict marks in both continuous assessments and end-semester examinations. Depending on the group of students considered (business or engineering), the timing of the clicks and type of click by content accessed also influences grades, with the timing of clicks relatively more important for predicting final examination marks and the type of content clicked on having more explanatory power for predicting continuous assessment marks. While we find that both the prior ability of the student and design of the course page are important confounding factors, they cannot explain away the relationship between LMS interactions and student outcomes. It should be noted that the results presented here are affected by the novice online learner nature of the students, at least in the case of the Business students. As such, there is likely to be additional noise around the LMS interactions observed for these students. While this is accounted for to some extent through the inclusion of the cohort-specific fixed effects, it could still affect the precision of these results. However, it is reassuring that even with this element of noise, we still observe significant associations between the learner interactions and their outcomes.

In all, these results have important implications for current and future usage of online or hybrid learning as the evidence presented suggests that students with low or inconsistent access to the LMS can be flagged for early intervention. Of course, the key to encouraging greater LMS usage among students is better course page design, including more interactive content for students to engage with. Further study of the evolution of course page design over this transition period and investigation of the types of activities that generate the most meaningful student engagement is left for future research.

References

- Agudo-Peregrina, Á.F., Iglesias-Pradas, S., Conde-González, M.Á. and Hernández-García, Á., (2014). "Can we predict success from log data in VLEs? Classification of interactions for learning analytics and their relation with performance in VLE-supported F2F and online learning", *Computers in human behavior*, 31, 542-550.
- Baughner, D., Varanelli, A., and Weisbord, E., (2003). "Student hits in an internet-supported course: How can instructors use them and what do they mean?", *Decision Sciences Journal of Innovative Education*, 1(2), 159-179.
- Biktimirov, E.N. and Klassen, K.J., (2008). "Relationship between use of online support materials and student performance in an introductory finance course". *Journal of education for business*, 83(3), 153-158.
- Brancaccio-Taras, L., Mawn, M.V., Premo, J., and Ramachandran, R., (2021). "The Editors' Perspectives on Adjusting STEM Education to the "New Normal" during the COVID-19 Pandemic", *Journal of Microbiology & Biology Education*, 22(1), 22.1.65. <https://doi.org/10.1128/jmbe.v22i1.2679>
- Coldwell, J., Craig, A., Paterson, T. and Mustard, J., (2008). "Online students: Relationships between participation, demographics and academic performance", *Electronic journal of e-learning*, 6(1), 19-28.
- Crampton, A., Ragusa, A.T. and Cavanagh, H., (2012). "Cross-discipline investigation of the relationship between academic performance and online resource access by distance education students", *Research in Learning Technology*, 20(1), doi: 10.3402/rlt.v20i0.14430.
- Damianov, D.S., Kupczynski, L., Calafiore, P., Damianova, E.P., Soydemir, G. and Gonzalez, E., (2009). "Time spent online and student performance in online business courses: A multinomial logit analysis", *Journal of Economics and Finance Education*, 8(2), 11-22.
- Ferguson, Rebecca and Shum, Simon Buckingham. (2012). "Social learning analytics: five approaches". In *Proceedings of the 2nd International Conference on Learning Analytics and Knowledge (LAK '12)*. <https://doi.org/10.1145/2330601.2330616>
- Grandzol, C.J. and Grandzol, J.R., (2010). "Interaction in online courses: More is not always better", *Online Journal of Distance Learning Administration*, 13(2), 1-18.
- Hayashi, R., Garcia, M., Maddawin, A., and Hewagamage, K.P., (2020). "Online learning in Sri Lanka's higher education institutions during the Covid-19 pandemic", *ADB Briefs No. 151*. Manila: ADB.
- Lee, Kyungmee, Fanguy, Mik, Bligh, Brett and Lu, Xuefei Sophie, (2022). "Adoption of online teaching during the COVID-19 Pandemic: a systematic analysis of changes in university teaching activity", *Educational Review*, 74:3, 460-483, DOI: 10.1080/00131911.2021.1978401
- Li, X, Lin, X, Zhang, F and Tian, Y., (2022) "What Matters in Online Education: Exploring the Impacts of Instructional Interactions on Learning Outcomes", *Front. Psychol.* 12:792464. doi: 10.3389/fpsyg.2021.792464
- Macfadyen, L.P. and Dawson, S., (2010). "Mining LMS data to develop an "early warning system" for educators: A proof of concept", *Computers & education*, 54(2), 588-599.
- Means, B. and Neisler, J., (2020). *Unmasking Inequality: STEM Course Experience During the COVID-19 Pandemic* [online], Digital Promise Global. Available from: <https://files.eric.ed.gov/fulltext/ED614284.pdf> [accessed 27 January, 2022]
- Pagoto, S., Lewis, K.A., Groshon, L., Palmer, L., Waring, M.E., Workman, D., et al., (2021). "STEM undergraduates' perspectives of instructor and university responses to the COVID-19 pandemic in Spring 2020", *PLoS ONE*, 16(8): e0256213. <https://doi.org/10.1371/journal.pone.0256213>

- Rapanta, C., Botturi, L., Goodyear, P., Guardia, L., and Koole, M., (2020). "Online University Teaching During and After the Covid-19 Crisis: refocusing teacher presence and learning activity", *Postdigital Science and Education*, 2: 923–945. <https://doi.org/10.1007/s42438-020-00155-y>
- Ruipérez-Valiente, J.A., Muñoz-Merino, P.J., Delgado Kloos, C., (2018). "Improving the prediction of learning outcomes in educational platforms including higher level interaction indicators", *Expert Systems*, 35:e12298. <https://doi.org/10.1111/exsy.12298>
- Ulfa, S. & Fatawi, I., (2021). "Predicting Factors that Influence Students' Learning Outcomes Using Learning Analytics in Online Learning Environment", *International Journal of Emerging Technologies in Learning*, 16(1), 4-17.
- Vengroff, R. and Bourbeau, J., (2006). "In-class vs. on-line and hybrid class participation and outcomes: Teaching the introduction to comparative politics class", In *Proceedings of the Annual Meeting of the APSA Teaching and Learning Conference 2006*.
- World Bank, (2020). COVID-19 Response – South Asia: Higher Education [online], World Bank. Available from: <https://documents1.worldbank.org/curated/en/150411590701072157/COVID-19-Impact-on-Tertiary-Education-in-South-Asia.pdf> [accessed 01 July, 2021]
- Zacharis, N.Z., (2015). "A multivariate approach to predicting student outcomes in web-enabled blended learning courses", *The Internet and Higher Education*, 27, 44-53.

Bridging Contemporary Theory With Online Practice: The Sustained Impact on Student Identities

Caro Galdames and Paula Charbonneau-Gowdy

Universidad Andrés Bello, Santiago, Chile

carogaldamesq@gmail.com

paula.charbonneau@unab.cl

Abstract: Higher Education (HE) Institutions that offer online programs seek to connect their training promises with the kind of learning and learners 21st century workplaces demand. Fulfilling these objectives implies promoting empowered, collaborative, and self-directed identities in learners during their formal learning and beyond. While learning theories and societal demands might support such identity development in individuals, ensuring these goals are met and importantly sustained has been problematic for institutions. Putting theory into practice becomes a greater challenge when the training process is completely mediated online. This inquiry is one of a four-part longitudinal study aimed at aligning the instructional design, pedagogical practices, and use of social learning-based technology tools in all programs with 21st century goals and contemporary theory of e-learning at a fully online technical HE institution in Chile. In the first three studies, we examined the impact of this alignment across all programs on the learner identities of students: 1) at the outset of their programs ($n=2,300$), 2) after 5 months ($n=14$), and 3) through the perspectives of faculty ($n=82$). Findings in all three studies suggested that many students in the institution, most from socially and academically disadvantaged backgrounds, transitioned to clearly evident 21st century learner behaviours. In the present investigation, our aim was to gather a deeper understanding of these changes and the implications of the design/practice/technology alignment *after one year*. We focussed on the same students ($n=14$) to uncover evidence, if any, of *sustained* changes as they graduated and moved back full time to their respective workplaces. A qualitative methodology was employed where data collection involved individual interviews, field notes, observations, and online digital activity. Findings reveal student identities with significantly increased confidence in their abilities and skills, placing important value on life-long learning as a means to transform their present and future lives and positively influencing their workspaces. This study provides strong empirical evidence of sustained changes that an instructional design based on social learning and mediated by technology generated in our students. At the same time, it contributes valuable and practical answers for overcoming the challenges that still beset many online programs in higher education.

Keywords: Instructional Design, Higher Education, Distance Education, Contemporary Learning Theories, 21st Century Learning Goals, Connecting Theory To Practice.

1. Introduction

HE Institutions must be able to respond to the new social, economic and technological challenges that society presents. In response to the various educational needs to meet these challenges, decades ago, in many countries distance learning programs in HE began to be installed (Chavez, 2017). Currently, due to the prolonged migration of academic programmes to online delivery as a result of the pandemic, a large body of literature (Zhang et al., 2022) has been generated. Based on the outpouring of scholarship, it remains a challenge to understand and demonstrate how it is possible to position the learner at the centre of the learning process, especially in technology-mediated spaces. Scholars working to ensure quality education in online programs have produced a growing body of studies documenting promising theories and frameworks for online education (García, 2019; Picciano, 2017), in which educational models and instructional designs position students as the protagonists of their learning. Understanding the influence of putting these contemporary theories into practice in virtual environments and reflecting the development of 21st century learning skills remains of academic interest and requires further empirical evidence (Charbonneau-Gowdy and Galdames, 2022). This research is part of a longitudinal study conducted during the years 2020-2023, which was carried out in a HE Technical Training Institution in Chile. A collaborative initiative was developed involving the macro/meso/micro levels of the institution aimed at aligning the frameworks of its online programmes with contemporary learning theories and 21st century goals. In the first three studies, we examined the impact of this cross-program alignment on students' learning identities: 1) at the beginning of their programs ($n=2,300$), 2) after 5 months ($n=14$), and 3) through the teachers' perspectives ($n=82$). Findings in all three studies suggested that many students at the institution, the majority from socially and academically disadvantaged backgrounds, transitioned to 21st century learning behaviors and more confident and empowered learner identities (Charbonneau-Gowdy and Galdames, 2022). Although these signs were encouraging, the findings from all three mini studies were not considered sufficient evidence to show that these transitions would be sustained over time and influence the trajectory of lifelong learning.

In the present study, we aimed to unravel a deeper understanding of these changes and the implications of design/practice/technology alignment after one year. We focused on the same students ($n=14$) following up after one year, to uncover evidence, if any, of sustained changes in these individuals in the final stage of their formative process and, if so, indications of an influence of the changes on their future learning and work.

To achieve this objective, we used the following questions to frame the study:

- 1) What kinds of sustained changes, if any, occur in students' learning practices?
- 2) How do their learner identities evolve, if at all, until the end of their training process?
- 3) How does a social learning-based online instructional design relate to the changes in their learner identities at the end of their programmes and beyond?

2. Theory and literature underpinnings

The core of our study, as in the two previous studies (Charbonneau-Gowdy and Galdames, 2021; Charbonneau-Gowdy and Galdames, 2022) lay in contemporary learning theories, especially those reflecting 21st century socio-cultural perspectives and goals that: a) place students and their agency at the centre of the learning process; b) are based on the understanding that learning is a complex interactive social phenomenon; c) engage students in community by collaborating in the co-construction of knowledge based on their individual and social context and experiences; and d) have important implications for students' competencies and identities in a dynamic, technology-driven society. The three components of the initiative we had launched at the institution involved: 1) the pedagogical practices of instructors and online students, 2) the instructional designs at the core of these practices (ID), and 3) technological tools used to support the programmes. These components were intended to reflect the principles and theoretical objectives listed above and as a way of possibly influencing students' learner identities and practices throughout their formative process in the institution.

2.1 Current Online Learning Theories, Models and Designs

Scholars working to develop online learning models that reflect contemporary learning theories and 21st century goals to ensure quality in education are based on principles framed by Moore's (1989) Interaction Theory (IT), Garrison et. al's, (2000) Online Learning Theory (CoL), Siemens' (2004) Connectivism Theory of Online Learning (CTOL) and Harasim's, (2012) Online Collaborative Learning theory (OCL). Based on these e-learning theories, social interaction is a backbone for the creation of intentional participation in a learning community, emphasizing collective learning experiences and community over individualism, through collaborative or co-constructed learning processes. These theories have a common vision positioning students as the protagonists of their learning, as active participants involved in a mutual relationship with others supported by social media technology (Picciano, 2017). Instructional design (ID) is considered an effective vehicle for ensuring conformity in the application of theory, models and technology in practice. Our study used Picciano's (2017, p.178) Multimodal Model for Online Education as its theoretical backbone, which is strongly influenced by IT, CoL, CTOL and OCL theories. This model is composed of seven interconnected elements that promote the generation of learning experiences to deliver a quality online programme. These components are reflected in the pedagogy/design/technology aligned programmes that participants and all newcomers to the institution faced when returning to formal learning after many years, and completely in an online space (Charbonneau-Gowdy and Galdames, 2022). The learning pathway of the online programmes guided by these components generated the types of activities that facilitate students to appropriate new learning practices and to reconstruct their identities.

2.2 Perspectives on Identity and Investment in Online Learning

As we mentioned in the previous article (Charbonneau-Gowdy and Galdames, 2022), learning from a socio-cultural perspective is receiving increased attention in the e-learning literature. Within this perspective, the academic sphere plays a fundamental role in the construction and reconstruction of people's identities. Norton (Darvin and Norton, 2015) defines identity as "how a person understands his or her relationship to the world, how that relationship is constructed across time and space, and how the person understands possibilities for the future" (p. 4). Seen from this perspective, identity is conceived as a site of struggle, structured by the power relations existing in social contexts, including educational systems. As Bourdieu (1998, p.43) points out "A large part of social suffering is due to the poverty of people's relationship with the educational system, which not only determines social destinies, but also the image they have of themselves and also the image they have of their destiny".

Many scholars have shown that online education, based on human interactions and machine-mediated content, has placed students as passive recipients of information, pushing them to work individually, a situation that has become evident during the migration of this modality in the wake of COVID-2019. This scenario limits the possibility for individuals to become more understanding of themselves and their learning experiences, prevents them from reconstructing their identities, and marginalizes them from accumulating social, cultural and symbolic capital. Norton has coined the term 'investment' (Darvin and Norton, 2015) to explain an opposite scenario in which learners are offered opportunities to exercise agency in their learning through interaction and knowledge construction with others. In these social interactions, which increasingly occur in digital spaces, an individual's strengths, experience and knowledge are made available to others. In reaction to such favourable conditions for exercising agency, their desire to invest in learning is ignited with a view to gaining a broader range of symbolic and material resources. In other words, in these ideal conditions, learners will choose to engage and invest in learning for the value they see in doing so for increasing their capital and social power and for the visions they have of their futures (Darvin and Norton, 2015, p.46).

Engel and Coll's (2021) model of learner identity (LI) also served to frame our inquiry. This model explains the various components in learning contexts, including multimodal-based ones, that are involved in the act of identity mediation. The elements include: i) reasons for participating in learning activities and the learning goals pursued; ii) significant others participating in the learning experiences and their acts of recognition; iii) discursive resources present in the broader sociocultural context; iv) convergence or interference of other identities of a person; v) characteristics of the learning activities; and vi) emotions associated with the learning. Importantly, the model exposes the critical nature of social context and material resources to our understanding of learner mediation of identity especially in online sites.

We considered these models and theories as a framework of the study in analyzing participants' accounts of their academic experiences, emotions and expectations in the final stages of their programmes.

3. Methodology

The study was carried out during the final semester of the participants' academic career, January to March 2023. This inquiry is positioned within the qualitative paradigm in which we adopt a case study approach, longitudinally following the 14 students who started their programs at the beginning of 2022. Case studies are considered an ideal methodological approach when the goal is to understand in depth a social phenomenon taking place in an educational context and as a means of "getting to the details and nuances of the experience, emphasizing processes and meanings" (Da Costa et al., 2016, p.649). In addition, e-learning research is increasingly recognized as a social practice (Gruba et al., 2016). As Koro-Ljunberg and Douglas (2008) point out constructive research should, in most cases, ask 'why' and 'how' questions rather than 'how many'. These premises supported our methodological choices. Data included: 1) transcripts of individual interviews; 2) transcripts of interviews with focus group teachers; 3) questionnaires to teachers; and 4) field notes that included digital activity in the forums and feedback from the faculty. The ethical guidelines established by our institution to protect the rights and privacy of the participants were strictly adhered to throughout the study process.

3.1 Context and Participants

The study was conducted in a technical institute of higher education in Chile. Chile is considered an economically stable country, one of only two OECD members in South America. Stability has not been enough to appease the social inequality that has led to marked social protests comprised mainly of students seeking greater access to quality education. This drive for higher levels of education can explain why distance undergraduate programmes from 2014 to date have shown a sustained growth in enrolment in the first year of undergraduate education, with a 17.9% increase in 2022 compared to the previous year, and a 162.7% increase in the last five years. Online education has an entry profile mainly of working adult students, since this modality allows them to continue or resume their studies, especially because of the flexibility they offer to reconcile their different roles (Chávez, 2017). The challenges posed by the social and educational demands in Chile are fully aligned with those outlined by UNESCO (2022), in the context of lifelong learning: "The abiding challenge for adult learning and education is to reach those who need it most"(p.4) and it is considered an indispensable factor to achieve equity and inclusion, to alleviate poverty and to build equitable, tolerant, sustainable and knowledge-based societies (UNESCO, 2009). In order to respond to these challenges, HE institutions are required to take their online programmes along the path of continuous improvement to guarantee quality processes in accordance with the learning demanded by the 21st century. The institute where the study was conducted is privately owned,

founded in 1985. Since 2017 it offers all its programmes 100% online, one of the few HE institutes in Chile pre-pandemic to do so. Currently, the institution offers 19 technical careers organised in 5 areas: administration, education, industrial, health and social. Its mission includes not only the development of its students' professional disciplinary skills and competences, but also the promotion of their well-being, attitudes and competences to respond to the current dynamic demands of working and social life. In general, learners are working adults, mostly from socially, educationally and economically disadvantaged backgrounds, who wish to upgrade their skills or obtain a certification that will enable them to propel their career path in their field of work. The programmes receive an average annual intake over the last 3 years of 2,500 new students, composed of 58% women and 42% men. The average dropout rate before starting the original study in 2020 was 44%.

Of the 14 participants who originally volunteered to be studied in their final stages in the program, we managed to interview twelve - 11 women and 1 man with ages in the following ranges: four in their 20s, two in their 30s, two in their 40s, four in their 50s and one in his 60s. Their technical careers included: Early Childhood Education (3), Information Systems and Networks (1), Logistics Management (1), Human Resource Management (2), Pharmacy (3), Social Work (1). Of the original fourteen participants, one man withdrew for health reasons although continued his studies and another left the institution.

3.2 Research Design

This study was developed in three phases, which allowed a comprehensive understanding of the evolution of the students' practices and identities in their final stage of the program. The first phase consisted in the follow-up, in virtual classrooms, of the 14 participants who had been involved in a previous study in 2022. Field notes were generated every four months until the last course of the course in 2023. In these observations, attention was paid to the degree of participation, mainly in reflective forum activities and collaborative work.

The second phase was a review of the results of previous research where information was collected from teachers through a questionnaire ($n=72$) and focus groups ($n=10$) on the general perception of students including: i) student participation in the different activities; ii) the possibilities of developing transversal competencies in students with the pedagogical resources of the classrooms; iii) changes in the academic trajectory of students; iv) the influence of teacher-student and student-student interaction spaces to develop learning. These results served as a point of comparison for our analysis of the data in the current study.

The third phase of the study took place between February and March 2023. Individual interviews were conducted with the participants. In these semi-structured interviews, the 6 elements of identity construction framed in Falsafi and Coll's (2011) model explained by Engel (2021) were considered. These elements include: i) the learner's motives for engaging in learning activities and the learning objectives pursued; ii) the significant others involved in the learning experiences and their acts of recognition; iii) the discursive resources present in the broader sociocultural context; iv) the convergence or interference of other identities with an individual's learner identity; v) the characteristics of the learning activities; and vi) the emotions associated with these activities. This information led to an in-depth understanding of the evolutions of these students' practices and identities during this final stage of their academic programs.

3.3 Data Collection and Analysis

Data were analyzed using qualitative coding methods based on a combined inductive-deductive process (Miles et al., 2014). Through this rigorous process, we sought to ensure the reliability of the findings. After establishing a conceptual framework, the six steps suggested by Braun and Clarke (2006) were followed: i) familiarization with the data; ii) generation of initial codes; iii) search for topics; iv) review of topics; v) definition and name of the topics; vi) preparation of a report in relation to the findings and responses to the research questions.

4. Analysis and Discussion of Findings

Higher education in an online modality at a national and international level is mainly chosen by adult students to continue or return to the dream of obtaining a degree that was often forgotten, or worse, that they believed that they lacked the skills to achieve. When analyzing the data that emerged at the end of their formative process, the responsibility that institutions have to deconstruct these beliefs was revealed. Three themes emerged in the thematic analysis process: 1) sustained transformations in learning practices; 2) reconstruction and sustainable transformation of the identities of adult learners; 3) life-wide and life-long learning.

4.1 Sustained Transformations in Learning Practices.

In recent decades, social learning perspectives, and the designs and theories to implement them, have received special attention as viable or even desirable frameworks for research and practice related to the teaching-learning process, particularly in virtual environments (Hill et al, 2009). Although there is a diversity of social learning frameworks, one commonality shared by these models is the principle that learning usually takes place among peers or between groups of people, in collaboration, and/or in communities (Shea et al, 2019). Teachers who adhere to the value of this social constructivist principle promote activities that favour the co-construction of learning, or in the words of one of the teachers participating in an earlier inquiry "Collaborative learning allows students to make their contributions and express their concerns (Teacher Interviews January 2023).

From the student's perspectives, the learning experiences that allow them to both create a community and interact with their peers and teachers, are seen as a means to enhance their learning. Ana attested to her recognition of their value in the following excerpt: "Thematic forums help us a lot to know the points of view of other colleagues or perhaps ideas that can come to serve us at some point" (Ana, Individual interviews, March 2023). Many students also recognized that the forums allowed them to feel part of a community, and to generate affective ties, which are key elements in learning. As Luciana pointed out: "You still feel that affinity with the other, you still share with the other, maybe we don't see each other physically, but we still share experiences, lessons learned" (Luciana, March 2023). Another student, Nilma, shared: "We form an affective bond, but a great one, although we don't know each other" (Individual interviews, March 2023). According to Garrison et al. (2000) these affective bonds can help develop a sense of social community defined not only by the interaction of the participants, but also by their ability to integrate cognitive knowledge, social and educational presence. Only one student, Colomba, indicated that he was not able to create bonds with his peers and form trust. In an act of transparency, Colomba admitted: "The issue of teamwork, for me it is a totally issue... I am a person who is too distrustful" (Individual interview, March 2023). Colomba's admission shows that it is neither easy nor simple to rebuild our identity and appropriate new learning practices, as all the other students evidenced. It is a path that for some takes longer. Yet, these spaces allowed him to become more aware of the importance of developing these skills: "I feel, unfortunately, that, on this occasion, I was not able to develop teamwork" (Individual interviews, March 2023). Table 1 shows the appropriation by the students of new active learning practices, which from the first months showed emerging changes in their ways of learning and then after a year how these changes were sustained in line with 21st century skills.

Table 1: Evolution of student learning practices

Perceived changes in learning practices	Evidence from teachers	Evidence from students
Valuing and incorporating social practices for learning.	"In the case of teamwork, collaborative work, although it was an instance that was difficult to implement at the beginning, has become evident and most of the students have commented on it as a vital instance forgetting to know each other, sharing, developing a group activity and also feeling identified with the institution in their formative process". (Interviews January, 2023)	"From Rancagua, from Iquique, from Santiago. So that also helps to complement all this, because you can see that there are other people with the same effort and sacrifice to get ahead in their careers and at different ages. That is extremely important" (Luciana, March 2023). "It helps us... and also to give us strength, to give us energy, because we are the four women" (Sara, March 2023).
Participation with further reflections and opinions.	"There has been an important growth, from those who were not very interested in participating, some of them have been migrating, and you can see the difference, and today it is more technical, with more argumentation, more knowledge; (Teacher interview, January 2023). "The collaborative work is a sign that teamwork is strengthened, students manage to strengthen ties and discuss their ideas and opinions on the various topics covered, the feedback in the forums with their peers, and the fact that they are able to work together as a team" (Teacher interview, January 2023).	"In the forums, we are there answering things that we are learning as we go through the subjects...And I feel that it is very good to get to that point and say, oh, am I prepared to answer the question, to do this topic? Or to talk to my classmates, because in reality, as we don't really know each other in person... as time goes by I feel that now I am less afraid, because we are getting to know each other as we interact" (Elena, March 2023).
Self-directed practice: researching ideas, proposing topics for further study, active participation in forums and classes.	"Students demonstrate assertive communication in the thematic forums. Teamwork in "Collaborative Work", Creativity in their video exam, as no rigid structures are asked, but they can create their answers" (Teacher interview, January 2023).	"In the forums I obviously put my observations, and as I am a bit controversial, even to encourage, with the intention of encouraging learning" (Gael, 2023).

The testimonies in Table 1 reflect theoretical frameworks where technology is a medium for quality learning (Garcia, 2019; Medina, 2018; Picciano, 2017) where flexibility and interaction respond to the social needs of individuals in adult education. These features of quality learning should be the concerns and on the agendas of institutions globally. As UNESCO (2022, p.6) reminds us: "In the future, the key feature will be the openness of education systems and their capacity to bring about personal and social change".

4.2 Reconstruction and Sustainable Transformation of The Identities of Adult Learners

According to scholars who work in the field of identity, such as Falsafi and Coll (2011) and Norton (2015), learner-centred instructional designs provide opportunities for students to experience academic and social relationships. The results presented in Table 1 are evidence of these postulates. These relationships affect the reconstruction of a learner's identity and investment in learning, highlighting the role of agency in learners' commitments to a specific task, i.e. having an interest in performance and persevering in that performance (Engel and Coll, 2021). Many students, upon accessing these online programs, experience feelings of inadequacy and insecurity as learners. Yet, the designs of the online programs based on social learning along with the pedagogical approaches and technologies permit these students to interact with other students and with teachers and in so doing construct changes to their identities as learners. In these spaces of interaction, acts of recognition, which are a powerful tool aimed at promoting the construction of the learner's identity (IdA) by mediating the attribution of meaning to learning, were fundamental (Falsafi and Coll, 2015). We can hear this construction of identity in the words of the participants when talking about the interaction with others in their learning: "It feels good that they [other learners] value your opinion and your comment, your participation".... "it excites me, because it's nice to be told, hey, that's good, I think so" (Student interview, March 2023). Interaction in virtual environments has been widely studied, noting that it should have a qualitative dimension characterized by intentional and systematic discourse (Moore, 2003) and is considered a mode of communication that aims to influence critical and reflective thinking (Garrison and Cleveland-Innes 2010).

Table 2 illustrates with excerpts from the data the sustained transformations in the students' learner identities that have been mediated during their formative online educational process.

Table 2: Sustained transformation in the learner identities of adult learners.

Perceived changes in students' identities.	Evidence from teachers	Evidence from students
Learners who are more capable, confident and self-assured in themselves and in their learning.	"I think that in each of the existing instances we are seeing a change, a mutation, a migration, at different levels of intensity... So, this empowerment can be seen in all the instances. From the structure of the responses in a forum, for example, in the collaborative work as well, where you see a consolidation and a maturity".	"Honestly, yes, I feel like I make a contribution... you kind of live in the moment through the comments... the instance where you're learning. "Today I really feel much more capable. When I started studying, I said, this is not going to be my thing. So, if I got this far and I have nothing left, I can continue studying". "Oh, look at the confidence, the security and showing young people that if they work hard, they can do it.
Improved participation and analysis in reflection forums.	"It is very comforting to see how students broaden their analytical skills by acquiring new learning" (Teachers' questionnaires, January 2023).	"The truth is that when my peers respond, I feel very good... it's what I think from my point of view and that others see it as I see it, I think it's great".
Increased engagement with their learning in all learning experiences.	"and there one sees this maturity that is acquired in the different interventions, in the way of interacting. These are aspects that go beyond knowledge, empowerment"	"Well, I'm committed to studying, so my goal is to do well and be committed. "I want to continue studying... at that level of continuing to advance as a woman, as a mother, etc."
Researchers and agents of their learning.	"They have developed the capacity to learn quickly and to provide solutions to the problems that arise, I see that they are becoming more and more empowered in their territorial contexts"	"I feel amazing, I am at a stage where I want to study and I like it, I am learning things that I thought I would never learn. The truth is, I have changed... I am a mature woman who does her best to make things go well, I am focused on my future and on getting my degree"
Increased empathy with peers and leadership development.	"I have been able to see the development of skills such as leadership, problem solving, empathy, tolerance, goal-oriented teamwork, can be appreciated through the synchronous classes with their stories and also in the collaborative work"	"I have developed patience, why not say it too, and in a way empathy for others. I had a hard time when my mother passed away. Then other classmates also, others were parents, and we learned to be empathetic." "I feel like it has given me tools to be like a leader in my studies and in my field of work." "I feel like I don't have that fear anymore, that fear of speaking my mind, I feel calm and I encourage others, you don't have to be afraid of success."

In the narratives of students and teachers, there were notable and sustained signs of empathy, leadership and active co-construction of knowledge in different spaces where interaction takes place, inside and outside the classroom. These appropriations of skills generated sustained transformations in their learner identities, allowing them to see themselves as more self-confident, competent, empowered learners and as individuals who value learning how to learn. These findings highlight the responsibility that HE institutions have in generating academic activities that favour the reconstruction of identities in students where they can identify themselves as competent, with greater confidence in their academic and social skills, a view that is shared by a growing number of recent scholars in learning, of which e-learning is a part (Abello, 2019; Valdés et al., 2016).

Our analysis of the significant data detailed in Tables 1 and 2, which align closely with findings in our previous studies, and summarized in Figure 1 (Charbonneau-Gowdy and Galdames, 2022) we believe offer compelling evidence that changes to students' learner identities in the institution, were sustained over the year(s) they spent in the program.

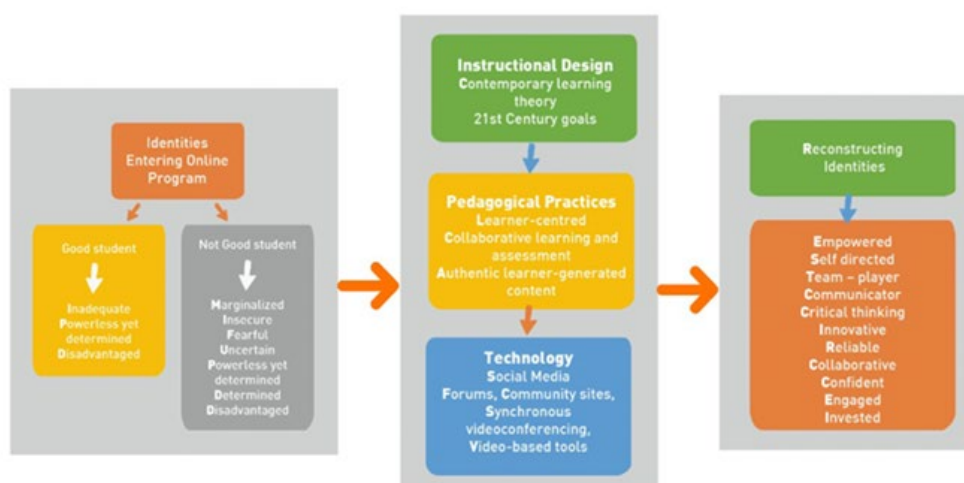


Figure 1: Identity transformations in aligning pedagogy, design and practice (Charbonneau-Gowdy and Galdames, 2022)

4.3 Life-Wide and Life-Long Learning

According to Engel and Coll (2021) "The learner identity (IdA), can be influenced, supported or inhibited by the learner's other identities such as social class, culture or gender... In this case we speak of identity interference, as a more elaborated type of identity" (p.8). The results of our findings lead us to share this premise. Students' testimonies denote how their socio-cultural capital, gender and age had defined the way they see themselves as learners and these new experiences allowed them to deconstruct those identities and feel proud. Examples of such compelling testimonies from the students about to graduate include: i) "For us it is still an achievement as a family, we are going to be the only two professionals of all the siblings"; ii) "As a student, having achieved what was difficult for me before, with my own means, with my own effort, I feel like a more fulfilled, more complete woman"; iii) "Even there in the clinic they also admire the fact that I am studying at my age. And I give it as an example, you too, go on, study, get your degree"; iv) "You also feel proud that your family is proud of you, I have shown them that I have been able to make the time to study. Now they feel confident to ask me for help with their homework, which has generated an educational connection with my daughters"; v) "Now that I have taken up my studies again, I intend to continue with my professional career, even if I am as old as I am, and maybe I won't find a job because of my age, but it is a personal satisfaction that I want to achieve". (Student interviews, March 2023). These quotes are a small sample of how students have overcome their previous beliefs about when and who could successfully achieve higher education and how this achievement is not only lifelong but also involves life-wide and life-deep learning (Banks et al, 2007). As (Schuetze and Slowey, 2012) point out: "Human beings not only learn throughout life, but they also learn throughout and across the lifespan" (p.71). From this view of lifelong and life-wide learning, the testimonies presented reveal how a person's different identities as women, adults, workers, mothers, and fathers are interfered with by new learning experiences in their different daily roles.

5. Conclusion

The powerful evidence presented in this study on evolutions to more collective learning practices and more empowered, confident and self-directed identities underlines the fundamental role of HE Institutions in the design of learning activities, particularly in virtual environments. This design of academic experiences, where social learning is an axis of educational practice, supported the installation of spaces for the evolution of skills aligned with the learning demanded in the 21st century: teamwork, critical thinking, effective and assertive communication. Undoubtedly, such skills and identities are projected into present and future social and occupational spheres. The impressive reconstructions of learner identities that we show in this study along with the solid data that was generated by the three previous inquiries, allow us to understand the necessary synergy and harmonisation that must exist in a pedagogical/design/technology alignment (Charbonneau-Gowdy and Galdames, 2021). We strongly believe that participants' decisions to persevere in their academic path and invest actively in learning have roots in this alignment. Learning activities involving interaction in its three dimensions (student-content/student-teacher/student-student) such as: synchronous classes; reflective forums; collaborative work and co-assessment, offered opportunities to share experiences and opinions that developed or enhanced transversal competences that are critically necessary and valued today: empathy, companionship, teamwork, assertive communication and creativity (García, 2019, p.260). For the development of these opportunities to take place in virtual classroom practices, it was not enough for the institution to declare in its formative and normative frameworks its aspirations for students. Importantly, it was essential to involve and unite all stakeholders in the institution at macro/meso/micro levels with contemporary theories of social learning and 21st century goals. We believe that the results of this research combined with those of previous studies provide empirical evidence that a consistent design of these principles, where all levels of the institution adhere to them, provided powerful educational experiences for students where they are called to be agents of their learning process mediated by technology. Based on the foundations of constructivist qualitative research, we recognise that the stories of appropriations of reconstructed empowered identities uncovered in our findings cannot be generalized for all learners, let alone across all virtual environments. Yet, we also recognise that the longitudinal nature of the combined studies carried out from 2020 to 2023 has allowed us in the present study to raise solid results where the transformations of learner identities have been sustained over time and, as Engel (2021) pointed out, have positively intervened in their other identities (social, cultural or gender). We argue then, in light of the events experienced in the transition of distance education in recent years as a result of the pandemic, that our findings support the search for theoretical, practical and global solutions to the challenges we face in education. Furthermore, considering that lifelong learning is currently at the forefront of national and international educational agendas, our findings could be a viable way forward in providing quality opportunities in technology-mediated educational spaces for people who have felt marginalised from educational systems for years.

References

- Abello, R., Vila, I., Pérez, M. V., Lagos, I., Espinoza, C., y Díaz, A. 2016. "Identidad de aprendiz como herramienta analítica de experiencias universitarias en el contexto de la permanencia y el abandono: propuesta teórica". *Paideia*, No. 58, pp. 11-34 <http://revistasacademicas.udec.cl/index.php/paideia/article/view/1448>
- Banks, J. A., Au, K. H., Ball, A. F., Bell, P., Gordon, E. W., Gutiérrez, K., Heath, S.B., Lee, C.D., Lee, Y., Mahiri, J., Nasir, N.S., Valdes, G. I., & Zhou, M. (2007). "Learning in and out of school in diverse environments. Life-long, life-wide, life-deep". The LIFE Center for Multicultural Education.
- Braun, V., and Clarke, V. 2006. *Using thematic analysis in psychology*. *Qualitative research in Psychology*, Vol. 3, No. 2, pp. 77–101. <https://doi.org/10.1191/1478088706qp063oa>
- Bourdieu, P. 1998. *Acts of resistance: Against the new myths of our time*, Polity Press, Cambridge.
- Charbonneau-Gowdy, P. and Galdames, C. (2021). "Connecting the Dots: Putting Instructional Design Theory to Practice in Online Courses". *Proceedings of the 20th International Conference on e-Learning*, (ECEL, 2021), University of Applied Sciences HTW, Berlin, Germany, pp. 80-88.
- Charbonneau-Gowdy, P. and Galdames, C. (2022). "The Impact on Learners' Identities of Aligning Pedagogy, Design and Technologies With Theory in Online Courses". *Proceedings of the 21th International Conference on e-Learning*, (ECEL, 2022), University of Brighton, Brighton, England, 51-60.
- Chaves Torres, A. 2017. "La educación a distancia como respuesta a las necesidades educativas del siglo XXI". *Revista Academia y Virtualidad*, Vol. 10, No. 1, pp. 23-41.
- da Costa, R. B., Hall, S. M., and Spear, A. 2016. "Whose reality? A meta-analysis of Qualitative Research in international and comparative education". *The Qualitative Report*, Vol. 21, No. 4, pp. 661-676. <https://doi.org/10.46743/2160-3715/2016.2252>

- Darvin, R. and Norton, B. (2015) "Identity and the Power of Investment in Applied Linguistics", *Annual Review of Applied Linguistics*, Vol 35, pp. 36–56
- Engel, A. y Coll, C. 2021. "La identidad de aprendiz: El modelo de Coll y Falsafi". *Papeles de trabajo sobre cultura, educación y desarrollo humano*, Vol. 17, No. 1, pp. 1-12. [online] http://psicologia.udg.edu/PTCEDH/menu_articulos.asp
- Falsafi, L. and Coll, C. 2011. "La construcción de la identidad de aprendiz: Coordinadas espacio-temporales". En J. I. Pozo y C. Monereo (Coords.). *La Identidad en psicología de la educación: Necesidad, utilidad y límites*, pp. 77-98. Narcea, Barcelona. [online] http://psyed.edu.es/archivos/grintie/Falsafi_Coll_ConstruccionIdA_2011.pdf
- García Aretio, L. 2019. "El problema del abandono en estudios a distancia. Respuestas desde el diálogo didáctico mediado". *RIED. Revista Iberoamericana De Educación a Distancia*, Vol. 22, No. 1, pp. 245–270. <https://doi.org/10.5944/ried.22.1.22433>
- Garrison, D. R., Anderson, T. and Archer, W. 2000. "Critical inquiry in a text-based environment: Computer conferencing in higher education mode". *The Internet and Higher Education*, Vol. 2, No. 2-3, pp. 87-105.
- Gruba, P., Cárdenas-Claros, M. Suvorov, R. and Rick, K. 2016. *Blended learning program evaluation*. Palgrave Macmillan, London.
- Harasim, L., 2012. *Learning theory and online technologies*, Routledge/Taylor & Francis, New York.
- Hill, J., Song, L. and West, R. 2009. "Social learning theory and web-based learning environments- A review of research and discussion of implications". *American Journal of Distance Education*, Vol. 23, No. 2, pp. 88-103. <https://doi.org/10.1080/08923640902857713>
- Koro-Ljungberg, M. y Douglas, EP 2008. "El estado de la investigación cualitativa en la educación en ingeniería: Metanálisis de artículos JEE, 2005-2006". *Revista de Educación en Ingeniería*, Vol. 97, No. 2, pp. 163-175. <http://doi:10.1002/j.2168-9830.2008.tb00965.x>
- Medina, L., 2018. "Blended learning: Deficits and prospects in higher education". *Australasian Journal of Education Technology*, Vol. 34, No. 1, pp. 42-56. <https://doi.org/10.14742/ajet.3100>
- Moore, M. G. 1989. "Three types of interaction". *The American Journal of Distance Education*, Vol. 3, No. 2, pp. 1-6.
- Moore, K., Bartkovich, J., Fetzner, M., e Ison, S. 2003. "Success in cyberspace: Student retention in online courses". *Journal of Applied Research in the Community College*, Vol. 10, No. 2, pp. 107-118. <https://eric.ed.gov/?id=ED472473>
- Norton Peirce, B. 1995. "Social identity, investment, and language learning". *TESOL Quarterly*, Vol. 29, No. 1, pp. 9–31.
- Picciano, A. G. 2017. "Theories and frameworks for online education: Seeking an integrated model". *Online Learning*, Vol. 21, No. 3, pp. 166-190. <http://doi:10.24059/olj.v21i3.1225>
- Shea, P., Li, C.S., Swan, K., and Pickett, A. 2019. "Developing learning community in online asynchronous college courses: the role of teaching presence". *Online Learning The Official Journal of OLC*.
- Siemens, G. 2004. Connectivism: A learning theory for the digital age. [online] <http://www.elearnspace.org/Articles/connectivism.htm>
- United Nations Educational, Scientific and Cultural Organization. 2009. *Global report on adult learning and education*. UNESCO Institute for Lifelong Learning. [online] ISBN 978-92- 820-1169-0
- United Nations Educational, Scientific and Cultural Organization. 2022. *5th global report on adult learning and education: citizenship education: Empowering adults for change*. UNESCO Institute for Lifelong Learning. [online] ISBN 978-92- 820-1247-5
- Valdés, A., Coll, C., and Falsafi, F. 2016. "Experiencias transformadoras que nos confieren identidad como aprendices: las experiencias clave de aprendizaje". *Perfiles Educativos*, Vol. 153, pp. 168-184. http://www.iisue.unam.mx/perfiles/perfiles_articulo.php?clave=2016-153-168-184
- Zhang, L., Carter Jr, R. A., Qian, X., Yang, S., Rujimora, J. and Wen, S. 2022. "Academia's responses to crisis: A bibliometric analysis of literature on online learning in higher education during COVID-19". *British Journal of Educational Technology*, Vol. 53, No. 3, pp. 620-646

Is this an e-School? e-Learning Using Information Communication Technologies in South Africa

Mandlenkosi Thwala and Leila Goosen

University of South Africa

54904412@mylife.unisa.ac.za

GooseL@unisa.ac.za

Abstract: The study reported on in this paper reviewed the readiness of a specific high school in the township of Soweto to the south of Johannesburg, South Africa, to deliver the curriculum by using Information and Communication Technologies (ICTs), as well as to find the barriers and limitations thereto. For the empirical research, a quantitative mode of inquiry was adopted. A sample of learners and teachers was selected to answer the research questions, using two different questionnaires. The principal responded to a questionnaire on the ICT infrastructure available to establish what the school had in this regard, as well as the skills available to implement pedagogy using ICTs. Data analysis was carried out using a common spreadsheet application and multiple criteria, and the findings are discussed to provide value to, and should be of use to, the stakeholders involved for development purposes. The work discussed in this study covered curriculum topics, as well as lesson planning and reporting. In other words, it covered the process of teaching and learning up to reporting for teachers. A summary of the findings of the research conducted at the high school showed that the school does not have a stable internet connection and more technical support is needed from the government to strengthen the ICT infrastructure to enable the school to fully implement the curriculum using ICTs, compared to using traditional or hybrid methods. These strengthening recommendations include a stable internet connection, ICT staff, to support both e-teachers and e-learners with ICT problems, as well as software to deliver the curriculum. The findings also showed that learners are more comfortable with mobile devices and a little uncomfortable using computers for learning, which means that some aspects of e-learning requirements are not met, and it is very difficult to achieve some of the curriculum goals using mobile devices.

Keywords: Information and Communication Technologies, e-Learning, e-School.

1. Introduction

According to the then South African (SA) national Department of Education (DoE, 2004, p. 9), the “lack of developed infrastructure for” Information and Communication Technologies (ICTs) “are widening the gap between Africa and the developed world”. Africa being a developing continent is still faced with little to no resources in some countries and had to upscale their ICT standards so that they are able to integrate strategies using ICT-enabled teaching and learning to meet the standards of the world. *e-Learning* is the ability to use information and communication technology tools to teach and learn. Having learning and teaching through ICT resources had become one of the most popular platforms across the world. The challenge of ICT resources use in schools remains a limitation for some school districts in some areas of the world, especially in developing countries across Africa. ICTs in education are aimed at improving teaching and learning, administration and management in schools, ICT education in general and ensuring better understanding of ICTs for use in communities (Mpungose, 2020). As the years go by and research is conducted, more ICTs emerge for teaching and learning. However, there are still areas that still use and prefer the ‘traditional’ models of teaching and learning. It is noted that the quality of teaching and learning can be improved by using ICT tools, which also enables understanding and easy adaptation to this information age (Mqina and Goosen, 2021). An ideal e-school is considered to be one where computer hardware and software, as well as connectivity and sufficient skills, are available, and where teachers and learners are confident enough to implement the curriculum using ICT resources. However, according to Abegbenro, Gumbo, and Olakanmi (2017), in many parts of the world, teachers are still faced with challenges when using basic technologies to deliver educational activities to school children.

Tonui, Kerich and Koross (2016) identified ICTs at least five levels of education, namely presentation, demonstration, drill, practice, as well as interaction and collaboration. The different levels can each be used collaboratively to reach the next. In order to reach their full potential in terms of confidently using ICTs to deliver teaching and learning in schools, both learners and teachers are required to integrate all levels of ICTs daily.

ICTs had proven to have a huge impact on education through research and practice. Developed countries had reached over 90% of schools having computer-based learning in the early 2000s. Some African countries had also been in favour of introducing computer-based learning. The then national Department of Education (DoE, 2004) in South Africa (SA) also undertook to introduce ICT-based pedagogy in the country.

ICTs have different components, namely hardware, software and networks that work together to execute the different outcomes for humans. Computers are still considered by many to be the most important device that enables all the components to communicate and provide the platform to practise ICT education (Tonui, et al., 2016), even though the latest developments have shown other devices that provide similar features, like tablets and smartphones. However, these other devices are often limited to certain supported software and functionalities.

1.1 Objective

Information and communication technologies are used in various ways to help in pedagogy for both teachers and learners. Using ICTs goes beyond the basic skills acquired from training provided by teachers or during teacher training provided by government (Ghavifekr and Rosdy, 2015). Daily use of ICTs improves not just in education delivery but also decision making and creativity. Electronic game playing is also another method to increase learners' interest in using ICTs, which in turn makes it easier to use these tools for learning.

This report is focused on attempting to solve the problems related to ICTs used for teaching and learning, as well as access to ICT resources at this high school. The researchers explored different methods used by others, who had conducted research on similar topics and/or used suitable and effective methods that will assist in solving the problem at hand.

1.2 Research problem and questions

Based on the characteristics of an e-school provided by the DoE (2004, p. 18), the research questions are to establish to what extent a particular school is characterised as an institution that has:

- “learners who utilise ICTs to enhance learning”?
- “qualified and competent teachers who use ICTs to enhance teaching and learning”?
- “access to ICT resources that support curriculum delivery”?

1.3 Purpose

The purpose of this report was to investigate ways to strategically assist teachers interested in using ICTs for teaching and learning, and ultimately, learners, to utilise the ICTs in their learning processes (Abegbenro, et al., 2017). This should improve the delivery of the curriculum in schools, as well as the use of these tools in more detail.

2. Literature review

2.1 Early development

In the earlier stages of the introduction of modern teaching and learning in SA by the DoE (2004), the strategies for and importance of ICTs in education were explained and most importantly, introduced to many of the countries' schools. Due to the digital divide, research cited in by the DoE (2004, p. 8) showed that “only 6.4% of South Africans” had access to and used the Internet. A set of development areas that needed to form part of the process in its entirety had been set aside with strategies on how to achieve each of the stages of the development strategy. The DoE (2004) also introduced a teacher development course including eleven modules to introduce teachers to the use of ICTs in schools.

2.2 Adoption and integration

The integration of ICT use in schools by the DoE (2004) had a lot of broad information that needed to be conceptualized, implemented, reviewed and maintained regularly over a period of time to continue to monitor the evolution of the use of ICTs in schools to deliver curriculum (Wilson-Strydom, Thomson, & Hodgkinson-Williams, 2005). At this point, teachers were assisted with their integration of pedagogical practices into modern ones that included the use of ICTs.

2.3 Type of research

Most of the research previously conducted used mixed methods. Quantitative research methods use questionnaires to collect opinions, behaviours, beliefs and other types of information to draw conclusions using

the supplied answers, whilst in qualitative research, they use case studies that enable them to analyse the data to obtain a deeper understanding and come to informed conclusions in their research. Yunus and Suliman (2014) indicated that attitudes towards the introduction of ICT tools in literature lessons for both learners and teachers were what guided the success of the adaptation and integration of the use of ICTs in learning. Designing effective *e-learning* environments in Gweru, Midlands Province, Zimbabwe led to both teachers and learners understanding the role of ICTs and the benefits of these, not just in school but also for the broader community (Farikayi and Goosen, 2022).

2.4 Limitations of Current Literature

There were also limitations in current literature regarding the age, gender, location, and years of experience of teachers (Abegbenro, et al., 2017). Findings from Fu (2013) revealed that age plays a huge role in learning faster and converting interest in the technological aspects of ICT devices, which makes it easier to attract learners' attention. In terms of exploring teachers' acceptance of *e-learning* technologies, if their self-efficacy is low, it becomes difficult to even try to attempt to use the educational resources or they think such tasks are beyond their capabilities (Abegbenro, et al., 2017; Yuen and Ma, 2008).

Li and Wong (2008) mentioned the issue of questionnaires asking 'personal' questions, so that the respondent would question their self-efficacy with respect to the use of ICTs in general. This means that there may be ethical issues with respect to the content of research questions, as it seems to invade participants' privacy. However, privacy and confidentiality should be maintained at all times. According to the SA Protection of Personal Information (POPI) Act (Republic of South Africa, 2013), information available to participants should include the purpose of the research, the type of data to be collected and where the data is going to be used (Adams, et al., 2021). If there is any additional use of the data that was not included in the original consent form, further consent should be obtained, outlining the changes involved.

Time and financial resources are also a limitation in conducting this kind of research (Setati-Legodi and Goosen, 2022). The researcher may need more time and resources to work on finding in-depth ways of achieving the proposed research aim. However, these may not be available. Furthermore, the availability of respondents during specified times may also be a problem, as they are busy with their daily tasks and may have other commitments when they may not be available (Wilson-Strydom, et al., 2005). This means that some respondents may not be able to complete all research activities.

During the COVID-19 pandemic, Farikayi and Goosen (2022) looked at a school in Gweru in the Midlands province of Zimbabwe to see how ready the school was with regard to using ICTs in teaching and learning. In that period, *e-learning* progress was in the limelight, seemingly taking over education and ensuring that it continued, even during the difficult time (Al-Abed Al-Haq, 2022). One limitation found is that the findings will only come from that school and cannot be used across other schools (Farikayi and Goosen, 2022). Another factor affecting the successful implementation of an e-education policy and community engagement towards acquiring 21st century skills through *e-learning* was the lack of accessibility of resources in the schools (Muzambi and Goosen, 2022). Jones (2004) asserted that ICTs need to be of good and effective quality to offer adequate throughput.

2.5 Possible Solutions

Hill (2018) suggested several possible solutions for learning using ICTs as part of having both learners and teachers ready to use the technological environment to learn. Bui (2020) also recommended gamification as part of learning using ICTs as a fun and more engaging process. The government can focus more on rural schools without resources and little exposure to technologies, rather than the already equipped areas (Patel, 2018). Tapscott and Tascott (2017) further proposed introducing blockchain technologies into pedagogy and learning, as these are more collaborative and livelier in terms of content exchange and innovation, which anyone would want to be part of. Wepner, Tao and Ziomek (2006) further aimed at providing more ICT services that will not only teach but also bring interest for learning through ICTs around the world through the global web.

2.6 Future Possibilities

As research continues to take place in different areas of the world, now particularly in developing countries, more research needs to be conducted on blockchain technologies with respect to teaching and learning, which will lead to interest from different genders and age groups (Buabeng-Andoh, 2022). The India Today Web Desk (2022) suggested finding ways that will provide for the evolution that develops together with the current

technological trends, while providing for optimal education. One should strategize towards providing more action learning that is more engaging and globally competitive using technologies, that takes place, even outside the classroom, which makes it even more about self than the curriculum. Such a shift in methodologies was presented by Goosen (2018) as it presented action research as a research paradigm that produce research with more in-depth understanding of the directions that *e-learning* is taking. Future research also needed to shift from the stereotype that a learner is a recipient and the teacher is the expert, who is responsible for information dispensing (Tong and Triniada, 2005).

2.7 Project Scope

The use of technologies had evolved and taken over teaching and learning in different ways, including, but not limited to, formal internet teaching, videos and sometimes gaming, compared to more traditional forms or methods of teaching. This project aimed at investigating how conversant learners, teachers and the management of a high school based in the east of a township in the south of Johannesburg, SA, were with using ICTs to deliver the school curriculum and manage lesson plans, as well as for management to administer the school in general. This project ran from July 2022 after the semester recess until the end of 2022 and depended on the availability of learners and teachers. The population of the school was mainly black disadvantaged South Africans.

The limitations expected when the study was undertaken included the availability of participants, because of school times and the different grades selected, and only one school taking part in this project with a small sample size (Mqina and Goosen, 2021). In this project, the researchers also compared the current skills and attitudes of learners and teachers at the school so that the investigator was able to plan, based on the current skill basis at the school.

Research limitations further included that the research only involved one school. The number of learners and teachers limited “the transferability of the study to other learners” and teachers (Mqina and Goosen, 2021, p. 170). This meant that only the selected sample received the benefits related to the study being carried out. As small as the sample size was, it still had benefits for the chosen participants.

3. Research Methodology

Setati-Legodi and Goosen (2022) perceived methodology as providing a systematic method to solve real-life problems through research. The process was controlled to ensure that responses were valid and verifiable. The more controlled a process is, the more accurate it will be; the inquiry will be more valid and will take the research in the right direction towards improving any limitations at the school.

3.1 Research Approach

This study looked at exploring the current knowledge, skillsets and attitudes of learners and teachers at this school on the use of ICTs for curriculum delivery (Majumdar, 2006). This approach assisted in establishing the current state at the school and made it possible to draw up an action plan to improve on the lacking aspects. The respondents should be more motivated and have increased interest in using the provided skills in their pedagogy after the research.

This subsection provides the overall systematic step-by-step process followed towards finding a solution by choosing an appropriate research design. In this research project, mainly quantitative methods were used, and questionnaire surveys and interviews were developed for data collection aimed at statistical analysis (Farikayi and Goosen, 2022).

The questionnaires were distributed to the teachers and learners at the high school during an agreed-upon time slot and completed during the specified time. The questionnaires were short and precise to address the problem of ICT access and use for teaching and learning at the high school (Ghavifekr and Rosdy, 2015). The investigator was at the school during completion of the questionnaires to ensure that any questions participants had could be responded to if anything needed be clarified. This was done to ensure accuracy and understanding in the answering of the questions and avoid unwanted mistakes, which could interfere with the quality of the data. Surveys have been used for many years for conducting research (Setati-Legodi and Goosen, 2022).

The questionnaires were followed by structured interviews as used by Yunus and Suliman (2014), with the interviews taking place after the completion of the questionnaires to complement the content of the latter.

The method used by Yuen and Ma (2008) of questionnaire completion would not be possible in this research, as respondents might not remember to complete the surveys or be biased when completing the surveys. The method of collection used in this research was to ensure understanding of the questionnaire and provide support while completing the survey to ensure that the information provided was based on self-reported skills and attitudes toward the use of ICTs in pedagogy. The data collected should follow the pedagogical principles and support the delivery of the curriculum in return (Hill, 2018).

3.2 Sample

The respondents in the study were teachers and learners from the school. Specifically, a sample of fifteen learners from different grades and five teachers teaching different subject fields, inclusive of the principal, were selected depending on their availability and using the consent form (Yunus and Suliman, 2014). The learner respondents did not have any exclusion criteria, compared to the teachers, who should have had at least five years' experience at minimum, based on recommendations from previous research. The data collected investigated the self-reported skills of each respondent regarding the use of ICTs in learning.

The reason for using a small number of participants was to work along with the schedule of the school, due to school holidays in the country and examinations taking place during the research period.

3.3 Research instruments

Multiple research methods had initially been considered for the study. However, there was a time limitation as schools closed in September, and in the same month, there were preparatory examinations, which meant that the principal would not have agreed to the research being undertaken using extensive qualitative research methods. Informed consent had been obtained from the high school principal to allow the project to run at the school, which clearly stated how the respondents were ethically protected and what the project was about. The first author generated paper-based questionnaires for both the learners and teachers to explore their experiences and mindsets towards the use of ICTs for learning and teaching (Mpungose, 2020).

In order to unpack the "access to ICT resources that support curriculum delivery", there was an additional baseline questionnaire directed at the principal to answer as he had the details of the school inventory and knew where and how resources could be attained (DoE, 2004, p. 18). It enquired about the ICT infrastructure at the school, which was not limited to computer devices, the network and software, but also included continuous support from experts to enhance teachers' confidence in using ICTs for curriculum delivery.

The interviews did not take more than twenty minutes to complete and unpacked how the learners utilised ICTs to enhance learning and qualified and competent teachers used "ICTs to enhance teaching and learning".

The first section of both the learners' and teachers' questionnaires asked questions about the respondents' biographical details, and also contained a section on what they thought of/their attitude towards the use of technologies for curriculum delivery.

The learner questionnaire further contained sections on (Yunus and Suliman, 2014):

- Their use of ICT related tools, and
- What they thought about learning using ICTs.

The teachers' questionnaire also includes a section on their approaches to a literature lesson.

The questionnaires contained two types of questions: Some sections included Yes/No answers, while the others provided more options. However, participants were enabled to show their knowledge and understanding (DoE, 2004; Wilson-Strydom, et al., 2005).

3.4 Data analysis

The data collected from the collection instruments were aimed at answering the research questions by using data analysis and visualized in tables and graphs using Excel (Yunus and Suliman, 2014) to draw conclusion from the research (Setati-Legodi and Goosen, 2022). The former was due to the unavailability of other statistical software and license to run such analysis. Furthermore, the investigator included figures to make it easy for readers to understand (Farikayi and Goosen, 2022; Buabeng-Andoh, 2012).

4. Findings and Recommendations

The findings of the research conducted at the high school from July – November 2022 showed that the school does not have a stable internet connection and more technical support is needed from the government to strengthen the ICT infrastructure to enable the school to fully implement the curriculum using ICTs, compared to using traditional or hybrid methods. These strengthening recommendations include a stable internet connection, ICT staff, to support both e-teachers and e-learners with ICT problems, as well as software to deliver the curriculum. The findings also showed that the learners are more comfortable with mobile devices and a little uncomfortable using computers for learning, which means that some aspects of *e-learning* requirements are not met, and it is very difficult to achieve some of the curriculum goals using mobile devices. Table 1 provides further explanation on the results of the research.

Table 1: Details for participating teachers

Gender		
	Frequency	Percentage
Female	4	67%
Male	2	33%
Ages		
	Frequency	Percentage
20-40	3	50%
41-55	2	33%
56+	1	17%
Years of experience		
	Frequency	Percentage
0-3	2	33%
4-7	2	33%
8+	2	33%

Some mental stimulating games or videos were made available to learners, to get them used to using computers and as a result, they were more comfortable using computers for learning. The teachers at the school are partly comfortable and confident using ICTs for teaching and administration. However, they need more capacitation to be able to cover the whole curriculum confidently. The learners in the school cannot tell which platform works better for learning and as such, they use their cell phones to access educational materials, which is disadvantageous in their learning using ICTs, as these have limitations. More computer literacy practice will enable the learners to use computers more confidently for learning than using cell phones. The school is faced with the challenge of teachers' and learners' confidence in using ICTs because of their attitudes and expectations (Shan Fu, 2013).

4.1 Discussion of results

The integration of information and communication technologies into curriculum delivery was also discussed by Wepner, et al. (2006). The latter authors emphasized that the attributes of what needs to be achieved should be clearly defined and assessed. Statistics on the expectations and responsibilities related to using ICTs in pedagogy from developed countries that already were already using ICTs to deliver teaching and learning were provided by Yuen and Ma (2008), who tested the significance of teachers' intention to use ICTs, and found significant direct positive effects for users to use the *e-learning* system.

5. Contribution of the Research to Theory and Practice

Three teaching environments were evaluated in the school, which uncovered that both e-learners and e-teachers prefer a hybrid approach. The research was significant to the school towards understanding their current base state regarding ICTs, as well as what is required for them to move along the way towards becoming an e-school.

The school will have to rethink their main objective with the learners with regard to strengthening especially learners' knowledge of ICT use. The research is also significant as it will assist the school to plan their year to include ICT infrastructure and personnel to support the school towards becoming fully ICT-enabled.

6. Future Research Directions

More research needs to be done on what characterizes an e-school in SA as a country in relation to the outside world, so that it is clearly defined and supported (Mqina and Goosen, 2021). Also, this being an information age, ways need to be found to ensure that e-learners are well-equipped to use ICTs, as these are now the preferred implementation method and they should be groomed from a young age to spark their interest. More research can be undertaken on the behaviours and interests relating to ICT use so that the curriculum can be implemented to cover the interests of more learners and teachers, towards choosing to use ICTs to learn and teach.

7. In Conclusion

The high school investigated in this project cannot be characterized as an institution utilizing ICTs to enhance teaching and *e-learning*, since, according to the findings of this research, it does not have all the required qualities.

References

- Abegbenro, J., Gumbo, M., and Olakanmi, E. (2017) "In-Service secondary school teachers' ICT-enhanced classroom", *The Turkish Online Journal of Educational Technology*, 16, No. 3, pp 79-87.
- Adams, R., Adeleke, F., Anderson, D., Bawa, A., Branson, N., Christoffels, A., . . . Ramsay, M. (2021) "POPIA Code of Conduct for Research", *South African journal of Science*, Vol. 117, No. 6, pp 1-12.
- Al-Abed Al-Haq, F. (2022) *OPINION*. Retrieved from <https://www.jordantimes.com/opinion/fawwaz-al-abed-al-haq/ict-education-enables-brighter-future-all>
- Buabeng-Andoh, C. (2022) What critical factors forecast student-teachers utilization of online learning system in the University of Education, Ghana during the Covid19 pandemic? *Education and Information Technologies*, 1-14. doi:<https://doi.org/10.1007/s10639-022-11041-4>
- Bui, S. (2020, November 2020) *eLearning Trends*. Retrieved July 13, 2022, from eLearning Industry: <https://elearningindustry.com/top-educational-technology-trends-2020-2021>
- Department of Education. (2004, September 2) White Paper on e-Education: Transforming Learning and Teaching through Information and Communication Technologies (ICTs). *Government Gazette* (26734), pp 3 - 46.
- Farikayi, B., and Goosen, L. (2022) Designing Effective E-Learning Environments in Gweru, Midlands Province, Zimbabwe: An E-School's Community Engagement Case Study. In *Designing Effective Distance and Blended Learning Environments in K-12* (pp 258-281). Hershey: IGI Global.
- Fu, J. S. (2013) Complexity of ICT in education: A critical literature review and its implications. *International Journal of Education and Development using ICT*, Vol. 9, No. 1, pp 112-125.
- Ghavifekr, S., and Rosdy, W. A. (2015) Teaching and learning with technology: Effectiveness of ICT integration in schools. *International journal of research in education and science*, Vol. 1, No. 2, pp 175-191.
- Goosen, L. (2018) Trans-Disciplinary Approaches to Action Research for e-Schools, Community Engagement, and ICT4D. In T. A. Mapotse (Ed.), *Cross-Disciplinary Approaches to Action Research and Action Learning* (pp 97-110). Hershey, PA: IGI Global. doi:10.4018/978-1-5225-2642-1.ch006
- Hill, J. (2018) *The Future of ICT in Education: Opportunities and Recommendations*. UK: Save the Children.
- India Today Web Desk. (2022, Apr 17) *5 biggest educational technology trends in near future*. Retrieved from <https://www.indiatoday.in/education-today/featurephilia/story/5-biggest-educational-technology-trends-in-near-future-1938402-2022-04-17>
- Jones, A. (2004) A REVIEW OF THE RESEARCH LITERATURE ON. *British Educational Communications and Technology Agency*, 29. Retrieved from <http://www.becta.org.uk>
- Li, S., and Wong, E. (2008) Framing ICT implementation in a context of educational change: a multilevel analysis. *School effectiveness and school improvement*, Vol. 19, No. 1, pp 99-120.
- Majumdar, S. (2006) Changing schools through exploring innovative pedagogical practices using ICTs. *Educational Technology and Society*, Vol. 8, No. 1, pp 94-101.
- Mpungose, C. B. (2020) Emergent transition from face-to-face to online learning in a South African University in the context of the Coronavirus pandemic. *Humanities and Social Sciences Communications*, Vol. 7, No. 1, pp 1-9. doi:<https://doi.org/10.1057/s41599-020-00603-x>
- Mqina, B., and Goosen, L. (2021) Investigating the Roles of School Management Teams in Curriculum Delivery Through ICTs in Education: e-Schools' Community Engagement. In *Investigating the Roles of School Management Teams in Curriculum Delivery* (pp 158-178). Hershey: IGI Global.

- Muzambi, A., and Goosen, L. (2022) Factors Affecting the Successful Implementation of an E-Education Policy and Community Engagement: Acquiring 21st Century Skills Through E-Learning. In *Handbook of Research on Acquiring 21st Century Literacy Skills Through Game-Based Learning* (pp 580-605). Hershey: IGI Global.
- Patel, A. (2018) *Special reports*. Retrieved from <https://mg.co.za/article/2018-06-15-00-the-future-of-ict-is-in-gautengs-classrooms/>
- Republic of South Africa. (2013, November 26) Protection of Personal Information Act. *Government Gazette*, 581(37067).
- Setati-Legodi, M., and Goosen, L. (2022) Policy and Practice Challenges for Equality in Information and Communication Technology Education: Community Engagement With a Primary School. In *Policy and Practice Challenges for Equality in Education* (pp 56-77). Hershey: IGI Global.
- Tapscott, D., and Tapscott, A. (2017) *The Blockchain Revolution and Higher Education*. Retrieved from <https://er.educause.edu/articles/2017/3/the-blockchain-revolution-and-higher-education>
- Tong, K., and Triniada, S. (2005) Conditions and constraints of sustainable innovative pedagogical practices using technology. *Journal of International Electronic for leadership in learning*, Vol. 9, No. 3, pp 1-24.
- Tonui, B., Kerich, E., and Koross, R. (2016) An Investigation into Implementation of ICT in Primary Schools, in Kenya, in the Light of Free Laptops at Primary One A Case Study of Teachers Implementing ICT into Their Teaching Practice. *Journal of Education and Practice*, Vol. 7, No. 16, pp 12-16.
- Wepner, S., Tao, L., and Ziomek, N. (2006) Broadening our view about technology integration: Three literacy educators' perspectives. *Reading Horizons*, 46, No. 3, pp 215-237.
- Wilson-Strydom, M., Thomson, J., and Hodgkinson-Williams, C. (2005) Understanding ICT integration in South African classrooms. *Perspectives in Education*, Vol. 23, No. 4, pp 71 - 85.
- Yuen, A., and Ma, W. (2008) Exploring teacher acceptance of E-learning technology. *Asia-Pacific Journal of Teacher Education*, Vol. 36, No. 3, pp 229-243.
- Yunus, M., and Suliman, A. (2014) Information & Communication Technology (ICT) Tools in Teaching and Learning Literature Component in Malaysian Secondary Schools. *Canadian Center of Science and Education*, Vol. 10, No. 7, pp 136-152.

Digital Addiction and Financial Literacy: A Study on University Students

Abdurrahman Gümrah and Hüseyin Karagöz

Selcuk University, Department of Management and Organization, Konya, Turkey

Karamanoglu Mehmetbey University, Department of Banking and Insurance, Karaman, Turkey

agumrah@selcuk.edu.tr

huseyinkaragoz@kmu.edu.tr

Abstract: Addiction, basically two groups are examined. The first is piracy of individuals, and the second is psychological theft. Examination as the use bodies of substances related to external factors constantly get used to these substances, depending on external factors, and undesirable results may occur when these components cannot be taken into the body. Traditional habitual hacking, which is described as digital addiction, brings with it an interest in technological devices and a lack of access to them. Digital components guide the spirits that feed the conflict in case the higher units cannot access the relevant devices, and tolerance for guests and other children is observed. Financial literacy, which is the other variable of the research, defines the limits of being able to make effective decisions about the management of money. This concept, which can also be defined as the act of saving information, does not include intelligent action in details such as investment, budget, debt, portfolio diversification. Financial literacy can also be interpreted as making behavioral decisions such as making financial plans, saving and spending results. Financially literate people are well versed in money management and are well acquainted with the economic processes of saving. This concept, which is considered important of financial resources in crisis environments, is evaluated as individuals' correct interpretation of their financial resources and acting in this context. The increase in the concept of financial literacy has revealed economic fluctuations. As a matter of fact, it is seen that countries and societies with high financial information have high savings. These countries are generally the ones that have learned lessons from the financial crises. The aim of the research is to determine whether digital addiction has an effect on financial literacy. In this context, university students were selected as a sample in the study, and a face-to-face survey was applied to 372 university students. Digital addiction scale and financial literacy scale were used as data collection tools in the research. Both of the research scales are in five-point Likert type. The research data were analyzed by the SPSS 26 program, correlation and regression analyzes were carried out between the two related variables that constitute the subject of the study. When the results of the analysis were examined, it was determined that digital addiction did not have a significant relationship on financial literacy. At the same time, within the scope of testing the research hypothesis, it was determined that digital addiction did not have any significant effect on financial literacy.

Key Words: Digital addiction, Financial literacy, University Students

1. Introduction

In the last few years, digital addiction (DA) has emerged as an important research area due to its increasing prevalence (Pan, Chiu and Lin, 2020). Digital addiction, which is considered one of the most important addictions of today's world, is more dangerous for young individuals. It is known that young people feel uncomfortable when they are away from their phones, cannot check their e-mails, and cannot log in to social media (Altınok, 2021: 263). Children who do not have adaptation problems related to the acceptance and use of technology are called "digital natives". This new generation of children is very successful in the use of technology and technological devices compared to the older generations. In this case, the role of the digital elements they are exposed to from the moment they are born is great (Cho, Kim and Lee, 2016: 365). Researching young people's technology use and addiction, Almourad et al. (2020: 240) digital addiction; game addiction, internet addiction and phone addiction. Internet addiction, Wolfling et al. (2014: 7); It is defined as psychosocial behaviors that occur as a result of individuals' excessive internet use. Game addiction is defined as "people who have difficulty in controlling playtime, have low academic performance, do not attend school regularly, engage in interpersonal conflicts, and display maladaptive behaviors due to excessive online gaming, including feelings of anxiety and distress when withdrawing from online games" (Alrobai et al., 2016; Kiraly et al., 2014). One of the reasons why smartphone addiction has become so widespread is that these phones have many functions. Thanks to this technology, individuals can access their bank accounts, control their social media accounts, e-mails, and do many other things remotely. However, as a result, this addiction also changes the habits, socialization and routines of individuals (Samaha and Hawi, 2016: 322).

Although financial literacy, another variable of the research, is a popular concept in the finance literature, there is no clear definition of the concept. Huston (2010) defines the concept as the ability to make effective decisions about the management of money (Huston, 2010). The concept of financial literacy has been revealed by the economic contractions in the world. As a matter of fact, it is seen that countries and societies with high financial

knowledge have more savings. These countries are generally those that have learned lessons from financial crises (Taylor and Wagland, 2013). Financial literacy is also defined as making quality decisions about making financial plans, saving and borrowing (Lusardi and Mitchell, 2014). Individuals with financial literacy are well-versed in money management and know the functioning of economic institutions well (Mahdizadeh and Tabiani, 2013). This concept, which is considered to be financially important in crisis environments, is defined as the individual's correct interpretation of financial information and acting in this context (Mason and Wilson, 2000).

In the light of this information, firstly, the introduction part is given for the research, in this context, the related variables are conceptually discussed and a literature review regarding these variables is included. Then, the data collection tools and the validity and reliability analyses of these tools were included in the method section, and the correlation and regression analyses and results were mentioned in the findings section. In the conclusion part, the results of the research are interpreted, the limitations of the research and suggestions for other researchers are given.

2. Literature Review

Within the scope of the literature review, firstly, the researches on digital addiction, one of the variables of the research, which have been examined in recent years, are included.

Savcı and Aysan (2017) investigate the effects of internet addiction, social media addiction, digital game addiction and smartphone addiction on social commitment. Analyzing data from 201 adolescents, the study found that these technological addictions significantly predicted 25% of social connectedness. Internet addiction has the strongest effect, followed by social media addiction, digital game addiction and smartphone addiction. These findings highlight the important role of technological addictions in shaping social connectedness.

Marsch (2020) discusses the role of digital technologies in promoting and understanding health, particularly in the context of addiction. It emphasizes the application of digital health approaches in addiction medicine, focusing on advances in real-time measurement of drug use events, factors in the environment, and the use of real-time data to inform sensitive interventions to prevent and treat substance use disorder. While using addiction medicine as an example, the manuscript highlights that science-based digital health has the potential to provide scalable solutions for precision healthcare delivery in a variety of diseases worldwide.

Aleksic (2018) examines the relationships between digital game preferences, habits and addiction among early adolescents. The research sample includes 1262 students aged between eleven and fifteen from 22 schools in Serbia. Within the scope of the study, a psychometric tool was developed and evaluated. The effect of socio-demographic factors on digital game preferences, habits and addiction was analyzed. The research hypotheses were confirmed as the results supported the existence of an association between digital gaming and addiction among early adolescents.

Dresp-Langley and Hutt (2022) examines the relationship between digital addiction and sleep. He discusses how excessive online activity and internet use can lead to sleep disruption and insomnia. The study highlights the neurological implications, behavioral symptoms, and impact of altered motivation, memory function, mood, and lifestyle variables. The article highlights the importance of addressing sleep deprivation as a key factor in digital addiction.

Ali (2018) examines the use of gaming and behavior-changing mechanisms in digital media to enhance user engagement and experience, while also considering their potential negative impact on well-being. As certain usage patterns of digital media meet the criteria for behavioral addiction, concerns arise about the ethical concerns, practices, and responsibilities of software companies. Unlike alcohol, digital media can be designed to detect and respond to problematic use. This invited talk highlights the importance of involving the software engineering community in designing conscious and conscious use of technology.

Aktas, et al. (2022) aimed to examine the relationship between digital addiction, academic performance and sleep disturbance in nursing students. The study included 429 nursing students and used a relational and cross-sectional design. Results revealed a significant positive correlation between mean Sleep Disorder (SD) T-scores and Digital Addiction Scale (DAS) scores ($r = 0.203$, $p < 0.01$). In addition, a positive correlation was found between mean SD T-scores and DAS subscale scores ($p < 0.01$). The results highlight the impact of digital addiction on sleep disturbance among nursing students. It is recommended that nursing students be given training to raise awareness about the negative effects of digital addiction.

The researches that have been examined in recent years during the literature review on financial literacy, which is another variable of the research, are given below.

Nesleha (2017), "Financial Literacy: Study of the Financial Literacy Level" examines the objective level and subjective self-assessment of financial literacy among different age groups. The study aims to measure the difference between the two and identify potential gaps. The research collects data through an electronic questionnaire and uses statistical methods such as t-tests and descriptive statistics to analyze the results. The findings of the study provide valuable information to suggest changes in formal and non-formal education systems to improve financial literacy.

Karakorum-Ozdemir, et al. (2019) explores the importance of financial literacy in increasing the financial well-being of individuals in developing countries. The study focuses on Mexico, Lebanon, Uruguay, Colombia and Turkey and aims to identify the least financially literate groups in each country to facilitate targeted public policy. The findings reveal that low financial literacy scores are associated with women, young adults, and people who do not have literacy skills in their country's official language. Consistent with previous research in developed countries, the study shows that financial literacy is positively associated with education, including both years and quality of education. In addition, the study highlights the existence of regional differences in Mexico and Turkey that should be noted. Persistent inequalities in financial literacy between countries can be explained in part by differences in financial inclusion.

Hidajat and Hamdani (2017) specifically address the need for a measurement tool to assess the level of financial literacy regarding Islamic financial products and services. While traditional financial literacy measures have and continue to evolve, there is currently no comparable tool for Islamic finance. The use of traditional financial information as a measurement tool for Islamic financial literacy is insufficient. Financial literacy has been shown to positively influence financial decision-making and behavior, emphasizing the importance of a specific measurement tool for Islamic financial literacy. This article presents a conceptual framework that aims to develop and measure financial literacy from an Islamic perspective. The proposed Islamic financial literacy index will serve as a valuable tool to measure literacy level related to Islamic financial products and services.

Dolakova (2014) examines the financial literacy of students enrolled in the "Financial Literacy" course at Masaryk University. The study focuses on students' financial literacy levels at the beginning of the course. The aim is to evaluate students' initial financial literacy levels and to determine the impact of the course on their knowledge and abilities. The contribution includes a description of key financial literacy concepts and theoretical knowledge in the first section. The research was conducted through a survey questionnaire, which served as an entrance exam for course enrollments. The results of the survey show that students who completed the course showed improvement in their financial literacy knowledge and skills. Although not all of the enrolled students were enrolled or passed the course, the findings show that the "Financial Literacy" course has a positive effect on the students' financial literacy levels.

Kawamura et al. (2021) examines the relationship between households' financial literacy, behavioral factors, and financial choices using data from a 2018 survey conducted in Japan. The study reveals that financial literacy has a significant impact on financial decision making. Surprisingly, individuals with high levels of financial literacy display counterintuitive behaviors such as taking excessive risks, accumulating high levels of debt, and having naive financial attitudes. In other words, higher financial literacy tends to make individuals more daring and reckless in certain financial aspects. However, financially literate individuals exhibit better retirement planning skills and remain indifferent to gambling. The study also highlights the impact of discount factors on financial choices, as well as individual preferences such as risk and loss aversion.

Zhu (2021) explores the relationship between types of financial literacy, financial behaviors, and the role of financial education among adolescents. The study divides financial literacy into four types based on objective and subjective financial literacy scores: financial literacy overconfidence, underconfidence, competence, and naivety. Data were collected from 330 students aged around 15 years in Hong Kong. The findings reveal that adolescents who are overconfident in their financial literacy are more likely to engage in risky financial behaviors and exhibit higher levels of financial autonomy. Additionally, a randomized experimental study was conducted to evaluate the effect of financial education on the mismatch between financial goal and subjective information. The results showed a significant increase in lack of confidence following the financial education intervention, while no significant change was seen in the other three categories. These findings highlight the existence of overconfidence in financial literacy among both adolescents and adults, highlighting the importance of financial advisors and educators in increasing adolescents' financial inclusion.

Wilson, et al. (2014), explore the need for a clear understanding of the nature and definition of financial literacy. This chapter examines financial literacy in a variety of contexts, including households and government agencies such as for-profit businesses and public sector organisations. Before delving into financial literacy, this section examines the broader concept of literacy, which includes numeracy as a basis for understanding financial literacy. This section addresses the confusion surrounding financial awareness and financial literacy, which are often considered synonymous terms. This confusion is in part attributed to inadequate definitions of financial literacy that hinder its practical application. The authors discuss these limitations and propose a comprehensive definition of financial literacy that serves as a reference point for accounting educators.

Goel and Khanna (2013) emphasize the importance of financial education in achieving financial literacy amid the rapidly evolving financial landscape. With the millions of new consumers entering the global economy each year and the increasing complexity of the financial sector, individuals need to be equipped with the skills, knowledge, attitudes and understanding necessary to make informed financial decisions and protect themselves. The report discusses financial literacy and the meaning of financial education, the need and challenges of financial education in today's financial environment, and highlights various national and international financial education initiatives. The authors also make recommendations to promote financial education.

Findings from the literature reveal that digital addiction may have an impact on financial literacy. In this direction, the model of the research was created as in Figure 1. In addition, the hypothesis put forward within the scope of the research is as follows:

H₁: Digital addiction has an impact on financial literacy.

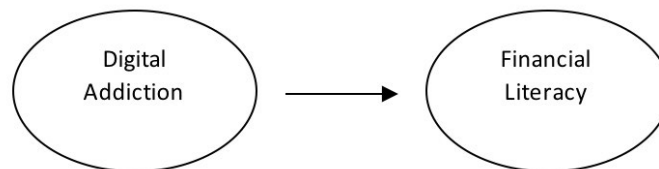


Figure1: Research Model

3. Method

In this section, information about data collection tools, reliability analysis, correlation analysis and simple regression analysis findings for hypothesis testing are given.

Digital Addiction Scale: In this study, which was conducted with a group of 687 students from Siirt, Dicle and Erzincan Universities, a draft scale of 28 items was created based on interviews with two students and their friends who spend a long time with digital tools, and expert opinions. In the pilot application, the Cronbach's alpha value of the scale was calculated as 0.874. For the scale development study conducted by Kesici and Tunç (2018), the test-retest reliability was calculated as $r=.779$ ($p<.001$), which was performed with three-week intervals. According to the results of the factor analysis, it was seen that the scale has a structure consisting of five sub-dimensions called Overuse, Non-Restriction, Inhibition of the Flow of Life, Emotional State and Addiction. According to the findings of the research, it is possible to say that this scale is a valid and reliable measurement tool that can be used to measure the digital addiction of university students. The Cronbach's alpha value of the 14-item scale in this study was determined as .835. This value indicates that the data is reliable on a high surface.

Financial Literacy Attitude and Behavior Scale: The scale was developed by Sarıgül (2015). During the development of the scale, the deductive method was preferred due to the availability of sufficient theoretical knowledge in the foreign literature. In this context, it was aimed to put the scales on a theoretical basis by conducting a wide literature review. In particular, Nash (2011), Robb and Woodyard (2011), OECD (2013), Dew and Xiao (2011), Prawitz et al. (2006) and Jorgensen (2007) used measurement tools. The questions in the scale are in a five-point Likert style. Internal consistency analysis was used to reduce the questions prepared for the scale. In the pilot study, the Cronbach's alpha coefficient was calculated as 0.75. In social sciences, it is stated that the reliability value should be at least 0.70. On the other hand, low-level alpha value is 0.60 for pilot studies for scale development, 0.80 for basic research, and 0.90 - 0.95 for applied research (Şencan, 2005). Then, exploratory factor analysis was performed and Kaiser Mayer Olkin (KMO) was found to be 0.812. The fact that the KMO coefficient is at least 0.60 and the Barlett test is significant indicates that the data are suitable for factor

analysis (Büyüköztürk, 2005). The Cronbach's alpha value of the 23-item scale in this study was determined as .940. This value indicates that the data is reliable on a high surface.

After this stage, frequency analyzes were started. The findings are as in Table 1.

Table 1: Demographic Data of Participants

Variables	Group	Frequency	Percentage
Gender	Female	178	47.8
	Male	194	52.2
Age	18	5	1.3
	19	34	9.1
	20	99	26.6
	21 and over	234	62.9
Class			
	High school	18	4.8
	Associate degree	214	57.6
	Licence	140	37.6
Total		372	100

When Table 1 is examined, it is seen that 47.8% of the students participating in the research are female and 52.2% are male. In the relevant sample, approximately 63% of the participants are 21 years or older. When the education degrees are examined, it is seen that associate degree graduates constitute approximately 58% of the total participants.

Before starting the regression analysis to test the research hypothesis, correlation analysis was performed to determine the relationship between the variables. The results are as in Table 2.

In the related study, correlation analysis was performed to determine whether there is a relationship between the variables and the data regarding the correlation obtained as a result of the analysis are given in Table 2.

Table 2: Correlation Between Variables

		1	2
Digital Addiction	Pearson Correlation	1	
Financial Literacy	Pearson Correlation	-.035	1

As seen in Table 2, no statistically significant relationship was found between the variables according to the results of the correlation analysis ($p > 0.000$). After this stage, simple regression analysis was applied for hypothesis testing. Since the results of the analysis on the scales reveal that regression analysis can be done to determine whether there is an effect between the two variables, regression analysis is included in order to determine the effect of digital addiction on financial literacy at this stage. The results are as in Table 3.

Table 3: Regression Analysis Findings on the Effect of Digital Addiction on Financial Literacy

Dependent Variable	Independent Variable	t	B	F	p	R ²
Digital Addiction	Constant	16.945	-.038	.457	.500	.001
	Digital Addiction	-.676				

When Table 3 is examined, it is seen that the p value produces an insignificant result ($p > 0.000$). This shows that digital addiction does not have any statistically significant effect on financial literacy. According to this finding, the hypothesis of the research, H_1 , was rejected.

4. Conclusion

In the related research, it is aimed to determine whether digital addiction has an effect on financial literacy. 372 students participated in the research conducted on university students and answered the survey questions. The Digital Addiction Scale and the Financial Literacy Scale were used to determine the effect of the research variables on each other. Both related scales are in 5-point Likert type. According to the findings of the research

conducted on the relevant sample, it was determined that digital addiction did not have a significant effect on financial literacy. In other words, the hypothesis H_1 : "Digital addiction has an impact on financial literacy" is rejected. In this context, the determination of the relationship and effects between digital addiction and different variables may be meaningful for future research. On the other hand, as in every study, this study has certain limitations. The cross-sectional type of the research brings with it the obligation of the students to answer the survey questions in a limited time. In other words, the answers given by the students to the relevant propositions are a reflection of their current psychology. On the other hand, the number of questionnaires applied to different samples for quantitative research designs in social sciences is quite high. This situation is evaluated negatively in terms of participant candidates. In addition to these, the application of the relevant variables in different samples may bring different results.

References

- Aktas, Y.Y., Karabulut, N. and Arslan, B. (2022). DigitalAddiction, AcademicPerformance, AndSleepDisturbanceAmongNursingStudents. *Perspectives in PsychiatricCare*, Vol 58, No. 4, 1537-1545.
- Aleksic, V. (2018). EarlyAdolescents' DigitalGameplayPreferences, Habits, andAddiction. *CroatianJournal of Education - Hrvatskičasopiszaodgojiozbrazovanje*, Vol 20, No. 2, 463-500.
- Ali, R. (2018). DigitalMotivation, DigitalAddictionandResponsibilityRequirements. InFucci, D.,Novielli, N. and Guzman, E. (Eds.), *Proceedings of the 2018 1st International Workshop on Affective Computing forRequirementsEngineering (AffectRE 2018)* (pp. 27-27). IEEE.
- Almourad, M. B., McAlaney, J., Skinner, T., Pleva, M. ve Ali, R. (2020). Defining Digital Addiction: Key Features from the Literature. *Psihologija*, 53(3), 237-253. <https://doi.org/10.2298/PSI191029017A>.
- Alrobai, A., McAlaney, J., Phalp, K. ve Ali, R. (2016). Online Peer Groups As A Persuasive Tool To Combat Digital Addiction. *Persuasive Technology* (pp.288-300): Springer. https://doi.org/10.1007/978-3-319-315102_25
- Altınok, M. (2021). Lise Öğrencilerinin Dijital Bağımlılık ve Yaşam Doyumunun İncelenmesi. *Türk Eğitim Bilimleri Dergisi*, 19(1), 262-291.
- Büyüköztürk, Ş. (2005). *SosyalBilimlerİçin Veri Analizi El Kitabı*, PegemYayıncılık, Ankara.
- Cho, J.Y., Kim, T. ve Lee, B.G. (2016). Effective Parental Mediation For The Right Use Of Smart-Ophones in Early Childhood. *International Information Institute (Tokyo) Information*, 19(2), 365-372.
- Dew, J. ve Xiao, J.J. (2011).The Financial Management BehaviorScale: Development andValidation. *Journal of Financial Counselingand Planning*, Vol 22, No. 1, 43-59.
- Dolakova, B. (2014). "Financial Literacy of MasarykUniversityStudents in 'Financial Literacy' Course." InDeev, O.,Kajurova, V. and Krajicek, J. (Eds.), *Proceedings of theEuropean Financial Systems 2014* (pp. 151-158). 2014.
- Dresp-Langley, B. andHutt, A. (2022). DigitalAddictionandSleep. *International Journal of EnvironmentalResearchandPublicHealth*, Vol 19, No. 11, 6910.
- Goel, I. andKhanna, S. R. (2013). "Financial education as a tooltoachievefinancialliteracy." In M. Kuek, H. Cheng and R. Zhao (Eds.), *Proceedings of 2013 International Conference - WTO & Financial Engineering* (s. 338-345).
- Hidajat, T. andHamdani, M. (2017). MeasuringIslamic Financial Literacy. *Advanced ScienceLetters*, Vol 23, No. 8, 7173-7176.
- Huston, S. J. (2010). Measuring Financial Literacy. *Journal of Consumer Affairs*, Vol 44, No. 2, 296-316.
- Jorgensen, B.L. (2007).Financial Literacy of CollegeStudents: Parentaland Peer Influences. Master'sThesis, Virginia PolytechnicInstituteandStateUniversity, <http://scholar.lib.vt.edu/theses/available/etd-10162007-143627/unrestricted/CSFLCSurvey.pdf> , (30.07.2023).
- Karakurum-Ozdemir, K.,Kokkizil, M. and Uysal, G. (2019). Financial Literacy in DevelopingCountries. *SocialIndicatorsResearch*, Vol 143, No. 1, 325-353.
- Kawamura, T., Mori, T., Motonishi, T. andOgawa, K. (2021). "Is Financial Literacy Dangerous? Financial Literacy, BehavioralFactors, and Financial Choices of Households." *Journal of theJapaneseand International Economies*, 60, ArticleNumber: 101131.
- Kesici, A. and Tunç, N. F. (2018). The Development of theDigitalAddictionScalefortheUniversityStudents: ReliabilityandValidityStudy. *Universal Journal of EducationalResearch*, Vol 6, No. 1, 91-98.
- Kiraly, O., Nagygyörgy, K., Ggjifths, M. D. ve Demetrovics, Z. (2014). Problematic Online Gaming Behavioral Addictions: Criteria, Evidence, And Treatment (pp. 61-97). Elsevier. <https://doi.org/10.1016/B978-0-12407724-9.00004-5>
- Lusardi, A. andMitchell, O. (2014). TheEconomicImportance of Financial Literacy: TheoryandEvidence. *Journal of EconomicLiterature*, Vol 52, No. 1, 5-44.
- Mahdzan, N. S. and S. Tabiani (2013). TheImpactof Financial Literacy on IndividualSaving: An ExploratoryStudy in TheMalaysianContext. *Transformations in Business andEconomics*, Vol 12, No. 1, 41-55.
- Marsch, L. A. (2020). DigitalHealthandAddiction. *CurrentOpinion in SystemsBiology*, 20, 1-7.
- Mason, C. L. J. and Wilson, R. M. S. (2000). Conceptualising Financial Literacy. *LoughboroughUniversity Business School*.
- Morahan-Martin, J. (2005). Internet Abuse: Addiction? Dizorder? Symptom? AlternativeExplanations. *SocialScienceComputerReview*, Vol 23, No. 1, 39-48.
- Nash, J. (2011). Adult Financial Literacy in Australia. *Australiaand New ZealandBankingGroup Limited SocialResarch*.

- Nesleha, J. (2017). "Financial Literacy: Study of the Financial Literacy Level." In Nesleha, J., Plihal, T. and Urbanovsky, K. (Eds.), *European Financial Systems 2017: Proceedings of the 14th International Scientific Conference*, Pt 2 (pp. 120-124).
- O'Reilly, M. (1996). Internet Addiction: A New Disorder Enters the Medical Lexicon. *Canadian Medical Association Journal*, 154, 1882 – 1883.
- OECD (2013). OECD/INFE Toolkit to Measure Financial Literacy and Inclusion: Guidance, Core Questionnaire and Supplementary Questions. http://www.oecd.org/daf/fin/financial-education/TrustFund2013OECDINFE_toolkit_to_measure_fin_lit_and_fin_incl.pdf, (30.07.2023).
- Pan, Y. C., Chiu, Y. C., & Lin, Y. H. (2020). Systematic Review And Meta-Analysis Of Epidemiology Of Internet Addiction. *Neuroscience & Biobehavioral Reviews*, 118, 612-622.
- Prawitz, A.İ. Et al. (2006). In Charge Financial Distress/Financial Well-Being Scale: Development, Administration, and Score Interpretation. *Journal of Financial Counseling and Planning*, Vol 17, No. 1, 34-50.
- Robb, C. ve Woodyard, A.S. (2011). Financial Knowledge and Best Practice Behavior. *Journal of Counseling and Planning*, Vol 22, No. 1, 60-70.
- Samaha, M. ve Hawi, N. S. (2016). Relationships Among Smartphone Addiction, Stress, Academic Performance, And Satisfaction With Life. *Computers in Human Behavior*, 57, 321-325.
- Sarıgül, H. (2015). Finansal Okuryazarlık Tutum Ve Davranış Ölçeği: Geliştirme, Geçerlik ve Güvenilirlik. *Journal of Management and Economics Research*, Vol 13, No. 1, 200-218.
- Savci, M. and Aysan, F. (2017). Technological Addictions and Social Connectedness: Predictor Effect of Internet Addiction, Social Media Addiction, Digital Game Addiction, and Smartphone Addiction on Social Connectedness. *Düşünen Adam - Journal of Psychiatry and Neurological Sciences*, Vol 30, No. 3, 202-216.
- Şencan, H. (2005). *Sosyal ve Davranışsal Ölçümlerde Güvenilirlik ve Geçerlilik*, Seçkin Yayıncılık, Ankara.
- Taylor, S. M. and Wagland, S. (2013). The Solution to the Financial Literacy Problem: What is the Answer? *Australasian Accounting Business and Finance Journal*, Vol 7, No. 3, 69-90.
- Wilson, R. M. S., Abraham, A. and Mason, C. L. J. (2014). "The nature of financial literacy." In R. M. S. Wilson (Ed.), *Routledge Companion to Accounting Education* (s. 50-80). *Routledge Companions in Business Management and Accounting*.
- Wolfling, K., Beutel, M.E., Dreier, M., ve Müller, K. W. (2014). Treatment Outcomes in Patients With Internet Addiction: A Clinical Pilot Study On The Effects Of a Cognitive-Behavioral Therapy Program. *BioMed Research International*, 2014, 1-8. <https://doi.org/10.1155/2014/425924>
- Zhu, A. Y. F. (2021). Financial Literacy Types and Financial Behaviors Among Adolescents: Role of Financial Education. *Journal of Financial Counseling and Planning*, Vol 32, No. 2, 217-230.

ChatGPT-Proofing: Redesigning Assessment Practices for E-Learning

Tapiwa Gundu

Nelson Mandela University

tapgun@gmail.com

Abstract: The 21st century has ushered in a profound transformation in the realm of education, fueled by the widespread integration of e-learning, fueled by technological advancements and the pursuit of adaptable and accessible learning modalities. As the e-learning landscape continues to evolve, a pertinent question emerges: Do conventional assessment methods align effectively with the exigencies of the digital era and the competencies imperative for thriving in the knowledge economy? This systematic literature review undertakes a comprehensive exploration of this significant question. Through a meticulous synthesis and analysis of a diverse body of existing research, this review effectively brings to light compelling evidence that underscores the pressing need for the redesign of assessment practices within the context of e-learning. In probing this multifaceted subject, the review critically examines how traditional assessment approaches may fall short in capturing the intricacies of modern-day skillsets, critical thinking proficiencies, and adaptability demanded by the swiftly evolving digital landscape. In its conclusion, this study serves as a pivotal catalyst for change, illuminating the urgency and potential benefits of reimagining assessment practices for the dynamic realm of 21st-century e-learning. Based on the findings, it provides stakeholders with prudent and actionable recommendations, empowering them to embark on a purposeful journey of redesigning assessment strategies. By proactively embracing these recommendations, educators, policymakers, and institutions can engender a learner-centric ecosystem that optimally nurtures and empowers learners for a future defined by innovation and adaptability.

Keywords: ChatGPT, Generative AI, e-Learning, Assessment Methods, Higher Education

1. Introduction

The advent of the 21st century has brought about a remarkable transformation in the field of education, primarily driven by the rapid advancement of technology (Ebner et al., 2020). As digital technologies have revolutionized the way knowledge is acquired, disseminated, and accessed, e-learning has emerged as a prominent mode of education delivery, offering unprecedented flexibility and accessibility to learners worldwide (Ebner et al., 2020). However, despite the remarkable progress in e-learning methodologies, the assessment practices employed in this digital era often lag behind, relying on traditional methods that have roots dating back to ancient times. This paper delves into the critical issue of assessment practices in 21st-century e-learning environments and examines the extent to which these practices align with the dynamic and evolving educational landscape. Specifically, we explore the idea that contemporary e-learning, coupled with transformative language models like ChatGPT, has unveiled the shortcomings of traditional assessment methods, which are reminiscent of practices from as early as the 7th century.

In recent years, the integration of artificial intelligence (AI) and natural language processing (NLP) technologies into e-learning has provided new avenues for personalized and adaptive learning experiences (Baidoo-Anu & Owusu Ansah, 2023). Among these AI-powered innovations, ChatGPT, an advanced language model developed by OpenAI, has significantly reshaped the landscape of human-computer interaction and information processing. ChatGPT's ability to generate coherent, contextually relevant responses and its capacity to simulate human-like conversation have sparked a need for reevaluation of traditional educational practices, including assessments (Gundu, 2023).

The 7th-century assessment methods, characterized by written examinations, oral recitations, and tests which were all memorisation-based evaluations (Monroe, 1905), and have become questionable. These have served as the primary means of evaluating knowledge and understanding for centuries. While these methods may have been suitable for the educational needs of their time, they fail to accommodate the multifaceted demands of modern e-learning environments (Bryan & Clegg, 2019). The dynamic nature of digital education requires assessments that can assess critical thinking, problem-solving, creativity, collaboration, and adaptability skills that are pivotal in a rapidly changing world (Cahapay, 2020).

The transformative potential of ChatGPT and similar AI technologies in e-learning has highlighted the need for a paradigm shift in assessment practices as students can use these technologies to generate answers for assessments. This has shown a need to shift from static, standardised assessments to dynamic and adaptive evaluations for lecturers to have a deeper understanding of the students' progress (Cotton et al., 2023).

In this paper, we investigate the challenges in the current assessment methods and discuss opportunities in redesigning assessment practices for e-learning in the 21st century, with an emphasis on fostering a learner-

centric approach that nurtures creativity, critical thinking, and a growth mindset. Additionally, we explore how AI technologies can complement human expertise, enabling educators to focus on mentorship and personalized guidance.

Ultimately, this paper aims to shed light on the transformative potential of e-learning assessment practices, prompting educators, policymakers, and stakeholders to reconsider the traditional methods inherited from the past by exploring alternative assessment methods, such as project-based evaluations, portfolios, and performance assessments can better assess students' critical thinking, creativity, and problem-solving skills vs assessing knowledge retention. These innovative assessment approaches seem to align better with the evolving needs of learners and the ever-changing knowledge economy.

The rest of the paper is structured as follows, next, the background of the study will be discussed followed by the purpose and objectives of the study. A literature review and methods applied will then be discussed, these would then be followed by findings and discussion of the findings. The paper will round up with a conclusion that will discuss the recommendations and possibilities for future studies.

1.1 Background

There has been a significant shift in the way teaching and learning occur, with advancements in technology playing a major role. Some popular learning methods of the 21st century include online learning, gamification, mobile learning, personalized learning, project based learning, social learning and artificial Intelligence assisted learning (Cahapay, 2020). The internet and advancements in online education technology have made it possible to access courses and educational content from anywhere in the world. The Use of game elements in non-game contexts, such as education, to motivate and engage students has also been noticed in the education environment of this day and age (Manzano-León et al., 2021). Most students have a mobile device of some sort, be it a smartphone or a tablet. The use of these devices for learning purposes, including educational apps, podcasts, and mobile-responsive e-learning platforms has also been greatly reported in literature. Social learning through interactions with others, including peers, instructors, and mentors has also been reported as a common form of teaching and learning. The surfacing of ChatGPT in November 2022 has led to a rise in the use of artificial intelligence to enhance the learning process (Baidoo-Anu & Owusu Ansah, 2023).

Some commonly used assessment methods in universities are tests, exams, essays, projects and group work. While the objective of tests and exams is to measure a student's knowledge and understanding of the course material, essays are written assignments that require students to critically analyze and present their arguments on a given topic (Bryan & Clegg, 2019). On the other hand, projects are meant to be hands-on assignments that challenge students to apply their learning to real-world scenarios. Presentations are oral assessments that allow students to demonstrate their knowledge and communication skills. And lastly, group work is collaborative assignments that assess students' teamwork, leadership, and problem-solving skills (Brown, 2019). Although this shows a broad array of assessment techniques, usually most weight is put on exams and tests which this paper regards as a weak assessment method mainly because ChatGPT can generate answers for such. But besides that, this method was not relevant anymore because of the following limitations and drawbacks.

Exams and tests:

- have a Narrow focus, they typically assess only a limited set of knowledge and skills, and may not provide a complete picture of a student's understanding of the material (Eltahir et al., 2022).
- Exams and tests can often place too much emphasis on memorisation, rather than critical thinking and problem-solving skills (Sato et al., 2015).
- can create stress and anxiety for students, especially if they are high-stakes or the sole basis for grading. This can lead to poor performance and can detract from the overall educational experience (Woldeab & Brothen, 2019).
- typically only assess what students have learnt, rather than their ability to apply that learning in new and creative ways (Awad Ahmed et al., 2021).
- often provide limited feedback to students, which can make it difficult for them to identify areas for improvement and to learn from their mistakes (Winstone & Boud, 2022).
- can sometimes be culturally biased, as the types of questions and methods of assessment may not be equally accessible to all students, particularly those from non-dominant cultural groups (Dahlgren & Hansen, 2015).

1.2 Purpose of the study

The purpose of this study is to investigate and expose the ineffectiveness of 7th-century assessment methods in 21st-century e-learning environments and to redesign assessment Practices with more learner-centric evaluation strategies.

1.3 Objectives of the study

The objectives of this study are as follows:

1. Exploration of the historical roots and origins of assessment methods and identifies traditional practices that date back to ancient civilizations. By understanding the historical context, the research establishes a foundation for evaluating the persistence of these methods in modern e-learning environments.
2. Investigating the effectiveness of traditional assessment methods and their relevance to 21st-century e-learning.
3. Propose reforms in assessment practices in e-learning environments based on the findings.
4. Provide recommendations for educators, policymakers, and stakeholders on how to redesign assessment practices in 21st-century e-learning.

2. Literature review

There has been a great shift in the way learners engage with information and interact with educators. With advancements in artificial intelligence and natural language processing, language models like ChatGPT have revolutionized human-computer interaction, sparking discussions about their impact on educational practices. This literature review critically examines the role of traditional methods of assessments in the era of ChatGPT and similar AI technologies.

2.1 Different subjects have different assessment requirements

Different subjects have different assessment requirements (Shraim, 2019), however, this study has a special emphasis on assessment requirements for practical subjects. Practical subjects refer to academic areas that focus on the application of hands-on and experiential learning, rather than theoretical or conceptual knowledge (Popkewitz, 2018). Practical subjects prepare students for specific careers in fields such as technology, arts and crafts, manufacturing and trades, agriculture and natural resources, etc. Practical subjects often require students to complete hands-on projects, internships, or apprenticeships to gain experience and develop skills in their chosen field (Popkewitz, 2018).

On the other hand, theoretical subjects are academic areas that focus on the study of concepts, ideas, and abstract reasoning, rather than hands-on or practical skills (Popkewitz, 2018). Theoretical subjects are focused on building a strong foundation of knowledge in areas such as mathematics, humanities, social sciences, etc. Theoretical subjects often require students to engage in critical thinking, problem solving, and independent research to gain a deeper understanding of their chosen subject area (Popkewitz, 2018). In addition, theoretical subjects may be offered in conjunction with practical subjects, such as laboratory or studio classes, to provide a well-rounded education and prepare students for further study or careers in their chosen field.

2.2 Purpose of assessments

The purpose of assessments in higher education, particularly in the context of e-learning, serves several essential functions that contribute to the overall educational experience and student development (Bryan & Clegg, 2019). These assessments are supposed to play a crucial role in evaluating student progress, promoting effective learning, and ensuring the attainment of 'educational objectives'. The assessments aim to measure and evaluate the extent to which students have achieved the desired 'learning outcomes' (Gamage et al., 2020). Through various assessment methods, educators can gauge the level of knowledge, skills, and competencies acquired by students, providing valuable feedback to both learners and instructors. The question we can ask ourselves is, are the educational objectives and learning outcomes of today's e-learning environments still measurable by these assessments? Another purpose of assessment is for affording students' feedback for improvements and encouraging active learning (Winstone & Boud, 2022). Through various assessment formats, such as quizzes, projects, and discussions, e-learning encourages students to actively engage with the course content. Interactive assessments prompt critical thinking, problem-solving, and application of knowledge, fostering deeper understanding and higher-order cognitive skills.

Ultimately the goal of higher education is to build a competitive workforce/entrepreneurship-force to meet the job market/entrepreneurial demand. Are the current assessments still able to measure if students have achieved relevant and industry-specific competencies, preparing them for successful entry into the economy? Is there a need for them to memorise information when they will have gadgets in, their pockets to give them that

information if required at the workplace? This study advocates for assessing the ability to apply knowledge and skills as opposed to the ability to retain knowledge. Therefore, there is a strong need to rethink assessments in order to optimize students educational experience, promote continuous improvement, and prepare them for the demands of a rapidly evolving global workforce.

2.3 The evolution of assessment methods

Historically, assessment practices in education have “evolved” from oral recitations and memorisation-based evaluations to the use of written examinations and standardized tests. These methods, while effective in their time, have been critiqued for emphasizing rote learning over critical thinking and problem-solving skills (Birenbaum, 2007; Bryan & Clegg, 2019). The contemporary e-learning environment demands assessments that align with the skills required for success in the 21st-century workforce, including creativity, collaboration, adaptability, and digital literacy (Herckis, 2018). The history of written exams and tests dates back to ancient civilizations, where assessments were conducted to evaluate individuals' knowledge and skills. Figure 1 is an overview of the evolution of written exams and tests throughout history.

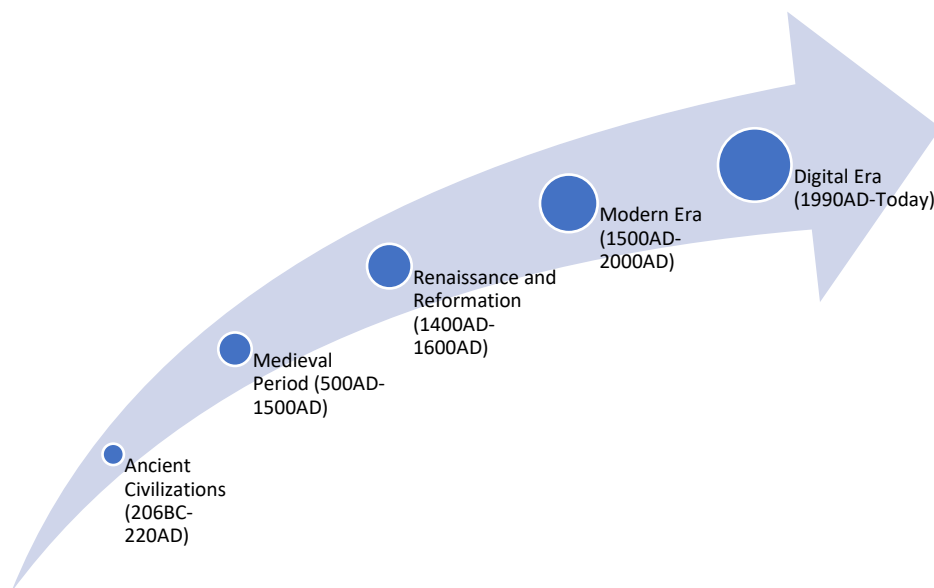


Figure 1: Overview of the evolution of written exams and tests

1. **Ancient Civilizations:** The concept of written exams can be traced back to ancient civilizations like China and Mesopotamia. In China, during the Han Dynasty, civil service exams were conducted to select government officials based on their knowledge of Confucian classics and administrative abilities (Li & Hayhoe, 2012). Similarly, in Mesopotamia, scribes were tested on their ability to write and interpret cuneiform script.
2. **Medieval Period:** In the Middle Ages, educational institutions like monasteries and cathedral schools in Europe used written exams as a way to assess students' understanding of religious texts and other subjects like arithmetic and grammar (Mounier-Kuhn, 2020).
3. **Renaissance and Reformation:** With the rise of humanism during the Renaissance, education shifted focus from religious subjects to broader knowledge in fields like literature, history, and philosophy (Eskelson, 2020). Written exams became more common in universities and schools to evaluate students' comprehension of these subjects.
4. **Modern Era:** The 19th century saw the establishment of standardized examination systems in various countries. Notable examples include the British "General Certificate of Education" (GCE) exams and the French "baccalauréat" exams (Brooks, 1993).
5. **Digital Era:** With the advent of digital technology, traditional paper-based exams have begun to transition to computer-based formats. Online examinations allow for more efficient grading and provide opportunities for remote testing (Herckis, 2018). As the history of written exams continues to evolve, alternative forms of assessment, such as project-based evaluations, are being explored to assess a broader range of skills beyond rote memorisation.

It is interesting to note that, throughout history, the purpose of written exams has remained consistent. The purpose being to evaluate individuals' knowledge, skills, and readiness for further education or professional

roles. However, the formats of these exams have continuously evolved to meet the changing demands of education and society.

2.4 Impact of ChatGPT on Assessments in e-learning assessment environments

ChatGPT's sophisticated language processing capabilities have prompted educators and researchers to reconsider traditional assessment methods. While Chat GPT has the potential to enhance learning experiences, its misuse by students can pose significant challenges to academic integrity and ethical conduct (Cotton et al., 2023). Students may exploit Chat GPT during online exams or quizzes to seek answers in real-time, bypassing the intended evaluation process. This form of cheating can compromise the fairness and accuracy of assessments. Studies suggest that Generative AI is here to stay and that being so, there is a great need for an assessment mindset shift, from focusing on memorisation to application, encouraging critical thinking and problem-solving skills that AI algorithms cannot emulate (Baidoo-Anu & Owusu Ansah, 2023).

3. Method

A systematic literature review is a rigorous and comprehensive method of reviewing existing research to identify, assess, and synthesize relevant studies on a specific research topic or question. In this paper, a systematic literature review is employed to gather evidence to prove that the assessment methods that are being used might be outdated for 21st-century e-learning environments.

3.1 Search Strategy

A comprehensive search of peer-reviewed articles, conference papers, and relevant academic databases was conducted. Keywords such as "e-learning," "artificial intelligence," "ChatGPT," "assessment practices," and "redesign" were used in various combinations to ensure the inclusiveness of the search.

A 'who', 'what', 'how' and 'where' (WWHW) table was used to assist in the creation of the key search terms and ultimately the research string. The WWW table, Table 1 is presented below.

Table 1: WWW Table

	WHO	WHAT	HOW	WHERE	OTHER ISSUES
Are 7th-century engineered assessment methods still effective for 21st-century e-learning styles	Lecturers/ students	Assessment Methods	Assessment Plan	University/ College	E-Learning/ Remote Learning

The development of the search string was an iterative process. The resultant research string was:

("Assessment Method" OR "Assessment Plan") AND ("e-learning" OR "remote learning") AND ("higher education" OR "tertiary education" OR "university" OR "College")

For this study, the researcher utilized several bibliographic databases, including EBSCOhost Research database, Emerald Insight, Science Direct, and Google Scholar. The same search string was applied consistently across all the selected databases. The research process involved both initial and secondary screening of the search results. To manage the systematic reviews efficiently, the researchers employed Rayyan, a web-based application designed to assist researchers in creating and organizing their reviews.

3.2 Inclusion Criteria

For this study, the researcher utilized several bibliographic databases, including EBSCOhost Research database, Emerald Insight, Science Direct, and Google Scholar. The same search string was applied consistently across all the selected databases. The research process involved both initial and secondary screening of the search results. To manage the systematic reviews efficiently, the researchers employed Rayyan, a web-based application designed to assist researchers in creating and organizing their reviews. The inclusion and exclusion criteria are shown in Table 2.

Table 2: Inclusion and exclusion criteria

INCLUSION CRITERION	EXCLUSION CRITERION
- assessment methods - Higher education; university; college; tertiary education - Learning technologies; digital technologies; e-learning; remote learning	- Not applicable - Not relevant (outdated) - No abstract - Full-text unavailable - No translation for foreign language

3.3 Data Synthesis

The selected studies were subjected to data extraction, including information on research design, methodology, key findings, and implications. Thematic analysis was employed to identify common themes, patterns, and contradictions across the literature.

The aim of data synthesis is to combine multiple sources of information into a single, integrated, and comprehensive representation. This process involved collecting and integrating data from various sources discussed in section 3.1, and then using meta-analysis, and modelling techniques to create a synthesized dataset that provided a more complete and accurate picture of the subject matter. The goal of data synthesis is to improve understanding and decision-making by combining the strengths of individual sources and reducing the limitations and biases inherent in any one source.

4. Findings

A total of 342 articles were identified and retrieved for the research. The study focused on publications from 2013 up to the present, except for referenced articles specifically related to the learning style models mentioned in numerous citations. Refer to Table 3 for further details.

Table 3: Results of searches

Search String	("Assessment Method" OR "Assessment Plan") AND ("e-learning" OR "remote learning") AND ("higher education" OR "tertiary education" OR "university" OR "College")		
Database	Number of Hits	Database	Number of Hits
Google Scholar	125	Science Direct	107
EBSCOHost	34	Emerald Insight	76

After implementing the research string and obtaining the outcomes as described in Table 3, a PRISMA diagram was created. The PRISMA diagram serves as a visual representation of the information flow through the various phases of the systematic review, and it was utilised to report the findings from the conducted searches. Refer to Figure 2 for the diagram.

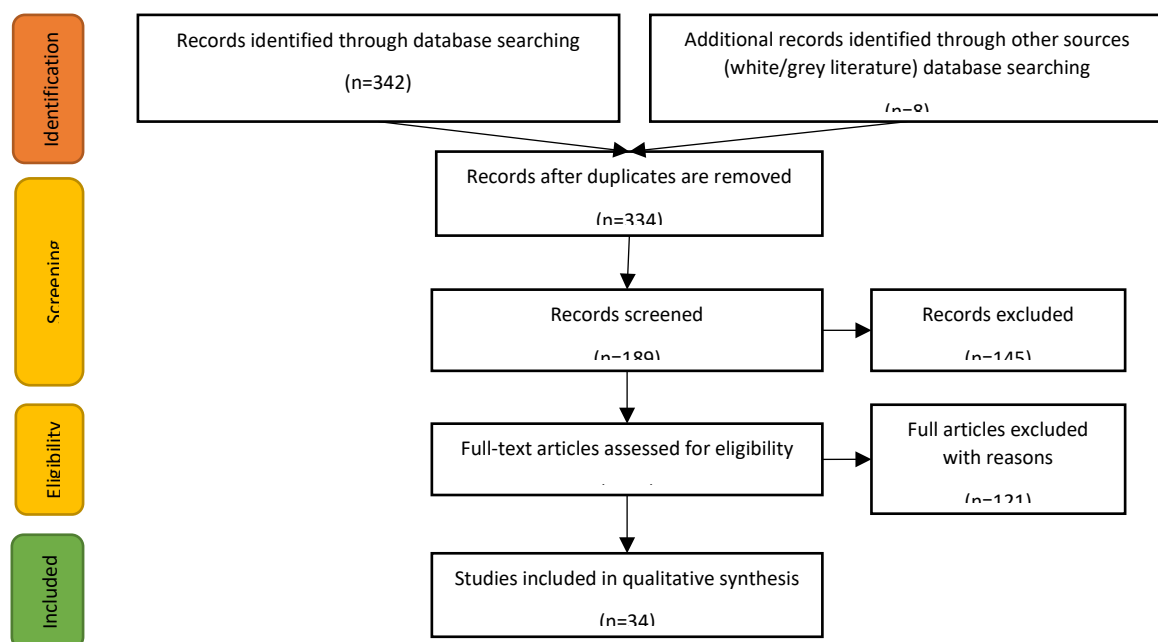


Figure 2: Systematic review flow

A total of thirty-four (34) articles that met the eligibility criteria underwent a quality assessment. Out of these, twenty-eight (28) papers were deemed suitable for inclusion in this systematic review.

To present the relevant and significant findings from these selected papers, data extraction tables were utilised. These tables contained valuable information and insights related to the research. Due to conciseness, the six (6) pages of data extraction tables have been summarized in Table 4.

Table 4: summary of data extraction table

	Major assessment methods			Learning Style			Subject Content	
Subcategories	Projects	Tests/Exams	Assignments	F2F	Online	Blended	Practical	Theoretical
Citing	6	20	2	0	26	2	25	3

As may be seen in Table 4, the majority of papers are based on e-learning (26) and are largely reliant on tests and exams (20) for practical e-learning modules (25). focused on blended learning components followed by 12 papers relating to blended learning styles.

5. Discussion

This section will critically discuss recommendations based on the findings for educational practices in the context of e-learning. It will highlight how to redesign assessment practices to meet the demands of the knowledge economy based on the outcome of the systematic literature review.

5.1 Recommendations for Redesigning Assessment Practices for 21st-Century E-Learning

Traditional assessment methods, such as written examinations and standardised tests, were designed for a different era and often fall short in assessing the diverse skills and competencies required in the modern workforce. This section discusses recommendations based on what was found in literature review. It was revealed that the 21st century education systems demand a more holistic approach to assessments that goes beyond testing memorisation and instead evaluates critical thinking, problem-solving, creativity, collaboration, and digital literacy (Bryan & Clegg, 2019). E-learning provides a unique opportunity to rethink assessment practices and align them with the needs of the skills and knowledge economy.

5.1.1 Recommended Assessment Practices

Adaptive Assessments: E-learning environments can be easily utilised for adaptive assessments, formative assessments, and authentic assessments. One of the key advantages of e-learning lies in its ability to harness technology for adaptive assessments (Brown, 2019). Adaptive assessments provide personalized feedback, allowing learners to focus on areas that require improvement and encouraging a growth mindset.

Formative assessments: these are ongoing and diagnostic in nature, play a crucial role in the learning process. In e-learning, formative assessments can be seamlessly integrated into courses, providing continuous feedback to learners and instructors (Sudakova et al., 2022). These assessments foster a deeper understanding of the course material, encourage active engagement, and support metacognitive skills as students monitor their own progress.

Authentic assessments: these mirror real-world challenges and tasks, allowing learners to demonstrate their knowledge and skills in practical contexts (McArthur, 2023). In e-learning, authentic assessments can be designed to simulate workplace scenarios or real-life problem-solving situations. Such assessments promote deeper learning, as students can apply their knowledge to meaningful and relevant situations (Woldeab & Brothen, 2019).

The dynamic nature of e-learning and the ever-changing demands of the 21st-century workforce call for these three discussed assessment strategies to prioritize the needs and individuality of learners. Learner-centric evaluation strategies place the focus squarely on the student, empowering them to take ownership of their learning journey and fostering a deeper understanding of course material.

5.1.2 Promoting Learner-Centric Evaluation Strategies

This section explores the importance of learner-centric evaluation strategies in e-learning and the various approaches that educators can adopt to create a more personalized and engaging assessment experience.

Empowering Learners through Self-Assessment

In learner-centric evaluation, self-assessment plays a vital role in helping students become active participants in their learning process (Luić, 2022; Riswanto et al., 2022). Encouraging learners to reflect on their progress, set learning goals, and assess their own performance fosters metacognitive skills and a sense of agency. E-learning platforms can facilitate self-assessment through quizzes, rubrics, and guided reflections, allowing learners to monitor their growth and make informed decisions about their learning path (Coutinho, Isabel, 2022).

Formative Assessments for Timely Feedback

Formative assessments are a cornerstone of learner-centric evaluation, providing ongoing feedback to support continuous improvement (Coutinho, Isabel, 2022; Sudakova et al., 2022). In e-learning, formative assessments can take various forms, such as quizzes, discussions, and interactive simulations. These assessments offer immediate feedback, enabling learners to identify areas of weakness and address misconceptions in real-time. The iterative nature of formative assessments promotes a growth mindset, where learners view mistakes as opportunities for learning and improvement.

Personalized Learning Pathways

Technology-driven adaptive assessments in e-learning platforms offer the potential for highly personalized learning pathways (Cevikbas & Kaiser, 2022). By analyzing individual learner data, such as learning preferences, strengths, and areas of improvement, educators can tailor assessments to match each student's unique needs. Personalized learning pathways ensure that learners receive content and challenges aligned with their current level of understanding, maximizing engagement and knowledge retention (Raj & Renumol, 2022; Zheng et al., 2022).

Authentic Assessments for Real-World Relevance

In e-learning, authentic assessments can simulate workplace scenarios, case studies, and project-based evaluations. These assessments encourage critical thinking, problem-solving, and creativity, preparing learners for the demands of their future careers. Authentic assessments also motivate learners by demonstrating the practical relevance of their learning outcomes (McArthur, 2023).

Engaging Learners through Gamified Assessments

Gamification elements can enhance learner engagement and motivation in assessments (Manzano-León et al., 2021). E-learning platforms can incorporate gamified assessments, such as badges, points, and leaderboards, to make the assessment experience more enjoyable and rewarding. Gamified assessments tap into learners' intrinsic motivation, promoting a sense of accomplishment and progress as they master course content (Zainuddin et al., 2021).

6. Conclusion

Exams are still a common and widely used method of assessing college students, however, rethinking assessment in e-learning is pivotal to unlocking the full potential of digital education. Embracing innovative assessment practices can lead to more meaningful learning experiences, better learner outcomes, and the development of agile, adaptable individuals equipped to thrive in the dynamic challenges of the 21st century. As we forge ahead into the future of education, a student-centered, technology-enhanced, and ethically sound approach to assessment is essential to empower learners and shape the future of e-learning.

Through this exploration, we have identified several key points that highlight the importance of rethinking assessment in the context of e-learning. E-learning platforms equipped with adaptive assessment tools can tailor learning experiences to individual student needs. By analyzing learners' performance data and providing timely feedback, personalized assessments foster a deeper understanding of strengths and areas for improvement, maximizing student engagement and motivation. This instant feedback loop empowers learners to take ownership of their learning journey and fosters a culture of continuous improvement. E-learning allows for the integration of authentic assessments that mirror real-world challenges and scenarios. By moving beyond traditional exams and incorporating real-life projects, case studies, and simulations, learners develop practical skills that are directly applicable to their future careers.

The significance of rethinking assessment in e-learning extends beyond formal education. E-learning enables lifelong learners to acquire new skills, update their knowledge, and stay relevant in rapidly evolving industries, fostering a culture of continuous learning. For future research, it is recommended to explore innovative assessment methods tailored to the digital era's demands, investigate adaptive and personalized assessment systems, conduct longitudinal studies on the impact of redesigned assessments, address equity issues, leverage assessment analytics, consider cross-cultural perspectives, assess teacher training programs, evaluate policy implications, incorporate student perspectives, encourage interdisciplinary approaches, explore emerging technologies, conduct qualitative studies, and perform comparative analyses to inform the ongoing transformation of assessment practices in e-learning for the 21st century.

References

- Awad Ahmed, F. R., Ahmed, T. E., Saeed, R. A., Alhumyani, H., Abdel-Khalek, S., & Abu-Zinadah, H. (2021). Analysis and challenges of robust E-exams performance under COVID-19. *Results in Physics*, 23, 103987. <https://doi.org/10.1016/j.rinp.2021.103987>
- Baidoo-Anu, D., & Owusu Ansah, L. (2023). *Education in the Era of Generative Artificial Intelligence (AI): Understanding the Potential Benefits of ChatGPT in Promoting Teaching and Learning* (SSRN Scholarly Paper 4337484). <https://doi.org/10.2139/ssrn.4337484>
- Birenbaum, M. (2007). EVALUATING THE ASSESSMENT: SOURCES OF EVIDENCE FOR QUALITY ASSURANCE. *Studies in Educational Evaluation*, 33(1), 29–49. <https://doi.org/10.1016/j.stueduc.2007.01.004>
- Brooks, V. (1993). The resurgence of external examining in Britain: A historical review. *British Journal of Educational Studies*, 41(1), 59–72. <https://doi.org/10.1080/00071005.1993.9973949>
- Brown, G. T. L. (2019). Is Assessment for Learning Really Assessment? *Frontiers in Education*, 4. <https://www.frontiersin.org/articles/10.3389/feduc.2019.00064>
- Bryan, C., & Clegg, K. (2019). *Innovative Assessment in Higher Education: A Handbook for Academic Practitioners*. Routledge.
- Cahapay, M. B. (2020). *Rethinking Education in the New Normal Post-COVID-19 Era: A Curriculum Studies Perspective* (SSRN Scholarly Paper 3707838). <https://papers.ssrn.com/abstract=3707838>
- Cevikbas, M., & Kaiser, G. (2022). Promoting Personalized Learning in Flipped Classrooms: A Systematic Review Study. *Sustainability*, 14(18). <https://doi.org/10.3390/su141811393>
- Cotton, D. R. E., Cotton, P. A., & Shipway, J. R. (2023). *Chatting and Cheating. Ensuring academic integrity in the era of ChatGPT*. EdArXiv. <https://doi.org/10.35542/osf.io/mrz8h>
- Coutinho, Isabel, J. A., Cláudio Farias, Ana Ramos, Cristiana Bessa, Patrícia. (2022). Empowering Learners' Self-Assessment, Peer-Assessment, and Sport Learning Through Technology. In *Learner-Oriented Teaching and Assessment in Youth Sport*. Routledge.
- Dahlgren, G. H., & Hansen, H. avarð. (2015). I'd rather be nice than honest: An experimental examination of social desirability bias in tourism surveys. *Journal of Vacation Marketing*, 21(4), 318–325.
- Ebner, M., Schön, S., Braun, C., Ebner, M., Grigoriadis, Y., Haas, M., Leitner, P., & Taraghi, B. (2020). COVID-19 Epidemic as E-Learning Boost? Chronological Development and Effects at an Austrian University against the Background of the Concept of "E-Learning Readiness". *Future Internet*, 12(6), Article 6. <https://doi.org/10.3390/fi12060094>
- Eltahir, M. E., Alsahhi, N. R., & Al-Qatawneh, S. S. (2022). Implementation of E-exams during the COVID-19 pandemic: A quantitative study in higher education. *PLOS ONE*, 17(5), e0266940. <https://doi.org/10.1371/journal.pone.0266940>
- Eskelson, T. C. (2020). How and Why Formal Education Originated in the Emergence of Civilization. *Journal of Education and Learning*, 9(2), 29–47.
- Gamage, K. A. A., Silva, E. K. de, & Gunawardhana, N. (2020). Online Delivery and Assessment during COVID-19: Safeguarding Academic Integrity. *Education Sciences*, 10(11), Article 11. <https://doi.org/10.3390/educsci10110301>
- Gundu, T. (2023). Chatbots: A Framework for Improving Information Security Behaviours using ChatGPT. In S. Furnell & N. Clarke (Eds.), *Human Aspects of Information Security and Assurance* (pp. 418–431). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-38530-8_33
- Herckis, L. (2018). Passing the Baton: Digital Literacy and Sustained Implementation of eLearning Technologies. *Current Issues in Emerging ELearning*, 5(1). <https://scholarworks.umb.edu/ciee/vol5/iss1/4>
- Li, J., & Hayhoe, R. (2012). *Confucianism and higher education*.
- Luić, L. (2022). DEVELOPING STUDENTS\textbackslash{}textquotesingle DIGITAL COMPETENCIES - 21ST CENTURY TEACHING SKILLS: BASED ON SELF-ASSESSMENT OF HIGHER EDUCATION TEACHERS. *EDULEARN22 Proceedings*, 8979–8988. <https://doi.org/10.21125/edulearn.2022.2160>
- Manzano-León, A., Camacho-Lazarraga, P., Guerrero, M. A., Guerrero-Puerta, L., Aguilar-Parra, J. M., Trigueros, R., & Alias, A. (2021). Between Level Up and Game Over: A Systematic Literature Review of Gamification in Education. *Sustainability*, 13(4), Article 4. <https://doi.org/10.3390/su13042247>
- McArthur, J. (2023). Rethinking authentic assessment: Work, well-being, and society. *Higher Education*, 85(1), 85–101. <https://doi.org/10.1007/s10734-022-00822-y>
- Monroe, P. (1905). *A Text-book in the History of Education: By Paul Monroe*. Macmillan.
- Mounier-Kuhn, P. (2020). Forms of Higher Education in Ancient Civilizations and beyond Europe. *Images Des Mathématiques*. <https://hal.science/hal-03955087>
- Popkewitz, T. S. (2018). What Is 'Really' Taught As The Content of School Subjects? Teaching School Subjects As An Alchemy. *The High School Journal*, 101(2), 77–89.
- Raj, N. S., & Renumol, V. G. (2022). A systematic literature review on adaptive content recommenders in personalized learning environments from 2015 to 2020. *Journal of Computers in Education*, 9(1), 113–148. <https://doi.org/10.1007/s40692-021-00199-4>
- Riswanto, Heydarnejad, T., Saberi Dehkordi, E., & Parmadi, B. (2022). Learning-oriented assessment in the classroom: The contribution of self-assessment and critical thinking to EFL learners' academic engagement and self-esteem. *Language Testing in Asia*, 12(1), 60. <https://doi.org/10.1186/s40468-022-00210-4>
- Sato, B. K., He, W., Warschauer, M., & Kadandale, P. (2015). The Grass Isn't Always Greener: Perceptions of and Performance on Open-Note Exams. *CBE—Life Sciences Education*, 14(2), ar11. <https://doi.org/10.1187/cbe.14-08-0121>

- Shraim, K. (2019). Online Examination Practices in Higher Education Institutions: Learners' Perspectives. *Turkish Online Journal of Distance Education*, 20(4), Article 4. <https://doi.org/10.17718/tojde.640588>
- Sudakova, N. E., Savina, T. N., Masalimova, A. R., Mikhaylovsky, M. N., Karandeeva, L. G., & Zhdanov, S. P. (2022). Online Formative Assessment in Higher Education: Bibliometric Analysis. *Education Sciences*, 12(3). <https://doi.org/10.3390/educsci12030209>
- Winstone, N. E., & Boud, D. (2022). The need to disentangle assessment and feedback in higher education. *Studies in Higher Education*, 47(3), 656–667. <https://doi.org/10.1080/03075079.2020.1779687>
- Woldeab, D., & Brothen, T. (2019). 21st Century assessment: Online proctoring, test anxiety, and student performance | *International Journal of E-Learning & Distance Education / Revue internationale du e-learning et la formation à distance*. <https://www.ijede.ca/index.php/jde/article/view/1106>
- Zainuddin, Z., Farida, R., Keumala, C. M., Kurniawan, R., & Iskandar, H. (2021). Synchronous online flip learning with formative gamification quiz: Instruction during COVID-19. *Interactive Technology and Smart Education*, 19(2), 236–259. <https://doi.org/10.1108/ITSE-01-2021-0002>
- Zheng, L., Long, M., Zhong, L., & Gyasi, J. F. (2022). The effectiveness of technology-facilitated personalized learning on learning achievements and learning perceptions: A meta-analysis. *Education and Information Technologies*, 27(8), 11807–11830. <https://doi.org/10.1007/s10639-022-11092-7>

Challenges of Using Social Media as a Teaching Tool in Secondary Schools

Rafeeq Jaffer¹, Zane Davids^{1,2} and Lisa Florence Seymour^{1,2}

¹Department of Information Systems, University of Cape Town, Cape Town, South Africa

²CITANDA, University of Cape Town, Cape Town, South Africa

jffmuh001@myuct.ac.za

mo.davids@uct.ac.za

lisa.seymour@uct.ac.za

Abstract: The COVID-19 pandemic resulted in a significant shift towards the use of social media platforms to support teaching with educators being responsible for integrating social media into their pedagogical practices. Yet its use has many challenges. This research aimed to describe the challenges secondary school teachers shared about using social media as a teaching tool. This descriptive multiple case study followed an interpretive, inductive, and qualitative approach. Four secondary schools were selected as cases and teachers who used social media as a teaching tool were interviewed. Multiple challenges are described that impact teachers and students. Many are due to the features of social media, and some are due to school infrastructure and policies. Practically this research can help teachers have a better understanding of these challenges before using social media for their own teaching. Policies, curricula, applications, and pedagogies can also be adapted and changed based on the finding of this research.

Keywords: Social media, Teaching tool, Pedagogical practices, Teachers, Technology challenges, WhatsApp.

1. Introduction

Social media is an online network that allows users to generate and communicate their content and participate in social interactions (Giumetti and Kowalski, 2022). WhatsApp, Telegram, Facebook, and Instagram are some examples of social media applications. At the start of the COVID-19 pandemic, governments in many countries, including South Africa, closed schools (Spaull, 2020). Because of this, teachers had to quickly pivot and use online technologies to teach their students and students were encouraged to use these same online technologies to learn (Hatip, 2020). With the resultant increase in the use of social media for teaching, teachers were required to successfully integrate the use of social media into their pedagogical practices (Jenaibi and Mansoori, 2021). Yet there are challenges inherent in using social media for teaching, which if better understood can help teachers manage them, hence there have been calls for more research to be conducted (Ekberg and Gao, 2018). Our research study responds to this call for more research with a focus on the South African context to help provide the needed insights into these challenges. In section 2 we present literature related to the research problem. Section 3 discusses the methodological approach used in the study, while Section 4 discusses the findings. Section 5 concludes by discussing the contributions made by the study, the limitations and future research opportunities.

2. Literature review

As Information and Communication Technologies (ICTs) like social media get used more in classrooms, teachers need to understand the platforms to support teaching (Jenaibi and Mansoori, 2021). For example, secondary school teachers in Nigeria have used Facebook, WhatsApp, Twitter, and YouTube as interactive teaching and learning channels for communication and to share information. Their students experienced a positive increase in their overall learning experience (Olowo et al., 2020). WhatsApp has been identified as the simplest and most convenient way to conduct teaching (Mhlanga and Ramoroka, 2021; Olowo et al., 2020). YouTube has been found to be useful for sharing videos between teachers and students (Bicen and Taspolat, 2019). Yet a concern that is expressed by teachers is boundaries between work and leisure getting blurred because of the availability of access to communication and content online (Rosenberg and Asterhan, 2018).

There are also challenges in accessing the relevant required technologies. Reliable internet access, required for social media use, is an issue in many countries (Pokhrel and Chhetri, 2021). Not having access to one's own digital device is also an inhibiting factor (Pokhrel and Chhetri, 2021). The digital divide refers to disparities in ICT access, usage, and outcome (Lythreathis, Singh, and El-Kassar, 2022). School principals in Gauteng have shared concerns that several students lack ICT skills, have no Wi-Fi access, can't afford data, and struggle with network connection issues which limit the use of ICT for teaching (Chisango and Marongwe, 2021). In South Africa, schools are classified into five quintiles from the poorest (Quintile 1) to the least poor (Quintile 5). Unequal ICT

within and across schools leads to knowledge, information, and digital divides (Chisango and Marongwe, 2021). Schools with inadequate ICT could not run online classes during COVID-19 which led to a knowledge divide as schools with ICT access taught online.

The successful integration of social media into the school curriculum has become a key focus area of the South African Department of Education (Chisango and Marongwe, 2021). Besides being competent in their subject's content, teachers need to be comfortable executing pedagogical methods that are relevant in the 21st century (Moodley, 2019). Teachers from disadvantaged schools with limited ICT resources tend to not have the expertise or skills needed to effectively use ICT for teaching (Jenaibi and Mansoori, 2021). These teachers tend to resist using ICT (Jenaibi and Mansoori, 2021). Some educators also believe the use of social media for teaching detracts from a learner's time. Hence educators resist using the platforms to teach (Al-Bahrani, Patel, and Sheridan, 2016). Lack of teacher training is also a major concern. Most schools offer inadequate or no ICT training (Ekberg and Gao, 2018). There are also policy concerns. In South Africa, the school policy by the Department of Basic Education does not advocate for the use of social media in teaching English, but some teachers still use it (Rwodzi, de Jager, and Mpofu, 2020).

In summary, current literature on the challenges of using social media in teaching focuses mainly on higher education. Some studies do explore social media use challenges in secondary schools, but their focus is on developed countries like Sweden (Ekberg and Gao, 2018). A clear knowledge gap on the challenges of using social media as a teaching tool within secondary schools in less developed countries like South Africa is noted (Chugh, Grose, and Macht, 2020). Our study starts to address this important gap in literature by describing the challenges experienced by secondary school teachers in South Africa who use social media to support teaching. Our central research question we ask is "What are the challenges with using social media to support teaching in secondary schools?"

3. Research method

This multiple case study took an interpretive and inductive approach to theory development (Walsham, 2017). The case studies were four public, fee-paying secondary schools (C1 – C4) that used social media as the predominant online tool to assist their teaching. C1 was a Quintile 4 school while the other schools were Quintile 5. These schools were selected as they continued teaching using social media during COVID-19. Consent from the Western Cape Education Department to conduct the study was obtained as well as approval from the authors' university ethics committee. Table 2 lists the case characteristics and secondary data collected. C4 described their school Wi-Fi as usually working, C1 and C2 described theirs as intermittent and C3 as mostly offline as there was no electricity due to vandalism. In C2 teachers had access to training on technology usage while there was no training offered to teachers on technology for teaching in any of the other schools. Semi-structured interviews performed in 2022 were the primary data source. The sample consisted of one to two teachers at each school with social media teaching experience and teaching diverse subjects. Table 1 summarises the respondents, all used WhatsApp other than RP03 who used Telegram. NVivo software was used to organise the interviews and secondary data whilst thematic analysis (Braun and Clarke, 2012) was used to discover emerging categories and themes within the data.

Table 1. Research participants of this study

ID	Grades taught	Subjects taught	Social media years for teaching	Caseld
RP01	Grade 8-10	Natural science and Life sciences	3	C1
RP02	Grade 8 - 9, 11 – 12	Social science	3	C1
RP03	Grade 8-10	Information technology	3	C2
RP04	Grade 8	Afrikaans	3	C2
RP05	Grade 9-12	Business studies	3	C3
RP06	Grade 10-12	Physical Science	5	C4

Table 2. Case descriptions

Caseld	Quintile	Approximate teachers	Approximate students	Secondary documentation
C1	4	28	1000	C1D1 - Code of conduct
C2	5	31	1100	C2D1 - Cell phone policy
C3	5	24	1000	
C4	5	42	900	C4D1 - Social media policy

4. Research findings and discussion

There were several uses for social media in teaching in secondary schools mentioned by the participants. The most prominent use was for sending resources. The other uses included communication, sending homework, and one participant using social media as a translation tool. This section describes the challenges associated with using social media, classified into different categories namely: student challenges, teacher challenges, application challenges and lastly institutional challenges. Finally, we visually present a summary of our findings.

4.1 Student challenges

Students experience challenges when using social media for school. The main challenges identified were the device and associated constraints, safety and privacy concerns, and lack of data.

4.1.1 The Device and Associated Constraints

Literature notes that families with limited resources might only be able to afford a cell phone with low specifications that cannot access WhatsApp (Chisango and Marongwe, 2021). The lack of access to a device and devices with low specifications were mentioned by all participants as major challenges to social media use in teaching. Participant RP03 stated that *“our learners come from impoverished backgrounds. Having a smartphone isn't the first thing on top of the list at home.”* Participant RP05 added: *“some students have phones that are not WhatsApp friendly which we cannot use for teaching.”*

4.1.2 Student Safety and Privacy Concerns

Two participants from C2 mentioned that cyberbullying on social media was a big issue at their school. As RP03 stated: *“Yes. And we have had quite a lot of cases when it comes to cyberbullying, not only via WhatsApp via Instagram, Facebook, you name it”*. Sharing numbers can lead to giving students access to each other and this can increase cyberbullying. Participants mentioned that some students were worried about their privacy, and this led to some learners being hesitant to participate. As RP04 stated *“Initially, there was some hesitancy, by only a few because they did not want to have it, their number, with private Contact Detail shared amongst so many people.”* Literature supports this as learners are concerned about their privacy when joining social media as they have a concern for their information being shared (Chugh, Grose, and Macht, 2020). Participants also highlighted that impoverished students who live in dangerous neighbourhoods were at risk of having their cell phones stolen. Participant RP03 explained that *“learners who walk or use public transport to school, if they have their devices with them, it does make them a target of crime.”* Participant RP02 adds that *“our kids get robbed a lot so if their phones are stolen, they usually don't get a replacement.”* Student safety as a theme linked to the crime of having one's cell phone stolen is not mentioned in the current academic literature.

4.1.3 Lack of Data or Internet Access

All interviewees mentioned that while some students have access to a device, these same students don't have the necessarily data on the device to access and use social media applications like WhatsApp. Participant RP03 emphasised that *“access to data is a major challenge that we have not overcome yet.”* Participant RP01 highlighted that *“many people lost their jobs during COVID-19. These same people are struggling to buy basics like food, so data has become a very low priority.”* This confirms literature that reports that some students and teachers can't afford data and lack internet access at home (Chisango and Marongwe, 2021).

4.1.4 Lack of Participation and Falling Behind

Three participants mentioned that some students lack the skills to use technology to access resources sent on social media. *"So, it depends on where you go because some of them get the new phones and it's not always installed as a default program, and they say, 'I can't open this'"* (RP04). Alternatively, three participants shared that some learners do not want to use social media. *"Yes, there are quite a few of the learners who are very hesitant, so they basically don't want to be part of it. And you can't force them because at the end of the day, that is their right"* (RP03, C2). These learners fall behind the others in the class that have access. *"That 8 people (learners not participating) they're not benefiting from videos that I sent because I don't have the time to actually show them the videos. So, I send it in the group and that 8 people they are not benefiting while the 32 people are."* (RP05, C3). Using social media for teaching can affect the performance of students who are reluctant to use the technology, can't access the technology and those who lack the skill to use it (Wyse et al., 2020) which increases the knowledge divide.

4.2 Teacher challenges

Teachers themselves experience challenges when using social media for teaching. The main challenges identified were concerns over their privacy, increased work for teachers, difficulties with co-ordinating groups and the lack of teacher training.

4.2.1 Concerns Over Teacher Privacy

All participants mentioned that learners having access to their personal cell phone numbers is a real concern. The challenge is trying to keep one's work and personal life separate. Participant RP02 said that *"the teacher can exclude students from statuses, but they still see your profile picture. Some students would save this picture as their own WhatsApp status. Obviously, I messaged them about respecting my privacy."* To try and address privacy concerns, participant RP04 highlights that *"I have another number that I use outside of work. Even my email address. I have a personal email address that is linked to all my other social media."* The findings confirm the current academic literature in that teachers are concerned for their privacy when using social media for teaching (Chugh, Grose, and Macht, 2020). Not everything in these WhatsApp groups stay private which further exacerbates the privacy concerns teachers have (Chugh and Ruhi, 2017).

4.2.2 Increased Work for Teachers

Similarly, all participants mentioned that using social media increased their workload and increased working outside the normal school hours. Additional activities include conversing with students after school hours and the making and editing of teaching videos. Participant RP02 explained that *"students would message you two o'clock in the morning. There is a rule to not message the teacher after school hours, but they still ignore it. Even though you don't reply, you still get the notification which is a disturbance."* Furthermore, participant RP03 adds that *"I need to record the videos and after that I need to go and check through the videos if I have made any mistakes or errors. I then need to go back and correct it. So, unlike the classroom environment, where if I made a mistake, I could quickly go back and correct it. With a video however I need to make sure my facts are 100% correct which means it takes much longer."* Social media is intrusive which makes teachers more accessible to their learners. Students contact their teachers after school hours even though there are school rules that forbids this. Creating teaching videos as extra content for learners are done outside of school hours. These findings confirm the academic literature where the line between work and personal time for teachers gets blurred. This is due to making themselves available to their students on social media (Rosenberg and Asterhan, 2018).

4.2.3 Lack of Teacher Training

Teachers not having adequate training to use social media is identified as a significant issue. Some teachers knew more about the use of technology for teaching than others. These teachers assisted their counterparts by providing guidance on how to incorporate social media use into teaching. Participant RP02 highlights that *"the challenge is older teachers asking us to show them because they do not know how to use WhatsApp in the classroom. Our school did not get training. So, it is a challenge for the older teachers. But we as young teachers try our best to help them."* Participant RP04 adds that *"I've had to teach many of them how to restrict access to the WhatsApp groups, how to even change the names of groups."* Some teachers do not feel confident when using social media. These teachers rely on their colleagues' help to make the best use of social media within

their classrooms. Literature confirms that teachers need to be educated on how to use social media. If not, they will be hindered from effectively using social media in the best way possible (Moodley, 2019).

4.2.4 Difficulty Co-ordinating Groups

Several participants mentioned that it is challenging to co-ordinate social media groups for teaching. It is also difficult to constantly add new or replacement cell phone numbers to the groups. The teacher is then left with the nightmare of managing multiple contacts. Participant RP04 explains co-ordination as *"I would do lessons with the one group. For this group I would also send reminders not to forget homework tasks. For the group coming tomorrow I must remember to send a reminder to not forget to bring a textbook. You must remember all of this."* Participant RP02 adds that *"students always get new numbers. And the challenge for me is I need to resend the previous lessons to the learners every time they ask me: 'can I add you'. That means more admin on my phone. I need to add new numbers and I get so confused. I have so many new numbers. Sometimes it is even a parent's number."* The challenges associated with co-ordinating the lesson activities of different student groups and constantly having to manage the contacts linked to the social media group themselves are not mentioned in the current academic literature.

4.3 Software application challenges

Limitations associated with the social media application itself are limits set for file sizes and the lack of teaching features on social media applications.

4.3.1 File Size Limitations

WhatsApp's file size limit makes it difficult to send large files over WhatsApp. Videos, documents and even voice notes are blocked. Participant RP01 describes that *"the video length allowed by WhatsApp is a limitation. If you want to send a video, it only allows files with a certain number of megabytes. This is not enough for the teaching videos we create. I literally cut the video in increments to send it over WhatsApp."* Participant RP04 agrees and says *"It (WhatsApp) is very limiting because your voice notes can only be a certain length long."* Size file limits is a significant hinderance to teachers who want to send larger files to learners. Increasing the file sizes that can be sent by WhatsApp for educational purposes is not mentioned in the current academic literature.

4.3.2 Lack of Teaching Features in Social Media Applications

Many social media characteristics restricted use for teaching. A challenge that half of the participants stated they experienced with the application is tools to manage groups and that WhatsApp does not allow new participants to see old messages. Because of this, learners request old notes and teachers must find all the previous resources that they sent and resend them. WhatsApp lacking a presentation mode was identified as a software limitation that reduces the teacher's ability to effectively teach to their students. Also, the language translator in WhatsApp is not good. Participant RP01 highlights that *"WhatsApp doesn't allow us to present a PowerPoint document. The fact that you can't put a presentation up is a challenge."* Two teachers that use the social media application as a virtual class identified that WhatsApp limits the number of users in a video call, and this is a challenge as they cannot have the whole class for a lesson at a time. Participant RP04 further identified that *"there's a translator in WhatsApp [laughter]. It's not the best."* WhatsApp lacks quality features that could help better facilitate online teaching. Enhancing the social media platform to include these features to facilitate better online teaching is not mentioned in the current academic literature.

4.4 Institutional challenges

The school also plays a significant role in the success rates achieved when using social media as an online teaching tool. The challenges identified include intermittent or broken Wi-Fi, social media not being fully supported, and lack in teachers' participation.

4.4.1 Intermittent or Broken Wi-Fi

Most participants indicated that they experienced challenges with Wi-Fi connectivity. The Wi-Fi was either intermittent or inaccessible. Weak signals, having no electricity, and vandalism are mentioned as the reasons for the teachers' connectivity challenges. Participant RP05 stresses that *"Wi-Fi is always down. Like now it's down. I have no electricity in my class. The entire block of our school has no electricity due to vandalism. That also explains why the Wi-Fi is always off."* Similarly, participant RP02 affirms that *"like today, the Wi-Fi isn't working"*

again. So, we have these connection problems throughout the year which is very challenging.” Teachers rely on the school’s Wi-Fi to access social media and subsequently send resources and communicate with students. Similarly, students depend on the school’s Wi-Fi to download resources sent from teachers. When the Wi-Fi does not work, teachers and students must then rely on their own data which can be costly. The school needs to ensure that there is adequate Wi-Fi access and that it works. Within the literature a lack of Wi-Fi access is identified as context specific. Some schools in South Africa provide both teachers and learners adequate access to working infrastructure while others don’t (Chisango and Marongwe, 2021).

4.4.2 Social Media not Being Fully Supported

School policies that do not fully support the use of social media applications for teaching prevent WhatsApp from being fully utilized. Participant RP03 said that *“the school policy does allow for social media to be used in teaching, but it also doesn’t allow cell phone devices to be used by learners, unless prior permission is given.”* Additionally, the code of conduct for C1 states that *“learners are not permitted to use cell phones during school times. Cell phones will be confiscated and returned at a fine of R50,00.”* The school policy declares that learners will be punished when using technology during school times. Students may not use phones unless they are permitted by teachers which can hinder them from making full use of social media. The findings confirm the current academic literature in that school policies tend to not fully support the use of social media in education (Chugh and Ruhi, 2017; Manca and Ranieri, 2016; Pokhrel and Chhetri, 2021).

4.4.3 Teachers’ Reluctance to use Social Media for Teaching

Challenges with the technology and teachers not wanting to fully commit to using social media for teaching leads to feelings that the use of WhatsApp within the classroom is a pointless exercise. Participant RP02 asserts that *“it’s pointless if only the young teachers are using WhatsApp, but the older teachers don’t know how to use social media. They’re struggling with no training.”* Additionally, participant RP05 highlights that *“for some teachers their WhatsApp profile is their private life thus they are not willing to share their contact details. Some are parents and they do not want to be disturbed during certain times of the day. Not availing themselves on WhatsApp after school hours.”* The findings confirm the current academic literature in that teachers who tend to not avail themselves to online activities after school hours or lack the ability to use ICTs are inclined to not want to use them (Jenaibi and Mansoori, 2021).

4.5 Summary of findings

The purpose of this study was to describe the challenges secondary school teachers experience when using social media to support teaching. Several categories and associated themes emerged that helped answer the research question. Figure 1 summarises those challenges faced by secondary school teachers when trying to use social media, in particular WhatsApp, as a teaching tool.

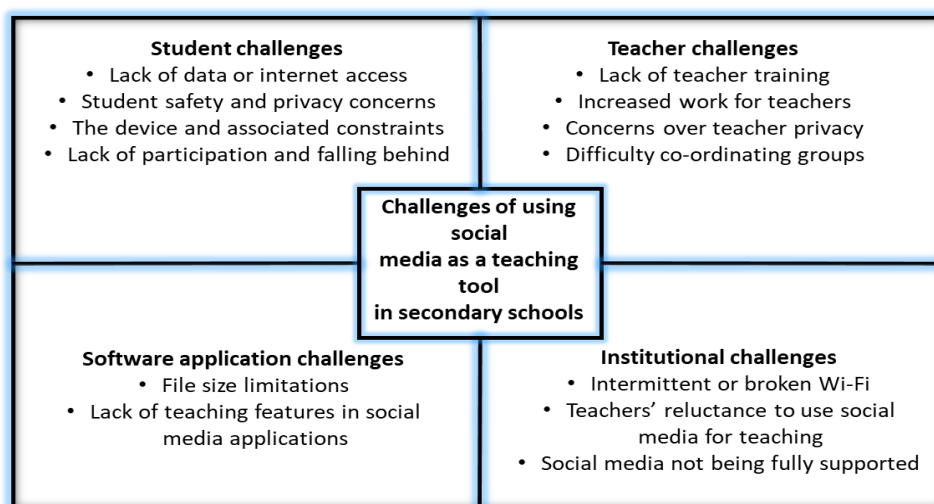


Figure 1: Summary of the challenges associated with social media use for teaching.

The context of this study is South Africa. Hence several of the challenges, such as safety concerns and poor Wi-Fi connectivity are relevant to this context. Yet the findings of this study can potentially be generalised to other less developed countries as well.

5. Conclusion

Our study aimed to answer the question “What are the challenges with using social media to support teaching in secondary schools?” We have described the relevant challenges predominantly in the use of WhatsApp. The contribution of this research is to describe those challenges adding to the academic literature and practically to help teachers have a better understanding of these challenges before using social media for teaching.

The biggest concern within the South African context is the unequal access to the internet and that not all students have a smart phone. There is also the risk of being robbed of their cell phones and privacy and cyberbullying concerns. Hence students not using social media eventually fall behind because they don't receive learning materials from their teachers. Teachers struggle with increased work which using social media brings including working outside the normal school hours as well as privacy concerns. Some of this work is because of the lack of software features. The lack of social media features to support teaching include limits to file sizes, not having a presentation mode and an inadequate language translator. Teachers also lack the required social media training. The schools themselves are not always supportive as they are unable to provide a reliable Wi-Fi connection and school policies often restricted students from using cell phones at school. These challenges made some teachers reluctant to use social media to support their teaching.

This study was limited to the choice of case since only teachers at quintiles four and five secondary schools were interviewed. Future research should involve a wider range of quintiles to produce a more informed study. Additionally, only the teacher's perspective on the challenges associated with social media use within the classroom was obtained. Future research should include the views of students, parents, and management. Finally, most participants used WhatsApp. Future research could also include other social media platforms.

Acknowledgements

Funding support to write this study is acknowledged from the National Institute for the Humanities and Social Sciences. This research was conducted as part of a BCom Honours in Information Systems empirical research.

References

- Al-Bahrani, A., Patel, D. and Sheridan, B. J. (2016) “Have economic educators embraced social media as a teaching tool?” *The Journal of Economic Education*, 48(1), pp. 45-50. Available at: <https://doi.org/10.1080/00220485.2016.1252290>
- Bicen, H. and Taspolat, A. (2019) “Students’ Views on the Teaching Process Based on Social Media Supported Flipped Classroom Approach.” *Brain. Broad Research in Artificial Intelligence and Neuroscience*, 10(4), pp. 115-144. Available at: <https://doi.org/10.18662/brain/08>
- Braun, V. and Clarke, V. (2012) “Thematic analysis.” *APA handbook of research methods in psychology*, 2, pp. 57-71. Available at: <https://doi.org/10.1037/13620-004>
- Chisango, G. and Marongwe, N. (2021) “The digital divide at three disadvantaged secondary schools in Gauteng, South Africa.” *Journal of Education*, (82). Available at: <https://doi.org/10.17159/2520-9868/i82a09>
- Chugh, R., Grose, R. and Macht, S. A. (2020) “Social media usage by higher education academics: A scoping review of the literature.” *Education and Information Technologies*, 26(1), pp. 983-999. Available at: <https://doi.org/10.1007/s10639-020-10288-z>
- Chugh, R. and Ruhi, U. (2017) “Social media in higher education: A literature review of Facebook.” *Education and Information Technologies*, 23(2), pp. 605-616. Available at: <https://doi.org/10.1007/s10639-017-9621-2>
- Ekberg, S. and Gao, S. (2018) “Understanding challenges of using ICT in secondary schools in Sweden from teachers’ perspective.” *The International Journal of Information and Learning Technology*, 35(1), pp. 43-55. Available at: <https://doi.org/10.1108/ijilt-01-2017-0007>
- Giumetti, G.W. and Kowalski, R.M. (2022) “Cyberbullying via social media and well-being,” *Current Opinion in Psychology*, 45. Available at: <https://doi.org/10.1016/j.copsyc.2022.101314>
- Hatip, A. (2020) “The Transformation Of Learning During Covid-19 Pandemic Towards The New Normal Era.” *Proceeding Umsurabaya*. Available at: <https://journal.um-surabaya.ac.id/index.php/Pro/article/view/5947>
- Jenaibi, B. A. and Mansoori, A. A. (2021) “Use of Social Media in Teaching High School Students: A Case of United Arab Emirates.” *Contemporary Review of the Middle East*, 9(2), pp. 158-183. Available at: <https://doi.org/10.1177/23477989211017567>
- Lythreathis, S., Singh, S. K. and El-Kassar, A. N. (2022) “The digital divide: A review and future research agenda. Technological Forecasting and Social Change.” 175. Available at: <https://doi.org/10.1016/j.techfore.2021.121359>

- Manca, S. and Ranieri, M. (2016) "Facebook and the others. Potentials and obstacles of Social Media for teaching in higher education." *Computers & Education*, 95, pp. 216-230. Available at: <https://doi.org/10.1016/j.compedu.2016.01.012>
- Mhlanga, F. J. and Ramoroka, T. M. (2021) "Student diversity and online teaching and learning of mathematics in higher education during covid-19 lockdown: planning towards post covid-19 era." *African Perspectives of Research in Teaching & Learning*, 5(1). Available at: https://www.ul.ac.za/aportal/application/downloads/Article%20oct_2021.pdf
- Moodley, M. (2019) "WhatsApp: Creating a virtual teacher community for supporting and monitoring after a professional development programme." *South African Journal of Education*, 39(2), pp. 1-10. Available at: <https://doi.org/10.15700/saje.v39n2a1323>
- Olowo, B. F., Alabi, F. O., Okotoni, C. A. and Yusuf, M. A. (2020) "Social Media: Online Modern Tool to Enhance Secondary Schools Students' Academic Performance." *International Journal on Studies in Education*, 2(1). Available at: <https://doi.org/https://doi.org/10.46328/ijonse.7>
- Pokhrel, S. and Chhetri, R. (2021) "A Literature Review on Impact of COVID-19 Pandemic on Teaching and Learning." *Higher Education for the Future*, 8(1), pp. 133-141. Available at: <https://doi.org/10.1177/2347631120983481>
- Rosenberg, H. and Asterhan, C. S. C. (2018) "WhatsApp, Teacher? - Student Perspectives on Teacher-Student WhatsApp Interactions in Secondary Schools." *Journal of Information Technology Education: Research*, 17, pp. 205-226. Available at: <https://doi.org/10.28945/4081>
- Rwodzi, C., de Jager, L. and Mpofu, N. (2020) "The innovative use of social media for teaching English as a second language." *The Journal for Transdisciplinary Research in Southern Africa*, 16(1). Available at: <https://doi.org/10.4102/td.v16i1.702>
- Spaull, N. (2020) "COVID-19 and schooling in South Africa: Who should go back to school first?" *Prospects*, 51(4), pp. 563-572. Available at: <https://doi.org/10.1007/s11125-020-09470-5>
- Walsham, G. (2017) "Doing interpretive research." *European Journal of Information Systems*, 15(3), pp. 320-330. Available at: <https://doi.org/10.1057/palgrave.ejis.3000589>
- Wyse, A., Stickney, E., Butz, D., Beckler, A. and Close, C. (2020) "The Potential Impact of COVID-19 on Student Learning and How Schools Can Respond." *Educational Measurement: Issues and Practice*, 39. Available at: <https://doi.org/https://doi.org/10.1111/emip.12357>

Analysis of the Factors Affecting Successful Completion of Asynchronous Online Learning Programs

Buddhika Karunaratne, Vishaka Nanayakkara, Eshana Ranasinghe, Malik Ranasinghe, Supunmali Ahangama, Sandareka Wickramanayake and Chathuranga Hettiarachchi

University of Moratuwa, Sri Lanka

buddhika@cse.mrt.ac.lk

vishaka@cse.mrt.ac.lk

enranasinghe1@gmail.com

malik@uom.lk

supunmali@uom.lk

sandarekaw@cse.mrt.ac.lk

chathuranga@cse.mrt.ac.lk

Abstract: Within a year of its launch, the University of Moratuwa's open learning platform (open.uom.lk) has over 180,000 registered participants, providing free and open access to a series of asynchronous online courses in software development. Nearly 17,000 people have completed the two foundation courses: Python for Beginners and Web Development for Beginners. Considering the low overall completion rate compared to the total number of registered users, it is important to study the factors contributing to successful completion while promoting meaningful learning. To support the learning process, there are multiple activities like lecture videos, lecture notes, coding playgrounds, lecture slides, assessments, and discussion forums. Thus, this study investigates student behaviour to understand activities that are high in cognitive load and promote active engagement. The study is carried out using learning management system (LMS) user logs and feedback from completed and ongoing students. The elaborative logs with user activities and time stamps help identify the pace of completion by students with different capabilities and learning patterns. The study's findings will be useful to educators because they will be able to design similar LMS platforms that optimise student performance and promote effective learning outcomes. Furthermore, it would be useful to evaluate how students would manage the load in asynchronous online learning programs. Understanding how the learning and assessment activities are related to the completion of the course would enable predicting completion rates and times to properly plan for the employment opportunities for the successful learners.

Keywords: E-Learning, Online Asynchronous Learning, Student Performance

1. Introduction

1.1 Introduction to online learning

Online learning is a method of delivering teaching and learning content to students via electronic methods. The devices used may include computers, tablets, and smartphones. Online learning can be synchronous or asynchronous. In the synchronous mode, the students and instructors interact in real time while in the asynchronous mode, the students can access the content at their own pace. The content may be in different formats such as recorded video, tutorials, automated assessments.

Many advantages of online learning over traditional e-learning methods can be identified. Online learning programmes may be designed in a self-paced manner, thus making them more flexible. The high costs incorporated with developing physical infrastructure may be cut down significantly by shifting to online learning methods. It is likely that there will be more ways that the students can engage with the teaching and learning content in an online learning setting. Some of these components would include recorded interactive videos, interactive tutorials and automated assessments and quizzes.

1.2 The importance of online learning

Online learning has become increasingly popular in recent years, especially with the pandemic situations that the society has encountered. It has proven to be a massive experiment with adopting online learning methods substituting traditional learning activities. That experiment has yielded positive results and the effectiveness of online learning has been showcased.

Online learning can help students to develop important skills including time management, self-discipline and critical thinking (Clark & Mayer, 2016). The methods in online learning can effectively support a wide range of user groups differing in age, gender, ethnicity and many other factors.

1.3 Historical evolution of online learning

The concept of distance learning has been in existence for a long time (Mayer, 2019). Correspondence courses were offered as early as the 1800s, which is the earliest reference to evolution of online learning. In the correspondence courses students could learn at their own pace which made the courses popular especially among the students from the rural areas. Since those students found it much convenient to follow the self-paced method delivery.

In the 1900s, with the invention of radio and television, new paths were identified to deliver learning content. Distance education was slowly gaining popularity with the usage of radio and television as medium of communication and delivery. These distance methods allowed students to learn from subject experts even though they were not physically present at the same place and hence provided increased interactive learning experience.

With the introduction of computers in the 1960s the concept of computer-based learning was introduced. These types of courses enhanced the online learning concept and provided more personalised learning experience.

With the development of the internet in the latter parts of the 20th century, online and distance learning methods were gaining more and more popularity. Online courses offered a more convenient and affordable learning option than traditional forms of distance education, and they quickly became popular with students of all ages.

1.4 Recent trends in online learning adaptation

Online learning has gained worldwide popularity in recent years and has become essential in the field of education. Universities, colleges, schools and other institutions were left with no choice but to switch to online mode, especially as the pandemic was in full effect.

The recent growth of popularity of online learning is expected to continue. Increasing number of people are on mobile devices and have access to the internet. Many online courses are now available and optimised for mobile platforms increasing the reach.

The concept of microlearning focuses on short, focused modules of content. This type is gaining popularity and it is convenient especially for the users on mobile platforms to follow a learning content in a shorter period of time.

Social media platforms provide increased support for online learning. Instructors and students can use social media to connect with each other, share resources, and collaborate on projects.

Online learning platforms are becoming more personalised, allowing students to learn at their own pace and in their own way. This personalization can help students to be more engaged and to learn more effectively.

1.5 Cognitive aspects of online learning

Cognitive aspects of learning should be considered in any form of learning. They are especially important in online learning settings. If the students are new to the online learning methods, it will be important to pay considerable attention to the cognitive aspects.

In online learning, attention is one of the most important cognitive aspects (Ayres & Sweller, 2014). Many potential distractions may be present in an online environment such as social media, communication platforms and other web content. Students need to be able to manage these distractions in order to be successful in online learning.

Other cognitive aspects including the ability to store and retrieve information, interpret information from senses, logical thinking and problem solving are vital in an online learning setting (Brunken et al., 2010; Azevedo & Alevén, 2013)

1.6 Active engagement

Benson (2022) reported a strong correlation between procrastination and key outcomes like course completion and course grade. The case study, going against the claims of previous studies which did not report such a definitive relationship, provides an important insight on success or failure of online asynchronous courses.

Active engagement is highly important for effective learning in an online environment. Unlike the conventional setting, the students and the teachers are not in the same physical location which makes it difficult to maintain active engagement. This especially becomes a concern when the learning mode is asynchronous.

It is important to track student engagement especially in online learning settings. It will actually be challenging to maintain high levels of engagement in online learning programmes. New and innovative approaches have to be used in the delivery of online courses to maintain student interest and engagement.

Possible methods of assessing student engagement includes tracking the participation in student discussions, completion of assignments, attendance and conducting surveys on student engagement.

1.7 More related work

Arnold and Pistilli (2012) proposed a signalling method to communicate to the student on how they are doing in a course, using a prediction method based on grades, demographic information, past academic performance and student efforts. Seaton et al. (2014) conducted a comprehensive study to show the usage of large amounts of data available in Massive Open Online Courses (MOOCs). Such data is effectively analysed qualitatively to investigate the attrition, retention, time distribution among resources, usage of resources and the usage of resources for problem solving.

Cluster analysis conducted in Rienties et al. (2015) identified four learning design patterns, namely: constructivist, assessment-driven, balanced-variety and social constructivist modules. The study provided crucial insights on learning design and how it impacts academic performance. Pilli and Admiraal (2017) formulated a series of suggestions that will be beneficial in designing MOOCs. The suggestions include increasing student participation, providing clear and structured assessments, facilitating learner-centred communities and many more. The Open University Learning Analytics Dataset (OULAD) is a learning analytics dataset which can be used for benchmarking in the learning analytics domain (Alhakbani and Alnassar, 2022). Such datasets provide ways to assess the students in Virtual Learning Environments (VLEs).

1.8 The open learning platform of the University of Moratuwa

The open learning platform of the University of Moratuwa currently provides free and open access to the Trainee Full Stack Developer (TFSD) programme (Nanayakkara et al., 2022). The programme consists of six courses related to Python Programming, Web Development and Professional Practice in Software Development. The participants can follow the courses in a self-paced, asynchronous manner. This study uses data collected from the platform which records all the activities of the participants on the platform. The dataset is ever-growing and can be utilised to analyse user behaviours on the platform. No restrictions have been imposed on who can join the platform. Anyone having access to the internet can register on the platform and get started with the courses.

2. Problem statement

The open learning platform of the University of Moratuwa keeps receiving registrants on a daily basis with the total number nearing 200,000. However, at the time of this statement, the total number of overall completions of the TFSD programme is 141. To fully complete the TFSD programme, a participant should complete six courses in total. The percentage of overall completion is lower than the expectations set forth at the initiation of the platform. The low completion rate may be due to multiple factors, considering that the courses are offered in an asynchronous mode and there are no restrictions on who can register and do the courses. All courses are self-paced. Compared to a traditional mode of learning, it is difficult to keep track of the students' behavioural patterns. Hence this study focuses on identifying the factors that may affect the completion rate of the programme.

Fig1. graphically illustrates the completion behaviour of the participants. The low completion rate is observed especially at the later stages of the programme.

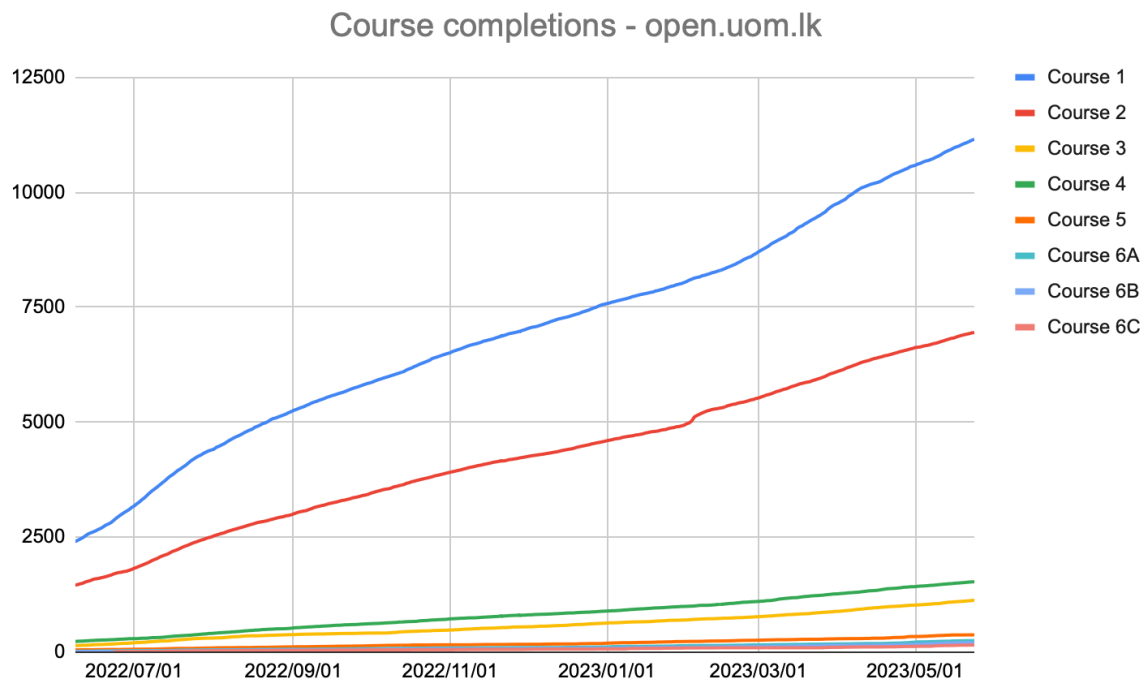


Figure 1: Course completions - Trainee Full Stack Developer Programme on open.uom.lk

3. Methods and Data

3.1 Introduction to the online learning platform of the University of Moratuwa

The online learning platform of the University of Moratuwa Sri Lanka has been in operation for over 15 months. The platform generates massive amounts of data on a daily basis. The platform offers six courses related to information and communication technologies (ICT) which leads to the Trainee Full Stack Developer certification issued by the University of Moratuwa.

Each course in the platform consists of a line-up of activities including video lessons, text-based tutorials and assessments. All activities are recorded on the platform and the extracted data can be used to perform analytics related to teaching and learning activities.

3.2 Assessing the experience of the participants who completed the full programme

An overview of the survey is given in Table 1.

Table 1: Overview of the survey conducted on participants who completed the TFSD programme.

Question(s)	Aspects covered
1 - 5	Demographic information
6	Level of education
7	Level of English proficiency
8	Programming skills before completing TFSD
9 - 10	Web development skills before and after completing TFSD
11	Most challenging course in the programme
12	Whether or not currently employed in the ICT domain

Question(s)	Aspects covered
13	Whether TFSD programme was helpful in getting into ICT domain
14	Applicability of the knowledge gained in the TFSD programme
15	Rating of courses in the TFSD programme
16	Suggestions for improvement
17	Whether or not they will recommend the TFSD programme to others

3.3 The source of data and the method of collecting data

The method of data collection was two-fold. The records from the online learning platform were available immediately and were extracted at different time intervals. On top of that a survey was conducted targeting the participants who completed all six courses currently available on the platform. Out of the 141 participants who have completed the programme as of now, 63 responded to the survey.

3.4 Overview of the dataset

The new registrants on the platform are provided access to Course 1 and Course 2. The participants can start those courses and continue learning in parallel. Since the courses are self-paced it is entirely up to the participants to decide which course to complete first and how much time to spend in each course. Once they complete Course 1 and Course 2, they are provided access to Course 3 and Course 4. There onwards, the courses access is provided in a sequential manner as and when the participants complete the courses. Course 6 consists of three parts. When a participant completes all courses, they are considered to have completed the full TFSD programme.

Apart from the usage data collected from the platform, a survey was designed and conducted to gather information from the participants who completed all six courses on the platform. The objective of this survey was to analyse the experience and the behaviour of those participants who completed the full programme.

4. Results and Discussion

4.1 Overview of course completion statistics

Table 2: TFSD - Course registration and completion statistics

Course	Registered Users	Completions	Completion percentage (%)
Python for Beginners [Course 1]	128047	11151	8.71
Web Design for Beginners [Course 2]	128049	6943	5.42
Python Programming [Course 3]	11137	1118	0.87
Front-End Web Development [Course 4]	6915	1518	1.19
Server-side Web Programming [Course 5]	1520	363	0.28
Soft Skills [Course 6A]	322	237	0.18
Technical Skills [Course 6B]	235	198	0.15
Capstone Project [Course 6C]	198	141	0.11

The course completion statistics of the TFSD programme is given in Table 2. Course 1 has the highest percentage of completion while the other courses have declining completion rates. It should also be noted that the difficulty of the courses increase as the programme progresses.

It is encouraging to see the number of completions of Courses 1 and 2, which has surpassed 18,000. In a short duration of time, the programme has produced individuals who can write programs in Python and develop basic web applications.

4.2 Analysis of the participants who completed the TFSD programme

Figure 2 provides the breakdown of the employment status of the participants who completed the TFSD programme. Interestingly it was noted that the majority (34%) of the participants were unemployed. 30.4% of the participants were active university students while 9.6% were employed. With 12.7%, a considerable portion of the participants were school goers.

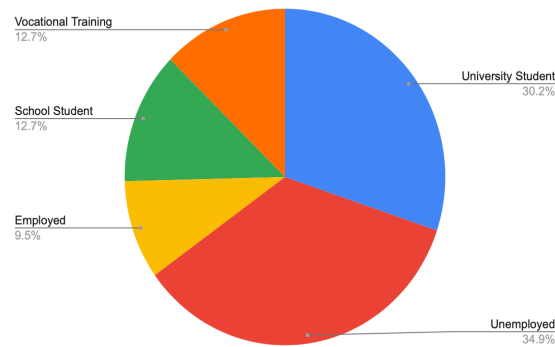


Figure 2: Employment status of the participants who completed the TFSD.

A separate question in the survey asked for the employment status in the ICT domain. The results are given in Figure 3.

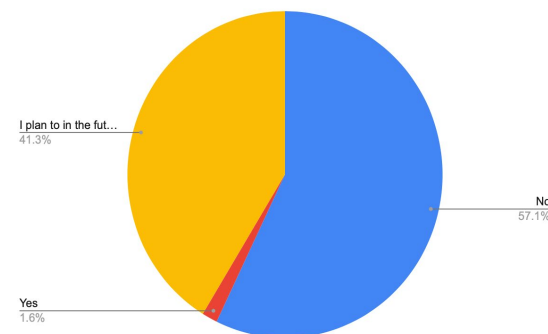


Figure 3: Employment status in the ICT domain.

Observations in Figure 3 indicate that only 1.6% of the total population of participants were employed in the ICT domain. As expected, a vast majority of the participants said No to this question. It was interesting to note that 41.3% of the respondents are interested in joining the ICT industry in the future.

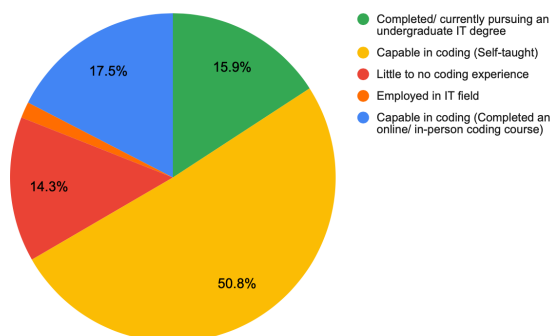


Figure 4: The programming skills of the participants when starting the TFSD programme.

Over 50% of the participants were capable of coding at the beginning of the programme. Observations in Figure 4 show that only 14.3% of the participants had little or no coding experience.

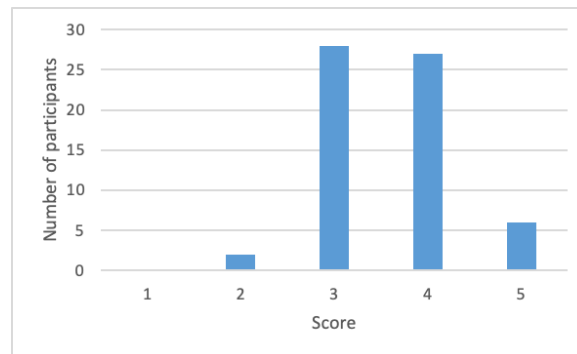


Figure 5: English proficiency scores of the participants on a scale from 1-5

Majority of the participants assessed themselves as having English language proficiency of 3 or above on a scale from 1 - 5. Figure 5 represents the English proficiency scores recorded.

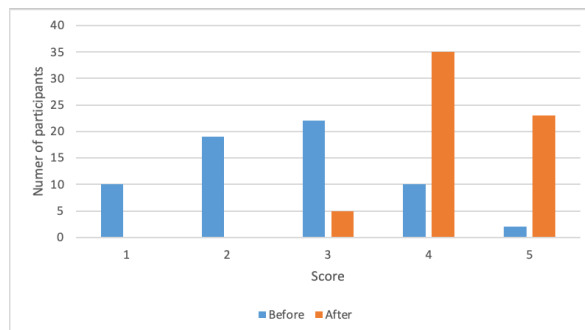


Figure 6: Programming and web development proficiency score before and after completing the TFSD programme.

The medium of instruction of the programme is English, and majority of the participants are non-native English speakers. The self-assessment of English proficiency of the participants, shows that in order to perform better in the programme, language proficiency is important. Identifying this relationship, the courses in the programme provide translations of the lecture scripts into two local languages, Sinhala and Tamil.

Figure 6 leads to an interesting observation where it shows the effect of the TFSD programme on the programming and web development skills of the participants. The programme has clearly facilitated in improving those skills. This is important from the perspective of the TFSD programme which targets to produce industry-ready trainee full stack developers.

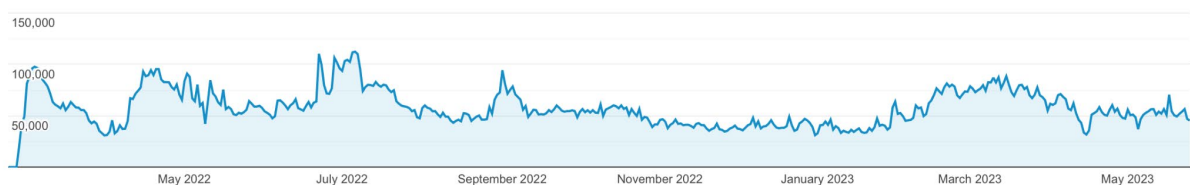


Figure 7: Page views on <https://open.uom.lk> for the period Feb 2022 - May 2023

Page view data collected from the Google Analytics platform reveal that the user presence on the platform has been steady from the launch of the programme. This can be linked to the active user engagement in the courses of the programme. Active user engagement is highlighted to be one of the major factors for successful completion of the programme.

5. Conclusion

Based on the illustrations and analysis conducted on the survey data we can identify several factors that may affect the successful completion of online learning programmes. The employment status, the level of education, the proficiency level of the medium of instruction and the level of student engagement are likely to affect the successful completion of an online learning programme. It should also be noted that, with the availability of massive amounts of data in such online platforms, vital information about the user behaviour may be inferred by using analysis of data.

The effectiveness of the TFSD programme in providing knowledge and skills related in ICT domain is clearly identified. Vast majority of the participants who have completed the programme have indicated that their programming and web development skills improved as a result of successful completion of the TFSD programme. Hence the impact made by the programme is highlighted.

In the case of asynchronous, self-paced online learning approaches, student engagement is vitally important. If the engagement levels are low, the likelihood of successful completion may decrease. Those who design asynchronous online learning programmes should pay special attention to the student engagement aspect.

6. Future Work

A predictive model based on the factors affecting successful completion of the online learning programme is proposed as future work. The model will be helpful in determining the probability of completion, given the behaviour of the students in the online learning environment. Especially with the availability of large amounts of data on the platform, it would be possible to develop such a model with reasonable accuracy and robustness.

References

- Alhakbani, H.A. and Alnassar, F.M. (2022). Open Learning Analytics: A systematic review of benchmark studies using Open University Learning Analytics Dataset (OULAD), Proc. ICMLT2022, 81-86.
- Arnold, K.E. and Pistilli, M.D. (2012). Course Signals at Purdue: Using Learning Analytics to Increase Student Success, Proc. LAK'15, 1-4.
- Ayres, P., & Sweller, J. (2014). The split-attention principle in multimedia learning. In R. E. Mayer (Ed.), *The Cambridge handbook of multimedia learning* (2nd ed; pp. 206-226). New York: Cambridge University Press.
- Azevedo, R. & Aleven, V. (Eds.). (2013). *International handbook of metacognition and learning technologies*. New York: Springer.
- Benson, B. (2022). Procrastination is a key indicator of success or failure in some online business courses, Proc. LAK'22, 1-6.
- Brunken, R., Seufert, T., & Paas, F. (2010). Measuring cognitive load. In J. L. Plass, R. Moreno, & R. Brunken (Eds.), *Cognitive load theory* (pp. 181-202). New York: Cambridge University Press.
- Clark, R. C., & Mayer, R. E. (2016). *e-Learning and the science of instruction* (4th ed). Hoboken, NJ: Wiley.
- Mayer, R.E., 2019. Thirty years of research on online learning. *Applied Cognitive Psychology*, 33(2), pp.152-159.
- Nanayakkara, V., Karunaratne, B., Ranasinghe, M., Perera, S., Yaggahavita, H., Wickramanayake, S. and Amarasinghe, G. (2022). A sustainable approach to address the human resource requirement of the information technology industry in Sri Lanka. In *Proceedings of the 40th National Information Technology Conference* (pp. 21-27). The Computer Society of Sri Lanka.
- Nanayakkara, V., Karunaratne, B., Ranasinghe, M., Perera, S., Yaggahavita, H., Ahangama, S. and Mahadewa, K. (2022). open.uom.lk: A sophisticated open online learning platform. In *Proceedings of the 40th National Information Technology Conference* (pp. 28-33). The Computer Society of Sri Lanka.
- Nanayakkara, V., Karunaratne, B., Ranasinghe, M., Perera, S., Amarasinghe, G., Wickramanayake, S., Ahangama, S., Mahadewa, K., Hettiarachchi, C. and Yaggahavita, H. (2022). open.uom.lk: A Free Online Knowledge Sharing Platform. In *Proceedings of the 21st European Conference on e-Learning, ECEL 2022*. Academic Conferences International, 2022.
- Pilli, O. and Admiraal, W. (2017). Students' Learning Outcomes in Massive Open Online Courses (MOOCs): Some suggestions for course design, *Yuksekokretim Dergisi*, 7(1), 46-71.
- Rienties, B., Toetenel, L. and Bryan A. (2015). "Scale up" learning design: impact of learning design activities on LMS behavior and performance, Proc. LAK'15, 315-319.
- Seaton, D. T., Bergner, Y., Chuang, I., Mitros, P. and Pritchard, D.E. (2014). Who does what in a Massive Open Online Course?, *Communication of the ACM*, 57(4), 58-65.

Is it the new Google: Impact of ChatGPT on Students' Information Search Habits

Thashmee Karunaratne and Adenike Adesina

Department of Computer and Systems Sciences, Stockholm University, Kista, Sweden

thasmee@dsv.su.se

niike.adesina231@gmail.com

Abstract: The traditional subject of information search and retrieval (IR) paradigm shifted to an entirely new era since artificial intelligence (AI) techniques were introduced into the field. Browser-based IR solutions powered by AI for personalised recommendations-based information retrieval, such as the Google search engine, were one of the early examples. The IR field has advanced to its next level with the newest conversational applications based on large language model (LLM) techniques. It is becoming clear that Generative Pretrained Transformer (GPT) applications such as ChatGPT will significantly impact information retrieval behaviour in the education sector. Though this application has become widespread in acclaim, no previous study has shown its impact on information seeking and retrieval. However, based on the observation of the fast penetration of this technology and the growth of public interest, a pre-assumption was built that it is essential to investigate if students may also be showing a similar interest in this new tool. Hence, this study is set up to systematically and empirically explore how ChatGPT influences the IR behaviour of students in HEIs. A survey approach is utilised to collect the perceived IR behaviour through a questionnaire administered to 60 students in HEIs. The findings reveal that the tool is already widely known among HEI students. They also perceived the use of the tool in the context of information retrieval and proclaimed its usefulness, acknowledging its efficiency (reduced time) in finding information. Furthermore, the technology has considerably affected the typical use of other conventional information retrieval and search engine tools. On the contrary, 10% of the respondents are less likely to use ChatGPT during information seeking for various reasons, from credibility and relevance to technology infrastructure issues such as connectivity. Although a deeper analysis is required to establish a general conclusion on how and in which ways GPT-based models will override contemporary IR practices, the study outcome provides evidence for a possible behavioural change among HEI students in their IR habits in the future.

Keywords: Information Retrieval, Artificial Intelligence, ChatGPT, Higher Education, Student behaviour

1. Introduction

Technology advancements challenge the traditional ways and practices of society, and it demands a change in the mindset of the people to benefit from it. Information seeking has been a significant preoccupation of humans since aeon and a high-level cognitive process of learning or problem-solving (Tubachi, 2018). As people constantly need ways to resolve their information problems relatively quickly, information retrieval (IR) has always been a topic in cutting-edge research (Kadir et al., 2018). For information seekers, improvements in the field over time have made the possibility of finding information efficiently, due to the development of various IR mechanisms that ensure information is easily found or obtained (Sambe, 2017). Currently, the traditional way of IR is severely impacted due to technological disruptions. From AI's offshoot, several tech-offspring have emerged, paving the way for a conversational interface for the IR field (CRLT, 2023). Particularly machine learning (ML) together with Natural Language Processing (NLP) has established conversational agents such as Google Assistant, Alexa, ManyChat, ChatGPT, and so on that can simulate human behaviour by adding emotions, sentiments, and affect to the context through a conversational interface (Kulkarni et al., 2019). ChatGPT, an AI-based solution for large language models (LLMs), rather abruptly the technology and linguistics markets recently, shaking the current practices in many domains (ChatGPT, 2022). A recent study reported that nearly a third of 1000 US College students who participated in a study had used ChatGPT to complete written homework assignments, and close to 60% use it on more than half of their work (GT, 2023). Despite the ChatGPT's acclaim for a speedy response to query search in a smooth conversational style and pointing out the challenges it has raised about misinformation and unethical use of it by early adopters, particularly students (CRLT, 2023), no previous study has vividly hinted on the need to investigate how ChatGPT has affected information users' behaviour, particularly students in HEIs. Based on the observation of the fast penetration of this technology and the growth of public interest, a pre-assumption was built that it is essential to investigate if students may also be showing a similar interest in this new tool. In this light, it is essential to investigate the influence of this newest advancement, ChatGPT, on students' information-seeking behaviour. Focusing on the general users' perspectives and other application areas where studies have provided insights on the use and benefits of conversational tools, this study rather examines the behaviours these study subjects exhibit while trying to solve their information problem through an information aid tool like ChatGPT. Hence, this research systematically and

empirically explores how ChatGPT influences the IR behaviour of students in HEIs. The choice of the scope of HE is based on the growing interest and wider popularity among higher education students, who are typically early adopters of technology. The study focus is hence on the students of bachelor, master and PhD levels. While the study recognises the existence of other conversational AI applications, their inclusion is beyond the scope of this research.

The rest of the article is organised as follows. The second chapter briefs about the state of the art of information search and retrieval and the impact of the current technology disruption on IR. Chapter 3 focuses on the methodological approach of this study in shedding light on the role of new technology and the LLM-based tool ChatGPT on students' information retrieval habits. In Chapter 4, the study results are analysed and discussed against the state-of-the-art IR methods and practices, and finally, in Chapter 5, the concluding remarks including the limitations identified as well as possible ways forward, are summarised.

2. Background

The literature on the history of information research shows that IR history is long and did not originate with the Internet (Sanderson & Croft, 2012), even though one of the primary uses of the Internet is information retrieval (Liaw & Huang, 2003). Students, who are constant information seekers for knowledge-building purposes, rely on factually correct, scientifically proven information and largely trusted collections of information originating from the discipline of librarianship (p. 1). This was also stated by (Wilson, 2000) when he noted that in the course of seeking information, students might interact with manual information systems like the library (Tubachi, 2018). However, the need for a retrieval system shortly became essential when the information collection became too difficult to manage by traditional cataloguing in the library (Sanderson & Croft, 2012). At present, technology has significantly impacted the use of conventional IR since computer-based IR tools emerged on the horizon of IR due to the ease of storing and mechanically retrieving large amounts of information with technology (Singhal, 2001, p.35). Since the information search strategies, impacted by modern technologies and methods that are highly flexible in adapting to one's choice, are growing in attraction, the traditional methods are losing their 'weight of attraction' (Singhal, 2001).

The development of search engines and ranked retrieval enabled by the World Wide Web (www) also made IR services easily accessible (Sanderson & Croft, 2012). Internet-based information retrieval would have collapsed if there were no search engines soon enough, as Liaw & Huang (2003) point out. While seeking information, individuals, including students, interact with computer-based systems using the Internet (Thindwa et al., 2019). Currently, there is an offshoot of Artificial Intelligence (AI) called Conversational AI, which can engage in conversation with users when they are trying to access information during information-seeking (Kulkarni et al., 2019). These applications, which are now components of IR systems, mimic human interactions by identifying speech and text inputs and translating their contents into other languages using massive amounts of data, machine learning, and natural language processing (Rangoli, 2023). Initially, Natural Language Processing (NLP) was proposed as a tool to enhance retrieval effectiveness but was seen to have limited success (Singhal, 2001). However, Sanderson & Croft (2012) stated that the route to creating successful IR systems required much innovation and thoughts over a long period. Today, this is justified by the role of AI and how it is increasingly constituting a major source of innovation by performing various tasks hitherto attributed to humans alone by using a combination of NLP to analyse language with the use of machine learning (ML) (Rangoli, 2023). Moreover, there is a growing interest in and adoption of conversational AI applications across sectors for various purposes. In the education sector, for example, a study showcased the role of conversational AI and why users utilise conversational AI applications to fulfil their information needs (Mckie et al., 2022). In addition, the potential of using conversational agents to improve the academic research experience for university students for enhanced service delivery has also been explored (Mckie & Narayan, 2019; Schmitt et al., 2022). As the field of AI continues to advance at a rapid pace, it is becoming increasingly clear that conversational applications such as ChatGPT will have a significant impact on the education sector, particularly on the way scientific articles are written and edited (Gilat & Cole, 2023). However, what is not yet clear is the influence of these applications, especially ChatGPT, on the information-seeking and retrieval behaviour of students in HEIs. No previous study has investigated nor considered how the use of ChatGPT as an IR tool is being used for information discovery by students in HEIs. As this field of study remains in an emerging stage, this study will therefore aid future studies and can provide perspective in designing IR tools that are more user-inclined by investigating how information has been impacted.

3. Methodology

In this research, a survey approach is chosen to empirically and systematically capture the perception and behaviour of students in the context of ChatGPT as an IR tool. Data collection was based on an Internet questionnaire due to its flexibility and reachability. This choice is also partly due to the target group chosen, i.e., higher education students, who prefer digital forms over manual forms when it comes to data collection options (Denscombe, 2021). For wider reachability, personalised messages were sent through various student social media groups, particularly WhatsApp. Follow-up messages were sent per time as reminders to click on the provided link that leads to the web form. Also, the minds of respondents were prepared as to the probable duration of the questionnaire and expectations. The questionnaire consisted of 23 close-ended questions, divided into two sections; 1) demographic information and 2) ChatGPT and Information Search Process, which was developed based on the ISP model (Kuhlthau et al., 2008) and other literature on information search. The questionnaire, including a cover letter, was designed using Google Forms and the same was sent to different student groups and platforms using the Internet.

The sample was drawn from a broad population of students from undergraduate to postgraduate levels. Non-probability sampling was chosen due to the aim of this study which is to produce an exploratory sample rather than a representative cross-section. Blended with the snow-balling technique, students contacted were requested to share among their networks which created a rippled effect. Both techniques are used to get the best information available from the respondents who are in different degrees of study as it is particularly suited for creating an exploratory sample that can best give insight into the research question at hand. A summarisation and visualisation approach was followed to interpret the data collected from the research instrument since visualisations are better at providing a holistic view of student perceptions. Numerical data was generated after assigning codes to responses collected through a close-ended questionnaire. Descriptive summarisations were performed on nominal data collected, and a quantitative data analysis platform IBM SPSS (Statistical Package for the Social Sciences), was used for the presentation of the summaries.

There was no ethical complication associated with the data collection and analysis of this study since no sensitive data was collected, nor were the conclusions subjected to ethical implications. To ensure anonymity, no personal details were collected, inclusive of email addresses. To ensure this, an informed consent form was introduced at the beginning of the questionnaire, which vividly describes the purpose of the research and concerns that potential respondents may likely have.

4. Results and Discussion

Following the research design, a questionnaire with two sections was created and opened for three days in March 2023, and data was gathered using an online survey in Google Forms. The link to the form was sent directly to students' platforms on popular social media. Students in higher institutions (undergraduate, graduate, and postgraduate) were the respondents. In the span of 3 days, 60 responses were collected.

4.1 Sociodemographic of respondents

The sociodemographic distribution of the respondents is presented in Table 1. Accordingly, the respondents are mostly from graduate and postgraduate levels, with nearly equal proportions of males and females, and mostly distributed among subject areas of Health, Social Sciences and STEM.

Table1: Sociodemographic data of the respondents

Variables		Frequency (%); N = 60
Gender	Male	34 (56.7)
	Female	26 (43.3)
Age	18-25yrs	9 (15)
	26-32yrs	25 (41.7)
	33-40yrs	22 (36.7)
	41-45yrs	2 (3.3)
	Above 45yrs	2 (3.3)
	Undergraduate	4 (6.7)

Variables		Frequency (%); N = 60
Level of education	Graduate	26 (43.3)
	Postgraduate	30 (50.0)
Field of study	Humanity	6 (10.0)
	STEM	15 (25.0)
	Social sciences	16 (26.7)
	Health sciences	17 (28.3)
	Business	6 (10.0)

4.2 Analysis of the Results

Awareness: Findings from the empirical data collected revealed that ChatGPT is mostly explored by students at the postgraduate level of education. Although the AI tool is commonplace nowadays, the popularity among the population studied is not as high as typically forecasted (Rudolph et al., 2023). The cumulative frequency of respondents who use it sometimes and those who use it often is just more than half the number of respondents, i.e., 52%. Though this result seems to be mixed, it revealed certain influences and experiences of the sampled users. Figure 1 shows this distribution of responses.

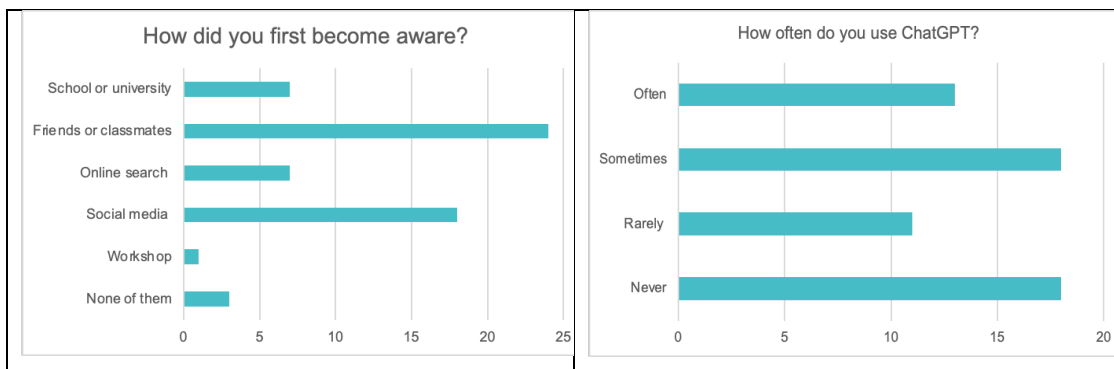


Figure 1. Channels of awareness (left) and Frequency of use (right) of ChatGPT as an IR tool

Accordingly, the trends of using ChatGPT are yet to emerge. Students have become aware of the tool via different channels, mainly friends and social media. The analysis also indicates the existence of diverse reasons why students seek information. Some reasons are obligatory, while some are optional.

Use and effectiveness: The purpose and context of the use of ChatGPT are shown in Figure 2.

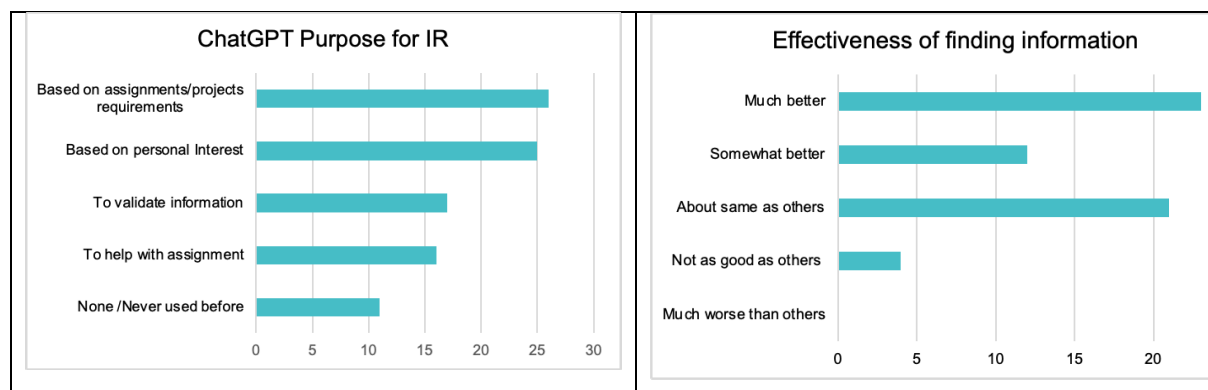


Figure 2. The purpose of use (left) and goodness of the results (right)

Respondents in this study have explored the tool mostly when carrying out their project tasks or writing their assignments as a part of their academic engagement. A reasonable number of the respondents also use it based on pure personal interest. This trend aligns with what Tubachi (2018) stated about the reason information is sought. The results also show that ChatGPT is more effective at finding information compared to other competitive AI tools. When considering the effectiveness of the information search, students also trust the tool

compared to other conversational AI applications such as Google Assistant and Search engines such as Google and Bing. Of the respondents, 23 believed that ChatGPT is much better than other AI conversational tools and Search engines (c.f. Figure 2 (right)). Only 4 (6.7%) stated that it is less effective than other tools.

Challenges: On average, students have not been challenged by the demands the tool is associated with. However 16 students mentioned various problems they encountered during the use of the tool, while 15 others had some issues but did not hinder using it. For instance, network and connection issues (due to the heavy demand for the tool) and the difficulty involved with evaluating the credibility of the information it provides have been questionable for some students. A few respondents (16.7%) stated that it is difficult to enter an appropriate prompt or query that works best for the AI tool. The total outcome of students' perception of the quality and the efficiency of the tool is in Figure 3.

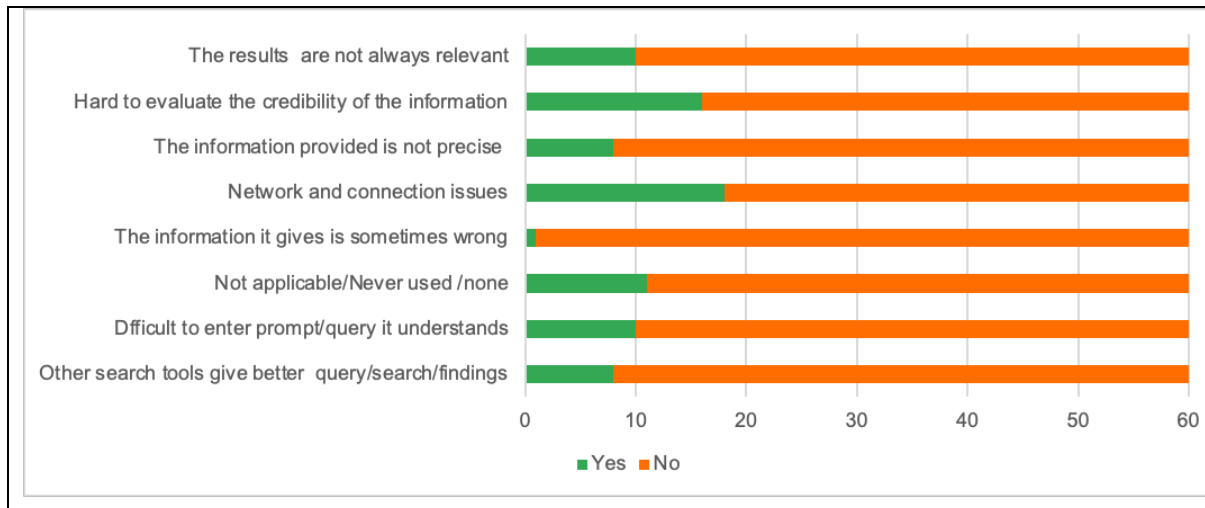


Figure 3. Challenges associated with using ChatGPT

Trust in the functions: The respondent's perception of the trustworthiness of the tool was surprisingly high. Only 8 out of 60 thought information provided by the tool can be wrong sometimes. As twice as much as that believed, the credibility of the information cannot be verified easily. Furthermore, the students recognised the precision of the information in ChatGPT outcomes, with only ten students doubting the relevance. Regarding the effectiveness of the approach for seeking information, 27 indicated that ChatGPT had raised their curiosity level. More than half the group stated that ChatGPT usage had increased their confidence in finding information. Although seven respondents indicated that the emergence of ChatGPT has probably reduced their research skills, the majority think the use of the tool doesn't impact their abilities. While only 15% indicated that ChatGPT has made them become more sceptical about information they find online, 53 out of 60 were using it as a tool for IR at some point in their academic life. The complete summary of the respondents' behavioural impact is presented in Figure 4.

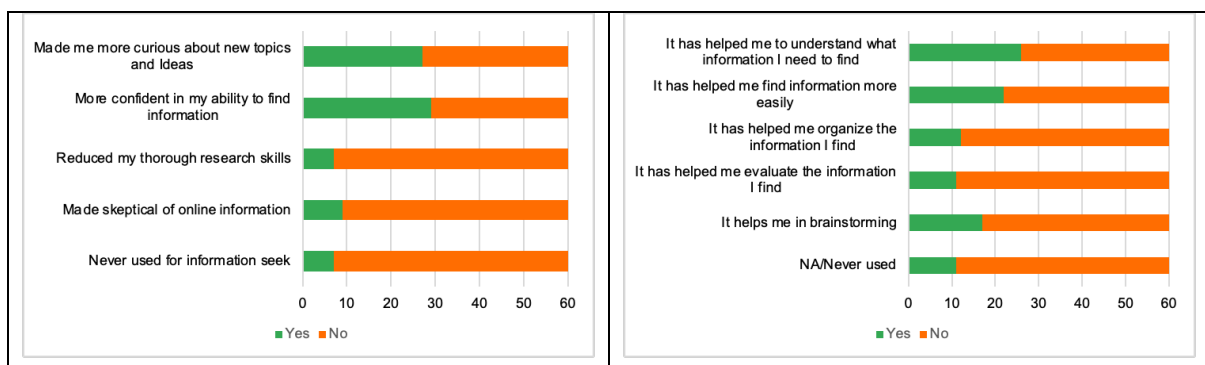


Figure 4. ChatGPT impact on students' IR behaviour (left) and the support for IR (right)

Obviously, the support students think they can get from the tool varies in a large spectrum since, naturally the information-seeking behaviour is associated with many factors (Tubachi, 2018). 26 respondents (43.3%) felt that ChatGPT has helped them understand the exact information they need to find. Respondents rarely recognized

the impact of the tool as an information evaluation tool; only 11 respondents (18.3%) indicated that it has helped them evaluate the information they find. All in all, they may not be seeing a great challenge or negative impact of using the tool. The respondents perceive that ChatGPT has grossly reduced the time needed to search for information online as well as the anxiety associated with the search process. This may be a reason for the sporadic acclaim the application was able to acquire since its launch in 2022. According to (Morville, 2005), individuals will use an interface or methodology that is most straightforward when finding information. In terms of the impact on the respondents' approach to seeking information, this study identified the increased curiosity level and increased confidence level among higher education students as the greatest impacts. The varied kinds of experience are also in tandem with the ISP model (Kuhlthau et al., 2008) which posited that there are affective and cognitive feelings users encounter when seeking information. The deep understanding of feelings associated with its use is significant. It can be explored to make positive interventions when aiming to improve IR efficiency in this era of AI for IR.

User competence: The results also show that ChatGPT is more efficient in finding information compared to the other competitive AI-based tools. Even though the use of it is not pronounced among the population studied, many of the respondents (50%) stated that they are very confident in their ability to find and evaluate information drawn by ChatGPT. The complete spectrum of responses is as in Figure 5.

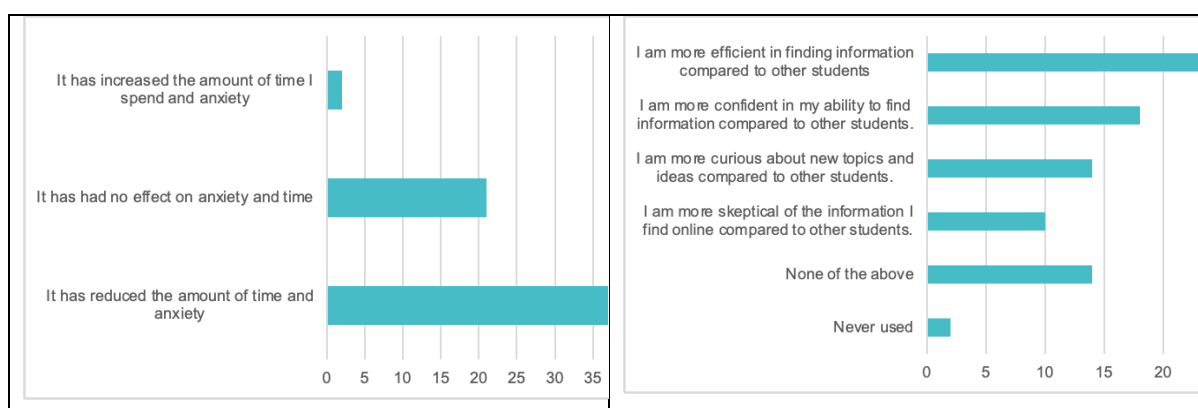


Figure 5. Students' perception of IR-associated time and anxiety perspective (left) and self-assessment of IR competence (right)

Accordingly, 60% of the respondents indicated that using ChatGPT has reduced the time needed to search for information, thereby the anxiety associated with seeking information. On the converse, 3.3% stated that it had increased the time associated with seeking the information as well as the anxiety level (c.f Figure 5 (left)). As Figure 5 (right) indicates, students believe in them when it comes to finding information. 24 students recognise themselves as more efficient than their fellow students in IR. 18 are confident in their ability of IR. The self-assessment of the student's competence is a strong indicator of information literacy of students, which indirectly may also contribute to reduced anxiety and improved confidence in using the tool in the future.

4.3 Discussion of the study outcomes and research validity

During this empirical work, it has become apparent that research on conversational AI tools for IR is becoming popular, and there is a vast and relatively unexplored research domain in this field. There are several aspects of AI for IR, particularly from the users' perspectives that are yet to be investigated. The results are in agreement with previous studies that have explored why students primarily seek information, which is the goals laid down by their educational pursuits (Tubachi, 2018) and also the fact that during information seeking, students interact with IR tools (Sambe, 2017; Wilson, 2000), which results in varied experiences. A strong linkage has also been shown between seeking information, and the students' preferences to explore digital IR tools. This is in tandem with (Sambe, 2017), where it was stated that it is more traditional for students to search for information beginning with digital tools like web search engines. The work of (Morville, 2005) also is in agreement with this study and shows that HEIs prefer the use of digital tools enabled by the Internet instead of resources provided by librarians in the library, although it did not specifically highlight the use of ChatGPT during the information search process. The summary of the findings is encapsulated in Figure 6.

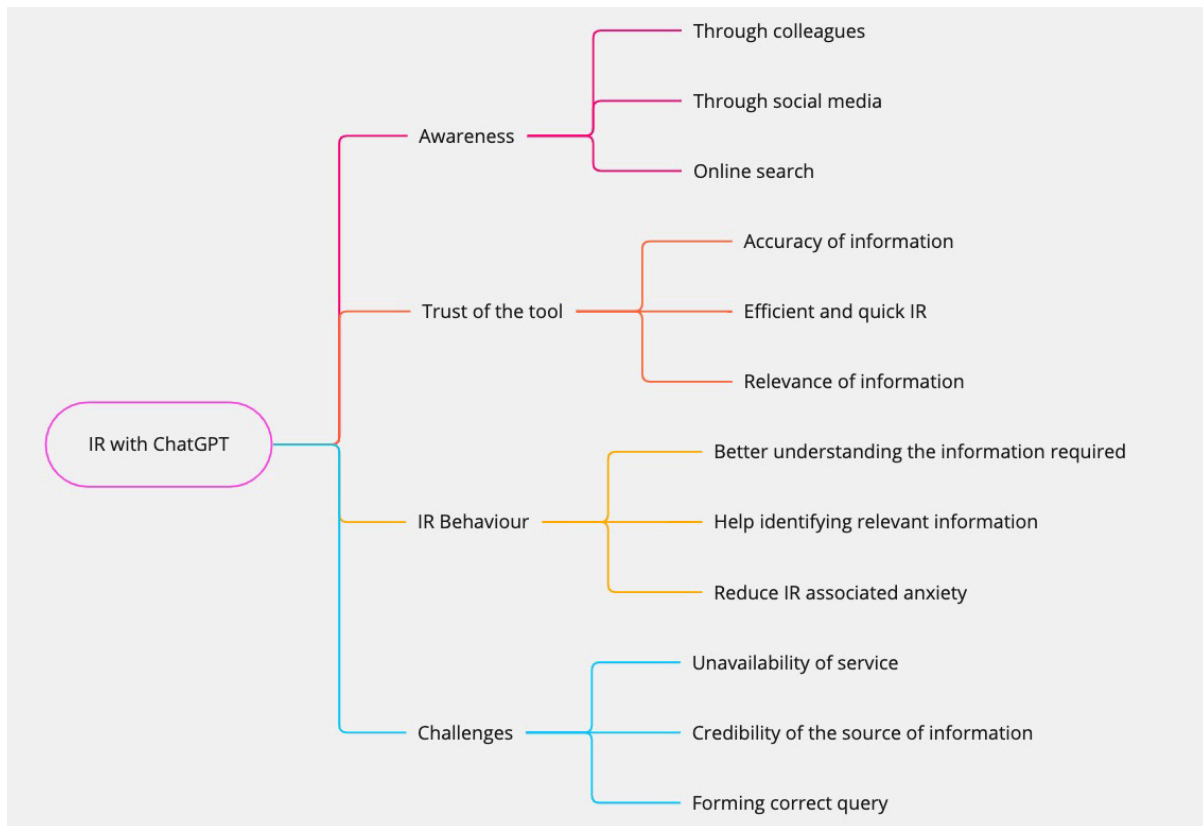


Figure 6. The summary of the outcome

Further studies might be in demand to further establish the discoveries of this research, the research only covered a specific sample of students, partly due to its methodological choices. Due to the maturity of the tool, the technology penetration, and typical resource (time-inclusive) constraints in conducting the research may have possible biases on the outcome. As suggested by (Denscombe, 2010), a mixed-method approach could provide deeper insights into the facts found in this study. This is, however, not to disparage the findings described in this study in whatsoever way. Continued research into the influence of ChatGPT as an IR tool appears fully justified as it has become necessary to expand the knowledge base in this domain due to its recency. Also, since there is a mixed result about the usage of ChatGPT, the study population can be widened to enable more diverse samplings of students especially at the undergraduate level, as this study could not elicit more data from them. Likewise, future studies streamlined to a certain field of study can possibly be explored. By it, certain fields within the HEIs can be concentrated on to know how the use of ChatGPT influences students in such spheres. Areas such as the usefulness and efficiency of the tool in the context of IR can also be delved into for deeper research inquiry or comparative discussion within the scope of other search engines or conversational AI tools. Likewise, since many information-seeking theories are prevalent, future work can concentrate on the relevance of these theories to AI tools for IR which would further help to deepen understanding of their usage and effects over time. This can help steer more interest in how students in HEIs seek knowledge, interact with them, their perception of AI usefulness based on experience, and understand how conversational AI applications can be designed to better support students' information needs and learning outcomes, particularly by using technology adoption frameworks such as Technology Acceptance Model (TAM) (Silva, 2015).

5. Concluding remarks

Information seeking is both a compulsory and voluntary exercise among students (Tubachi, 2018). Several approaches are employed by students when seeking information and a variety of tools are used to facilitate the science of seeking information. While the library still plays a vital role in seeking information, it is however being shifted towards search engines followed by conversational AI tools. This study has shown that the use of the library for information is becoming a rather uncommon or archaic activity among students. The empirical data from 60 respondents indicate that ChatGPT, the conversational AI tool based on LLM, is a known tool for IR

among HEI students and that it has some weighted influence on the way they seek information through their perceived experiences. The use of ChatGPT has reduced the anxiety of information search, the time associated with seeking information, and increased the confidence with which students seek information, as well as the curiosity levels among the respondents studied. However, challenges in and of using the tool were highlighted. This includes appropriate prompts and difficulty in evaluating the credibility of the search outcomes, the network and connection issues (due to the popularity of the tool) are some of the negative users' experiences that must be improved upon to maximise this disruptive AI tool. Overall, because of its acclaimed effectiveness in IR, the practice may have shifted from the traditional ways of seeking information towards the new technology affordances. Analysis revealed that only 10% of the respondents are less likely to use ChatGPT for IR purposes. This is a good indicator of the usefulness of the tool for the purpose. This knowledge can be used to further improve user experience and continued satisfaction with the application for IR in practice. Furthermore, this study revealed that students prefer technology-based tools for IR and their selection of a particular tool is premised on its effectiveness in meeting their diverse information needs. Results from this study can result in practical applications for improving the efficiency of libraries in the digital age and renewing their continued relevance for IR. Although this study has identified a gap by emphasising the need to examine the influence of AI conversational tools on HE students and has further confirmed studies from previous research on the varied nature of experiences underscoring information behaviour, it also highlights the need for further research to gain a deeper understanding of this AI phenomenon owing to the limited sample size. A larger-scale enquiry could provide more robust evidence and validate the findings described herein, which would be valuable for practitioners in the IR ecosystem.

References

- ChatGPT. (2022). *ChatGPT*. <https://chat.openai.com>
- CRLT. (2023). *ChatGPT: Implications for Teaching and Student Learning | CRLT*. <https://crlt.umich.edu/blog/chatgpt-implications-teaching-and-student-learning>
- Denscombe, M. (2010). *The good research guide: For small-scale social research projects (Open UP Study Skills)*. McGraw-Hill.
- Denscombe, M. (2021). *Ebook: The Good Research Guide: Research Methods for Small-Scale Social Research Projects*. McGraw-Hill Education (UK).
- Gilat, R., & Cole, B. J. (2023). How Will Artificial Intelligence Affect Scientific Writing, Reviewing and Editing? The Future is Here *Arthroscopy: The Journal of Arthroscopic & Related Surgery: Official Publication of the Arthroscopy Association of North America and the International Arthroscopy Association*, 39(5), 1119–1120. <https://doi.org/10.1016/j.arthro.2023.01.014>
- GT. (2023, January 25). *Study: 30% of College Students Have Used ChatGPT for Essays*. GovTech. <https://www.govtech.com/education/higher-ed/study-30-of-college-students-have-used-chatgpt-for-essays>
- Kadir, M. R. A., Johari, N. I. S., & Hussin, N. (2018). Information Needs and Information Seeking Behaviour: A Case Study on Students in Private University Library. *International Journal of Academic Research in Progressive Education and Development*, 7(3), 226–235.
- Kuhlthau, C. C., Heinström, J., & Todd, R. J. (2008). The 'information search process' revisited: Is the model still useful. *Information Research*, 13(4), 13–14.
- Kulkarni, P., Mahabaleshwarkar, A., Kulkarni, M., Sirsikar, N., & Gadgil, K. (2019). Conversational AI: An Overview of Methodologies, Applications & Future Scope. *2019 5th International Conference On Computing, Communication, Control And Automation (ICCUBEA)*, 1–7. <https://doi.org/10.1109/ICCUBEA47591.2019.9129347>
- Liaw, S.-S., & Huang, H.-M. (2003). An investigation of user attitudes toward search engines as an information retrieval tool. *Computers in Human Behavior*, 19(6), 751–765.
- Mckie, I. A. S., & Narayan, B. (2019). Enhancing the Academic Library Experience with Chatbots: An Exploration of Research and Implications for Practice. *Journal of the Australian Library and Information Association*, 68(3), 268–277. <https://doi.org/10.1080/24750158.2019.1611694>
- Mckie, I., Narayan, B., & Kocaballi, B. (2022). Conversational Voice Assistants and a Case Study of Long-Term Users: A Human Information Behaviours Perspective. *Journal of the Australian Library and Information Association*, 71(3), 233–255. <https://doi.org/10.1080/24750158.2022.2104738>
- Morville, P. (2005). *Ambient Findability: What We Find Changes Who We Become*. O'Reilly Media, Inc.
- Rangoli. (2023, January 26). Difference Between Conversational AI and Generative AI. *Analytics Insight*. <https://www.analyticsinsight.net/difference-between-conversational-ai-and-generative-ai/>
- Rudolph, J., Tan, S., & Tan, S. (2023). War of the chatbots: Bard, Bing Chat, ChatGPT, Ernie and beyond. The new AI gold rush and its impact on higher education. *Journal of Applied Learning and Teaching*, 6(1), Article 1. <https://doi.org/10.37074/jalt.2023.6.1.23>
- Sambe, M. T. (2017). *INFORMATION SEARCH STRATEGY AND RETRIEVAL TOOLS IN LIBRARIES*.
- Sanderson, M., & Croft, W. B. (2012). The history of information retrieval research. *Proceedings of the IEEE*, 100(Special Centennial Issue), 1444–1451.

- Schmitt, A., Wambsganss, T., & Leimeister, J. M. (2022). Conversational Agents for Information Retrieval in the Education Domain: A User-Centered Design Investigation. *Proceedings of the ACM on Human-Computer Interaction*, 6(CSCW2), 1–22.
- Silva, P. (2015). Davis' technology acceptance model (TAM)(1989). *Information Seeking Behavior and Technology Adoption: Theories and Trends*, 205–219.
- Singhal, A. (2001). Modern information retrieval: A brief overview. *IEEE Data Eng. Bull.*, 24(4), 35–43.
- Thindwa, T., Chawinga, W. D., & Dube, G. (2019). Information-seeking behaviour of security studies students: A case study. *South African Journal of Information Management*, 21(1), 1–10.
- Tubachi, P. (2018). *INFORMATION SEEKING BEHAVIOR: AN OVERVIEW*.
- Wilson, T. D. (2000). Human information behaviour. *Informing Science*, 3, 49.

Exploring the Student Perspective: Assessing Technology Readiness and Acceptance for Adopting Large Language Models in Higher Education

Claudia Lemke¹, Kathrin Kirchner², Liadan Anandarajah³, Florian N. Herfurth¹

¹Business Information Systems, Berlin School of Economics and Law, Berlin, Germany

²Department of Technology, Management and Economics, Technical University of Denmark, Lyngby, Denmark

³Computer Science, Humboldt-Universität zu Berlin, Berlin, Germany

Claudia.lemke@hwr-berlin.de

kakir@dtu.dk

liadan.anandarajah@student.hu-berlin.de

s_herfurth22@stud.hwr-berlin.de

Abstract: Digital technologies are changing and will continue to change how we learn and teach today and in the future. With the latest developments in the field of generative artificial intelligence (AI), particularly large language models (LLMs), the question of using AI-based tools in academic education is ruling the current discussions about the transformative impact of AI in higher education (HE).

These discussions range from banning these technologies for learning and teaching in HE to guided study support. This study avoids taking up these multifarious and partly controversial debates. Instead, we show how students perceive using AI-based tools for automated text generation for their studies. Drawing on a synthesis of two theories: the 'Technology Readiness Index' (TRI) and 'Technology Acceptance Model' (TAM). The model is validated based on survey data collected among undergraduate first-semester students ($N=111$) of a computer science-related study programme in Germany in winter 2022/23. The students had to evaluate their relationship to that new technology focusing on their readiness for technology adoption and acceptance. By analysing the collected data with a partial least squares model, we find that the optimism toward the new technology positively influences technology acceptance, while discomfort with the technology negatively influences perceived ease of use. The paper concludes with recommendations for action for adopting LLMs in HE. A proper investment in building AI skills in academic teaching plays a valuable role in fostering the students' positive attitude and innovativeness towards this new technology. Additionally, there is a need for more education about the risks and challenges of using this technology to reduce the impact of factors such as discomfort on ease of use. This requires a factual discourse, away from the current hype-induced exaggerated and hyperbolic statements, for instance, in developing formal guidance for universities.

Keywords: Student Perspective, Technology Readiness, Technology Acceptance, Large Language Models, Higher Education

1. Introduction

Recent breakthroughs in generative artificial intelligence (AI) have massively influenced the current AI hype and the discussions about the impact of such a transformative digital technology like AI. Generative AI is an umbrella term for general-purpose systems based on machine learning (ML) and natural language processing (NLP) for creating new content, including text, audio, video, software code or simulations. Such systems use vast amounts of data to train their deep neural networks and conceptualise patterns of multimedia-related new content based on their probabilistic nature, like art, images, movies, music, texts or software programs. A powerful representative of these AI systems is the Large Language Models (LLMs). These systems represent "generative mathematical models of statistical distribution of tokens" (Shanahan, 2022, p. 2) as universal language processing tools. These pre-trained models are parameterised by a neural network that gets their training data from the massive amount of publicly available human-generated text. With their ability to provide a probabilistic distribution of word sequences, they are modelling natural language texts based on statistics, information theory, and machine learning (Li, 2022). This transformation process demonstrates the current potential of large language models, which empower humans to ask the system questions in natural language (called prompts) and receive answers. LLMs are a new technology, especially their usage in (higher) education for teachers and learners. Even though tools already exist to support the writing process, this kind of technology, which might take over the entire creative writing process, is entirely new and unique. This kind of interaction with the system leads us to believe that these systems are intelligent and that the results are justifiable. An important debate about the results' trustworthiness, credibility and comprehensibility of generative AI is ongoing. It requires close attention and further research, not only in the (higher) education field (Crawford, Cowling and Allen, 2023; Bender et al, 2021; Weidinger et al, 2021).

Our paper sets a different focus by investigating how students perceive this new technology, what behaviour and what relationship they develop with this technology by measuring their readiness and acceptance. The long-established theories of TRI and TAM in information systems research (see Venkatesh, Davis and Moris, 2007) are particularly well suited for this investigation and are applied as a combined model for the first time in the context of LLMs. This paper contributes to making the current debate on the use of LLMs in HE more objective. In particular, we examine students' willingness to use these technologies by surveying 111 first-year undergraduate students in a German Higher Education Institution (HE). The students' perception of LLMs for their daily study work might shape future action plans for handling the use of LLMs in HE.

2. Related Work

The current hype around the potential uses of LLMs in HE has led to increased research. Kasneci et al (2023) or Gimpel et al (2023) investigate the opportunities and challenges of LLMs for HE from a teacher's and student's perspectives. Farrokhnia et al (2023) or Su and Yang (2023) combine general aspects of generative AI with a close focus on ChatGPT (a specific LLM product) and its adoption in HE. Lim et al (2023) demand attention to the paradoxes of generative AI and provide implications for the future of education from the perspective of management educators. Other work is devoted to specific aspects of generative AI in HE, such as Rudolph, Tan and Tan (2023) or Savelka et al (2023) about assessments in HE. Further work, such as Chan and Hu (2023) or Sullivan, Kelly and McLaughlan (2023), look mainly at the impact of using LLMs from the student's perspective.

Most papers show that generative AI in HE is an emerging technology, especially LLMs, with a broad scope of new applications but also risks and limitations for students and lecturers, which needs further investigation. Our paper answers this need by examining how students are prepared to anticipate this new technology based on a quantitative survey. We know from information systems research that the user's willingness to interact with a new technology influences the possibilities of technology adoption in an organisational setting. Therefore, our paper focusses on the students' behaviour, intentions, and treatment of this new technology. For this purpose, we apply the theory of Technology Readiness Index (TRI) and combine it with the Technology Acceptance Model (TAM). These two theories stand as research paradigms to explain technology adoption and acceptance, according to Porter and Donthu (2006).

While TAM predicts individual adoption and use of new technology (Venkatesh and Bala, 2008), TRI focuses on the measurement of technology readiness as "people's propensity to embrace and use new technologies for accomplishing goals in home life and work" (Parasuraman and Colby, 2015). These theories were initially developed separately and used insights from psychology (Levina, 2021) and marketing research (Parasuraman, 2000). Other works like Lin et al (2005), Lin, Shih and Sher (2007), Walczuch, Lemmink and Streukens (2007) or Godoe and Johanson (2012), Koivisto (2016) and Gao et al (2022) show how these two theories can be combined. Thus, the factors influencing the readiness positively and negatively, according to TRI, compose the exogenous variables that determine the perceived usefulness and ease of use of new technology in terms of TAM. We will call such an integrated framework TRI-TAM.

Current work that deals with the readiness of AI-based systems uses the findings from TRI combined with other approaches, especially from 'customer experience' research (Alami et al, 2021 or Gao et al, 2022) or only focusing on the investigation of technology acceptance and user experience (Mlekus, 2020). However, we see an advantage in applying an integrated model that measures the readiness of users and their influence on the acceptance of these new AI-based LLMs. Moreover, past research shows the usefulness of this integrated model. Therefore, we apply this approach as a theoretical framework for our study, specifically for the new technology of LLMs in HE.

3. Theoretical Framework and Hypotheses Development

The technology readiness for new technology is represented by positive and negative factors influencing the user's willingness to interact with this new technology. According to Parasuraman (2000) and Parasuraman and Colby (2001, 2015), optimism and innovativeness are *contributors* that increase an individual's readiness, while discomfort and insecurity as *inhibitors* show adverse effects on readiness. With a 36-item scale, TRI measures "people's propensity to embrace and use new technology for accomplishing goals in home life and at work" (Parasuraman 2000, p. 308).

TAM investigates how a technology's attributes affect an individual's perception of technology (Porter and Donthu, 2006). These two primary *predictors* are perceived usefulness (PU) and perceived ease of use (PEOU)

(Davis, 1989). According to Davis (1989, p. 320), PU is defined as “the degree to which a person believes that using a particular system would enhance his or her job performance”, while PEOU “refers to the degree to which a person believes that using a particular system would be free of effort”. Davis, Bagozzi and Warshaw (1989) show in the original TAM versions 1 and 2 the influence that PU and PEOU have on behavioural intentions, which affect the actual use of new technology. The different applications of the TRI-TAM framework recap this two-stage influence of technology acceptance to only one factor, mostly called actual use or use intention.

According to the different approaches of TRI-TAM, our research study will investigate only one contributor and one inhibitor factor and their effects of PU and PEOU in terms of LLM adoption in HE. Here, optimism is defined as a positive view of new technology, while innovativeness primarily expresses the tendency to be able to take on a pioneering role with the application of the technology. In contrast, discomfort expresses a perceived lack of control over technology, and insecurity encompasses distrust of technology. (Parasuraman and Colby, 2001).

Initial study results on LLM adoption in HE show some main positive aspects: the personalisation of learning or adaptive learning (Zhai, 2022; Su and Yang, 2023; Kasneci et al, 2023), the direct support of the writing process (Wessels, 2022; Kasneci et al, 2023), dissolving writer’s blocks (Wessels, 2022) or improving critical thinking and problem-solving (Kasneci, 2023). Furthermore, LLMs can work as tutors and mentors, analyse the learning process, identify specific learning or educational needs early on (Zhai, 2022; Kasneci et al, 2023), and making work (Su and Yang, 2023). In contrast, the positive aspects of being innovative and taking on a pioneering role with the use of such systems was hardly mentioned as a reason. Positive technology readiness refers to optimism or to students’ hope and confidence that LLMs will improve their study work. The optimistic motives predominate the positive factors and therefore we subordinate the aspects of innovativeness to one positive factor and name it *Optimism* (OP).

The negative factors of TRI reinforce the user's tendency to avoid adopting this new technology. Here, previous studies argue mainly from an ethical point of view (Tuomi, 2023; Weidinger et al, 2021) and discuss systems based on the functionality of ML and NLP (Chatterjee and Dethlefs, 2023). These include, for example, concerns about the originality and plagiarism of academic work using LLM or, more generally, the dangers of AI-assisted cheating (Lim et al, 2023; Milano, McGrane and Leonelli, 2023). The lack of trustworthiness in these systems is not a major issue that negatively influences the perceived usefulness and ease of use of LLMs, which might be due to the current hype around these systems (Hu, 2023). For these reasons, we combine insecurity and discomfort as an inhibitor for readiness and define only one TRI-related negative factor *Discomfort* (DI).

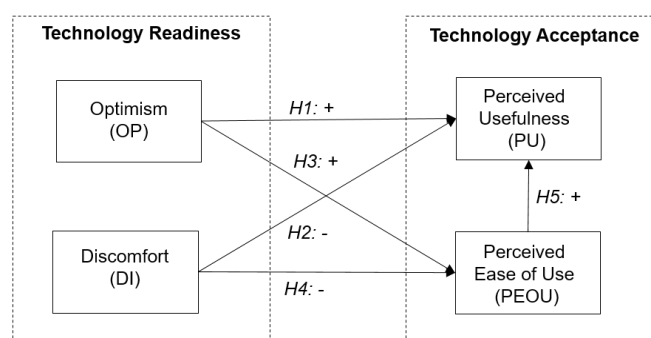


Figure 1: The integrated TRI-TAM framework for LLMs in HE (according to Lin et al. 2007; Godeo and Johanson 2012; Gao et al. 2022)

The TRI-TAM literature defines TRI-related factors as exogenous variables influencing technology acceptance (Lin et al, 2005; Godeo and Johanson, 2012). In our case, optimism and discomfort are the two exogenous variables that affect the perceived usefulness and ease of use of LLM adoption in HE. In particular, Gao et al (2022); their study of another AI-based new technology argues that a positive attitude towards this technology reinforces how, with what intensity and with what success it is used. On the other hand, a negative effect causes the user to feel overwhelmed by the technology because it seems too complicated and complex. The behaviour in the use of this technology is thus negatively influenced. Thus, according to these arguments, the strength of technology acceptance depends essentially on a positively PU and PEOU. In addition, PU is further enhanced by the effects of a PEOU. Previous findings from TAM (Davis, 1989; Venkatesh and Bala, 2008) show that PU represents the degree of AU, more so than PEOU. While PEOU tends to reflect experience and voluntariness, PU tends to show up in factors such as subjective norms, job relevance, or output quality (Venkatesh and Bala,

2008). Our theoretical TRI-TAM framework contains two TRI-related factors, one positive, one negative, which differently influence the technology acceptance typified as PU and PEOU with the corresponding hypotheses (see figure 2 in section 5). Based on the above-discussed literature, we pose the following five hypotheses to investigate the student's readiness and acceptance of LLMs in HE (see figure 1):

- H1. Optimism (OP) has a positive impact on perceived usefulness (PU).
- H2. Discomfort (DI) has a negative impact on perceived usefulness (PU).
- H3. Optimism (OP) has a positive impact on perceived ease of use (PEOU).
- H4: Discomfort (DI) has a negative impact on perceived ease of use (PEOU).
- H5: Perceived ease of use (PEOU) is positively related to perceived usefulness (PU).

4. Data and methodology

The entire study embodied two phases. In the first phase, to get familiar with the tools, the students were asked to use LLMs to generate three different texts. In the second phase, which took place from the end of December 2022 to the beginning of January 2023 and is the focus of this paper, each student must complete a questionnaire. The survey consisted of 45 items taken from the TRI and TAM literature. The items and their structure closely follow the study design of the Godoe and Johanson (2012) survey and are based on the original frameworks by Parasuraman (2000) and Davis (1989). Our questionnaire contains 31 technology belief statements, both positive and negative, related to our defined two readiness factors of OP and DI, our first two factors. The two other factors, PU and PEOU, with a total of twelve items, complement the questionnaire regarding technology acceptance. Each of the 45 items was measured either on a 5-point or a 7-point Likert-scale.

118 students from a bachelor's programme in Business Information Systems at a German university of applied science were asked about their attitudes and views on using AI-based automated text generation tools. The entire student group consisted of 15.3% women and 84.7% men with an average age of 19.67 years. After cleaning the not fully answered surveys from the collected data set, a usable sample of $N=111$ was available. 77.8% of the students reported having no experience with LLMs prior to the study. They first came into contact with the tools through this study and thus used them for the first time. Only 22.8% had already had their first experience. At the time of data collection, all students used the GPT-3-based playground with a technical interface which allowed tuning the language modelling algorithm and its outputs. The GPT-3 model (Generated Pre-Trained Transformer 3), founded and operated by the US-American company OpenAI, was the best-known and most widely used model at the time of this study.

Constructs and items		Mean (Std Dev)	Factorial Loading	Cronbach's Alpha
Optimism (Technology Readiness)				
OP1	AI-based tools for automated text generation give you as a student more control over your studies.	3.03 (1.13)	0.721	0.808
OP2	AI-based tools for automated text generation are more convenient to use than traditional writing tools.	3.96 (1.04)	0.661	
OP3	You like AI-based tools for automated text generation that (partially) automate your student assignments because they give you more freedom.	3.54 (1.11)	0.818	
OP4	You prefer to implement the latest technologies for your student assignments.	4.04 (0.99)	0.475	
OP5	You like such tools that allow you to adapt your student assignments to your needs.	4.18 (0.87)	0.458	
OP6	AI-based tools for automated text generation make completing your student assignments more efficient.	3.74 (1.10)	0.799	
OP7	AI-based tools for automated text generation give you more freedom to concretely complete your student assignments.	3.32 (0.98)	0.617	
OP8	Learning the AI-based tools for automated text generation can be just as rewarding as the technology itself.	3.70 (1.07)	0.519	
OP9	You feel confident that AI-based tools for automated text generation will do what you have instructed them to do.	3.21 (1.05)	0.555	
Discomfort (Technology Readiness)				
DI1	Instruction manuals or help pages on AI-based tools are not helpful because things are not explained in a way that you understand.	2.24 (0.90)	0.670	0.638
DI2	Sometimes you get the impression that the latest tools and technologies are not designed for use by 'normal' people.	2.62 (1.09)	0.576	
DI3	There are fundamentally no explanations about the latest tools or technologies written in simple language.	2.50 (1.07)	0.821	
DI4	Sometimes when you get help with the explanation of AI-based tools, you feel like you're being exploited by someone who understands more than you.	1.83 (0.97)	0.600	
DI5	It is embarrassing when you have trouble using concrete AI-based tools while others are watching.	1.81 (1.07)	0.495	
Perceived Usefulness (Technology Acceptance)				
PU1	AI-based tools for automated text generation allow me to complete assignments more quickly.	5.40 (1.16)	0.818	0.882
PU2	Using AI-based tools for automated text generation improves my work performance.	4.72 (1.32)	0.792	
PU3	Using AI-based tools for automated text generation increases my productivity.	4.70 (1.60)	0.820	
PU4	Using AI-based tools for automated text generation facilitates the completion of my student assignments.	5.04 (1.41)	0.824	
PU5	Overall, I find AI-based automated text generation tools useful for completing my student assignments.	5.29 (1.41)	0.869	
Perceived Ease of Use (Technology Acceptance)				
PEOU1	I find it easy to get AI-based automated text generation tools to do what I want.	5.14 (1.15)	0.826	0.787
PEOU2	The use of AI-based tools for automated text generation is clear and understandable.	5.23 (1.15)	0.872	
PEOU3	It is easy for me to remember how to perform tasks with the AI-based tools for automated text generation.	4.95 (1.40)	0.580	
PEOU4	Overall, I find the AI-based tools for automated text generation easy to use.	5.39 (1.04)	0.839	

Figure 2: Selected items for the final TRI-TAM scale according to its Cronbach's alpha of the TRI-TAM framework for LLMs in HE

5. Results and Discussion

Partial Least Squares (PLS) analysis was used to validate the measurement and structural properties of our theoretical research model. PLS was applied as it tests the properties of the measured items while also analysing the direction and strength of our hypotheses (Hair et al, 2022). The internal consistency was assessed through Cronbach's alpha (see figure 2), composite reliability and Average Variance Expected (AVE).

21 items were taken out because of low factor loadings. Only one Cronbach's alpha was between 0.6 and 0.7, all others had values above 0.7. The relatively high number of excluded items due to low Cronbach alpha's was a surprise as all questions were derived from verified scales. However, these scales were never used in connection to LLMs and we asked the questions to a relatively homogeneous group of survey participants.

The evaluation of the structural model (inner model) showed that all VIF values were below 3, so no collinearity issues could be found. The Standardized Root Mean Square Residual (SRMR) index of our model is below the recommended upper threshold of 0.1. The recommended criteria of 0.8 for the Normed Fit Index (NFI) has also been surpassed by our model. Results from the PLS analysis of the structural model, including path coefficients and their statistical significance, are illustrated in figure 3. Standard errors were computed by a bootstrapping procedure with 500 re-samples. Our analysis substantiated the hypothesised relationships H1, H3 and H4 by empirical evidence. OP has a positive and significant effect on PU ($\beta = 0.755$; $p \leq 0.001$) and PEOU ($\beta = 0.337$, $p \leq 0.001$). Furthermore, DI negatively and significantly influences PEOU ($\beta = -0.271$, $p \leq 0.001$). However, DI does not significantly influence PU, and PEOU does not significantly influence PU, so the hypotheses H2 and H5 do not hold as figure 3 shows.

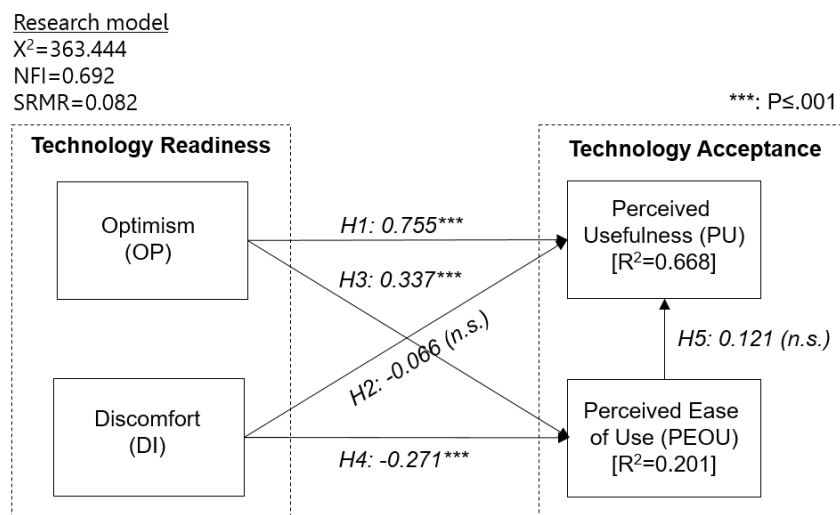


Figure 3: Research Model of TRI-TAM framework for LLMs in HE [sample $N=111$]

5.1 Optimism and perceived use and perceived ease of use

The results from our study confirm the hypotheses that optimism positively influences PU and PEOU. Several studies (Lin et al 2005, Godeo and Johanson, 2012) have already demonstrated this connection in examining various technologies that were new at that time.

The examination of the reliability and validity of the data also showed a high Cronbach's alpha (0.808) for the factor OP, so that only those items with a low factor loading were removed. These items were mainly related to statements addressing motives of innovativeness. We suspect that the homogeneity of the student group with a similar age and an assumed high affinity for technology through the field of study does not consider a pioneering role relevant compared with the group's peers. Students prefer using these tools if it simplifies their daily study routine, helps them to fulfil their writing tasks, and thus makes them more efficient. Consequently, these motives strongly impact the perceived usefulness of the tools more than the perceived ease of use. These insights also align with previous research findings (Gimpel et al, 2023; Sullivan, Kelly and McLaughlan, 2023) on the impact of LLMs in HE.

5.2 Discomfort and perceived use and perceived ease of use

Interpreting the results regarding the inhibitor factor of DI and its influence on PU and PEOU is more complicated. In particular, it was necessary to remove items that contained statements about the distrust or dangers of such tools. The students' answers were too homogeneous (very high or very low mean). Contrary to our expectations, the test of our hypothesis did not reveal a strong negative influence of Discomfort on PU and PEOU. We only find a moderately negative relationship of DI and PEOU, although we also hypothesised a negative influence of DI on PU. This is in line with, for example, the findings of Godeo and Johanson (2012, p 41), who argued that discomfort does not have a negative impact on PU because users “see the main value of a system, regardless of how they handle it”. We hypothesised negative impact on PU against the backdrop of excessive media attention on LLMs, especially ChatGPT, at the time of conducting the survey. On the one hand, the students used the technical interface of the GPT-3 playground model that helped them to influence the underlying algorithms and understand partly how they are working. On the other hand, when they had to answer the survey, the user-friendly interface for ChatGPT had just launched, causing the hype around LLMs, also in the education field. In particular, the debate about the dangers, risks and the first bans at universities or even countries might have negatively influenced the students. The results of the survey do not confirm this assumption. The students did not so much see the dangers or distrust the new technology, but motives such as the concrete functioning or handling of the tool played a determining role in answering the items. Interestingly, the students answered statements about the dangers or risks of these tools or the possibilities of being used by governments or states for manipulation without impacting their PU. These items also showed low factor loadings and were therefore removed. Thus, the assumption we made earlier that the students would be negatively influenced by adverse reporting and therefore assess the usefulness of such tools differently did not apply.

5.3 Perceived ease of use and perceived usefulness

Prior studies argue that perceived ease of use contributes to perceived usefulness (Godeo and Johanson, 2012; Lin et al 2005). We also followed this assumption but couldn't confirm this hypothesis here. It is, above all, the overwhelming simplicity of using these tools that others also see as an argument for their widespread everyday use (Milano, McGrane and Leonelli, 2023; Gimbel et al, 2023). While in past technology adoption there was often a gap between the usefulness of a tool and its ease of use, it is precisely these new tools of the digital age that are enormously easy to use.

6. Conclusion

6.1 Recommendations for Action

LLMs are regarded as a learning tool from the students' perspective, serving as aids in simplifying their everyday studies. This should be taken seriously by HE (UNESCO, 2023). In particular, the tools should be integrated into everyday teaching, given that students already exhibit high technology readiness and acceptance to use them. It also means that academic writing skills must be integrated into all teaching areas, for example, as a tool to strengthen critical thinking (Milano, McGrane and Leonelli, 2023). Overall, HE teachers should focus on enabling specific AI skills so that students can evaluate the output of the tools. They should be better able to assess the limitations and risks of these tools - as our study showed that students still need more awareness - and they should better understand how these tools work. The origin of the results should become the focus of a more substantial examination of these tools.

On the one hand, students need to understand that these systems mainly use freely accessible internet sources as data for their pre-training (Kasneci et al, 2023). Therefore, the prompt results may lack accuracy in areas with necessary specific expertise or may verge into plagiarism (Lucchi, 2023). On the other hand, these tools tend to generate speculative content (Bang et al, 2023), emphasizing the urgency to train students to check the correctness of content for meaningful everyday pedagogical practice. Additionally, LLMs have several potential ethical violations like threats to privacy and security, and consequences of biases (Dwivedi et al, 2023) and discrimination, that students should be more aware of when using these tools. The positive attitudes to using these tools are also increasingly reflected in the fact that students use them more and more for examinations, especially for writing academic papers. Here, teachers and HEs are challenged to rethink the existing structures and paradigms of exams in academia and look for new innovative evaluation methodologies. All in all, it requires guidelines for using these tools so that the perceived positive attitude of the students leads to the reinforcement

of individual and collective learning success (Dwivedi et al, 2023). These guidelines should also clarify the directives from the teachers' point of view and thus represent a fundamental new institutional document in HE.

6.2 Future Research

Further research should focus on some different facets. First, the teachers' perspective should also be examined. A comparative study could investigate the extent to which teachers are prepared to adapt to this new technology and the factors underpinning their readiness and acceptability. Second, while our study specifically collected data from information systems students with an inherent curiosity for new technologies, future work could encompass a more diverse spectrum of students, including other study subjects like social sciences. This would enrich the dataset and facilitate the control of demographic influences. Furthermore, we collected data during the first launch of Large Language Models, where the general risks of these models were not yet seriously discussed. Future studies should examine the associated ethical challenges and risks more closely.

Overall, the acceptance measurement of new technology adoption also shows comparable patterns to numerous past studies, e.g. Saber and Souiden (2010), Koivisto et al (2016), and Gao et al (2022). Optimism (and innovativeness in general) promote a positive attitude towards new technology. At the same time, discomfort and uncertainty weaken this attitude and thus influence the usability of new technology and the awareness of ease of use. Third, this study shows two significant changes requiring further and more extensive investigation, especially in further developing TRI and TAM theories alongside their associated measurement scales. On the one hand, the fundamental change in technology use has changed behaviour and attitudes towards new technologies. Today, ubiquity and omnipresence touch all areas of life and work and thus demand new ways of human interaction with new technologies, which generally create a higher level of technology acceptance to deal with new technologies. On the other hand, the user-friendliness or usability of modern technologies has also increased highly, so people are more open to using new technologies. These changes can impact how users perceive new technologies. These transformative dynamics necessitate reconsidering how users perceive and evaluate new technologies, thereby mandating a fundamental reevaluation of the underlying measurement scale structure.

References

- Alami, H., Lehoux, P., Denis, J.L. ... and Fortin, J. P. (2021) "Organizational readiness for artificial intelligence in health care: insights for decision-making and practice", *Journal of Health Organization and Management*, Vol. 35, No. 1, pp 106–114.
- Bang, Y., Cahyawijaya, S., Lee, N., Dai, W., Su, D., Wilie, B., Lovenia, H., Ji, Z., Yu, T., Chung, W., Do, Q. V., Xu, Y., & Fung, P. (2023) "A Multitask, Multilingual, Multimodal Evaluation of ChatGPT on Reasoning, Hallucination, and Interactivity". *ArXiv*. /abs/2302.04023
- Bender, E. M., Gebru, T., McMillan-Major, A. and Mitchell, S. (2021) "On the Dangers of Stochastic Parrots: Can Language Models Be Too Big?", *Proceedings of the 2021 ACM conference on fairness, accountability, and transparency*, pp 610–623.
- Chan, C.K.Y. and Hu, W. (2023). "Students' Voices on Generative AI: Perceptions, Benefits, and Challenges in Higher Education", *arXiv*, [online], <https://doi.org/10.48550/arxiv.2305.00290>.
- Chatterjee, J. and Dethlefs, N. (2023) "This new conversational AI model can be your friend, philosopher, and guide ... and even your worst enemy", *Patterns (N. Y.)*, Vol. 4, No. 1, article no.: 100676.
- Crawford, J., Cowling, M. and Allen, K.-A. (2023) "Leadership is needed for ethical ChatGPT: Character, assessment, and learning using artificial intelligence (AI)", *Journal of University Teaching & Learning Practice*, Vol. 20, No. 3, Quarterly Issue 1, article 02, pp 1–19.
- Davis, F.D. (1989) "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology", *MIS Quarterly*, Vol. 13, No. 3, pp 319–340.
- Davis, F.D., Bagozzi, R.P. and Warshaw, P.R. (1989) "User Acceptance of Computer Technology: A Comparison of Two Theoretical Models", *Management Science*, Vol. 35, No. 8, pp 982–1003.
- Farrokhnia, M., Banihashem, S.K., Noroozi, O., and Wals, A. (2023) "A SWOT analysis of ChatGPT: Implications for educational practice and research", *Innovations in Education and Teaching International*, 2023, pp 1–15.
- Dwivedi, Y. K., Kshetri, N., Hughes, L., Slade, E. L., Jeyaraj, A., Kar, A. K., ... & Wright, R. (2023) "'So what if ChatGPT wrote it?' Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy." *International Journal of Information Management*, 71, 102642.
- Gao, J., Ren, L., Yang, Y., Zhang, D. and Li, L. (2022) "The impact of artificial intelligence technology stimuli on smart customer experience and the moderating effect of technology readiness", *International Journal of Emerging Markets*, Vol. 17, No. 4, pp 1123–1142.

- Gimpel, H., Hall, K., Decker, S. ... and Vandirk, S. (2023) "Unlocking the power of generative AI models and systems such as GPT-4 and ChatGPT for higher education: A Guide for Students and Lecturers", *Hohenheim Discussion Papers in Business, Economics and Social Sciences*, Vol. 2023, No. 2, pp 1–46.
- Godoe, P. and Johansen, T. (2012) "Understanding adoption of new technologies: Technology readiness and technology acceptance as an integrated concept", *Journal of European psychology students*, Vol. 3, No. 1, pp 38–52.
- Hair, J.F., Hult, G.T.M., Ringle, C.M. and Sarstedt, M. (2022) *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*. 3rd ed. Sage Publishing.
- Kasneci, E., Seßler, K., Küchemann, S., Bannert, M., Dementieva, D., Fischer, F., ... and Kasneci, G. (2023) "ChatGPT for good? On opportunities and challenges of large language models for education", *Learning and Individual Differences*, Vol. 103, article no.: 102274.
- Koivisto, K., Makkonen, M., Frank, L. and Riekkinen, J. (2016) "Extending the Technology Acceptance Model with Personal Innovativeness and Technology Readiness: A Comparison of Three Models", *BLED 2016: Proceedings of the 29th Bled eConference*. Moderna organizacija, pp 113–128.
- Levina, N. (2021) "All Information Systems Theory is Grounded Theory", *MIS Quarterly*, Vol. 45, No. 1, pp 489–494.
- Li, H. (2022) "Language models: past, present, and future", *Communications of the ACM*, Vol. 65, No. 7, pp 56–63.
- Lim, W.M., Gunasekara, A., Pallant, J.L., Pallant, J.I., Pechenkina, E. (2023) "Generative AI and the future of education: Ragnarök or reformation? A paradoxical perspective from management educators", *The International Journal of Management Education*, Vol. 21, No. 2, article no.: 100790.
- Lin, C.-H., Shih, H.-Y., Sher, P.J. and Wang, Y.-L. (2005) "Consumer adoption of e-service: integrating technology readiness with the technology acceptance model", *Technology Management: A Unifying Discipline for Melting the Boundaries*, 2005, pp 483–488.
- Lin, C.H., Shih, H.Y., and Sher, P.J. (2007) "Integrating technology readiness into technology acceptance: The TRAM model", *Psychology & Marketing*, Vol. 24, Issue 7, pp 641–657.
- Milano, S., McGrane, J.A. and Leonelli, S. (2023) "Large language models challenge the future of higher education. *Nature Machine Intelligence*, Vol. 5, No. 4, pp 333–334.
- Lucchi, N. (2023) "ChatGPT: A Case Study on Copyright Challenges for Generative AI Systems". *European Journal of Risk Regulation*, <http://dx.doi.org/10.2139/ssrn.4483390>
- Mlekus, L., Bentler, D., Paruzel, A., Kato-Beiderwieden, A.L., and Maier, G.W. (2020) „How to raise technology acceptance: user experience characteristics as technology-inherent determinants", *Gruppe. Interaktion. Organisation. Zeitschrift für Angewandte Organisationspsychologie (GIO)*, Vol. 51, No. 3, pp 273–283.
- Parasuraman, A. (2000) "Technology Readiness Index (TRI), A Multiple-Item Scale to Measure Readiness To Embrace New Technologies", *Journal of Service Research*, Vol. 2, No. 4, pp 307–320.
- Parasuraman, A. and Colby, C.L. (2001) *Techno-Ready Marketing. How and Why Your Customers Adopt Technology*. The Free Press.
- Parasuraman, A. and Colby, C.L. (2015) "An Updated and Streamlined Technology Readiness Index: TRI 2.0", *Journal of Service Research*, Vol. 18, Issue 1, pp 59–74.
- Porter, C. E., and Donthu, N. (2006) "Using the technology acceptance model to explain how attitudes determine Internet usage: The role of perceived access barriers and demographics", *Journal of business research*, Vol. 59, No. 9, pp 999–1007.
- Rudolph, J., Tan, S. and Tan, S. (2023) "ChatGPT: Bullshit spewer or the end of traditional assessments in higher education?", *Journal of Applied Learning and Teaching*, Vol. 6, No. 1, pp 1–22.
- Saber, C., M., and Souiden, N. (2010) "Rethinking the TAM model: time to consider fun." *Journal of Consumer Marketing*, 27(4), pp 336–344.
- Savelka, J., Agarwal, A., Bogart, C., Song, Y. and Sakr, M. (2023) "Can Generative Pre-trained Transformers (GPT) Pass Assessments in Higher Education Programming Courses?", *arXiv*, [online], <http://arxiv.org/abs/2303.09325>.
- Shanahan, M. (2023) "Talking About Large Language Models", *arXiv*, [online], <http://arxiv.org/abs/2212.03551>.
- Su, J. and Yang, W. (2023) "Unlocking the Power of ChatGPT: A Framework for Applying Generative AI in Education", *ECNU Review of Education*, Vol. 0, No. 0, pp 1–12.
- Sullivan, M., Kelly, A. and McLaughlan, P. (2023) "ChatGPT in higher education: Considerations for academic integrity and student learning", *Journal of Applied Learning and Teaching*, Vol. 6, No. 1, pp 1–10.
- Tuomi, I. (2023) "A Framework for Socio-Developmental Ethics in Educational AI", *Proceedings of the 56th Hawaii International Conference on System Sciences 2023*, pp 6208–6217.
- UNESCO (2023), "UNESCO unveils new AI roadmap for classrooms". *United Nations*, [online], <https://news.un.org/en/story/2023/05/1137117>.
- Venkatesh, V. and Bala, H. (2008) "Technology Acceptance Model 3 and a Research Agenda on Interventions", *Decision Sciences*, Vol. 39, No. 2, pp 273–315.
- Venkatesh, V., Davis, F. and Morris, M. (2007) "Dead Or Alive? The Development, Trajectory And Future Of Technology Adoption Research", *AIS Educator Journal*, Vol. 8, No. 4, pp 267–286.
- Walczuch, R., Lemmink, J. and Streukens, S. (2007) "The Effect of Service Employees' Technology Readiness on Technology Acceptance", *Information & Management*, Vol. 44, No. 2, pp 206–215.
- Weidinger, L., Mellor, J., Rau, M. ... and Gabriel I. (2021) "Ethical and social risks of harm from Language Models", *arXiv*, [online], <https://arxiv.org/pdf/2112.04359.pdf>.

- Weßels, D. (2022) „Hochschullehre unter dem Einfluss des KI-gestützten Schreibens“. *Hochschulforum Digitalisierung*, [online], <https://hochschulforumdigitalisierung.de/de/blog/Hochschullehre-KI-gestuetztes-Schreiben>.
- Zhai, X. (2022) “ChatGPT User Experience: Implications for Education”, *SSRN Electronic Journal*, [online], <https://ssrn.com/abstract=4312418>.

Assessment of Academic ESL Writing in an Online Tutorial for Graduate Students

Zhi Li¹, Veronika Makarova¹ and Zhengxiang Wang²

¹University of Saskatchewan, Saskatoon, Canada

²Stony Brook University, Stony Brook, USA

z.li@usask.ca

v.makarova@usask.ca

zhengxiang.wang@stonybrook.edu

Abstract: English-as-a-second language (L2) graduate students often face challenges in developing academic writing skills, which can be exacerbated by a lack of timely support at institutional level. To help address this concern, an original set of online academic writing tutorials with a focus on the genre of Literature Review was designed by the authors to assist international graduate students enrolled in graduate programs in Canada. This paper introduces and compares multiple assessment tools employed in the online tutorial set for international English L2 graduate students. Our project pursues two major goals: First, to address the above-identified gap in Academic Writing support to English L2 graduate students with minimal costs and faculty involvement through designing the online tutorial set; second, to contribute to the research on e-learning of Academic English as a second language (ESL) writing in terms of developing integrated tools for online tutorial building, analysis of texts produced by learners, and assessment of learners' writing progress. The research questions are: 1. What resources can be combined to develop an online tutorial set for graduate students at minimal costs? 2. How can the learners' progress in academic ESL writing be assessed with different assessment tools? First, the paper describes the tools employed in the tutorial construction: MoodleCloud platform, H5P interactive e-book designed by the authors, surveys, and assessment tools. Second, we present and compare assessment tools employed to evaluate learners' writing progress: Expert assessment with an analytic rubric, self-assessments of progress by the participants, and automated text analysis with corpus-based tools as reported in Li, Makarova, and Wang (2023). A comparison of the scores across the three assessment tools shows some discrepancies, which seems to suggest that combined tools yield a more comprehensive picture. The expert assessments and self-assessments demonstrate improvement in the writing quality over the course of the tutorial series, which are partially supported with the findings from corpus-based analysis of participants' texts. The findings are of relevance to e-learning scholars, faculty, and administrators of English-medium universities with substantial intakes of international graduate students in Social Sciences and Education whose native languages are other than English.

Keywords: learners' progress assessment, online tutorials, Academic ESL Writing, International Graduate students whose native language is not English, e-learning

1. Introduction

Writing a literature review in academic English is a common but daunting task for both English as first language (L1) and as second language (L2) writers (Badenhorst, 2018; Li et al, 2023; Shi and Dong, 2015). What may make this task even more challenging is a lack of local or institutional support in English for academic purposes (EAP) due to limited resources that could be channelled into writing support. In addition, in research, there are few studies on standalone or supplementary resources designed to help English L2 graduate students develop literature review writing skills (Storch and Tapper, 2009). As a part of a larger project, this paper reports the development of an online writing tutorial series at a Canadian university and an evaluation of its effectiveness from the perspective of expert assessment of writing samples and participant self-assessment. The results of assessment analyses are then discussed in light of the findings of Li, Makarova, and Wang (2023), a relevant corpus-based study of the same group of writing samples.

1.1 Development of literature review writing skills

In this study, we conceptualize literature review (LR) as a special subgenre of academic writing (Swales and Feak, 2012). LR writing requires multiple skills, such as searching for relevant academic materials, integrating and citing materials properly, developing coherence (flow of ideas) and cohesion (connectedness among sentences), using appropriate academic vocabulary and grammatical structures. To help English L2 learners develop academic writing skills in general, one of the key steps is to raise their genre awareness (Crosthwaite, Sanhueza, and Schweinberger, 2021). In other words, learners need to understand the expected features in the texts of a particular genre. For example, in addition to the commonly investigated features in academic writing such as coherence, cohesion and cohesive devices (e.g., Abdi Tabari and Johnson, 2023; Basturkmen and von Randow, 2014), citation practices are uniquely important in literature review writing (Badenhorst, 2018). While previous studies have explored citation types and forms, functions, and use of reporting verbs in academic writing

(Hyland, 1999), it is not clear how English L2 I-students developed their citation practices as a result of learning. Related to citation practices are the use of academic vocabulary and grammatical structures for referencing purposes in literature review writing.

In a recent study on literature writing development from the same project, Li et al. (2023) performed corpus-based analyses on the literature writing samples completed by English L2 graduate students in an online writing tutorial series. Their analysis results showed that the writing samples produced at later stages of the tutorial series as compared to the beginning were stronger in certain linguistic features such as the use of connectives (e.g., 'so' and 'because') and academic vocabulary, while other linguistic features (e.g., syntactic complexity and global cohesion) remained at similar levels. The learners in the above study also performed better in citation practices, employing more citations and diverse reporting verbs. This study builds on Li et al. (2023) to further investigate other assessment types to examine the effectiveness of the same online writing tutorial series, which is described in the next subsection.

1.2 Design of an online writing tutorial series

A 5-unit online tutorial series was developed in-house to help graduate students improve literature writing skills. The design of this tutorial series was largely informed by the following theories or frameworks: Genre analysis of academic writing, academic English socialization, and corpus linguistics. Based on relevant literature on students' development of academic writing skills (Swales and Feak, 2012), these units included themes such as genre requirements, logic and structure in literature review, sentence structures, academic vocabulary, and grammar of reported speech, supplemented with practices and writing tasks (see Table 1).

Table 1: Overview of online writing tutorial series

Unit	Key notions	Activities	Duration	Writing task
1. Genre of literature review	Components in literature review writing, material selection, citation practices	Interactive e-book, Peer-review, Discussion forum, quiz	3 weeks	Individual writing on the social consequences of legalized cannabis
2. Structure and logic in literature review	Types of logic structure, terms and abbreviations, Coherence, Cohesion	Interactive e-book, Discussion forum, quiz	2 weeks	Collaborative writing on Canadian linguistic landscape
3. Sentence structures	Sentence structures and variety, nominalization, Phrase bank and Swales' CARS (Creating a Research Space) model	Interactive e-book, Peer-review, Discussion forum, quiz	3 weeks	Individual writing on the pros and cons of online learning
4. Academic vocabulary	(academic) formulaic expressions and their functions	Interactive e-book, Discussion forum, quiz	2 weeks	Collaborative writing on lessons from the COVID-19 pandemic
5. Grammar of reported speech	Direct vs. indirect speech, reporting verbs and expressions, verb tenses, modal verbs	Interactive e-book, Peer-review, Discussion forum, quiz	3 weeks	Individual writing on pacifism, peace-making, or just/justifiable war

The main content of each unit is packaged in an H5P (HTML5 Package) interactive e-book, which presents key notions under each theme with examples and allows participants to engage with corresponding practices to check their understanding of the notions (see Figure 1). For example, Tutorial 1 introduces literature review as a genre, focusing on its typical components and expected features such as citation practices for material integration. The tutorial series was delivered fully online via MoodleCloud, an online course management system, to a cohort of participants in three and half months. Since the tutorials, along with writing tasks, support materials, and weekly agenda, were prepared beforehand, participants could self-pace their study within a unit but needed to progress as a cohort across units with scheduled deadlines for the writing tasks.

LR requirements 3 / 11

Tutorial 1

The specific requirements of any academic literature review

1. Broad coverage of the subject of your literature review as it has been reflected in earlier studies (establishing the knowledge on the subject available up to date);
2. Use of reliable academic sources (Getting Started);
3. Inclusion of the required components of a literature review (Tutorial 1);
4. Correct use of citations, in-text and final references (Tutorial 1);
5. Stages of working on your literature review (Tutorial 1);
6. Avoiding plagiarism (Getting Started);
7. Presenting information in a well-structured and logical way (Tutorial 2).
8. Using academic paper writing style (formal academic English) including the use of specific academic vocabulary and formal grammar (Tutorials 3, 4 and 5).

Tutorial 1: Requirement 1, 3, 4, 5

Getting Started: Requirement 2, 6

Tutorial 2: Requirement 7

Tutorial 3, 4 & 5: Requirement 8

Summary & submit

Figure 1: Screenshot of HSP Interactive e-book in Tutorial 1 “Genre of literature review”

Each unit is matched with a writing task of literature review on a given topic and a feedback survey. The expected length of literature review writing is 700 to 800 words. Three writing tasks, hereafter referred to as T1, T3, and T5 for their positions in the tutorial series, were to be completed as individual writing tasks and supported with a peer-review process. On the other hand, the remaining two writing tasks hereafter called T2 and T4, were designed as collaborative writing tasks to be completed by a group of two or three participants so that the participants could further socialize with others to develop their writing skills.

To avoid heavy demand on disciplinary knowledge, we selected the writing prompts mainly from the areas of humanities or social sciences, such as social consequences of legalized cannabis (T1), Canadian linguistic landscape (T2), online learning (T3), lessons from the COVID-19 pandemic (T4), and pacifism (T5). For each writing task, a short bibliography on the selected topic was provided to the participants to help them start reviewing relevant studies and searching for other academic resources. In addition, a discussion forum was set up to elicit participants’ views on the key notions covered in the corresponding unit and to encourage them to share and develop their writing ideas. For individual writing tasks, peer review was conducted on MoodleCloud in the format of discussion forum participation. Google Docs, an online word processor, was used by the participants to work on the collaborative writing tasks. This study focuses on participants’ writing performance on the three individual writing tasks because these tasks should capture participants’ initial writing levels of literature review (T1), and then their developmental trajectories through the middle and the end of the tutorial series, respectively, T3 and T5.

Teaching assistants with English language teaching experiences were hired as moderators of discussion forums and raters of the literature reviews submitted by participants. At the end of the tutorial series, all participants were invited to respond to a final survey to reflect on their performance and gauge their progress in literature review writing during this tutorial series.

In this paper, we aim to address the following research question: To what extent could English L2 graduate students benefit from an online tutorial series on literature reviewing writing from the perspective of expert assessment and participants’ self-assessment?

2. Methodology

2.1 Participants

With ethics approval, participants who spoke English as a second language (ESL) were mostly recruited from two Canadian universities. While more than 280 prospective participants initially signed up for the project, only 29 completed the tutorial series in three cohorts in 2021. This high dropout rate was partially affected by the COVID-19 pandemic as well as the non-credit-bearing nature of the tutorial series. At the end of the tutorial series, each participant was paid a gift card of 100 Canadian dollars to compensate for their time and contribution.

The participant characteristics were extracted from a background survey at the beginning of the tutorials: 20 were female participants, seven were male, and two did not disclose gender information. Most of the participants were current master's students (19) or doctoral students (4), and six were prospective graduate students without clear education level information. The main study fields of the participants were Linguistics (7), Education (6), Political Science (5), Computer Science (2), Veterinary Science (2), Health Science (2), Humanities (1), Agriculture (1), and Business (1). A diverse group of first languages was included in this study. These were Chinese (4), Farsi (4), Russian (2), Bengali (2), Hindi (2), and one participant per each of the following languages: Punjabi, Turkish, Vietnamese, Urdu, Spanish, Igbo, Luo, Portuguese, Czech, Jamaican Patois, Lusaka, Arabic, and Ukrainian. The English proficiency levels were at 'upper intermediate' to 'advanced' levels as the average score of their most recent standardized English language tests was about IELTS Band 7 or equivalent based on score conversion from other standardized English language tests, with a range from IELTS 6.5 to 8.5 and a standard deviation of 0.55.

In addition to the participants, five researchers were involved as raters at different stages in this project, including two faculty members and three graduate students in Applied Linguistics. Each literature review was rated independently by two to three raters, including at least one faculty member. The rating was completed on an online platform.

2.2 Data collection and analysis

An analytic rating rubric was developed based on the themes covered in the tutorial series for this project. Nine dimensions of literature review writing were evaluated on a 10-point scale: (1) Material selection; (2) Material integration and citation; (3) Quality of key components; (4) Logic of structure; (5) Content and clarity of ideas; (6) Coherence; (7) Cohesion; (8) Grammar and sentence structure; and (9) Academic vocabulary. To detect changes in analytic scores across T1, T3, and T5 (independent variable), nine repeated-measures ANOVAs were performed with analytic scores as the dependent variable. Follow-up pairwise comparisons with Bonferroni p-value adjustment were reported.

As mentioned earlier, an end-of-tutorial survey was administered to the participants. The survey included two main sections: 1) a self-assessment with eight statements on a 4-point scale about perceived progress in various aspects of literature review writing, such as genre awareness, material integration, citation, cohesion, grammar, and academic vocabulary; 2) an evaluation of the usefulness of tutorial content and features with 12 statements on a four-point scale. Each section concluded with an open-ended question for additional comments or thoughts. The survey responses to scale-based statements were analyzed quantitatively for frequencies and the responses to open-ended questions were coded qualitatively for main themes.

3. Results

3.1 Analytic scores

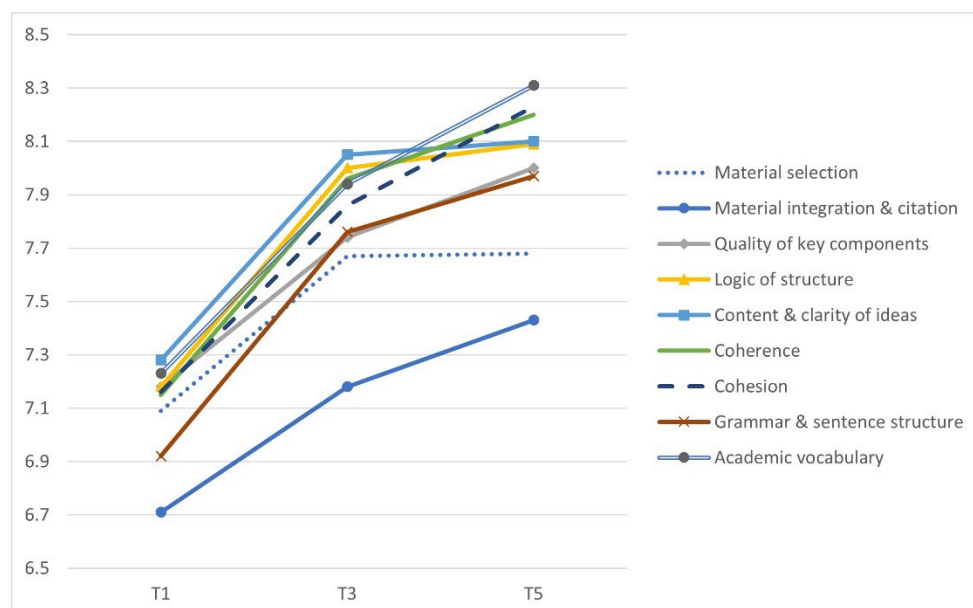
To investigate the participants' writing performance, we averaged the ratings awarded by two to three raters on each of the dimensions. As a result, a participant has nine scores for each of the three individual writing tasks. As shown in Table 2, on average, the participants made progress in all nine dimensions in their literature review writing samples. For example, the mean score in Material selection for the first writing task (T1) is 7.09 out of 10; the score increases to 7.68 for the last writing task (T5) at the end of the tutorial. In writing task 1 (T1), the lowest and highest average scores are 6.71 (Material integration and citation) and 7.28 (Content and clarity of ideas), respectively. By contrast, the average scores in T5 improved significantly and ranged from 7.43 (Material integration and citation) to 8.31 (Academic vocabulary), with remarkable improvement in the last four dimensions: Coherence, Cohesion, Grammar and sentence structure, and Academic Vocabulary.

Table 2: Descriptive statistics for average analytic scores across three writing tasks (T1, T3, and T5)

Score dimension	T1		T3		T5	
	Mean	SD	Mean	SD	Mean	SD
1. Material selection	7.09	0.48	7.67	0.62	7.68	0.68
2. Material integration & citation	6.71	0.71	7.18	0.69	7.43	0.74
3. Quality of key components	7.18	0.53	7.74	0.68	8.00	0.72
4. Logic of structure	7.18	0.59	8.00	0.65	8.09	0.59
5. Content & clarity of ideas	7.28	0.58	8.05	0.63	8.10	0.55
6. Coherence	7.15	0.57	7.96	0.60	8.20	0.54
7. Cohesion	7.16	0.49	7.86	0.60	8.23	0.44
8. Grammar & sentence structure	6.92	0.51	7.76	0.50	7.97	0.50
9. Academic vocabulary	7.23	0.55	7.94	0.75	8.31	0.52

These development trajectories are visualized in Figure 2. It is noticeable that the increases in scores from T1 to T3 were larger than the increases from T3 to T5. The results of repeated-measures ANOVAs confirmed the improvement in all dimensions. For the scores of Material selection, there was a statistically significant difference in the score between at least two groups ($F(2, 56) = 9.311, p < .001, \eta_g^2 = 0.18$). Pairwise comparisons indicated that significant differences existed between the first task (T1) and other tasks (T1 vs. T3: $p = .001$; T1 vs. T5: $p = .004$), while no statistically significant difference was found between T3 and T5 (7.67 vs. 7.68). For the score of Material integration and citation, statistically significant differences were revealed ($F(1.65, 46.22) = 10.118, p < .001, \eta_g^2 = 0.15$). Pairwise comparisons showed the same pattern as the score of Material selection (T1 vs. T3: $p = .002$; T1 vs. T5: $p < .001$). Similar trends are observed in other five dimensions: Quality of key components in literature review ($F(2, 56) = 26.752, p < .001, \eta_g^2 = 0.22$), Logic of structure ($F(1.59, 44.53) = 30.621, p < .001, \eta_g^2 = 0.32$), Content and clarity of ideas ($F(2, 56) = 52.375, p < .001, \eta_g^2 = 0.30$), Coherence ($F(2, 56) = 62.837, p < .001, \eta_g^2 = 0.39$), and Grammar and sentence structure ($F(2, 56) = 54.135, p < .001, \eta_g^2 = 0.46$).

However, the plateau phenomenon at the later stage, i.e., non-significant increase in scores from T3 to T5, does not apply to the scores in Cohesion and Academic vocabulary. For the score of Cohesion, the differences among the three writing tasks were relatively large ($F(2, 56) = 54.135, p < .001, \eta_g^2 = 0.46$) and all pairwise comparisons were statistically significant (T1 vs. T4: $p < .001$; T1 vs. T5: $p < .001$; T3 vs. T5: $p < .001$). The development of academic vocabulary also saw a similar pattern ($F(1.46, 41.04) = 42.052, p < .001, \eta_g^2 = 0.36$), with significant pairwise differences (all adjusted p values lower than .001).

**Figure 2: Average analytic scores across three individual writing tasks**

3.2 Participant's self-assessment and perceptions

The end-of-tutorial survey invited the participants to share their self-assessment of writing performance as well as perceptions of the tutorial series. Figure 3 presents an overview of the responses to the self-assessment. The majority of the participants agreed that they had made 'moderate' or 'strong' improvement in all eight categories: Overall performance (27 out of 29), Genre awareness (25), Material integration (24), Citation practice (24), Logic of structure (23), Cohesion (23), Academic vocabulary (22), and Grammar (25). This pattern is roughly in line with the expert assessment, as described above. Meanwhile, only a small number of participants reported 'no' to 'little' improvement in Academic vocabulary (7), Cohesion (6), Logic of structure (6), Citation practice (5), Genre awareness (4), Grammar (4), and Overall performance (2). This self-assessment outcome may be related to participants' perceived effectiveness of the tutorial units. Based on participants' reflection, the first three tutorials were deemed 'useful' by 20 or more participants, while the last two were 'useful' to 14 and 13 participants, respectively.

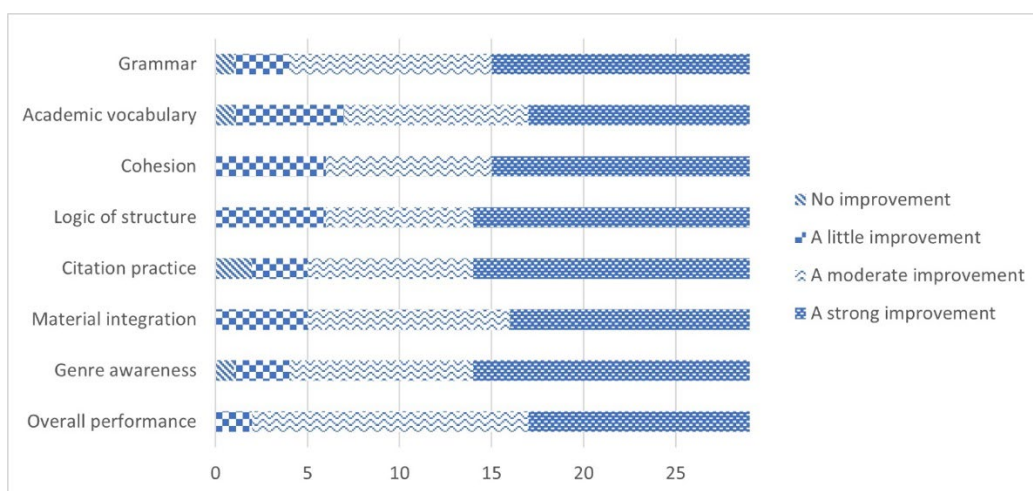


Figure 3: Participants' self-assessment of writing development at the end of the tutorial series

The participants also reported their perceptions of the main features used in the tutorial series (see Figure 4). All participants agreed that the most useful feature in this online tutorial series is instructor feedback. This shared perception highlights the importance of the presence of instructors. Other highly useful features included content structure in the tutorial series (28), H5P interactive e-books (27) and embedded quizzes (26). Nevertheless, the features for promoting peer interaction were perceived as less useful, for example, peer reviewing (24), use of comments from peers (23), and discussion forum (21).

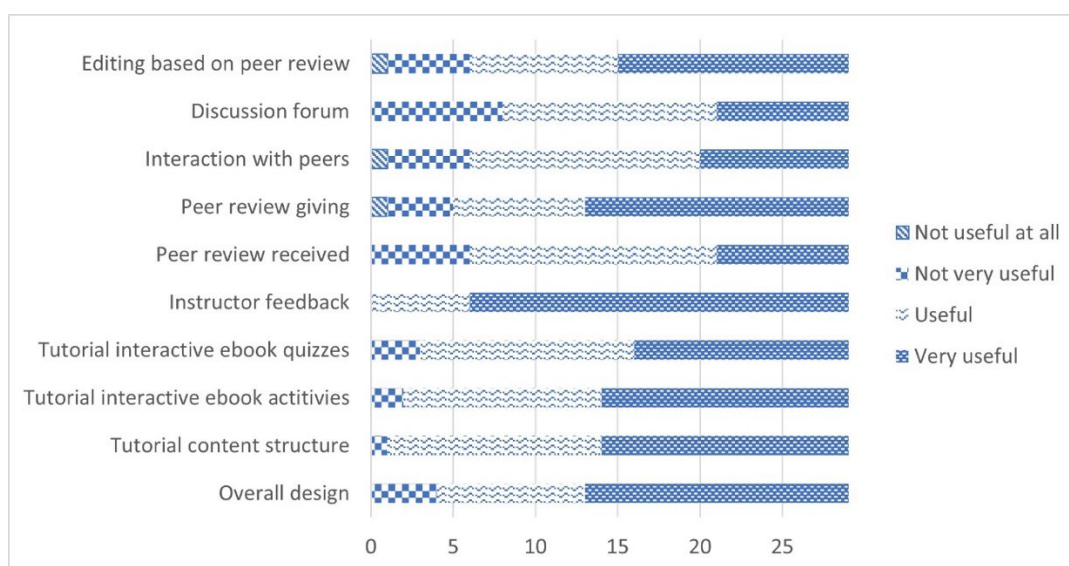


Figure 4: Participants' perception of tutorial features

Participant's self-assessment and perceptions may be further explained by their responses to the open-ended questions regarding tutorial experiences. Regarding the challenges faced during the tutorial series, three themes emerged from participants' responses: Effective peer interaction (5), time management or restraints (5), and topic familiarity (5). For example, one participant commented that *"the most difficult part for me was to communicate with my group-mates during group submissions and coordinate and combine everyone's work."* This response was echoed by other four participants, complaining about the effort needed to make peer interaction work during this online tutorial series. This concern was also related to the time commitment required in this project, which took three and half months to complete, and the ensuing challenges in time management. Five participants commented on their time management issues. One participant shared, *"The only difficulty was organizing my schedule to give the appropriate time for the readings."* Also related was some difficulty with writing on less familiar topics every two to three weeks, as reported by five participants. As described earlier, the participants had diverse academic backgrounds, including humanities, education, social sciences, business, computer science, and health sciences. Therefore, the selected writing prompts may be too far outside the research areas of some participants. For example, a participant mentioned that *"I need to spend time reading topics that I am not familiar with."* Another participant in social sciences explicitly commented on the last writing prompt, claiming that *"The one for T5, pacifism, was incredibly difficult to understand."*

When asked about what the participants enjoyed most in this tutorial series, four main aspects were highlighted in their responses: Tutorial content and activities (13), instructor feedback (7), writing topics (5), and peer interaction (4). More specifically, the features appreciated by the participants are H5P interactive e-book with embedded exercises, examples illustrated in the tutorials, and quizzes. At the same, participants also suggested some tips for improving the tutorial series, such as adding audio or video clips to supplement interactive e-books, more practices or exercises, and more online resources for self-study. Instructor feedback was greatly valued by seven participants in their responses, corroborating participants' positive perceptions of this practice. One participant stated that *"the instructor's comments were both encouraging and critical."*

The last two favoured aspects, namely writing topics and peer interaction, were enjoyed by some participants, despite the limitations identified above by some other participants. One participant shared that *"I loved the fact that I also enjoyed that the essay subjects made me think out of the box, read different resources. I really enjoyed this experience!"*. Nevertheless, some participants suggested more flexibility in writing prompt choices and consideration of disciplinary differences. Regarding peer interaction, four participants showed positive perceptions without any explanation. Furthermore, seven participants suggested some strategies to better engage participants for peer interaction, such as pairing participants in the same time zone, providing more detailed guidelines, allowing more time for group work, and facilitating online meetings with participants.

4. Discussion and conclusions

Overall, the outcomes of expert assessment and participants' self-assessment are promising regarding the effectiveness of the online writing tutorial series, despite the impact of the COVID-19 pandemic. The increases in analytic scores as well as the positive self-assessment indicate that the online writing tutorial series was helpful for raising participants' genre awareness and development of literature review writing skills. It is noteworthy that the comparisons of analytic scores between T3 and T5 suggest plateau effect in seven dimensions, which may be related to the developmental patterns commonly observed in second language acquisition (Rosmawati, 2014).

Compared to the findings in Li et al.'s (2023) study solely with participants' writing samples, the expert assessment and participants' self-assessment provided more macro-level information regarding genre features in literature review writing. Different from the uneven trajectories reported in Li et al. (2021) in the use of specific linguistic features such as lexical complexity, syntactic complexity, cohesion features, and citation practices, both expert assessment and participants' self-assessment suggested unidirectional development in main scoring dimensions. Such discrepancies can be accounted for by the differences in writing construct presentations in different assessment approaches. The construct of literature review writing captured with the analytic scoring rubric should be more polished, compared to the other approaches. The corpus-based approach focused on fine-grained linguistic features that were extractable by existing corpus tools. These features may not be able to fully represent the targeted writing construct.

The positive findings may be attributed to the design principles followed in this study. Firstly, the tutorial content was informed by multiple theories or frameworks, including academic genre analysis and corpus linguistics, to address English L2 graduate students' needs. Secondly, the activities and the writing tasks provided ample

opportunities to review key notions covered in the tutorials and to practice literature review writing. Considering the effectiveness of the tutorial series and positive perceptions of the participants, the design and content of this tutorial series may be used either as an extracurricular piece or as a part of an EAP program, especially for graduate level students (Douglas and Landry, 2021).

A few limitations need to be mentioned to better understand the findings of this study. Firstly, the sample size is relatively small even after three rounds of tutorial administration. While about 80 to 120 prospective participants were attracted at the beginning of each round, only 29 participants in total completed all tutorial units and the corresponding writing tasks. Several factors may have triggered such a high drop rate. The relatively heavy weekly workload and extended duration of the tutorial series may have made the free series somehow intimidating and tiring, as mentioned by one of the participants in the final survey. Secondly, only a fixed selection of writing prompts was employed in this project, leading to two possible consequences. On the one hand, using the same set of prompts allows participants to share writing experiences, develop ideas, and compose early drafts together when applicable. On the other hand, these pre-determined prompts may not be of interest to some participants or may be way outside their areas of expertise to produce a proper literature review. Some possible topic effect was noticed in the corpus-based analysis of texts (see Li et al., 2023).

Future development of the online writing tutorials or similar online resources should consider a balance of tutorial content and required writing tasks to ensure gradual progression to a final writing product, in this case, a literature review. For example, some bite-size activities can be prepared to help English L2 learners practice key steps in conducting a literature review and writing up the review, such as searching for academic materials (e.g., research articles) from reputable sources, evaluating the quality of academic materials, and synthesizing related academic materials with appropriate academic formulaic expressions. If possible, each unit in a series should be made self-contained and accessible separately, thus reducing the need to proceed in a linear fashion.

Initially, we planned to design a standalone online writing tutorial series that demands minimal involvement of instructors. As revealed in participants' survey responses, it turns out the presence of instructors and their feedback played key roles in engaging participants in this non-credit-bearing tutorial series. Future design should still maintain some involvement of instructors to support English L2 learners. While we also valued peer interaction for Academic English socialization, an interactive process in which English L2 learners become proficient in language use in a particular community of practice (Duff and Anderson, 2015), the asynchronous mode of the online tutorial series made it difficult to facilitate peer interactions for reviewing and collaborative writing. The peer interaction features in this tutorial series were deemed less useful than other features.

Other technologies or tools such as automated writing evaluation and generative AI (e.g., ChatGPT) may be incorporated in the future design to mitigate the sole reliance on instructors for feedback. Other peer interaction tools such as peer review plugins for Moodle and Zoom meetings may help promote connections among participants in this online environment.

Acknowledgements

We would like to thank Social Sciences and Humanities Research Council of Canada (SSHRC) for funding this project under the Insight Development Grants (430-2020-00179). We also appreciate three graduate students, i.e., Leslee G. Mann, Abdelrahman Alqudah, and Hanh Pham, who expertly assessed the participants' submitted writings. The research would not be possible without the participants, particularly those 29 who completed all the tutorial units.

References

- Abdi Tabari, M. and Johnson, M.D. (2023). 'Exploring new insights into the role of cohesive devices in written academic genres', *Assessing Writing*, 57, Available at: <https://doi.org/10.1016/j.asw.2023.100749>
- Badenhorst, C. (2018) 'Citation practices of postgraduate students writing literature reviews', *London Review of Education*, 16(1), pp. 121–135. Available at: <https://doi.org/10.18546/LRE.16.1.11>.
- Basturkmen, H. and von Randow, J. (2014). 'Guiding the reader (or not) to re-create coherence: Observations on postgraduate student writing in an academic argumentative writing task', *Journal of English for Academic Purposes*, 16, pp. 14–22. Available at: <https://doi.org/10.1016/j.jeap.2014.07.005>
- Crosthwaite, P., Sanhueza, A.G. and Schweinberger, M. (2021) 'Training disciplinary genre awareness through blended learning: An exploration into EAP students' perceptions of online annotation of genres across disciplines', *Journal of English for Academic Purposes*, 53. Available at: <https://doi.org/10.1016/j.jeap.2021.101021>.

- Douglas, R.S. and Landry, M.H. (2021) 'English for Academic Purposes Programs: Key Trends Across Canadian Universities', *Comparative and International Education*, 50(1), pp. 49–73. Available at: <https://doi.org/10.5206/CIEECI.V50I1.10925>.
- Duff, P.A. and Anderson, T. (2015) 'Academic language and literacy socialization for Second language students', in N. Markee (ed.) *The Handbook of Classroom Discourse and Interaction*. Hoboken, NJ: John Wiley & Sons, Inc, pp. 337–352. Available at: <https://doi.org/10.1002/9781118531242.ch20>.
- Hyland, K. (1999) 'Academic attribution: Citation and the construction of disciplinary knowledge', *Applied Linguistics*, 20(3), pp. 341–367. Available at: <https://doi.org/10.1093/APPLIN/20.3.341>.
- Li, Z., Makarova, V. and Wang, Z. (2023) 'Developing literature review writing skills through an online writing tutorial series: Corpus-based evidence', *Frontiers in Communication*, 8. Available at: <https://doi.org/10.3389/fcomm.2023.1035394>.
- Rosmawati (2014) 'Dynamic development of complexity and accuracy: A case study in second language academic writing', *Australian Review of Applied Linguistics*, 37(2), pp. 75–100. Available at: <https://doi.org/10.1075/aral.37.2.01ros>.
- Shi, L. and Dong, Y. (2015) 'Graduate writing assignments across faculties in a Canadian university', *Canadian Journal of Higher Education*, 45(4), pp. 123–142. Available at: <https://doi.org/10.47678/cjhe.v45i4.184723>.
- Storch, N. and Tapper, J. (2009) 'The impact of an EAP course on postgraduate writing', *Journal of English for Academic Purposes*, 8(3), pp. 207–223. Available at: <https://doi.org/10.1016/j.jeap.2009.03.001>.
- Swales, J. and Feak, C. (2012) *Academic writing for graduate students: Essential tasks and skills*. 3rd ed. University of Michigan Press.

A Systematic Review: Criteria and Dimensions of Learning Experience

Ying-Dong Liu¹, Simon Morard², Dina Adinda³, Eric Sanchez² and Marc Trestini¹

¹LISEC of University of Strasbourg, France

²TECFA of University of Geneva, Switzerland

³CREF UR 1589, Paris Nanterre University, France

yingdongliu@unistra.fr

simon.morard@unige.ch

dadinda@parisnanterre.fr

eric.sanchez@unige.ch

marc.trestini@unistra.fr

Abstract: There has been an increased interest in evaluating students' learning experiences in various academic domain. Some authors consider it an important aspect of education to assess the effectiveness of instructional methods, while others aim to enhance the quality of teaching and learning. Various perspectives can be highlighted, as many articles refer to the learning experience and its evaluation differently. However, few studies provide an explicit dimension to characterize it. Therefore, this study investigates how the learning experience is described in scientific literature, and what criteria are used to characterise learners' learning experiences. This work aims to answer the following questions: Are there any theories used to examine the learning experience? What are the principal dimensions of a learning experience? How did the studies evaluate the learning experience? This literature review aims to provide an overview of research related to the learning experience and its evaluation. The study includes journal articles published in *ScienceDirect*, *Springer*, *Wiley*, *IEEE Xplore Digital Library*, and *Google Scholar* from January 2012 to November 2022. The PRISMA method was used to conduct a systematic review for this work. After identifying, screening, and synthesising relevant literature (Moher et al., 2009), 68 articles were selected, of which 20 will be addressed in this research stage. The selected studies employ various methods to evaluate the learning experience, including questionnaires, surveys, and scales, and they are conducted in various educational contexts, such as medical education, biology, language teaching, etc. The review analysis shows three principal dimensions of learning experience: the learner's perception of the learning environment, their attitudes and behavior in learning, and the learning activities. The study's findings also highlighted that "learning experience" is used as a broad concept to describe specific teaching and learning scenarios or activities. Furthermore, few references from educational sciences have been identified to characterise it. This article delineates the dimensions characterising the learning experience, which helps develop and design new teaching and learning solutions.

Keywords: Learning Experience, Evaluation, PRISMA Method, Systematic Review, Instructional Design, Teaching Quality.

1. Introduction

Learning is a lifelong journey, and our experiences shape our understanding and perception of the world to some extent. The learning experience can be considered as an interaction between the learner and the environment (Dewey, 1938), whether in a classroom, an online course, or a virtual setting. This term is also frequently used to describe specific teaching and learning scenarios or activities (Ning & Downing, 2011). In the literature, student's learning experience is often related to the flow experience (Li & Liu, 2023), the user experience (Santoso et al., 2014; Az-zahra et al., 2020), and the experiential learning (Reed, 2012; Mor et al., 2018; Grota & O'Neal, 2020). Ning et Downing (2011, p.766) define learning experience as "interpreted as students' interaction with the teaching and learning environment", and Liu (2022, p. 198) states that "learning experience consists of all the feelings that the learner may experience and the results of his interactions with environments during the learning process."¹ Despite these various definitions, there is still a lack of consensus on the key characteristics and dimensions that make up a high-quality learning experience. Without a clear understanding of these factors, it is challenging for educators and instructional designers to create engaging and effective learning environments. Regarding these definitions, the learning experience evaluation can be understood as a general term used to encompass the process of evaluating the effectiveness of a learning experience which includes the evaluation of environment, instructional design, technology, and interaction with

¹ "L'expérience d'apprentissage consiste en l'ensemble des ressentis que l'apprenant peut éprouver et les résultats de ses interactions avec son environnement durant le processus d'apprentissage" (Liu, 2022, p. 198).

teachers and peers. Indeed, the evaluation of the learning experience can be considered as a form of feedback from learners on teaching and learning, allowing learners to express their thoughts, feelings, and perception about the learning experience and giving educators or instructional designers valuable insight into how to improve their activities. Therefore, it remains necessary to identify and characterise the essential dimensions of the learning experience to develop evidence-based practices and evaluation criteria that support effective teaching and learning.

This study aims to comprehensively review scientific articles on the learning experience and its evaluation. The objective is to understand better the theories used to characterise the learning experience, potential dimensions of learning experiences, and criteria for their evaluation. The theoretical background of the learning experience is presented in section 2. Section 3 then explains the adopted method for article searching, selection, and analysis. The main findings that emerged from the study of the selected articles are presented in section 4, and finally, the conclusion of this work is detailed in section 5.

2. Theoretical Background of Learning Experience

Learning experience refers to all the processes undertaken by an individual in a learning context. It focuses on creating engaging and meaningful learning experiences that enhance knowledge retention and application. One of the most influential works related to learning and experience is Kolb's (1984) Experiential Learning Theory, which suggests that learning occurs through a cycle that includes concrete experience, reflective observation, abstract conceptualisation, and active experimentation. Another prominent framework is Merrill's (2002), First Principles of Instruction, which identifies five elements of effective learning experiences: activation, demonstration, application, integration, and facilitation. The concept of learning experience can also be linked to the work of John Dewey. Dewey's ideas about experiential learning and the importance of active, hands-on learning experiences still influence educational theory and practice today. Dewey (1938) argued that learning is not simply a matter of acquiring knowledge or skills but an ongoing process of inquiry and problem-solving that is deeply connected to one's experiences and environment. He believed that education should be focused on helping individuals develop critical thinking skills and the ability to reflect on and learn from their experiences. Furthermore, Dewey emphasized the importance of learning experiences that are relevant and meaningful to learners' lives. In his view, learning is most effective when it is connected to real-world problems and challenges, and when learners are actively engaged in the process of discovery and exploration (Dewey, 1916). In contemporary research on learning and teaching, scholars have built upon Dewey's ideas by exploring how technology can be used to create engaging and meaningful learning experiences. For example, the use of simulations, games, and virtual environments can provide learners with opportunities to explore complex concepts and practice real-world skills in a safe and controlled environment (Sitzmann & Ely, 2011). Recently, technology has played an increasingly important role in shaping the learning experience. The use of simulations, gamification, virtual and augmented reality, and artificial intelligence has the potential to create immersive and personalized learning experiences (Lee & Wong, 2020). In all, creating a meaningful learning experience is essential for learners in all areas for the effectiveness of learning.

3. Research Method

In this study, the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) research method is employed to conduct a comprehensive review of the literature (Moher et al., 2009). This method provides a structured framework for conducting systematic reviews, ensuring transparency and rigour in the selection and analysis of articles. After the initial screening process, we conducted a thorough assessment of the full-text articles, applying specific exclusion criteria to ensure the inclusion of only high-quality studies. The following sections will provide a detailed account of the selected studies, data analysis methods, and key findings.

3.1 Targeted Database and Selection Criteria

This systematic review has been conducted within the extensively used database by the academic community: *ScienceDirect*, *Springer*, *Wiley*, *IEEE Xplore Digital Library*, and *Google Scholar*. The study focuses on the peer-reviewed journal articles published over the past ten years, in other words, published between January 2012 and November 2022. The inclusion and exclusion criteria of articles selection are as below:

Table 1: Inclusion and exclusion criteria

Criteria	Inclusion	Exclusion
Publication Period	January 2012 to November 2022	Before January 1, 2012, and after November 30, 2022
Publication Type	Peer reviewed journal article	No peer reviewed journal article
Thematic focus	Focus on learning experience and its evaluation: learning experience and evaluation in title	not focus on learning experience and its evaluation: learning experience and evaluation not in title
Population	All kinds of learners	No exclusion
Research type	Reflective, theoretical, conceptual articles, systematic review	Not concentrate on teaching or learning
Language	Articles published in English	Articles not published in English

3.2 Articles Selection

To focus on published works on the evaluation of learning experiences, we used the keywords and Boolean operator "learning experience" AND "evaluation" for title searches. We have chosen these keywords with the expectation that the articles will highlight the necessary criteria, characteristics, and dimensions to define the learning experience. Based on the specified criteria, 14 journal articles from ScienceDirect, 48 articles from Springer, 3 from Wiley, 30 from IEEE Xplore Digital Library, and 100 from Google Scholar were found during the identification step. Figure 1 below illustrates the three phases of the article selection process (Page et al., 2021):

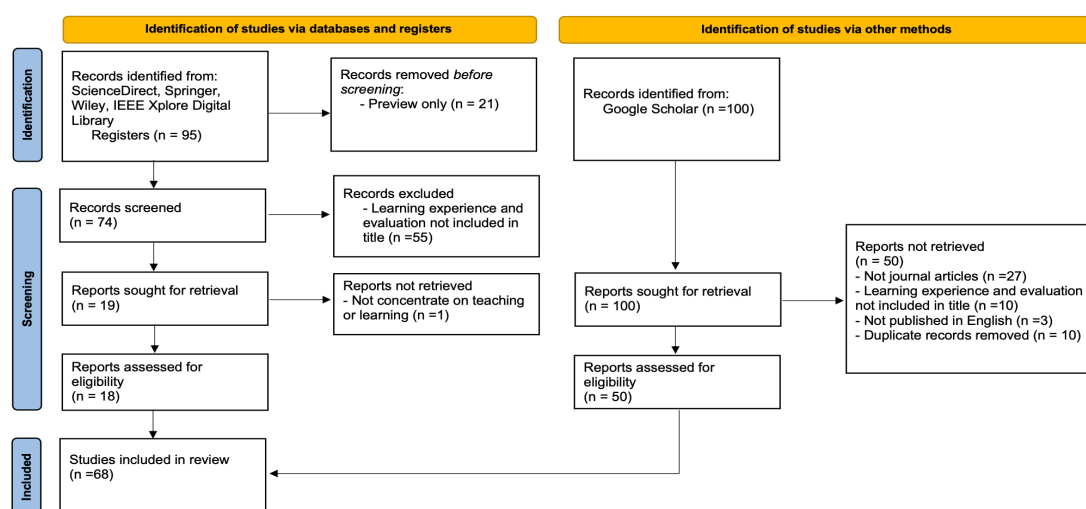


Figure 1: PRISMA flow diagram of the study

3.3 Analysis Method

After selecting the articles, each author independently reads several articles and creates summaries that fill in a comprehensive table containing information such as the article's authors, title, research domain, study characteristics, journal name, sample size and characteristics, methods and measuring instruments, research objectives, use of digital technologies or learning materials, learning type/procedure, learning activity, theories used and emerging characteristics, learning outcomes, proposed definition of learning experience, study results, and discussion. Then, we synthesised the dimensions describing learning experiences, criteria or indicators characterising these dimensions, and the theories mentioned in the articles. If an article does not explicitly mention these aspects, the authors will interpret the learning experience based on the article's main idea. The authors then organised several brainstorming sessions to extract primary dimensions and learning experience evaluation criteria from the selected articles. The current study is grounded on the analysis carried out on 20 out of the 68 chosen articles selected randomly.

4. Results

The chosen articles span four key domains: six pertain to education (Az-zahra et al., 2020 ; Chogo, 2020 ; Henda et Alkhezzi, 2021 ; Al-smadi et al., 2022; Ogeyik, 2022 ; Lakeman et al., 2022) ; one focuses on veterinary education (Mor et al., 2018), twelve discuss healthcare and medical education (Reed, 2012; Paliadelis et al., 2015 ; Smith et al., 2013; Díaz et al., 2016 ; Björn, 2017 ; Ferguson et al., 2017 ; Kang et Suh, 2018 ; Grota & O'Neal, 2020 ; Lamprect et al., 2020; Guasconi et al., 2021; Riley et al., 2022; Prosen et al., 2022), and one examines scientific studies (Leitão et al., 2021). A few articles use theoretical support related to the learning experience, but they do not specifically define it. Out of these twenty articles, only three mention the theory of experiential learning (Reed, 2012; Mor et al., 2018; Grota & O'Neal, 2020). Most of the studies aim to understand and improve the learning experience particularly in the context of online (Paliadelis et al., 2015; Chogo, 2020; Henda et Alkhezzi, 2021; Al-smadi et al., 2022; Prosen et al., 2022), and simulation-based learning without technologies (Díaz et al., 2016; Grota & O'Neal, 2020). Those includes determining elements related to student satisfaction (Díaz et al., 2016; Al-smadi et al., 2022), identifying user experience problems in e-learning applications (Az-zahra et al., 2020), and evaluating the effectiveness of teaching strategies (Kang et Suh, 2018; Lakeman et al., 2022). Several studies also aim to develop, validate, or translate measuring tools or scales to assess the learning experience (Grota & O'Neal, 2020; Guasconi et al., 2021; Prosen et al., 2022).

4.1 Learning experience dimensions

Through the steps outlined above, three main dimensions (activity, perception, and attitudes & behaviours) and eleven corresponding sub-dimensions (interaction, collaboration, technical and pedagogical aspects, relationship to knowledge, to competency, to learning, self-efficacy, satisfaction, motivation, and engagement) are identified. These results are then used to define the main characteristics that shape learning experiences in the selected articles.

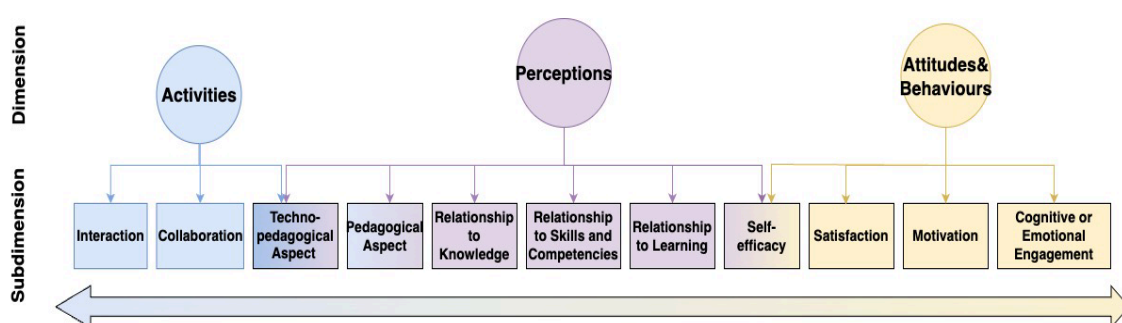


Figure 2: Dimensions and their sub-dimensions of the learning experience

4.1.1 Activities

According to those articles, learning experiences are activities related to any task learners perform, individually or collaboratively, to achieve specific learning outcomes. These activities can involve various levels of interaction between learners and educators (Björn, 2017; Lamprect et al., 2020; Ogeyik, 2022; Prosen et al., 2022), and the learning environment or resources (Grota & O'Neal., 2020; Henda et Alkhezzi, 2021; Ogeyik, 2022; Prosen et al., 2022), to foster engagement, understanding, and skill development. The selected articles also pointed out that activity is related to techno-pedagogical and pedagogical aspects. Although technology does not always use and presented as a key element to enhance learning, Díaz et al. (2016), Reed (2012), and Grota & O'Neal (2020) agreed that the technological aspects play crucial roles in shaping the effectiveness of learning activities. Furthermore, the design and implementation of technology-enhanced learning environments, such as e-learning platforms (Al smadi et al., 2022; Prosen et al., 2022) and simulations (Grota & O'Neal., 2020; Riley et al., 2022), are also considered essentials to facilitate active and collaborative learning.

Interactions refer to the actions taken by learners in response to information they perceive within a learning context, and these can manifest in various ways, such as engagement with teachers (Björn, 2017; Ogeyik, 2022; Prosen et al., 2022; Lamprect et al., 2020), with peers (Björn, 2017; Ogeyik, 2022; Prosen et al., 2022; Lamprect et al., 2020), or with specific learning resources or activities (Smith et al., 2013; Grota & O'Neal., 2020). When learners interact with teachers or tutors, the interaction may involve various actions such as discussions for knowledge validation, encouraging learner accountability, engaging in learning activities, and exchanging

feedback. These interactions help improve learners' self-efficacy and overall learning outcomes (Björn, 2017; Lamprecht et al., 2020; Ogeyik, 2022; Prosen et al., 2022). Peer interactions can take various forms, such as group discussions, teamwork, and collaborative projects. Sometimes, these interactions occur across different levels, with more experienced learners guiding novices (Björn, 2017; Ogeyik, 2022; Prosen et al., 2022; Lamprecht et al., 2020). Learners can also interact in specific learning activities using different tools and methods used in the learning process, such as simulators (Grotta & O'Neal, 2020), e-learning courses (Hendal & Alkhezzi, 2021; Lamprecht et al., 2020), educational materials (Lakeman et al., 2022), or role-playing situations (Smith et al., 2013). These interactions are often mediated by specific resources or instruments, such as chat platforms, forums, or learning management systems (Prosen et al., 2022; Ogeyik, 2022).

Collaboration in a learning experience refers to the process and action of working together with others (peers or between teachers and learners) to achieve a common goal or complete a shared activity. It can occur in various settings and facilitate learning through face-to-face interactions (Ferguson et al., 2017; Björn, 2017), digital environments (Leitão et al., 2021; Ogeyik, 2022), or even role-playing games (Smith et al., 2013). Collaboration is beneficial in various learning situations, such as practical training, where students from different years or backgrounds can learn from each other and enhance their knowledge (Lamprecht et al., 2020). However, it may not always be efficient for theoretical learning, especially when the gap in knowledge levels among participants is significant (Lamprecht et al., 2020). In some instances, such as game-based learning, collaboration is preferred over competition, fostering a cooperative learning environment (Leitão et al., 2021).

Furthermore, teachers often use techno-pedagogical aspects to create an effective and engaging learning environment that supports and enhances the learning process. This aspect is the integration of both technical and pedagogical components within a learning experience. From a technical perspective, the learning experience can be considered a series of interactions between the learner and the tools, technologies, or digital environments implemented to facilitate learning. These tools and technologies can include e-learning devices (Al Smadi et al., 2022; Prosen et al., 2022), online learning platforms (Hendal & Alkhezzi, 2021), simulations or software (Björn, 2017; Grotta & O'Neal, 2020), and mobile devices such as online tutoring mobile applications (Az-zahra et al., 2020). Additionally, fluid, smooth, intuitive navigation can provide students with a better learning experience (Al Smadi et al., 2022). In contrast, bugs or lack of in-person contact hinder the learning experience (Al Smadi et al., 2022; Hendal & Alkhezzi, 2021). From a pedagogical perspective, the learning experience is described as a teaching and learning process to develop the learner's knowledge, skills, and attitudes. In this context, the learning experience is designed to be interactive, collaborative, and learner-centred, allowing the learner to participate in their learning actively. It relies on learning scenarios that alternate individual and group work, interaction with peers, collaborative projects as presented in serious games, and interactions with digital learning spaces (Riley et al., 2022; Björn, 2017). Indeed, the technical and pedagogical aspects must be perceived as an indissociable combination, forming a balanced ensemble that contributes to the learning experience.

4.1.2 Perceptions

From the chosen articles, we deduce that the way learners perceive their learning experience can be shaped by various factors, such as pedagogical and technical elements (Björn, 2017; Grotta & O'Neal, 2020; Hendal & Alkhezzi, 2021; Al Smadi et al., 2022; Prosen et al., 2022), their connection with knowledge (Reed, 2012; Paliadelis et al., 2015; Díaz et al., 2016; Mor et al., 2018; Grotta & O'Neal, 2020; Chongo, 2020; Riley et al., 2022) and skills (Reed, 2012; Smith et al., 2013; Mor et al., 2018; Grotta & O'Neal, 2020; Lamprecht et al., 2020), including the learning process itself, and their self-efficacy (Díaz et al., 2016; Kang et al., 2018; Guasconi et al., 2021; Prosen et al., 2022; Riley et al., 2022). This perception is significant as it greatly affects learners' attitudes toward the act of learning. The perception of the learning experience relies on the subjectivity of the learners and the meaning they give to the learning situation. Furthermore, technical, and pedagogical aspects of learning environments also play a crucial role in shaping learners' perceptions. These aspects include the use of technology, instructional design, and teaching strategies employed in the learning process.

The relationship to knowledge can be defined as how people perceive, apprehend, and use knowledge and how they refer to and acquire it through their learning experiences (Hofer et al., 1997). Teaching methods, learning approaches, and educational systems are key aspects that influence one's relationship to knowledge. In the various selected articles, knowledge acquisition is stated as the goal or the desired outcome of any learning experience. Indeed, much effort in terms of scenario writing and pedagogical design must be ensured to match the knowledge that needs to be acquired and what learners already possess (Díaz et al., 2016; Paliadelis et al., 2015; Mor et al., 2018). Although the relationship to knowledge is not always explicitly mentioned in

articles, it is underlying and appears as a concern for designing and developing various learning devices or pedagogical methods.

Skills and competencies development is also the desired outcome of learning. The articles considered skills and competencies as technical gestures that must be mastered through repeated experimentation or as abilities to make decisions or solve complex problems (Grota & O'Neal., 2020). Therefore, at the heart of scenario writing and design, how skills will be solicited, developed, acquired, and transferred plays an essential role in any learning experience. This aspect also depends on the professional and didactic skills of the tutor (Reed, 2012). The skills targeted may vary depending on the topic and learning subjects. However, they are generally linked to those required in the professional world (Smith et al., 2013; Grota & O'Neal, 2020), while questions related to knowledge development tend to be more relevant to university learning experiences (Lakeman et al., 2022; Hendal & Alkhezzi, 2021).

When discussing the relationship of learning, some studies highlight the importance of a structured, reflective, and engaging learning process for the learning experience, which encourages learners to engage with the content actively, reflect on their experiences, and ultimately enhance their competency and understanding. In online environments, learners' abilities to manage their learning, access, and use technology, and interact with the learning materials and facilitators are essential (Chongo, 2020). Similarly, simulation-based learning, such as High-Fidelity Patient Simulation (HFPS), allows students to apply classroom content, engage in critical thinking, and enhance clinical competency (Smith et al., 2013; Díaz et al., 2016). Such experiences are particularly effective when followed by debriefing sessions, allowing learners to reflect on their performance and learn from their mistakes (Smith et al., 2013; Grota & O'Neal., 2020; Guasconi et al., 2021). Kolb's Experiential Learning model resonates in different contexts, such as field trips and classroom-based activities, where students can better understand professional practice (Mor et al., 2018). Furthermore, the use of gamified apps illustrates the integration of enjoyment and learning content, recognizing learning as a process that requires engagement with the material before mastery (Leitão et al., 2021).

4.1.3 Attitudes and Behaviours

Learning experience could also be understood as learners' attitudes and behaviours which are influenced by various approaches and strategies implemented by educators or instructional designers, for example, to improve students' motivation (Leitão et al., 2021; Prosen et al., 2022; Lakeman et al., 2022) and self-efficacy (Díaz et al., 2016; Kang et al., 2018; Guasconi et al., 2021; Prosen et al., 2022; Riley et al., 2022), enhance their cognitive and emotional engagement (Paliadelis et al., 2015; Lamprect et al., 2020; Leitão et al., 2021; Prosen et al., 2022; Ogeyik, 2022; Lakeman et al., 2022), and increase their learning experience's satisfaction (Kang & Suh, 2018; Lamprect et al., 2020; Guasconi et al., 2021; Hendal & Alkhezzi, 2021; Al Smadi, 2022; Prosen et al., 2022).

Self-efficacy in the learning context refers to an individual's belief in their ability to accomplish a specific learning task based on their experiences, skills, and knowledge. Self-efficacy is closely related to self-management, autonomy, and individual responsibility, contributing to learners becoming more proactive and responsible for their learning (Kang & Suh, 2018). For example, in simulation-based learning environments (Díaz et al., 2016; Guasconi et al., 2021), training offers advantages such as an improved patient approach to decision-making skills, collaboration, and promoting self-reflection and self-confidence (Guasconi et al., 2021). The study of Riley et al. (2022) indicates that valuable learning experiences in communication can contribute to the development of self-efficacy. Prosen et al. (2022) recognize self-efficacy as an essential motivator for academic success, although the study does not delve into the concept in detail. Kang and Suh (2018) measure self-efficacy as an attitude expected from learners, positively influencing their learning experience.

Furthermore, motivation is the internal or external drive that stimulates and sustains a person's behaviour and actions toward achieving a goal or objective. Motivation refers to the factors that inspire and direct a person's efforts and persistence to learn. Various factors can influence motivation, such as game-based learning elements such as points and badges (Leitão, 2019) and the e-learning system (Prosen et al., 2022). Leitão et al. (2021) focus on the characteristics of game-based learning to enhance motivation in learners. Points and badges serve as motivational stimuli, ranging from extrinsic motivators such as monetary rewards or status to intrinsic motivators. The study found that games have a more significant effect on intrinsic than extrinsic motivation. In Prosen et al. (2022) study, motivation is briefly mentioned in the e-learning context. While the study does not delve into motivation in detail, it acknowledges that certain shortcomings of e-learning, such as the lack of spontaneity in interpersonal interactions and communication, can negatively affect learners' motivation.

Engagement can refer to the determination to accomplish a task and put it into action, including emotional, cognitive, or learning engagement, depending on the context. Paliadelis et al. (2015) focus on emotional engagement, describing learners' ability to connect with characters and situations in online stories on a personal level. This emotional connection can help learners develop empathy and a greater appreciation for the challenges healthcare professionals face in rural areas. Ogeyik (2022) uses Bloom's Digital Taxonomy to evaluate how well webcast applications support different thinking skills (remembering, understanding, applying, analysing, evaluating, and creating) among student-teachers during the COVID-19 pandemic. Prosen et al. (2022) discuss how positive learning experiences contribute to greater learning satisfaction and engagement. These works highlighted the necessity of cognitive engagement in a learning process. These also revealed that learning satisfaction is an important indicator of students' enjoyment of their studies and is a vital evaluation component in assessing learning effectiveness.

Satisfaction refers to students' attitudes and behaviours about their learning experiences in e-learning, simulations, or gamified applications. It is a subjective measure that can affect the perception of personal experience and influence the success of learning methods and the willingness to continue learning. Several studies mentioned satisfaction as an indicator of the learning experience. Al Smadi (2022) examines students' satisfaction with e-learning through their attitudes and behaviour, including their self-efficacy, enjoyment, usage, perceptions, and insights about e-learning. Prosen et al. (2022) recognise satisfaction as a subjective dimension of each individual, which can affect their perception of personal experience. The study acknowledges the limitations related to the perception of personal experience and satisfaction due to its highly subjective nature. In this regard, Guasconi et al. (2021) use the self-report of Satisfaction with Simulation Experience (SSE) to assess nursing students' satisfaction after a clinical learning experience through simulation. Moreover, for Kang & Suh (2018), satisfaction is investigated using a gamified application and knowledge acquisition. Although different studies explore satisfaction through various approaches, including e-learning, simulation, and gamification, these studies showed that a high level of satisfaction promotes continuous learning and a willingness to engage in further training.

5. Conclusion

This work uses a unique approach to article analysis to illustrate dimensions and sub-dimensions of the learning experience. Despite the number of analysed articles in this preliminary stage, the summarised dimensions of the learning experience offer us a fresh perspective. The selected articles conclude that the learning experience is multidimensional, referring to the perception of any interaction, activity, or situation that enables an individual to acquire new understanding, knowledge, skills or competencies. The individual's emotions influence this process during the experience and occur in various contexts, such as traditional classrooms, e-learning platforms, simulations, or gamified applications, and may involve different instructional methods and materials with or without technologies. These experiences are also influenced by collaboration, self-efficacy, engagement, motivation, and satisfaction, which contribute to the effectiveness and success of the learning process.

The present work also shows that the learning experience encompasses the diverse ways learners interact with content, educators, and their peers to gain knowledge and develop skills that promote personal growth and development. Most articles focused on implementing technology in educational settings to facilitate learning. Indeed, technology serves as a mediator in learning contexts, and it becomes meaningful for learning activities when it is used and interacted with by the learner or teacher. Therefore, to evaluate a learning experience's effectiveness, technical and pedagogical aspects must be carefully considered. Educational technologies should be selected and used in conjunction with pedagogical objectives. In both contexts, with or without technology, elements such as instructional design, learning objectives, and feedback mechanisms can influence the learning experiences of learners (Grotta & O'Neal., 2020). This study also highlighted that the perception of a learning experience is influenced by factors such as personal epistemology, technical and pedagogical aspects of learning environments, relationships with competency, attitudes toward learning, and self-efficacy beliefs. Understanding these influences can help educators and instructional designers create engaging and effective learning experiences that cater to learners' needs, motivations, and aspirations (Chen et al., 2018). In future research, we intend to investigate whether these dimensions and sub-dimensions are also present in other articles and explore their interrelations.

Acknowledgements

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

- Al-smadi, A. M., Abugabah, A., & Smadi, A. A. (2022). Evaluation of E-learning Experience in the Light of the Covid-19 in Higher Education. *Procedia Computer Science*, Vol 201, pp 383–389.
- Az-zahra, H., Indah R, R., & Romansya, C. (2020). *Learning experience evaluation of indonesia online tutoring mobile application using heuristic for E-learning* (p. 238). <https://doi.org/10.1145/3427423.3427440>
- Björn, K. (2017). Evaluation of Open Source Medical Imaging Software: A Case Study on Health Technology Student Learning Experience. *Procedia Computer Science*, Vol 121, pp 724–731.
- Brooks, I. and Weatherston, J. (1997). *The Business Environment: Challenges and Changes*. Prentice Hall, London.
- Brown, S.L. and Eisenhardt, K.M. (1998). *Competing on the Edge: Strategy as Structured Chaos*. Harvard Business School Press, Boston.
- Brown, P. C., Roediger, H. L., & McDaniel, M. A. (2014). *Make it stick: The science of successful learning*. Harvard University Press.
- Chen, B., Wang, Y., & Kirschner, P. A. (2018). The role of guidance in technology-enhanced learning environments: A meta-analysis. *Review of Educational Research*, Vol 88, No. 4, pp 547-588.
- Chogo, P. (2020). An Evaluation of Higher Education Students Online Learning Experience. *International Journal of Scientific and Research Publications (IJSRP)*, Vol 10, pp 926–933.
- Dewey, J. (1916). *Democracy and education: An introduction to the philosophy of education*. Macmillan.
- Dewey, J. (1938). *Experience and education*. Kappa Delta Pi.
- Díaz, D. A., Louise, R., Shelton, D., & Barta, W. D. (2016). Psychometric validation of satisfaction with simulated clinical learning experience evaluation – corrections (SSCLEE-C). *International Journal of Nursing Sciences*, Vol 3, No.1, pp 58–62.
- Ferguson, C., DiGiacomo, M., Gholizadeh, L., Ferguson, L. E., & Hickman, L. D. (2017). The integration and evaluation of a social-media facilitated journal club to enhance the student learning experience of evidence-based practice: A case study. *Nurse Education Today*, Vol 48, pp 123–128.
- Grota, P. G., & O’Neal, C. (2020). Using International Nursing Association for Clinical Simulation and Learning Standards to Evaluate the Rigor of High-Fidelity Simulation Learning Experiences. *Clinical Simulation in Nursing*, Vol 46, pp 50–56.
- Guasconi, M., Tansini, B., Granata, C., Beretta, M., Bertuol, M., Lucenti, E., Deiana, L., Artioli, G., & Sarli, L. (2021). First Italian validation of the “Satisfaction with simulation experience” scale (SSE) for the evaluation of the learning experience through simulation. *Acta Bio-Medica: Atenei Parmensis*, Vol 92, No. S2.
- Hendal, B., & Alkhezzi, F. (2022). Kuwait University Students Evaluation of the E-Learning Experience During the Coronavirus Pandemic. *Journal of the Gulf & Arabian Peninsula Studies*. Vol 48, pp 19–42.
- Hofer, B. K., & Pintrich, P. R. (1997). The Development of Epistemological Theories: Beliefs about Knowledge and Knowing and Their Relation to Learning. *Review of Educational Research*, Vol 67, No. 1, pp 88–140.
- Kang, J., & Suh, E. E. (2018). Development and Evaluation of “Chronic Illness Care Smartphone Apps” on Nursing Students’ Knowledge, Self-efficacy, and Learning Experience. *Computers, Informatics, Nursing: CIN*, Vol 36, No. 11, pp 550–559.
- Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*. Prentice-Hall.
- Lakeman, R., Coutts, R., Hutchinson, M., Massey, D., Nasrawi, D., Fielden, J., & Lee, M. (2022). Playing the SET game: How teachers view the impact of student evaluation on the experience of teaching and learning. *Assessment & Evaluation in Higher Education*, pp 1–11. <https://doi.org/10.1080/02602938.2022.2126430>
- Lamprecht, R., Guse, J., Schimmel, M., Müller, F., Heydecke, G., & Reissmann, D. R. (2020). Benefits of combined quantitative and qualitative evaluation of learning experience in a gerodontology course for dental students. *BMC Medical Education*, Vol 20, No. 1, pp 281.
- Lee, J. J., & Wong, K. W. (2020). Gamification in education: A systematic review. *Educational Technology & Society*, Vol 23, No. 2, pp 1-22.
- Leitão, R., Maguire, M., Turner, S., Arenas, F., & Guimarães, L. (2022). Ocean literacy gamified: A systematic evaluation of the effect of game elements on students’ learning experience. *Environmental Education Research*, Vol 28, No. 2, pp 276–294.
- Liu, Y.-D. (2022). Une analyse de la revue de littérature scientifique sur l’expérience d’apprentissage. Dans *actes des neuvièmes rencontres jeunes chercheur-e-s en Environnements Informatiques pour l’Apprentissage Humain*. Lille, France.
- Li, Z. et Liu, Y. (2023). Theorising language learning experience in LOTE motivation with PERMA: A positive psychology perspective. *System*, Vol 112, pp 1-13.
- Merrill, M. D. (2002). First principles of instruction. *Educational Technology Research and Development*, Vol 50, No. 3, pp 43-59.
- Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & PRISMA Group. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *PLoS Medicine*, Vol 6, No. 7.

- Mor, S. M., Norris, J. M., Bosward, K. L., Toribio, J.-A. L. M. L., Ward, M. P., Gongora, J., Vost, M., Higgins, P. C., McGreevy, P. D., White, P. J., & Zaki, S. (2018). One health in our backyard: Design and evaluation of an experiential learning experience for veterinary medical students. *One Health (Amsterdam, Netherlands)*, Vol 5, pp 57–64. <https://doi.org/10.1016/j.onehlt.2018.05.001>
- Ning, H. K., & Downing, K. (2011). The interrelationship between student learning experience and study behaviour. *Higher Education Research & Development*, Vol 30, No. 6, pp 765–778.
- Ögeyik, M. (2022). Using Bloom’s Digital Taxonomy as a framework to evaluate webcast learning experience in the context of Covid-19 pandemic. *Education and Information Technologies*, Vol 27, No. 8, 11219–11235. Page M J, McKenzie J E, Bossuyt P M, Boutron I, Hoffmann T C, Mulrow C D et al. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*, Vol 372, No. 71. doi:10.1136/bmj.n71
- Paliadelis, P. S., Stupans, L., Parker, V., Piper, D., Gillan, P., Lea, J., Jarrott, H. M., Wilson, R., Hudson, J. N., & Fagan, A. (2015). The development and evaluation of online stories to enhance clinical learning experiences across health professions in rural Australia. *Collegian (Royal College of Nursing, Australia)*, Vol 22, No. 4, pp 397–403. <https://doi.org/10.1016/j.colegn.2014.08.003>
- Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D. et al. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*. Vol 372, No. 71.
- Prosen, M., Karnjuš, I., & Ličen, S. (2022). Evaluation of E-Learning Experience among Health and Allied Health Professions Students during the COVID-19 Pandemic in Slovenia: An Instrument Development and Validation Study. *International Journal of Environmental Research and Public Health*, Vol 19, No. 8.
- Reed, S. (2012). Debriefing Experience Scale: Development of a Tool to Evaluate the Student Learning Experience in Debriefing. *Clinical Simulation in Nursing*, Vol 8, pp211–217.
- Riley, E., McCance, C., Ward, N., & deGravelles, P. (2022). Evaluation of a simulation-based learning experience using a prenatal telehealth scenario with prelicensure nursing students. *Teaching and Learning in Nursing*, Vol 17, No. 2, pp 220–224. <https://doi.org/10.1016/j.teln.2022.01.006>
- Santoso, H. B., Schrepp, M., Isal, R. Y. K., Utomo, A. Y., & Priyogi, B. (2016). Measuring user experience of the student-centered E-learning environment. *Journal of Educators Online*, Vol 13, No. 1, pp 1-79.
- Sitzmann, T., & Ely, K. (2011). A meta-analysis of self-regulated learning in work-related training and educational attainment: What we know and where we need to go. *Psychological Bulletin*, Vol 137, No. 3, pp 421-442.
- Smith, K. V., Klaassen, J., Zimmerman, C., & Cheng, A.-L. (2013). The evolution of a high-fidelity patient simulation learning experience to teach legal and ethical issues. *Journal of Professional Nursing: Official Journal of the American Association of Colleges of Nursing*, Vol 29, No. 3, pp 168–173.
- Warren, V., & Bartholomew, A. (2016). *Students Enhancing Their Learning Experience: From Evaluation to Action*.

Online Modules Discussion Forums: A Pedagogical Platform Facilitating Learning in DE Environments

Dumisani Godfrey Mabasa

University of South Africa, Tshwane, South Africa

mabasdg@unisa.ac.za

Abstract: Student support in an open distance e-learning (ODEL) institution takes different forms and shapes. These forms and shapes are used in defining the nature of ODEL institutions. Bridging the distance gap between students in ODEL institutions, different platforms to facilitate interaction among students, students and their instructors are developed and made available. These interactions assist students by reducing the feeling of loneliness in the learning process. Loneliness is one of the experiences associated with dropout rates that negatively impact students' success rate. The question is, are students making use of these platforms as they were designed for, which is to facilitate the process of learning by interacting with other stakeholders such as with fellow students, students and instructors, students and content? The other question, given that students are from diverse backgrounds, is whether the platform is equally usable and accessible to all students. Are the other social challenges, such as poverty, low technological skills, inequality, network coverage, and loadshedding among factors, considered when introducing and rolling out these platforms to students? Leading the pack in these platforms is the online discussion forum, which is embedded in learning management systems (LMS), available on each online or blended or hybrid module registered for. For example, if a student has registered for two modules, each module has its own discussion forum. There is a concern whether participation in online discussion forums is related to students' success. The study determines whether participation in online discussion forums is related to a student's success in the module. Two modules were conveniently selected and used for meeting the purpose of study. The modules were offered using the blended or online pedagogy. The students' posting on the discussion forum was extracted and statistically analysed to determine whether it relates to success or performance in the modules. The study reported mixed results, where either participation or non-participation is related to student success. Student success comprises a variety of activities, for which participation by posting in online discussion forums forms part, however, it is not the only solution.

Keywords: Distance education, online discussion forum, pedagogical tools, student support, student success

1. Introduction and Background

Distance education (DE) is increasing exponentially, and it is common in many universities worldwide. There are generally two main types of education offering, namely the presence, also known as the conventional call, and DE (de Oliveira, Penedo & Pereira, 2018). DE's increased acceptance is established using technologies that allow interaction among students, students and instructors, students and content, being in different physical environments on virtual platforms and timelines (de Oliveira et al, 2018; Parker, 2020). Historically, in 1879, DE was delivered through the postal services, in the 1960s, radio and television were used, moving away from the postal services to electronic media as the purveyors of instruction. Various online learning platforms are identified, namely synchronous, asynchronous, blended or hybrid, massive online open courses (MOOCs), and open schedule online modules (Bergdahl & Nouri, 2021; Bozkurt, 2019; Dostál et al, 2018; Fidalgo et al, 2020; Hebebcı, Bertiz & Alan, 2020; Kara et al, 2019; Shearer et al, 2020; Williamson, Eynon & Potter, 2020; Xu & Xu, 2019). DE has several implications for stakeholders, such as administrators, instructors, instructional designers, and policy makers, requiring a huge investment (Kara et al, 2019). Important issues such as academic structures; curriculum and learning materials; delivery; assessment; staff roles, reward and structure; intellectual property rights; student roles; infrastructure; budget/resources reallocation; and administration, among other things, must be considered for DE (Xiao, 2018). Some studies report that DE is characterised by high rates of attrition or dropout from online modules compared to similar face-to-face modules due to factors such as student unpreparedness, where those who remain, stand to benefit more than those who opt to take face-to-face modules (Xu & Xu, 2019). The first question to ask, is whether these stakeholders realise a return on investment from DE through students' performance. The study focused on interactions by posting in online discussion forums by students among each other, students and instructors, students and content, if such was related to performance in a module. There is a geographical digital and resources divide between individuals living in developed and developing countries, urban and rural areas, that is critical for possessing and effective use of information communication technologies (ICTs) (Lembani et al, 2019). There is evidence in literature that some students benefit from institutional resources and services tailored for online learning. However, the provision of additional learning facilities alone cannot improve module performance if students do not make use of such facilities. It is recommended that institutions should provide services that are clear, easy to use and accessible

to all students for their most effective use (Xu & Xu, 2019). The modules' discussion forums were accessible and easy to use by all registered students.

2. Background of the Study

Various online learning platforms are identified, namely synchronous, asynchronous, blended, massive online open courses (MOOCs), and open schedule online courses in DE (Bergdahl & Nouri, 2021; Bozkurt, 2019; Dostál et al, 2018; Fidalgo et al, 2020; Hebebe et al, 2020; Kara et al, 2019; Shearer et al, 2020; Williamson et al, 2020; Xu & Xu, 2019). The study focused on the asynchronous platform, determining whether participation by posting on the modules' online discussion forums relates to students' performance.

2.1 Synchronous and asynchronous distance education

DE institutions consider technology for their educational purposes, analysing the strength and limitations of each. It is imperative to determine the capability of interactive exchange, deciding whether asynchronous or synchronous media best fits the needs of the DE students (Parker, 2020). In terms of higher-quality computer-based technology, synchronous and asynchronous instructions have grown to be as efficient as face-to-face instructions (Bozkurt, 2019). In both synchronous and asynchronous communication in the DE environment, there are possibilities of face-to-face meetings for tutorials, student-student interactions, library study, laboratory or practice sessions, and use of industrialised processes where labour is divided, and tasks are assigned to various staff who work together in module development teams (Bozkurt, 2019). In synchronous environments, the instruction is delivered through two-way video conferences or internet chats (Xu & Xu, 2019). The instructors and students meet online for the session at a predetermined platform and time (Fidalgo et al, 2020). In synchronous DE, live and simultaneous interactions amongst students and instructors are allowed, where video or web conferencing, online or virtual lectures are conducted (He et al, 2021). However, in the asynchronous instruction environment, the instructors and students do not have synchronous sessions and students have access to module content through the internet at any time they want or need (Fidalgo et al, 2020). The recorded learning videos comprise the most common formats of the electronic instruments, with teaching being provided through recorded educational tools for students without live interactions and communication among students and teachers (He et al, 2021). The University of South Africa, where this study was conducted, progressed through the path of technological development through blended learning using asynchronous learning on learning management system (LMS) of the time.

Both synchronous and asynchronous pedagogies in DE environments have some advantages and disadvantages. In synchronous DE, students interact with fellow students, instructor or content, and students are present at an agreed platform. In asynchronous education, students do not have the opportunity to interact with anyone and can access the learning material at any time and place convenient to them. Students take ownership of the learning process in the asynchronous DE environment, where personal and family commitments are somehow accommodated. Students do not have to travel to the learning centre to access learning materials and may access such online. The study focused on the online discussion forum, an asynchronous platform for two blended online modules in an open distance e-learning (ODEL). The modules were offered through myUnisa, the university LMS portal, with the discussion forum being an asynchronous platform where students could interact with fellow students, tutors, and with module content by posting back or initiating an online conversation (Aloni & Harrington, 2018). The learning activities in asynchronous learning are not instant, but spread over time, allowing students sufficient time to achieve module tasks, and discuss complex topics or subjects (Göksu et al, 2021).

2.2 Online discussion forum

For years, asynchronous DE has been provided mostly on the LMS, which allows for the sharing of the module content, giving assignments and quizzes, and serves as open discussion forums (Göksu et al, 2021), producing high levels of interaction between teaching and learning processes (Tirado, Hernando & Aguaded, 2015). Asynchronous computer-mediated communication (CMC) technologies have advanced, sparking and facilitating a proliferation of online modules and qualification programmes within institutions of higher learning, with the use of the online discussion forum pedagogies leading the way (Lewinson, 2005; Tirado et al, 2015). On the discussion forums, students ask questions and get or provide answers, discuss the module materials, learn from one another, or construct new knowledge. It acts as the virtual classroom for online modules. Students are able to respond to or ask questions, at their own pace, time and place, outside the constraints of time and place

(Aloni & Harrington, 2018; Jelodar et al, 2020). Students and instructors may express either positive or negative comments, or share questions, frustrations, problems, and good experiences (Jelodar et al, 2020). During times of pandemic crisis, reports showed that an increased use of networks produced connection failures in several modules in other countries, due to system overload (Ferri, Grifoni & Guzzo, 2020). The more participation on the online discussion forum is an indication of students' motivation and engagement in the learning process. However, such enthusiasm is welcome, the higher participation creates challenges for instructors in providing timely, individualised, and high-quality feedback (Aloni & Harrington, 2018; Goel & Polepeddi, 2018), which could be difficult to execute. Constructive and timely feedback encourages students' participation on the discussion forum (Chiu & Hew, 2018).

In contrast, poor student participation on the forum shows less motivation or engagement with learning, resulting in teaching staff having fewer challenges. Students unlikely participate on the discussion forum when there is less involvement from instructors (Chiu & Hew, 2018). Available evidence shows that asynchronous discussion forums were conducted in close environments, with few studies on the impact of the activities on the forum in open environments. Few studies have examined how forum activities with different cognitive processing, particularly commenting, impact on student performance and participation in open learning environments. The investigation of asynchronous discussion activities in online modules can facilitate understanding of whether student participation relates to module performance (Chiu & Hew, 2018). Students may substantially benefit from a well-managed online module with a high level of peer and instructor interaction. Maintaining high-level interaction requires instructors to devote a substantial amount of time throughout the module. In such instances, instructors post messages on a regular basis, reminding students about requirements and deadlines, responding to questions in a timely manner, providing multiple ways for students to communicate with one another and instructors, offering personal feedback on assignments, responding to each student postings, asking for student feedback and being responsive to the input on the highly interactive module (Xu & Xu, 2019).

Some studies on whether active users of online modules' discussion forums contribute either positively or negatively, only concluded that active users make positive contributions (Wong et al, 2015). An online discussion forum is the most effective way of engaging with students in a multi-user virtual classroom environment (Balaji & Chakrabarti, 2010; Wong et al, 2015). The three main components of an effective learning environment are interaction modalities among students, between students and instructors, and their module content (Balaji & Chakrabarti, 2010; Shearer et al, 2020). Interactions are essential for knowledge construction, student motivation, and establishment of a social relationship amongst stakeholders (Aloni & Harrington, 2018; Goel & Polepeddi, 2018; Paechter et al, 2010). The study analysed whether posting on the discussion forum relates to students' performance. Participation takes various forms, such as reading textual materials, listening to audio materials, or viewing visuals or video materials (Anderson, 2008; Chiu & Hew, 2018). It is coupled with the assumption that communication efficiency is improved by matching media to the students' task information needs, making a positive learning contribution by providing immediate feedback, message personalisation, available language variety, and communication and social cues (Balaji & Chakrabarti, 2010). The online learning interaction theory is shaped around the most elementary constructs of the field, namely, the structure of instructional programmes; interaction between students and instructor; and the nature and degree of self-directedness of students (Moore, 2013). The online discussion forum is aimed at ensuring that student support is provided in a DE environment. The interaction happening in the online discussion forum mitigates the most common challenges associated with distance learning, such as a feeling of loneliness, resulting in a high rate of attrition, dropout, or high failure rate. The discussion forum was introduced to bridge the distance and social divides among students, students and instructors, and students and content. The purpose of the study was to investigate whether participation by posting messages on the online discussion forum relates to student performance.

2.3 Problem Statement

The introduction of online modules or MOOCs has a huge investment implication. Online instructors must be employed, and other resources deployed to facilitate learning and realise the online leaning objectives. Leading the way in the communication process is the discussion forum embedded on the modules. Given the high level of inequality and geographical social divides in distribution of resources in South Africa, many people in rural areas have less or poor access to facilities compared to those in urban areas (Lembani et al, 2019). South Africa is characterised by high inequality regarding the provision of education, showing large inequalities in educational inputs and outcomes (Spaull, 2015). For example, it is reported that there are large racial inequalities in matric

(Grade 12) attainment, with only 44 percent of black and coloured youth aged between 23 and 24 having attained matric compared to 83 percent of Indian youth and 88 percent of white youth. Despite some improvements, these inequalities in educational outcomes between students from wealthy and poor backgrounds are large and firmly entrenched (Spaull, 2015). There was only 40 per cent of the South African population with access to internet as reported in 2016, which improved to 63 per cent in 2020, with a lack of connectivity in many places being reported (StatsSA, 2022; UNDP/South Africa, 2020). The geographical divides on connectivity depend on the network service provider and other factors such as loadshedding in different areas. However, the system is within reach of every registered student, where those who could not access it due to connectivity in their areas, could go to the nearest centre where such services are provided at no added cost. The university where this study is conducted, applies a one-size-fits-all approach to education and does not treat students according to their demographic profiles, such as from poor or rich, rural, or urban background. Few studies examined how participation on online discussion forum, particularly commenting, impacts on student performance in online modules, which if investigated, could assist in understanding how participation relates to performance (Chiu & Hew, 2018). There are mixed feelings towards the offering of online education, with some supporting the initiative, while others do not, indicating that it is a waste of resources since there is no evidence supporting that student participation in the online discussion forums leads to better academic performance. For any investment made in education, a good return is expected, including on resources invested in online pedagogies (Xiao, 2018). It was in the interest of the study to determine whether student participation in online discussion forums by posting relates to their performance.

2.4 Hypotheses

The hypotheses of the study were formulated as follows:

H_1 = Participation frequencies by posting on the discussion forums are related to students' final mark performance

H_0 = Participation frequencies by posting on the discussion forums are not related to students' final mark performance

3. Research Design

The two online modules were conveniently selected for the study. The posting data frequencies were extracted from the online discussion forums of the two modules on myUnisa, the university LMS portal. Their final mark data for two semesters was extracted and analysed through Social Package for the Social Sciences (SPSS).

3.1 Descriptive Data Analysis

There were 2 789 records of students registered for the two semesters for the two modules. The students enrolled for different qualifications, namely Diploma in Tourism Management (15), National Diploma in Commercial Practice (50), National Diploma in Policing (57), National Diploma in Management Services (70), Diploma in Accounting Sciences (86), National Diploma in Logistics (119), Diploma in Administration Management (220), Diploma in Office Management and Technology (289), National Diploma in Administration Management (427), and National Diploma in Human Resources Management (1 455). All registered students were provided with access to the online discussion forums in their respective registered modules. Some students could repeat the modules either once or twice in the two semesters under study due to failure or dropout.

3.2 Gender Distribution

The gender distribution of the participants is presented in table 1 below.

Table 1: Gender profile of registered students

Modules	Male	%	Female	%	Total number of students	Total percentages
Module 1	298	24	949	76	1247	100
Module 2	337	22	1205	78	1542	100
	635		2154		2789	

Table 1 above shows the two modules that were registered for the two semesters under study, namely semester 1 (starting in January to June) and semester 2 (starting in July to December). There were 2 789 registered students for the modules. More students were registered for module 2 than module 1.

3.3 Descriptive Analysis (Participants in all Modules in all Semesters)

The mean and median values were the same, namely 51, the median being the value that cuts the distribution of scores in half, or fifty percent above or below as shown on Table 2 and Figure 1 below.

Table 2: distribution of scores

	FINAL_MARK	Frequencies
Mean	51.108	2.188
N	223	223
Std. Deviation	11.5932	2.6492
Median	51.000	1.000
Kurtosis	-.381	30.108
Skewness	-.111	4.601
Minimum	23.0	1.0
Maximum	81.0	25.0

The final mark has negative skewness and kurtosis, suggesting that more students obtained marks above 51, as indicated by the median on Table 2 and Figure 1.

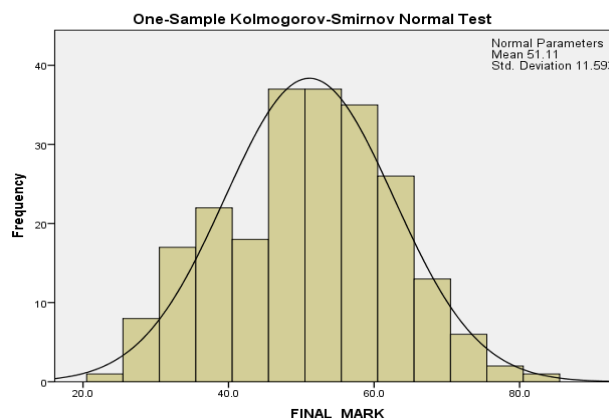


Figure 1: distribution of scores

The participation frequencies have positive skewness, suggesting lower participation.

3.4 Hypotheses Testing

In Table 3, the results of the Kolmogorov-Smirnov statistic were presented. A non-significant result (Sig. value of more than .05) indicates normality. In this case, the Sig. value is .000, suggesting violation of the assumption of normality.

Table 3: Hypothesis Test Summary

	Null hypothesis	Test	Sig.	Decision
1	The distribution of final mark is normal, with mean 51.1 and standard deviation 11.5932.	One-sample Kolmogorov-Smirnov Test	.000 ^a	Reject the null hypothesis.
2	The distribution of frequencies is normal, with mean 2.2 and standard deviation 2.6492.	One-sample Kolmogorov-Smirnov Test	.000 ^a	Reject the null hypothesis
<i>The significance level is .050.</i>				

The results show that the final mark and frequencies scores are not normally distributed, implying a need for non-parametric tests as presented below.

3.5 Non-Parametric Test (Kruskal-Wallis Test)

The Kruskal-Wallis test was used to test whether the distribution of scores for semesters and study units differs. Given that the significance level is more than 0.05 (e.g., .04, .01, .001), the study can conclude that there is no statistically significant difference in the continuous variable across the three groups as shown in table 4.

Table 4: Hypothesis test summary

	Null hypothesis	Test	Sig.	Decision
1	The distribution of final mark is the same across categories of semester.	Independent-Samples Mann-Whitney U Test	.296	Retain the null hypothesis.
2	The distribution of frequencies is the same across categories of semester.	Independent-Samples Mann-Whitney U Test	.239	Retain the null hypothesis.
<i>The significance level is .050</i>				

The distribution of the final mark and frequencies is not the same across categories of the semesters. These null hypotheses are retained.

3.6 Correlations Analysis

In table 5, the overall correlations between participation frequencies and final mark are presented. The results show that there are general correlations between participation frequencies and final mark.

Table 5: The overall correlations

			Final mark	Frequencies
Spearman's rho	Final mark	Correlation coefficient	1.000	.189
		Sig. (2-tailed)	.	.005
		N	223	223
	Frequencies	Correlation coefficient	.189**	1.000
		Sig. (2-tailed)	.005	.
		N	223	223
**. Correlation is significant at the 0.01 level (2-tailed).				

The Sig value of .005 was supported by the data and the correlation is significant at the 0.01 level (2-tailed) as shown in table 5.

Table 6: Correlations per semester

Semester				Final mark	Frequencies
Spearman's rho	1.0	Final mark	Correlation coefficient	1.000	.173
			Sig. (2-tailed)	.	.069
			N	111	111
		Frequencies	Correlation coefficient	.173	1.000
			Sig. (2-tailed)	.069	.
			N	111	111
	2.0	Final mark	Correlation coefficient	1.000	.218*
			Sig. (2-tailed)	.	.021
			N	112	112
		Frequencies	Correlation coefficient	.218*	1.000

	Semester		Final mark	Frequencies
			Sig. (2-tailed)	.021
			N	112
*. Correlation is significant at the 0.05 level (2-tailed).				

Regarding the results of the modules per semester, data did not support any positive contribution on final marks, as shown in table 6.

Mixed results were reported when looking at different modules per different semesters, as shown in table 7 below.

Table 7: The correlations per module across the semesters

	1			Final mark	Frequencies
Spearman's rho	1	Final mark	Correlation coefficient	1.000	.153
			Sig. (2-tailed)		.108
			N	112	112
		Frequencies	Correlation coefficient	.153	1.000
			Sig. (2-tailed)	.108	
			N	112	112
	2	Final mark	Correlation coefficient	1.000	.268*
			Sig. (2-tailed)		.004
			N	111	111
		Frequencies	Correlation coefficient	.268**	1.000
			Sig. (2-tailed)	.004	
			N	111	111
**. Correlation is significant at the 0.01 level (2-tailed).					

In one semester, the same module achieved some correlations between participation frequencies and final marks, which was not the case in the other semester.

Table 8: Correlation across the semesters

MODULE	Semester				Final mark	Frequencies
1	1.0	Spearman's rho	Final mark	Correlation coefficient	1.000	.224
				Sig. (2-tailed)		.077
				N	63	63
			Frequencies	Correlation coefficient	.224	1.000
				Sig. (2-tailed)	.077	
				N	63	63
	2.0	Spearman's rho	Final mark	Correlation coefficient	1.000	.117
				Sig. (2-tailed)		.423
				N	49	49
			Frequencies	Correlation coefficient	.117	1.000
				Sig. (2-tailed)	.423	
				N	49	49

MODULE	Semester				Final mark	Frequencies
2	1.0	Spearman's rho	Final mark	Correlation coefficient	1.000	.186
				Sig. (2-tailed)		.206
				N	48	48
			Frequencies	Correlation coefficient	.186	1.000
				Sig. (2-tailed)	.206	
				N	48	48
	2.0	Spearman's rho	Final mark	Correlation coefficient	1.000	.344*
				Sig. (2-tailed)		.006
				N	63	63
			Frequencies	Correlation coefficient	.344**	1.000
				Sig. (2-tailed)	.006	
				N	63	63

** . Correlation is significant at the 0.01 level (2-tailed).

When looking at all the modules per semesters, mixed results were reported, with one module not achieving any acceptable correlations in both semesters, whereas the other module achieved one acceptable correlation in one semester and none in the other semester, as shown in table 8.

4. Discussion of Findings (Results)

More participation on online discussion forum was an indication of students' motivation and engagement in the learning process. The higher participation is welcome, however can create challenges for instructors in providing timely, individualised, and high-quality feedback (Aloni & Harrington, 2018; Goel & Polepeddi, 2018). In contrast, poor participation on the forum shows less motivation or engagement with learning, resulting in teaching staff having fewer challenges. Students are unlikely to participate on the discussion forum when there is poor sense less involvement from instructors (Chiu & Hew, 2018). There were mixed results on whether participation in online discussion forum contributes towards student performance or not. The results of the current study were in line with evidence available in literature, stating that introducing online discussion forums does not make any difference if students do not use it.

5. Conclusion and Recommendations

The study concludes that, unless students use facilities such as online discussion forums, no positive contribution is made. Ways must be found to encouraged students to participate or use the pedagogical facilities made available to them. Despite a positive contribution from participation in online discussion forums, posting was a concern. There are mixed results supported by data, where some students who participated could not achieve a promotion marks, with some who did not post anything, achieving promotion marks. A comprehensive study is recommended, which study can look at all forms of participation in online discussion forum pedagogies, such as viewing, reading, or downloading, if such are related to performance. Online students support offers various advantages, however, must be used as part of the other learning support activities and not used in isolation.

Acknowledgements:

Dr NR Tjano and Prof MZ Ramorola for helping in the early stages of the paper.

References:

Aloni, M., & Harrington, C. (2018). Research based practices for improving the effectiveness of asynchronous online discussion boards. *Scholarship of Teaching and Learning in Psychology*, 4(4), 271–289.
<https://doi.org/10.1037/stl0000121>

- Anderson, T. (2008). Toward a Theory of Online Learning. In *The theory and practice of online learning* (pp. 33–60). Athabasca University Press.
- Balaji, M., & Chakrabarti, D. (2010). Student interactions in online discussion forum: Empirical research from 'media richness theory' perspective. *Journal of Interactive Online Learning*, 9(1), 1–22.
- Bergdahl, N., & Nouri, J. (2021). Covid-19 and Crisis-Prompted Distance Education in Sweden. *Technology, Knowledge and Learning*, 26(3), 443–459. <https://doi.org/10.1007/S10758-020-09470-6>
- Bozkurt, A. (2019). From distance education to open and distance learning: A holistic evaluation of history, definitions, and theories. In *A holistic evaluation of history, definitions, and theories. In Handbook of Research on Learning in the Age of Transhumanism* (p. (pp 252-273)). IGI Global. <https://doi.org/10.4018/978-1-5225-8431-5.ch016>
- Chiu, T., & Hew, T. (2018). Factors influencing peer learning and performance in MOOC asynchronous online discussion forum. *Australasian Journal of Educational Technology*, 34(4), 16–28.
- de Oliveira, M., Penedo, A., & Pereira, V. (2018). Distance education: advantages and disadvantages of the point of view of education and society. *Dialogia*, 29(1), 139–152. <https://doi.org/10.5585/Dialogia.n29.7661>
- Dostál, J., Drozdová, M., Kapounová, J., Kommers, P., Kotyrba, M., Leat, D., Lucká, M., Morze, N., Mozelius, P., Milková, E., Poullová, P., Sikorová, Z., Syslo, M., Šarmanová, J., Šimonová, I., & Turčáni, M. (2018). Problems of distance education. *International Journal of Information and Communication Technologies in Education*, 7(1), 1–39.
- Ferri, F., Grifoni, P., & Guzzo, T. (2020). Online learning and emergency remote teaching: Opportunities and challenges in emergency situations. *Societies*, 10(86), 1–18. <https://doi.org/10.3390/soc10040086>
- Fidalgo, P., Thormann, J., Kulyk, O., & Lencastre, J. (2020). Students' perceptions on distance education: A multinational study. *International Journal of Educational Technology in Higher Education*, 17(1), 1–18. <https://doi.org/10.1186/S41239-020-00194-2>
- Goel, A., & Polepeddi, L. (2018). Jill Watson: A virtual teaching assistant for online education. In *In Learning engineering for online education* (pp. 120–143).
- Göksu, İ., Ergün, N., Özkan, Z., & Sakız, H. (2021). Distance education amid a pandemic: Which psycho-demographic variables affect students in higher education? *Journal of Computer Assisted Learning*, 37(6), 1539–1552. <https://doi.org/10.1111/JCAL.12544>
- He, L., Yang, N., Xu, L., Ping, F., Li, W., Sun, Q., Li, Y., Zhu, H., & Zhang, H. (2021). Synchronous distance education vs traditional education for health science students: A systematic review and meta-analysis. *Medical Education*, 55(3), 293–308. <https://doi.org/10.1111/medu.14364>
- Hebebcı, M., Bertiz, Y., & Alan, S. (2020). Investigation of views of students and teachers on distance education practices during the Coronavirus (COVID-19) Pandemic. *International Journal of Technology in Education and Science*, 4(4), 267–282.
- Jelodar, H., Wang, Y., Orji, R., & Huang, S. (2020). Deep sentiment classification and topic discovery on novel coronavirus or COVID-19 online discussions: NLP using LSTM recurrent neural network approach. *IEEE JOURNAL OF BIOMEDICAL AND HEALTH INFORMATICS*, 24(10), 1–20.
- Kara, M., Erdogdu, F., Kokoç, M., & Cagiltay, K. (2019a). Challenges faced by adult learners in online distance education: A literature review. *Search.Informit.Org*, 11(1), 5–22. <https://doi.org/10.5944/openpraxis.11.1.929>
- Kara, M., Erdogdu, F., Kokoç, M., & Cagiltay, K. (2019b). Challenges faced by adult learners in online distance education: A literature review. *Open Praxis*, 11(1), 5–22. <https://doi.org/10.5944/openpraxis.11.1.929>
- Lembani, R., Gunter, A., Breines, M., Tapiwa, M., & Dalu, B. (2019). The same course, different access: the digital divide between urban and rural distance education students in South Africa. *Journal of Geography in Higher Education*, 44(1), 70–84. <https://doi.org/10.1080/03098265.2019.1694876>
- Lewinson, J. (2005). Asynchronous discussion forums in the changing landscape of the online learning environment. *Campus-Wide Information Systems*, 22(3), 162–167.
- Moore, M. (2013). The theory of transactional distance. In *In Handbook of distance education* (pp. 84-103). . (pp. 84–103). Routledge.
- Paechter, M., Maier, B., & Macher, D. (2010). Students' expectations of, and experiences in e-learning: Their relation to learning achievements and course satisfaction. *Computers & Education*, 54(2010), 222–229.
- Parker, A. (2020). Interaction in distance education: The critical conversation. *Association for the Advancement of Computing in Education, Educational Technology Review Journal*, 13–17.
- Shearer, R., Aldemir, T., Hitchcock, J., Resig, J., Driver, J., & Kohler, M. (2020). What Students Want: A Vision of a Future Online Learning Experience Grounded in Distance Education Theory. *American Journal of Distance Education*, 34(1), 36–52. <https://doi.org/10.1080/08923647.2019.1706019>
- Spaull, N. (2015). *Schooling in South Africa: How low-quality education becomes a poverty trap*.
- StatsSA. (2022). *COVID-19 and barriers to participation in education in South Africa, 2020 Report no. 92-01-08*.
- Tirado, R., Hernando, Á., & Aguaded, J. (2015). The effect of centralization and cohesion on the social construction of knowledge in discussion forums. *Interactive Learning Environments*, 23(23), 293–316.
- UNDP/South Africa. (2020). *Impact of COVID-19 on Micro and Informal Businesses: South Africa 2021*.
- Williamson, B., Eynon, R., & Potter, J. (2020). Pandemic politics, pedagogies and practices: digital technologies and distance education during the coronavirus emergency. *Learning, Media and Technology*, 45(2), 107–114. <https://doi.org/10.1080/17439884.2020.1761641>

- Wong, J., Pursel, B., Divinsky, A., & Jansen, B. (2015). An analysis of MOOC discussion forum interactions from the most active users. Springer International Publishing. In *Social Computing, Behavioral-Cultural Modeling, and Prediction: 8th International Conference, SBP 2015, Washington, DC, USA, March 31-April 3, 2015. Proceedings 8*, 452–457.
- Xiao, J. (2018). On the margins or at the center? Distance education in higher education. *Distance Education*, 39(2), 259–274. <https://doi.org/10.1080/01587919.2018.1429213>
- Xu, D., & Xu, Y. (2019). The Promises and Limits of Online Higher Education: Understanding How Distance Education Affects Access, Cost, and Quality. In *ERIC*.

Implementation of a Multilingual Booklet to Accommodate First-Year Students with Academic Work

Vuyokazi Mntuyedwa¹, Moeketsi Letseka² and Johannes Cronje¹

¹CPUT, Cape Town, South, Africa

² UNISA, Pretoria, South Africa

¹Mntuyedwav@cput.ac.za

²letsem@unisa.ac.za

¹Cronjej@cput.ac.za

Abstract: Academic writing is a major challenge within Higher Education. Poor writing skills and low academic literacy increase the chances of dropout among students from disadvantaged backgrounds and communities. A multilingual booklet was developed as a tool for improvement among first-year students. The multilingual booklet aims to allow students to engage their study material in their mother tongue. As an academic literacy lecturer, the researcher will be sharing what has inspired her to suggest such a project. This paper follows an educational approach through personal reflections. Availing and promoting multilingual reading material to students may reduce failure rates. Students may be equipped to understand their academic work when it is presented in their home language. Another advantage of the translated open resource material is that multilingual education provides monolingual students with the opportunity to learn a second language and become bilingual. The booklet can be accessed by other institutions as they are loaded on the university website. The booklet aims to contribute towards the decolonization of tertiary curricula—a notion to which first-generation students have no reference. The booklet is in line with the vision of enabling a smart university, rooted in the spirit of Ubuntu. Recommendation: South African universities should adopt multilingual tools in their curricula to accommodate the students who are not English, or first language speakers to do better in their academic work.

Keywords: Booklet, First-Year, Language, Multilingualism, Translation, Students, University

1. Introduction and Background

This paper introduces a response to the high failure rate in higher education, through the development of a multi-lingual language guide. Cushner, McClelland and Safford (2009: p.22) describe multicultural education as “a process of educational reform that assures that learners from all groups (racial, ethnic, socioeconomic, ability, gender) experience educational equality, success, and social mobility”. This translation of open education resources reduces the dropout rate during first years because students will read them in their mother tongue without fearing the medium of instruction of the university which is usually English most of the time. Another advantage of the translated reading material is that multilingual education provides monolingual students with the opportunity to learn a second language and become bilingual. Kaschula & Maseko (2014) claim that universities should ensure that there are initiatives for the development and use of African languages. This perception is supported by Afolabi (2020, p.203) that “students comprehend better when they are taught through their mother tongue or indigenous language”

The issue of higher education failure rates is not new and it persists. For instance, as far back as the 1990s Nyamapfene and Letseka (1995:160) studied the failure rates and the University of Fort Hare where they categorized the problems into “failure to understand the objective and structure of university education, and failure to understand processes involved in university learning”. Drawing on the Human Science Research Council (HSRC)’s Ford Foundation-funded study on ‘Why University students drop out’, Letseka and Maile (2008:5) argued that “30% of South African university students dropped out in their first year of study. A further 20% dropped out during their second and third years. While only 22% graduated within the specified three years’ duration for a generic Bachelor’s degree”. To that end Cosser and Letseka (2010:3) concluded that “If student attrition is a worldwide phenomenon, the problem is acute in South Africa”. With reference to UNISA, Letseka and Pitsoe (2014) ‘shock dropout rates’. For instance, while the university student intake had grown in excess of 300 000, there was absence of a commensurate increase or improvement in the institution’s throughput. For instance, 59% of first-time undergraduates dropped out in 2004, while only 14% graduated while 27% did not complete.

1.1 Analysis

The Higher education statistics in South Africa indicate a 47 percent dropout rate, and only 23 percent of students earn a qualification (Council of Higher Education (CHE), 2015). Academic writing has been a problem in

higher education, and there is ample research on the subject (O'Toole and Archer 2010). Students are expected to be fluent in English as an international language (Hsu, 2014). Many lecturers assume that students have the necessary basic language skills and knowledge of academic writing. Many universities consider academic writing to be a high-stakes activity, as written work remains one of the main forms of assessment (Archer, 2008 p.248). Students from South Africa who are not English-speaking are required to know English to master educational concepts and engage meaningfully in the information age on a global stage Department of Education (2009, p. 41).

Only a third of students graduating from high school are prepared or ready for college-level coursework (Bettinger, Boatman, & Long, 2013). Besides, this lack of academic preparedness has resulted in the need for remedial or developmental education at the post-secondary level (Crisp & Delgado, 2014). Writing is the highest and most complex form of human communication and it is considered to be the most complex because it develops after, and as a result of one's ability to speak and read (O'Toole 2010). Numerous factors such as students' academic background and psychosocial factors in South Africa contribute to students' success (Dumont 2009). There are four facts that universities and writing centers in South Africa need to keep in mind when assessing how language and writing impact students: (1) most students need to write in English, a language other than their mother tongue; (2) students are academically under-prepared, particularly those from previously disadvantaged communities; (3) all students need to learn the academic discourses of different disciplines; and (4) students come to tertiary institutions with different literacies and cultural conventions (Archer 2010).

In the development of this booklet the ADDIE (Analysis, Design, Development, Implementation and Evaluation) will be followed. This paper describes the Analysis, Design and Development. Future work will include the implementation and summative evaluation.

1.2 Aims and objective of the study

The aim of the study is to develop a guide/resource for academic writing of first-year students.

1.3 Objectives

- To analyse the target population of the study as well as their learning need.
- To design and develop a tri-lingual booklet that may address that need
- To consider ways of implementing such a booklet.

The aim of the booklet is:

- To allow students to engage their study material in their mother tongue.
- To make first-year students to comprehend the booklet in different languages

1.4 Theoretical Underpinning

Teaching for second-language acquisition has always shown a pendulum effect between behaviourist direct instruction methods, such as grammar-translation, and generative communicative methods (Kilfoil & Van der Walt, 1997). There has been a call for a more unified theory of second language acquisition (Gervain & Mehler, 2010; Miller, Jungheim & Ptok, 2014). In this respect, an integrative model of blended learning based on learning theory may provide a point of departure. The pendulum effect resonates with the traditional division between behaviourists and constructivist teaching, which are generally seen as opposite ends of a continuum. There has been a call for the integration of behavioural and constructivist learning (Ertmer and Newby 2013; Rieber 1992; Shabo 1997; Trollip and Alessi 2001).

Bearing in mind that the two models, behaviourism and constructivism have different points of departure, one being a model of instruction and the other a model of language acquisition it could be argued that they should rather be plotted orthogonally than in a straight line (Cronjé 2006). The resultant model would have four quadrants, as is shown in Figure 1.1.

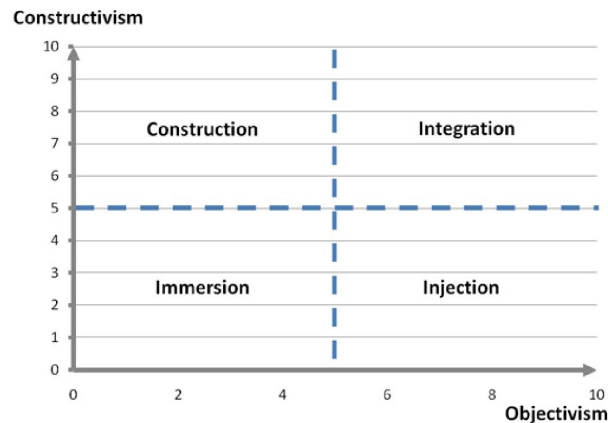


Figure 1.1: A model integrating Constructivism and Behaviourism/Objectivism (Cronjé, 2006)

The Injection quadrant in Figure 1.1 would consist of teaching and learning that is high in behaviourist characteristics, such as stimulus, response, and reinforcement. It would correspond largely with drill-and-practice models and the grammar-translation method and therefore fall in the behaviourist theory of language acquisition (Miller, 2014). Diagonally opposite, the Construction quadrant is high in constructivist (Miller, 2014) characteristics such as free exploration, communication, and scaffolding. The Immersion quadrant, being low in both direct instruction and scaffolded construction where the learner learns mainly through trial and error and Darwinian acceptance of what works and rejection of what doesn't corresponds with Millers (2014) nativist theories. The Integration quadrant corresponds with Interactionism (Miller, 2014) where the language learner interacts both with the language and with other speakers.

The aim of the open-source downloadable booklet that is described here, was to act as an electronic tool for language acquisition in either of the four quadrants described above. In subsequent work by Aylward and Cronjé (2022) it was shown that, depending on learner competency, students would work through the four quadrants working anti-clockwise from Injection through Immersion and Construction to Integration, as is shown in Figure 1.2.

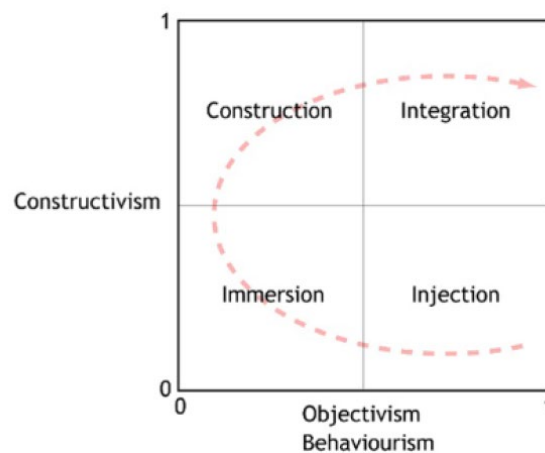


Figure 1.2: The path of learning from Injection to Integration (Aylward & Cronjé, 2022)

2. Design and Development

This section will clarify the design considerations for the study guide and describe how it was developed.

2.1 The Role of Academic Writing

This study describes the development of a multilingual guide to academic writing. The purpose of any academic writing is to inform, explain, compare, or persuade the readers. It is an essential skill for students and professionals of all disciplines (Gimenez, & Thondhlana, 2012). Academic writing usually requires students to look at somebody else's work or ideas and then form an informed opinion on it. This type of writing makes

students take in what they have read and decide how much importance it holds for their subject. When students learn about a complex subject at university, it can be difficult for them to explain what they have understood if they struggle with academic writing. Academic writing may be unnecessarily complicated, pompous, long-winded, technical, impersonal, autoreactive, humourless, elitist, and excludes outsiders (Hartly 2008). It necessitates providing and discussing information on a particular topic referencing literature to back up your writing, all the while trying to keep the reader's attention. It is an important practice for constructing knowledge and creating values and identity of a discipline. Research writing involves the "process of research, critical thinking, source evaluation, organization, and composition" (Rutten, 2011). According to students need to gain fluency in writing in English to develop their learning capacity (Hyland 2013).

2.2 Feedback

Feedback is an essential part of effective learning. It helps students understand the subject being studied and gives them clear guidance on how to improve their learning. Besides, Jessop, Hakim, and Gibbs (2014) argue that a feedback dialogue is seen as essential to student learning, enabling students to take control of their learning and improve their performance. However, Molloy, Borrel-Carrio, Epstein (2013) contend that feedback is a characteristically sensitive issue either verbal or written can have a long-lasting impact, beyond its intent and can affect students' performance. This assignment reports on the findings of a research study conducted at CPUT. The purpose of this activity is to critically examine to what extent feedback practices as part of the strategies used in the assessment of student work - are meaningful to the expected learning process. McBride (2012) claims that after all, university students are thought to write not because we expect them to become writers, but because writing is the evidence that they are mastering intellectual concepts.

2.3 Advantages of Feedback

Boud and Molloy (2013) and Carless (2015) argue that feedback can guide students on how to implement what is required from them as gives them a clue of the structure of academic writing. Kaufman and Schunn (2011) claim that stronger students must provide feedback to weaker students. Feedback is an essential part of effective learning. It helps students understand the subject being studied and gives them clear guidance on how to improve their learning. feedback to be sustainable, students in higher education cannot rely predominantly on the teacher to provide insights in that they need additional ways of developing their own capacity to make informed judgments (Carless, Salter, Yang, & Lam 2011). Besides, Jessop, Hakim, and Gibbs (2014) argues that a feedback dialogue is seen as essential to student learning, enabling students to take control of their learning and improve their performance. According to Hendry et al., (2011), feedback dialogue is learning to apply criteria; make judgments about samples and suggest how they can be improved. The feedback dialogue is good for their assignments and essays because it will guide them on what needs to be corrected and why. However, Molloy, Borrel-Carrio, Epstein (2013) contend that verbal or written feedback is a characteristically sensitive issue that can have a long-lasting impact, beyond its intent and can affect students' performance. McBride (2012) claims that after all, university students are thought to write not because we expect them to become writers, but because writing is the evidence that they are mastering intellectual concepts.

2.4 The Promotion of Multilingualism

The objective of creating multilingual and multimodal spaces of learning and teaching aligns with the goals of the Cape Peninsula University of Technology (CPUT)'s Vision 2030 and its priority to create a campus and university structure that embraces the Principles of 'Smartness' and 'Oneness'. Specifically, the inclusion of African languages through translanguaging and other multilingual practices speaks to the V2030 objectives to "build the capacity of students to engage in a CPUT student experience in ways that are both individually transformative and that build the social capital of CPUT and its broader community" and creating an "embed a suite of comprehensive and quality services for students that are integrated, responsive and focused on supporting students' holistic well-being and academic success and supported by smart technologies" (Cape Peninsula University of Technology 2021: p.23-24).

The first author began working with students writing at the Stellenbosch University African Language department, where she assisted students writing in isiXhosa, as a second language. Those first-year students, both international and domestic, struggled to compose sentences in response to the queries. Her responsibility as a part-time instructor at the time was to sit down with them and analyse the question, as well as aid them with sentence form and comprehension of what they wrote. The lecturers would provide her with feedback on

their students' writing and possibly send more students to assist. She understood the students' problem was the language they were exposed to because they were English second language speakers. She would like to assist them further. After Stellenbosch University, she worked at CPUT as a part-time lecturer teaching communication to first-year students. She also observed that students struggled to comprehend the question that was being asked for their essays and the linking words were not correctly used. What the department did was expose them to a program called 'Readers are Leaders,' in which students were aided in understanding questions and responding in accordance with what was expected of them without making any assumptions. She also noticed from students' writing that punctuation was not used correctly on their pieces of writing, which was easy to spot, especially if students failed to include a full stop at the conclusion of the phrase. The communication class helped first-year students a lot since she focused largely on their writing, which is academic literacy. Her assessment of their writing was crucial because there were first-year students who needed to improve in this area.

She is currently working at a writing centre, where she is responsible for reviewing students' assignments and providing extensive feedback on their pieces of writing. Students' writing is a challenge, as she noticed earlier at Stellenbosch University and the Education Faculty because they struggle to comprehend the assignment questions and how to write in a logical right manner, cohesive academic work. At the beginning of the year, she also realized some students find it difficult to structure proper sentences. These problems have been happening for a while as students were complaining about the medium of instruction, which is English. She has decided to take the initiative of developing a multilingual booklet with her colleagues from the language unit. As universities have implemented blended learning, it's easy for students to access information online.

Multilingualism, which is the focus of this article, is derived from two Latin words, namely "multi", which means many, and "lingua", which means language (Bussmann 1996). Thus multilingualism is referred to as the ability of a speaker to express themselves in several languages with equal and native-like proficiency. According to the language policy for higher education LPHE, (2002: p.15) "guides the promotion of multilingualism and development of African languages as academic languages and institutions of Higher Education were given the responsibility of developing their three-year strategic plans to implement multilingualism projects". This is supported by National Census (2011), that 75% of the South African population uses an African language as their first language. claim that universities should ensure that there are initiatives for the development and use of African languages (Kaschula and Maseko 2014). Moreover "students comprehend better when they are taught through their mother tongue or indigenous language" Afolabi (2020, p.203). Government and stakeholders in education pay more attention to the colonial language education system, and they use it as a medium of instruction than the indigenization languages, although the South African Constitution (1996) recognizes eleven official languages, namely: Afrikaans, English, isiNdebele, isiXhosa, isiZulu, Sesotho, Setswana, Sepedi, siSwati, Tshivenda, and Xitsonga. Section 29 (p.2) states that "Everyone has a right to receive education in the official language or languages of their choice in public educational institutions where that education is reasonably practicable". In addition, the National Policy on Education (2014) claims that the government will ensure the medium of instruction is principally the mother tongue or language of the immediate community to teach students from early childhood to the first three years in primary education.

2.5 Benefits of Multilingualism

Barasa, (2005, p. 300) claims that "it is estimated that over a billion people in the world speak more than one language fluently". Kolosova and Poplavskaya (2018) found that the most important global trend in twenty-first-century education is its integration and internationalization, creating the conditions for forming a single-world educational space. Multilingualism can refer to the multilingual language abilities of an individual or the state of having more than one language when referring to that society, more specifically, is concerning to this research, within a classroom (cf. Baker, 1996: p.4; Kemp, 2009:12; Van Huyssteen, 2002: p.69).

A few teachers used their mother tongue to interact with those students whose mother tongue is similar to their language when they teach. Prasad and Poudel (2010: p.127) claim that most teachers agreed that there should be multilingual teaching methods because only when the students get exposure to their language will they be able to grasp the real meaning of the concepts or information. R'boul (2021: p.7) stated that "Broadening the scope of intercultural communication research and allowing for epistemological transformation cannot be done without first unlearning White, Western, Northern centric discourses to consider other forms of conceptualizing intercultural communication".

In response to the need for multilingualism, a glossary was created to include the definitions of key terms in the three most common languages in the Western Cape province of South Africa – English, Afrikaans, and IsiXhosa (See Figure 1).

ENGLISH	AFRIKAANS	ISIXHOSA
CREATE design, formulate, build, invent, create, compose, generate, derive, modify, develop	SKEP genereer, beplan, produseer, skep, ontwerp, maak 'n hipotese, uitvinding, ontwikkel, kategoriseer, voeg saam, hersien, herskryf, som op	YENZA yila, qulunqa, -akha, qamba, yenza, qamba, velisa, fumana, guqula, phuhlisa
EVALUATE choose, support, relate, determine, defend, judge, grade, compare, contrast, argue, justify, support, convince, select, evaluate	EVALUEER kontroleer, kritiseer, beoordeel, stel voor, regverdig, maak 'n gevolgtrekking, verdedig, verduidelik, evalueer, assesseer, interpreteer, ondersteun, kontrasteer	VAVANYA khetha, xhasa, balisa, fumanisa/ gqiba, khusela, gweba, grade, thelekisa, qathanisa, xoxa, thethelela, xhasa, bonisa, khetha, vavanya

Figure 2.1 Multilingual translations

2.6 Punctuation

The section focuses on the various punctuation marks and their link to grammar. When punctuation is used poorly, it can obscure the meaning of the written text or create ambiguity. According to Mogahed (2012), the use of punctuation marks in academic writing has an effect on translation. Punctuation marks, according to Kirkman (2006), are necessary components of writing, one for grammatical aims and the other for rhetorical purposes. According to Field (2009), the comma should not be used in place of a full stop in English, and a sentence with two main clauses separated by a comma is improper; instead, use a full stop, a conjunction, or a semicolon to unite them. Furthermore, in grammatical words, adjective and adverb clauses and phrases might be necessary or non-essential (Woods, 2006). One of the reasons that punctuation in students' academic assignment writing must be exact is that misunderstandings might develop, uncertainty can ruin their work, arguments can become 'lost,' and marks can be removed for lack of clarity.

In response to students' poor understanding of punctuation, a section was included on its proper use, as is described in Figure 2.

3	COLON
A colon is used to introduce a list of items.	
✗	I have three majors, including: mathematics, computing and physics.
✓	I have three majors, including mathematics, computing and physics.
✓	I have three majors: mathematics, computing and physics.
✗	I study: mathematics, computing and physics.
✓	I study mathematics, computing and physics.
A colon is used to introduce a word, phrase or full sentence.	
✗	Every student knows to: study.
✓	Every student knows what to do: study.
✗	It's an absolute inspiration: Students who excel despite difficult circumstances.
✓	It's an absolute inspiration: students who excel despite difficult circumstances.
✗	The university bus was involved in an accident: two students were injured.
✓	The university bus was involved in an accident: Two students were injured.
Only capitalise the item following a colon if it is the start of a complete sentence.	
✗	She got what she worked for: The SRC position.
✓	She got what she worked for: the SRC position.
A colon is used before quoted text.	
✗	Karima said "I haven't studied for tomorrow's test."
✓	Karima said: "I haven't studied for tomorrow's test."

Figure 2.2: Punctuation

2.7 Bloom's Taxonomy

The introduction to Bloom's taxonomy for first-year students is critical for their academic work after they enrol at a higher education institution. Bloom (1913-1999) was an educational psychologist who was passionate about helping students learn better. Created in 1956, Bloom's Taxonomy provides a framework for developing strong learning objectives for children. It serves as a toolbox that teachers and students can use to classify and organise learning objectives (Akintolu, Dlamini and Letseka, 2022). In the late 1940s, Bloom and other educators worked on a framework to identify educational aims and objectives, which resulted in three learning categories: cognitive domain, affective domain, and psychomotor domain. Knowledge, comprehension, application, analysis, synthesis, and evaluation are among the categories. Later, the six key features were changed and classified as remembering, understanding, applying, analysing, evaluating, and lastly creating (Crowe, Dirks, & Wenderoth, 2008:369).



BLOOM'S TAXONOMY

Bloom's taxonomy is a classification system used to define and distinguish different levels of human cognition: **thinking, learning and understanding**

TAKSONOMIE VAN BLOOM

Bloom se taksonomie is 'n klassifikasiesistelsel wat gebruik word om verskillende vlakke van menslike kennis te definieer en te onderskei: **denke, leer en verstaan**

ITEKZONOMI KABLOOM

Itekzonomi kaBloom yinkqubo yokuhlela esetyenziselwa ukuchaza ngokunabileyo nokwahlula amanqanaba ahlukileyo okuqondisa kwabantu: **ukucinga, ukufunda nokuqonda**

	ENGLISH	AFRIKAANS	ISIXHOSA
	CREATE design, formulate, build, invent, create, compose, generate, derive, modify, develop	SKEP genereer, beplan, produseer, skep, ontwerp, maak 'n hipotese, uitvinding, ontwikkel, kategoriseer, voeg saam, hersien, herskryf, som op	YENZA yila, qulunga, -akha, qamba, yenza, qamba, velisa, fumana, guqula, phuhlisa
	EVALUATE choose, support, relate, determine, defend, judge, grade, compare, contrast, argue, justify, support, convince, select, evaluate	EVALUEER kontroleer, kritiseer, beoordeel, stel voor, regverdig, maak 'n gevolgtrekking, verdedig, verduidelik, evalueer, assesseer, interpreteer, ondersteun, kontrasteer	VAVANYA khetha, xhasa, balisa, fumanisa/gqiba, khusela, gweba, grade, thelekisa, qathanisa, xoxa, thethelela, xhasa, bonisa, khetha, vavanya

Figure 2.3 Blooms taxonomy translated verbs

3. Conclusions and Recommendations: Proposed Implementation and Evaluation

The booklet, which was produced as an open educational resource is available here: <http://https://mlg.cput.ac.za/resources/>

It is envisaged that it can be used in all four modes of learning described in Figure 2.3, depending on the level of Bloom's taxonomy at which the learning is pitched. At the level of knowledge, the booklet can be used as a resource for obtaining basic information, as well as drill and practice. Then, while the learners become accustomed to the work, they could be immersed in exercises where they begin to understand and apply the concepts. At the level of analysis and evaluation, they could work in the construction quadrant, and construct their own sentences and paragraphs. Finally, when they are proficient in the language, they could integrate all their skills to synthesize and create new works of their own, as is shown in Figure 3.1.

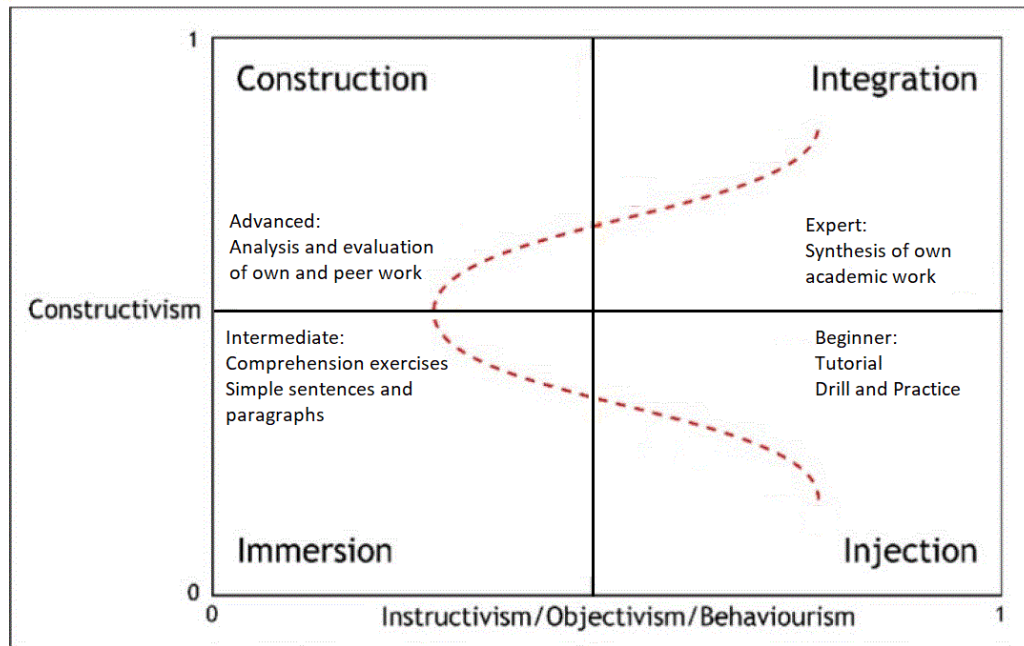


Figure 3.1 The proposed use of the booklet in all levels of blended learning

Limitations of this research are that the model has not yet been tested on a target population, and further research will be needed to develop exercises that accompany the booklet for each of the proposed quadrants of learning.

References

- Afolabi, O.O., 2020. Lost in Translation? Revisiting Language Decolonisation Project in Nigerian Education. *Developing Teaching and Learning in Africa: Decolonising Perspectives*, p.203.
- Anderson, L., 2002. Benjamin Samuel Bloom (1913-1999).
- Akintolu M, Dlamini N & Letseka, M. 2022. Bloom's taxonomy for the digital age student in a rural African context. *EUREKA: Social and Humanities*, 6:39-47.
- Archer, A.L. and Hughes, C.A., 2010. *Explicit instruction: Effective and efficient teaching*. Guilford Publications.
- Aylward, R.C. and Cronjé, J.C., 2022. Paradigms extended: how to integrate behaviorism, constructivism, knowledge domain, and learner mastery in instructional design. *Educational technology research and development*, 70(2), pp.503-529.
- Bußmann, H., 1996. *Lexikon der sprachwissenschaft*. Taylor & Francis.
- Cronjé, J., 2006. Paradigms regained: Toward integrating objectivism and constructivism in instructional design and the learning sciences. *Educational technology research and development*, 54, pp.387-416.
- Crowe, A., Dirks, C. and Wenderoth, M.P., 2008. Biology in bloom: implementing Bloom's taxonomy to enhance student learning in biology. *CBE—Life Sciences Education*, 7(4), pp.368-381.
- Cushner, K. and Mahon, J., 2009. Intercultural competence in teacher education. *The SAGE handbook of intercultural competence*, pp.304-320.
- Ertmer, P.A. and Newby, T.J., 1993. Behaviorism, cognitivism, constructivism: Comparing critical features from an instructional design perspective. *Performance improvement quarterly*, 6(4), pp.50-72.
- Field, M., 2009. *Improve your written English: Master the essentials of grammar, punctuation and spelling and write with greater confidence*. Hachette UK.
- Gervain, J. and Mehler, J., 2010. Speech perception and language acquisition in the first year of life. *Annual review of psychology*, 61, pp.191-218.
- Hofmann, S. G. (2011). *An introduction to modern CBT: Psychological solutions to mental health problems*. John Wiley & Sons.
- Ivanova, E., Kolosova, A. and Poplavskaya, N., 2018. METHODS OF LEARNING AND TEACHING INTERNATIONAL JOURNALISM. In *ICERI2018 Proceedings* (pp. 10461-10465). IATED.
- Kaschula, R. H., & Maseko, P. (2014). The intellectualisation of African languages, multilingualism and education: A research-based approach. *Alternation special edition*, 13(1), 8-35
- Kilfoil, W.R. and Van der Walt, C., 1997. *Learn 2 teach: English language teaching in a multilingual context*. Van Schaik Academic.

- Kirkman, B.L., Lowe, K.B. and Gibson, C.B., 2006. A quarter century of culture's consequences: A review of empirical research incorporating Hofstede's cultural values framework. *Journal of international business studies*, 37, pp.285-320.
- Kirkman, J., 2006. *Punctuation matters: Advice on punctuation for scientific and technical writing*. Routledge.
- Letseka, M., & Pitsoe, V. 2014. The challenges and prospects of access to higher education at UNISA. *Studies in Higher Education*, 39 (10), 1942-1954.
- Letseka, M., Cosser, M., Breier, B., & Visser, M. (eds). 2010. *Student Retention and Graduate Destinations: Higher Education and Labour Market Access and Success*, HSRC Press: Cape Town.
- Letseka, M and Maile, S. 2008. *High University Dropout Rates: A Threat to South Africa's Future*, HSRC Policy Brief, HSRC Press: Cape Town.
- Miller, S., Jungheim, M. and Ptok, M., 2014. First language acquisition research and theories of language acquisition. *HNO*, 62, pp.242-248.
- Mogahed, M.M., 2012. Punctuation Marks Make a Difference in Translation: Practical Examples. *Online Submission*.
- Nyamapfene, K., & Letseka, M. 1995. Problems of learning among first year students in South African universities. *South African Journal of Higher Education* 9 (1), 159-167.
- Poudel, A.P. and Dhankuta, N., 2018. Academic writing: Coherence and cohesion in paragraph. *Retrieved August, 8*, p.2019.
- R'boul, H., 2021. North/South imbalances in intercultural communication education. *Language and Intercultural Communication*, 21(2), pp.144-157.
- Rieber, L.P., 1992. Computer-based microworlds: A bridge between constructivism and direct instruction. *Educational technology research and development*, 40(1), pp.93-106.
- Shabo, A., 1997. Integrating constructionism and instructionism in educational hypermedia programs. *Journal of Educational Computing Research*, 17(3), pp.231-247.
- Trollip, S.R. and Alessi, S.M., 2001. Multimedia for learning: methods and development. *Massachusetts: Allyn & Bacon*.
- Wood, R.S., 2006. The dynamics of incrementalism: Subsystems, politics, and public lands. *Policy Studies Journal*, 34(1), pp.1-16.

Robot-Assisted Language Education and Speech Therapy for Children with Cleft Lip and Palate

Aveen Najm¹, Eysin Chew¹, Barry L. Bentley^{1,2}

¹EUREKA Robotics Centre, Cardiff Metropolitan University, Cardiff, UK

²CASMI, University College London (UCL), London, UK

ANajm@cardiffmet.ac.uk

ECheW@cardiffmet.ac.uk

BBentley@cardiffmet.ac.uk

Abstract: Cleft lip and palate (CLP) is a congenital anomaly that can have detrimental effects on an individual's ability to produce certain sounds, including bilabial sounds such as /m/ and alveolar sounds such as /n/, as well as sounds that require closure between the nasal and oral cavities, such as sounds ending in /-ɪŋ/. While surgical intervention can assist in correcting anatomical irregularities, consistent speech and language therapy sessions are often necessary to overcome obstacles associated with speech production. The research problem addressed in this study is the interruption of regular therapy, as evidenced by the discontinuation of services during the COVID-19 pandemic, which can lead to setbacks in progress and an increase in the risk of developmental delays in children. To explore the potential of educational robots to address this problem, this paper (i) investigates the user requirements, usability considerations, and attitudes to speech therapy robots, from the perspective of parents and carers of children with CLP, (ii) presents an experimental prototype for CLP language education and speech therapy using a humanoid robot, named Robot Lily, based on input from prospective users; and (iii) evaluates the prototype Robot Lily on a subject with CLP. The robot has been programmed to interact with the child in a naturalistic manner, using the same language and gestures employed by human speech and language therapists. The robot can respond to inquiries, practice articulation and pronunciation, aid the child with speech fluency, provide feedback, and encourage continued speech exercises. The primary interactions between a child with CLP and Robot Lily were observed and evaluated, with the robot shown to provide a unique opportunity to acquire speech and language abilities in a captivating and interactive manner. Compared to web-based applications, speech education assistant robots like Robot Lily may offer children a more appealing, engaging, and practical solution; and be remotely controlled by humans for specialized interventions at home, thereby circumventing the challenges encountered during COVID-19. These findings and methods have been used to develop an integrated model for ethical robotic speech therapy utilizing machine learning, which is expected to help meet the growing demand for speech therapy services.

Keyword : Human-Robot Interaction (HRI), Speech and Language Therapy, Cleft Lip and Palate, Educational Robot, CNN (Convolutional Neural Network), Language Learning.

1. Background and Introduction

1.1 Cleft lip and palate (CLP)

Cleft lip and palate (CLP) is a birth defect that affects the formation of the upper lip and palate, preventing the structures from closing. Orofacial clefts of the lip and/or palate are amongst the most common developmental defects, affecting up to 1 in every 700 children (Yilmaz et al., 2019). Children born with cleft lip and palate require extensive specialist care throughout childhood and adolescence, and affects about 10 million people adults worldwide (Sandy et al., 2020). Approximately 30% of children born with CLP will have associated syndromes, with an increased risk of glue ear and auditory processing disorders, which may lead to speech, language, and academic difficulties later in life (van Eeden & Stringer, 2020).

Cleft closure surgery can be performed to correct the anatomical malformations of the lip and palate; however, problems often remain that require follow-on therapy. Difficulties with speech production can result from an inability to articulate certain sounds during the early stages of speech learning; particularly, children with CLP struggle with sounds that require the closure of space between the nose, mouth, and soft palate, including bilabial sounds like /m/ and alveolar sounds like /n/, as well as sounds that require closure between the nasal and oral cavities like those ending /-ɪŋ/. These defects can affect a child's intelligibility, and ultimately their social and emotional development (Maier et al., 2019).

Speech impairments are one of the most important developmental consequences of CLP (Arai et al., 2021). Speech and language assessments need to be performed after surgery (Arai et al., 2021 and Cleland et al., 2022), and children with isolated CLP require speech and language therapy and additional support (Jurado et al., 2021), which is often not easily accessible, particular in developing countries (Prathanee et al., 2020). There is a need to address the lack of support and barriers to accessing speech services for patients with CLP to ensure they are

not developmentally delayed or disadvantaged later in life (Baigorri et al., 2021). By increasing access to speech services and language resources using technology, CLP patients can overcome these barriers.

1.2 The role of technology in speech and language therapy

Regular speech and language therapy is important for children with CLP to ensure that disruptions to normal development are minimised. During the COVID-19 pandemic, where many in-person support services were closed or limited, technology played a vital role in maintaining speech therapy provisions, such as through telehealth (Lyons et al., 2021). Independent of the COVID-19 pandemic, there has been a growing body of research exploring technologies that can augment or assist in speech and language therapy, such as web-based programs that can perform automatic evaluation of speech pathologies (Maier et al., 2019). Some of the benefits of web-based applications include avoiding the need for the end user to install software, access from different platforms—such as mobile devices—and the ability of speech and language therapists to track and monitor progress remotely. Unlike standalone software, web-based interactive applications have the potential to link-up to form part of a cohesive therapy plan, allowing, for example, multiple speech therapists to work collaboratively with a patient, and communicate remotely, improving the patient's experience and likelihood of adherence to therapy. Portable formfactor devices like iPads can be useful for children, with the large screen allowing them to be taught facial and tongue movements, and enable communication with their speech therapist through video conferencing (Dhaky et al., 2021).

1.3 Robot-assisted education and speech therapy

In addition to the development of web-based technologies to aid speech and language therapy, emerging research into AI and robotics has also begun to open up new application areas. Robotics and AI have already been widely explored in education and therapy settings, for example, in speech therapy (Qi et al., 2023; Zhanatkyzy et al., 2019), and in education and assistive technologies for older persons (Chew et al., 2021; Su et al., 2022; Garcia-Sanjuan et al., 2017). Over the past decade, applications of robots for children have also been explored to improve the educational experience of those with disabilities (Ioannou and Andrevia, 2019), as classroom aids (Kradolfer et al., 2014), and in language education for children with dyslexia (Mcvey et al., 2022).

Whereas screen-based software for education is limited in its interactive capabilities, as a result of its disembodied nature, robots can physically interact with a child to provide tangible social engagement as an extra feature, which can be considered an advancement over pure software-based learning (Mubin et al., 2013). Studies have shown that robot interaction can help to increase some aspects of social learning, for example, in language production (Warren et al., 2015), with children being more engaged and responsive to educational robots compared to humans or computer screens (Mavadati et al., 2016; Ioannou and Andrevia, 2019; Pinto et al., 2015). As a side-benefit, the direct interaction with robotic technology can provide additional motivation for children to engage with learning technology, science, and mathematics. The main advantage, however, of educational robots is in the targeted social interactions, that can increase the child's knowledge in a fun way (Jost et al., 2014). Although the use of a complex new technology, like robots, for teaching skills to young children sounds contradictory, the social and naturalistic manner of Human-Robot Interaction (HRI) means that children can find using robots easier, less complex, and more engaging, as it draws directly on their existing social skills without requiring them to learn a particular interface. Unlike humans, robots also have an advantage in ensuring consistency in their interactions, particularly where repetition of exercises is required. If any variation is required, it can be applied with a minimum effort and in a controlled manner (Huijnen et al., 2017).

A preliminary study describing a speech therapy robot for children with CLP proposed that this approach could be used to gamify the learning experience, help with pronunciation and articulation exercises in a more engaging manner, and increase the availability of therapies to those who cannot access specialised speech and language services (Ramamurthy and Li, 2018; Veleta, 2018).

Studies have shown that the gamification of education activities using robots can support learning (Ioannou & Andrevia, 2019). Indeed, gamification has the potential to enhance student motivation and increase engagement (Zourmpakis et al., 2022, 2023; Papadakis et al., 2022, 2023), particularly when combined with social robots (Yang et al., 2023; Tran et al., 2023; Issa et al., 2023). Robots provided many enticements to children, which urge them to continue therapy (Alwadain, Al-Ma'aitah, & Saad, 2020; Spaulding et al., 2018), and interaction with robots has been shown to help children with Autism Spectrum Disorder (ASD) and Delayed Speech Development (DSD) improve their social and communication skills (Bouhali et al., 2023; Amirova et al., 2023; Esfandbod et al.,

2023); furthermore, in studies carried out by Warren et al. (2015), children with speech disorders responded better to humanoid robots than adult administrators or typically developing counterparts.

It is worth noting that robots can be automated to aid in therapy for speech-related disorders; however, little research has been conducted on speech therapy robots specifically for CLP. Speech therapy assistant robots are still at an early stage of development, and this research is expected to help fill the growing demand for speech therapy services for children with CLP at home, with various techniques used to motivate children to participate, including playing games, singing songs, and reading books.

1.4 Research overview

Building on the use of emerging technologies for specialist language education and speech therapy, this research project seeks to develop a robot, named Robot Lily, that can support speech therapy specifically for children with CLP, informed by patients and parents, and expert communities of practice. As a first step, the project looks to develop a robot that can support reading and pronunciation learning exercises with children, as reading can be helpful for normal speech development and in building communication skills (McLaughlin, 2011), including auditory comprehension, expressive vocabulary, word memory, and building world knowledge.

In this paper, we describe the initial work to: (i) investigate the user and HRI requirements, usability considerations, and attitudes to speech therapy robots, from the perspective of the parents or carers of children with CLP; (ii) develop an experimental prototype of Robot Lily for CLP language education and speech therapy using a humanoid robot, based on input from prospective users; and (iii) evaluate the prototype Robot Lily on a subject with CLP. These are described in the following sections.

2. Methods

2.1 Survey and requirements gathering

To investigate the needs of parents and carers of children with CLP with respect to language education and speech therapy, a mixed methods survey was designed. The survey consisted of 15 close-ended qualitative and quantitative questions, using multiple choice Likert-type scales, to assess therapy age requirements, as well as experience and attitudes towards robots and educational technologies. In addition, one open-ended question was included to allow free-text responses. The questions were developed into a web-hosted survey, and prefaced with a consent form, using the Qualtrics XM software (Qualtrics, UT, USA). Qualitative responses and survey text were analysed using the thematic analysis method. The utilization of a thematic analysis was employed by the researcher due to the indication provided by the questionnaire themes, which elucidated the beliefs and desires of parents regarding the integration of robots within their domestic environment. Participants were recruited through support networks for parents and carers of children with CLP, including public groups on Facebook and Twitter. The questionnaire was available for two weeks.

2.2 Robot Lily

2.2.1 Software and hardware

The software for the Robot Lily speech therapy assistant was designed based on the requirements gathered from the user survey, and programmed to run on the NAO humanoid robot platform developed by SoftBank Robotics (SoftBank Robotics, 2021). Initial interactions were prototyped using the Choregraphe software, where the robot was programmed to, *firstly*, introduce themselves and interact with the child to learn their face and name to establish a social relationship for subsequent learning, and *secondly*, to lead the child in reading and pronunciation games using a set of cards that contain images and text.

2.2.2 Object recognition and Neural Network

To allow real-time visual object recognition for reading, a Convolutional Neural Network (CNN) was trained for image classification using the image and text cards, and expanded using the CIFAR-10 image dataset of 60,000 colour images (Krizhevsky, Nair & Hinton, 2009), with a 5:1 training to test image ratio. Several network models were constructed using the TensorFlow framework in Python via the Keras API (Abadi et al., 2015; Chollet et al., 2015), and evaluated to select the model with the best classification performance. For the prototype, this CNN was trained and run on a separate PC, with the intention to integrate and deploy the CNN and learning on the

NAO robot using the python-SDK and NAOqi API in following design iterations (SoftBank Robotics, 2021). Details of the system design and CNN models are described in the results section below.

2.3 Ethics and evaluation

The protocol for the survey and evaluations were reviewed and approved by the appropriate Institutional Research Ethics Committee (REC) at Cardiff Metropolitan University. Informed consent was obtained from all survey participants, and survey data was collected and handled in accordance with GDPR and Institutional Policies. Initial usability evaluations were conducted on a single six-year-old female child with CLP in her home environment, under the supervision of the parent-researcher at all times. The researcher observations, with feedback from the researcher's child, were used to inform the design of the system. Both the child and parent had complete autonomy to terminate the interaction with the robot at any point.

3. Results

3.1 Survey results

The survey of parents of children with CLP concluded with a total of 39 responses, with 35 respondents providing complete answers to all of the survey questions. In response to the question of what age they thought would be best to start speech therapy in children with CLP (Figure 1), the majority answered four years old (79.5%), with all remaining respondents answering three years old or younger (20.5%), indicating a strong preference for early intervention, and thus a need for therapy-aids and technologies to be accessible to children in these young age ranges.

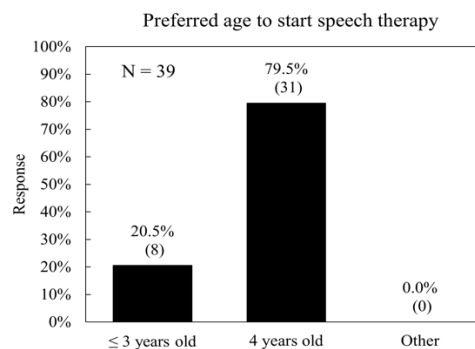


Figure 1: Age – Responses to the question “What do you think is the best age to start speech therapy?”

When questioned about their prior exposure to robots (Figure 2), the overwhelming majority of respondents had not had any previous experience using or working with robots (79.5%). Despite this unfamiliarity with the technology, on average the parents of children with CLP reported a willingness to use the speech therapy assistant robot for their child's speech therapy (Figure 3), with over 61% expressing positive sentiment (47.5% somewhat agreeing, and 19.4% strongly agreeing). Surprisingly, sentiment was even higher when asked about how optimistic they were that a robot could work effectively as a speech therapy assistant (Figure 4), with 65.7% replying positively.

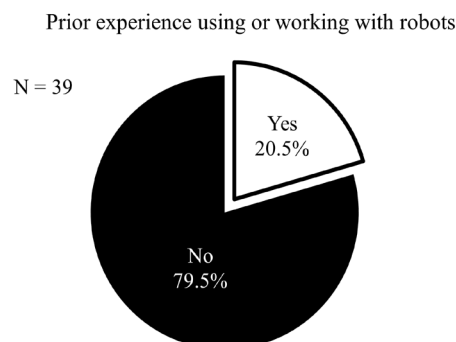


Figure 2: Experience – Responses to the question “Have you ever used or worked with a robot before?”

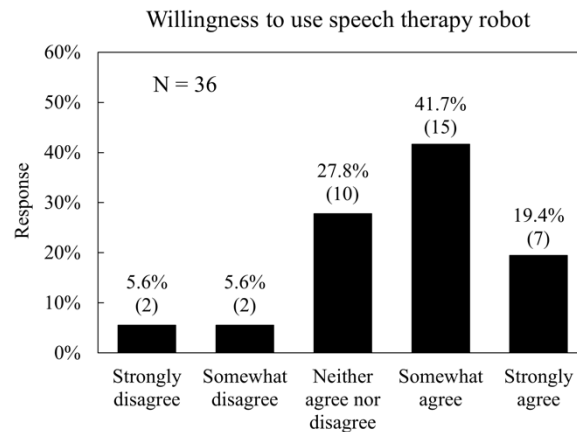


Figure 3: Willingness – Responses to questions relating to the parents’ willingness to use a speech therapy robot with their child.

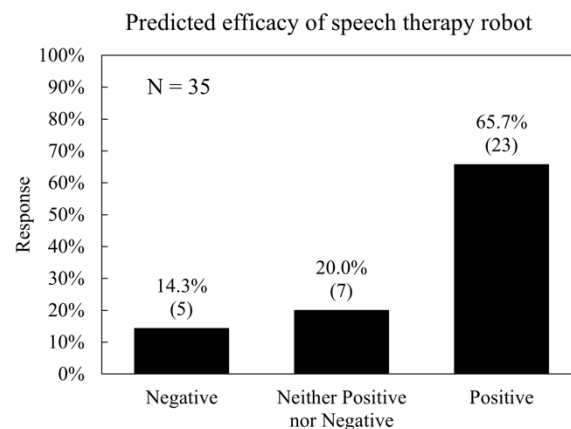


Figure 4: Efficacy – Responses to “How optimistic you are that robots can work as speech therapy assistants?”. Positive and negative responses were consolidated into the respective categories.

In the free-text responses, some parents expressed concerns about the accent that a robot might use, while others doubted the suitability of a robot for language education and speech therapy. One parent said *“I don’t think a robot can provide the language therapy. For speech therapy alone, a robot wouldn’t be any different to an app or an iPad”*; highlighting a need to clarify the strengths and weaknesses of robots as learning tools in comparison to screen-based apps, and to communicate these clearly to the intended users—particularly around the social learning, engagement, and motivation aspects of educational robots. Some parents also raised concerns about how lip and tongue movement would be communicated with a robot that does not have a human-like mouth.

3.2 Implementation – Robot Lily prototype

Based on the requirements from the CLP survey, along with informal feedback on how children may prefer to interact with the robot, an initial prototype of Robot Lily was created (Figure 5), with interactions taking place in two stages: (i) In the first meeting Robot Lily introduces itself, and interacts with the child to learn their name, which it can associate with the facial image of the child to recognise and greet them later; (ii) in the second meeting, and in all the later meetings, Lily uses the data it has stored to greet the child, and through a series of dialogues gives them the options to play games, where they can practice their reading and pronunciation using text and image cards, or to read a book together.

In the reading exercise games, the child can present Robot Lily with a text and image card, which the robot reads and encourages the child to repeat (Figure 6). If the child pronounces the word correctly, they receive positive feedback from the robot, and are asked for the next card; however, if their pronunciation is incorrect, the child is asked to repeat the word again. If the child does not pronounce the word correctly after three attempts, the

mistake is logged via email for review by the parent and/or speech therapist, and the game continues with the next item. Evaluation of speech is based on different performance parameters.

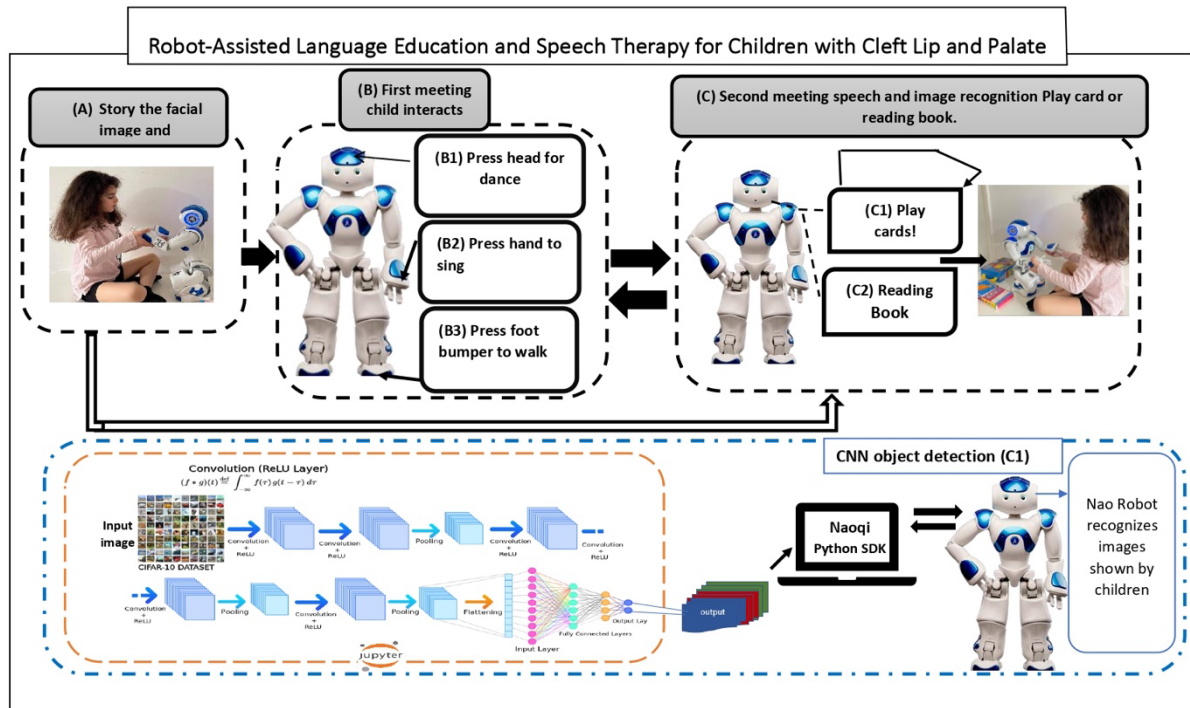


Figure 5: Robot-Assisted Language Education and Speech Therapy for Children with CLP – A diagram showing the Robot Lily system architecture, and example interactions that can be used for language education and speech therapy in children with CLP.

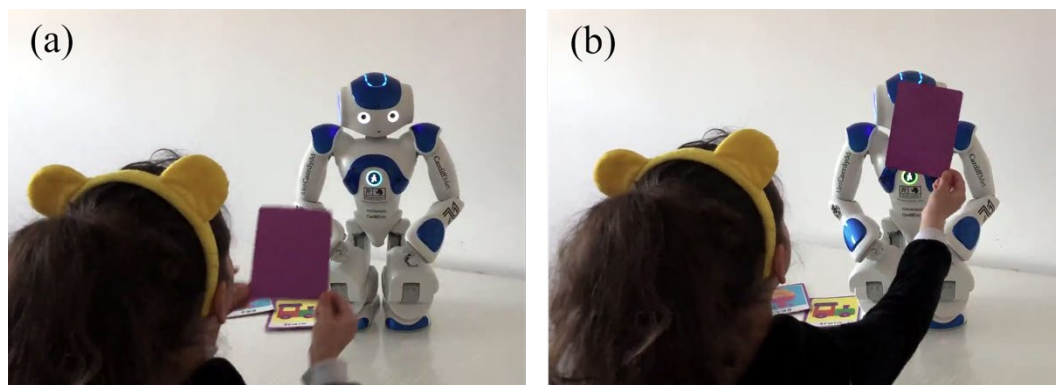


Figure 6: Child-Robot Interaction – Showing the research subject with CLP interacting with the Robot Lily speech therapy assistant. In an example interaction, the child (a) selects a card for the robot to read to, following which (b) the robot asks the subject to read the word on the card and provides feedback on the child's pronunciation.

3.3 CNN model training NAO for image recognition

As mentioned in Section 2 above, to improve the visual image recognition in the Robot Lily prototype, we explored the use of a Convolutional Neural Network (CNN) for image classification. In the initial training, three CNN models were trained on the CIFAR-10 dataset, with the best model (Model 1) yielding 0.92 and 0.78 accuracy in training and validation, respectively (Table 1). Given the consistent ability to accurately predict image classes in the prototype (Figure 7), we selected this model as the basis for future image classification in the Robot Lily speech therapy assistant robot.

Table 1: CNN results – Comparison of three CNN models for image classification.

Model	Training Accuracy	Validation Accuracy	Training Loss	Validation Loss	No. Epochs	Batch Size
1	0.92	0.78	0.26	0.85	1000	150
2	0.73	0.68	0.73	0.91	1000	150
3	0.72	0.70	0.76	0.83	1000	150

The model consisted of a feature map of convolutional layers, pooling and dropout. The convolutional layer in the CNN is used to extract features of image, while the pooling is used to reduce the number of features to reduce computational requirements. Dropout is used to randomly drop neurons to regularize the neural network. A summary of the network structure is shown in Table 2.

Table 2: Model 1 summary – Layers and parameters the Sequential CNN in TensorFlow.

Layer (type)	Output Shape	No. Param
conv2d (Conv2D)	(None, 30, 30, 32)	896
conv2d_1 (Conv2D)	(None, 28, 28, 32)	9248
max_pooling2d (MaxPooling2D)	(None, 14, 14, 32)	0
dropout (Dropout)	(None, 14, 14, 32)	0
conv2d_2 (Conv2D)	(None, 12, 12, 64)	18496
conv2d_3 (Conv2D)	(None, 10, 10, 64)	36928
max_pooling2d_1 (MaxPooling2D)	(None, 5, 5, 64)	0
dropout_1 (Dropout)	(None, 5, 5, 64)	0
conv2d_4 (Conv2D)	(None, 3, 3, 128)	73856
max_pooling2d_2 (MaxPooling2D)	(None, 1, 1, 128)	0
dropout_2 (Dropout)	(None, 1, 1, 128)	0
flatten (Flatten)	(None, 128)	0
dense (Dense)	(None, 256)	33024
dropout_3 (Dropout)	(None, 256)	0
dense_1 (Dense)	(None, 128)	32896
dropout_4 (Dropout)	(None, 128)	0
dense_2 (Dense)	(None, 10)	1290
<i>Total params</i>		206,634
<i>Trainable params</i>		206,634
<i>Non-trainable params</i>		0

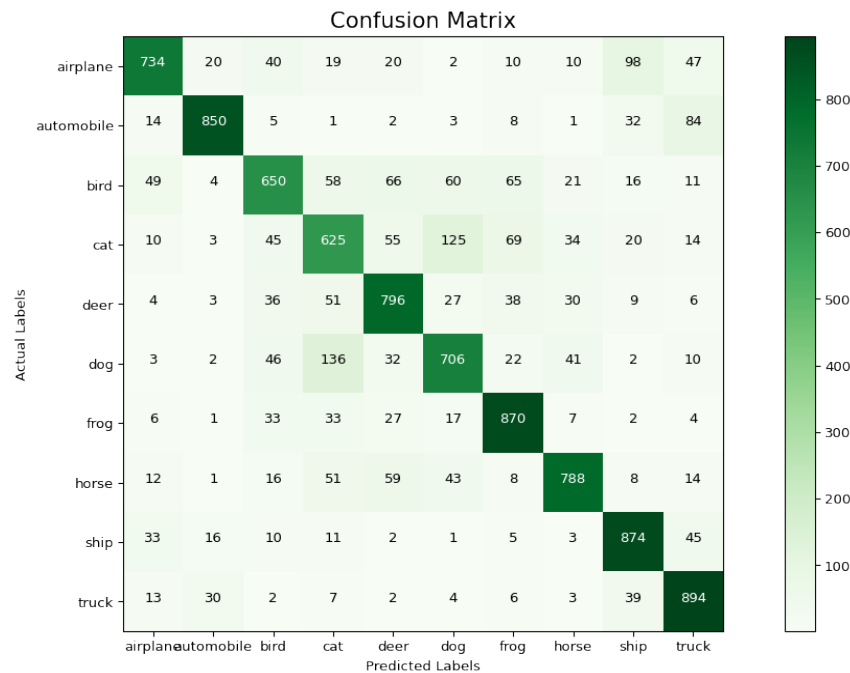


Figure 7: Confusion matrix – Classification performance of the image classification model of Robot Lily on a subset of images, comparing predicted to actual labels. The centre diagonal illustrates correct classification on the majority of images.

3.4 Robot evaluation

The Robot Lily prototype was evaluated with the six-year-old subject with CLP (Figure 6) on three separate occasions. In all cases, we observed that the subject maintained a high level of engagement with the robot throughout the activities, on both the reading and card-based exercises. Robot Lily correctly classified all of the text and image cards used in the exercises, however, in some instances, the fluidity of interaction was interrupted by the long response times of the robot. From an HRI usability perspective, one issue was observed in the robot's occasional failure to understand the subject's requests. In these cases, it was usually the result of the subject requesting interactions that fell outside the scope of Robot Lily's programming. For example, when at the end of the second meeting the robot asked, "do you need anything else?", the child replied, "can I hug you?", to which Robot Lily responded: "Sorry. I cannot understand you".

4. Conclusion and discussion

4.1 Summary

For children with CLP, regular speech therapy is essential to prevent the development of communication difficulties; however, access to speech therapists is not always available, as was witnessed during the COVID-19 pandemic. This paper has described the use of a robot assistant that can augment speech therapy and be remotely controlled by human therapists for specialist interventions at home, while also providing a novel and engaging approach to language education and speech therapy for children. The robot has been programmed to interact with the child in a naturalistic manner, using the same language and gestures used by human speech and language therapists to help the child with speech fluency, provide feedback, and encourage them to keep practicing their speech exercises. We observed and evaluated the primary interactions between a child with CLP and Robot Lily, finding that the robot can provide a unique opportunity to learn speech and language skills in an engaging and interactive way. From conducting the first survey on educational robots amongst parents of children with CLP, we found that the majority view the use of robots for speech therapy positively, and would be willing to use them with their own children.

The nativistic theory is the theoretical framework underpinning this study involving Robot Lily. This particular theory has demonstrated efficacy in facilitating communication among children experiencing speech difficulties, thereby aiding in the surmounting of such issues. Integrating interactive testing studies with the nativistic theory

presents an opportunity to provide optimal support for both children and their caregivers in instances where traditional support systems may be insufficient.

4.2 Future work

Further improvements, adjustments and research is required to improve the capabilities of the robot, and build the trust of parents and speech therapists. As seen from the initial evaluation, the naturalistic and human-like interactions that the robot facilitates can create a sense of engagement that supports the learning process; however, they can also lead to unrealistic expectations from users that the robot should possess human-like capabilities for which it is not designed, such as giving hugs (Section 3.4 above). Additional HRI research is required to determine how best to address these expectation-capability mismatches without compromising the social connection that the user has formed with the robot.

Future plans include expanding the CNN model on CLP children to increase the image recognition capability, and to conduct more extensive evaluations with parents whose children have CLP. Following these enhancements, updated versions of Robot Lily will be evaluated in clinic and hospital settings.

References

- Abadi, M., et al. (2015) *TensorFlow*. doi: 10.5281/zenodo.4724125.
- Alwadain, A., Al-Ma'aitah, M. and Saad, A. (2020) Developing computerized speech therapy system using metaheuristic optimized artificial cuckoo immune system. *Cluster Computing*, 23, pp.1755-1767.
- Amirova, A., Rakhymbayeva, N., Zhanatkyzy, A., Telisheva, Z. and Sandygulova, A. (2023) Effects of parental involvement in robot-assisted autism therapy. *Journal of Autism and Developmental Disorders*, 53(1), pp.438-455.
- Arai, S., Funada, A., Hasegawa, S., Matsumura, K., Mitsuyasu, T., Sasaguri, M., Sato, N., Umezaki, T. and Nakamura, S. (2021) A case of bilateral cleft lip and palate requiring long-term cannulation: A case report. *Journal of Oral and Maxillofacial Surgery, Medicine, and Pathology*, 33(3), pp.302-306.
- Baigorri, M., Crowley, C.J., Sommer, C.L. and Moya-Galé, G. (2021) Barriers and resources to cleft lip and palate speech services globally: a descriptive study. *The Journal of Craniofacial Surgery*, 32(8), p.2802.
- Bouhali, R., Al-Tabaa, H., Abdelfattah, S., Atiyeh, M., Esmaeili, S. and Al-Tabbakh, H. (2023) Otisma: an integrated application and humanoid robot as an educational tool for children with autism. *Journal of Medical Engineering & Technology*, 47(1), pp.44-53.
- Chew, E., Lee, P. L., Yang, J. and Hu, S. (2021) 'Investigating the first robotic nurses: humanoid robot nightingale and partners for COVID-19 preventive design', *New Trends in Medical and Service Robotics. MESROB 2021. Mechanisms and Machine Science*, 106. doi: 10.1007/978-3-030-76147-9_15.
- Chollet, F., et al. (2015) *Keras* [Online]. Available at: <https://github.com/fchollet/keras> (Accessed: 27 June 2023).
- Cleland, J., Crampin, L., Campbell, L. and Dokovova, M. (2022) Protocol for SonoSpeech Cleft Pilot: a mixed-methods pilot randomized control trial of ultrasound visual biofeedback versus standard intervention for children with cleft lip and palate. *Pilot and Feasibility Studies*, 8(1), pp.1-10.
- Dhaky, K., Bulsara, M. and Sethna, B. (2011) 'Speech Therapy and Assessment (via Multimedia Devices for Cleft Lip and Palate Patients)', in *Proceedings of the 2011 Global Humanitarian Technology Conference*, pp. 415–418. doi: 10.1109/GHTC.2011.46.
- van Eeden, S. and Stringer, H. (2020) Linguistic and auditory processing skills in non-syndromic children with cleft palate: A scoping review. *Journal of Communication Disorders*, 87, p.106029.
- Esfandbod, A., Rokhi, Z., Meghdari, A.F., Taheri, A., Alemi, M. and Karimi, M. (2023) Utilizing an Emotional Robot Capable of Lip-Syncing in Robot-Assisted Speech Therapy Sessions for Children with Language Disorders. *International Journal of Social Robotics*, 15(2), pp.165-183.
- Garcia-Sanjuan, F., Jaen, J., and Nacher, V. (2017). 'Tangibot: a tangible-mediated robot to support cognitive games for ageing people—a usability study', *Pervasive and Mobile Computing*, 34, pp. 91-105. doi: 10.1016/j.pmcj.2016.08.007.
- Huijnen, C.A.G.J., Lexis, M.A.S. and de Witte, L. (2017) 'Robots as New Tools in Therapy and Education for children with Autism', *International Journal of Neurorehabilitation*, 4(4). doi: 10.4172/2376-0281.1000278.
- Ioannou, A. and Andrevia, A. (2019) 'Play and learn with an intelligent robot: Enhancing the therapy of hearing-impaired children', *Human Computer Interaction – INTERACT 2019*, pp. 436–452. doi: 10.1007/978-3-030-29384-0_27.
- Jost, B. et al. (2014) 'Robots, Graphical Programming environments for Educational Robots', *Proceedings of the International Symposium on Multimedia*. Taiwan, pp. 381–386. doi: 10.1109/ISM.2014.24.
- Jurado, M.R.B., Cavalheiro, M.G., de Castro Corrêa, C., Whitaker, M.E., de Vasconcelos Hage, S.R., Lamônica, D.A.C. and Maximino, L.P. (2021) Global and communicative development skills in preschool children with cleft lip and palate. *Pediatric investigation*, 5(01), pp.33-37.
- Kradolfer, S. et al. (2014) 'A sociological contribution to understanding the use of robots in schools: The thymio robot', *Proceedings of the 6th International Conference on Social Robotics, ICSR 2014*. Springer International Publishing.
- Krizhevsky, A., Nair, V. and Hinton, G. (2009) *The CIFAR-10* [online]. Available at: <https://www.cs.toronto.edu/~kriz/cifar.html> (Accessed: 22 April 2022)

- Lyons, R., Loftus, L., Rodden, M., Lynch, S. W., Gaffney, S. and McAndrew, B. (2021) 'Establishment of an innovative telehealth speech and language therapy placement as a rapid response to COVID-19: Sharing the learning', *International Journal of Practice-Based Learning in Health and Social Care*, 9(2), pp. 11-20. doi: 10.18552/ijpblhsc.v9i2.738.
- Maier, A. et al. (2019) 'PEAKS- A system for the automatic evaluation of voice and speech disorders', *Speech Communication*, 51(5), pp. 425-437. doi: 10.1016/j.specom.2009.01.004
- Mavadati, S. et al. (2016) 'Robot-based therapeutic protocol for training children with Autism', *Proceedings of the IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN)*, 1(42). doi: 10.1109/ROMAN.2016.7745219.
- McLaughlin, M.R. (2011). 'Speech and language delay in children', *American Family Physician*, 83(10), pp. 1183-1188.
- Mcvey, S.M., Chew, E., & Carroll, F. (2022). 'Educational Robotics and Dyslexia: Investigating How Reinforcement Learning in Robotics Can Be Used to Help Support Students with Dyslexia', In *Proceedings of International Conference on Technological Ecosystems for Enhancing Multiculturality*, pp. 43-49. doi: 10.1007/978-981-99-0942-1_4.
- Mubin, O., Stevens, C.J., Shahid, S., Al Mahmud, A., and Dong, J.J. (2013). 'A review of the applicability of robots in education', *Journal of Technology in Education and Learning*, 1(209-0015). doi: 10.2316/Journal.209.2013.1.209-0015.
- Nagarajan, R., Savitha, S. and Subramaniyan, B. (2009) 'Communication disorders in individuals with cleft lip and palate: An overview', *Indian Journal of Plastic Surgery*, 1(49), pp. 137-143. Doi: 10.4103/0970-0358.57199.
- Papadakis, S., Kiv, A. E., Kravtsov, H. M., Osadchyi, V. V., Marienko, M. V., Pinchuk, O. P., ... & Semerikov, S. O. (2023). Revolutionizing education: using computer simulation and cloud-based smart technology to facilitate successful open learning. In *CEUR Workshop Proceedings* (Vol. 3358, pp. 1-18).
- Papadakis, S., Zourmpakis, A. I., & Kalogiannakis, M. (2023). Analyzing the Impact of a Gamification Approach on Primary Students' Motivation and Learning in Science Education. In *Learning in the Age of Digital and Green Transition: Proceedings of the 25th International Conference on Interactive Collaborative Learning (ICL2022)*, Volume 1 (pp. 701-711). Cham: Springer International Publishing.
- Pinto, A., Tozadore, D. and Romero, R. (2015) 'A Question Game for Children Aiming the Geometrical Figures Learning by Using a Humanoid Robot', in *Proceedings of the 12th Latin American Robotics Symposium and 3rd Brazilian Robotics Symposium (LARS-BRS)*, pp. 228-233. doi: 10.1109/LARS-SBR.2015.62.
- Prathanee, B., Pumnum, T., Yoodee, P. and Makarabhirom, K. (2020) Speech therapy model for patients with cleft palate in Lao People's Democratic Republic: Lack of speech services. *International journal of pediatric otorhinolaryngology*, 138, p.110366.
- Qi, J., Chew, E. and Yang, J. (2023) 'A Systematic Review for Robotic for Cognitive Speech Therapy for Rehabilitation Patient', In *Advances in Intelligent Manufacturing and Mechatronics*. Springer. doi: 10.1007/978-981-19-8703-8.
- Ramamurthy, P. and Li, T. (2018) 'Buddy: A Speech Therapy Robot Companion for Children With Cleft Lip and Palate (CL/P) Disorder', *International Conference on Human-Robot Interaction*, 1(46), pp. 359-360. doi: 10.1145/3173386.3177830.
- Sandy, J., Davies, A., Humphries, K., Ireland, T. and Wren, Y. (2020) Cleft lip and palate: Care configuration, national registration, and research strategies. *Journal of the World federation of orthodontists*, 9(3), pp.S40-S44.
- SoftBank Robotics (2021) *Education & Research* [Online]. Available at: <https://www.softbankrobotics.com/emea/en/pepper-and-nao-robots-education> (Accessed: 24 April 2022).
- Spaulding, S., Chen, H., Ali, S., Kulinski, M., and Breazeal, C. (2018) 'A social robot system for m10odelling children's word pronunciation', in *Proceedings of the 17th International Conference on Autonomous Agents and MultiAgent Systems*.
- Su, Z., Bentley, B.L., McDonnell, D., Ahmad, J., He, J., Shi, F., Takeuchi, K., Cheshmehzangi, A. and da Veiga, C.P. (2022) '6G and Artificial Intelligence Technologies for Dementia Care: Literature Review and Practical Analysis', *Journal of Medical Internet Research*, 24(4). doi: 10.2196/30503.
- Veleta, K. (2018) 'Speech Therapy Robot Helps Children with Cleft Lip', *Inside Indiana Business* [Online] Available at: <https://www.insideindianabusiness.com/story/38316789/speech-therapy-robot-helps-children-with-cleft-lip> (Accessed: 24 April 2023).
- Warren, Z. et al. (2015) 'Can robotic interaction improve joint attention skills?', *Journal of Autism and Developmental Disorders*, 45(2), pp. 3726-3734. doi: 10.1007/s10803-013-1918-4.
- Yilmaz, H.N., Özbilen, E.Ö. and Üstün, T. (2019) 'The prevalence of cleft lip and palate patients: a single-center experience for 17 years', *Turkish Journal of Orthodontics*, 32(3). doi: 10.5152/TurkJOrthod.2019.18094.
- Zhanatkyzy, A., Turarova, A., Telisheva, Z., Abylkasymova, G. and Sandygulova, A. (2019) Robot-assisted therapy for children with delayed speech development: a pilot study. In *2019 28th IEEE International Conference on Robot and Human Interactive Communication (RO-MAN)* (pp. 1-5). IEEE.
- Zourmpakis, A. I., Kalogiannakis, M., & Papadakis, S. (2023). A Review of the Literature for Designing and Developing a Framework for Adaptive Gamification in Physics Education. The *International Handbook of Physics Education Research: Teaching Physics*, edited by Mehmet Fatih Taşar and Paula R. L. Heron (AIP Publishing, Melville, New York, 2023), Chapter 5, pp. 5-1-5-26.
- Zourmpakis, A. I., Papadakis, S., & Kalogiannakis, M. (2022). Education of preschool and elementary teachers on the use of adaptive gamification in science education. *International Journal of Technology Enhanced Learning*, 14(1), 1-16.

Characteristics Promoted in Order to Develop Student's Critical Thinking Disposition in Online Discussions During a Fully Online Course

Minoru Nakayama¹, Satoru Kikuchi² and Hiroh Yamamoto²

¹Tokyo Institute of Technology, Tokyo, Japan

²Shinshu University, Matsumoto, Japan

nakayama@ict.e.titech.ac.jp

Abstract: Online discussion boards were organised to develop the critical thinking disposition of students and their attitude toward disaster mitigation during a fully online course. In order to promote participation in the discussions, an incentive was provided to all discussants. Assessment of the effectiveness of the lecturer's invitation to join the discussion was conducted to extract which participants posted once, and the learning activity and characteristics of these students was evaluated. In the results, the levels of participation in online discussions affected some factor scores for personality and learning performance. Also, the causal relationships of the development of literacy of critical thinking disposition were analysed, and the factor of participation level in online discussions was examined.

Keywords: Critical Thinking, Online Discussion, Student's Characteristics, Science And Technology Literacy, Learning Style

1. Introduction

Critical thinking disposition (CTD) and the ability to think critically may contribute to appropriate decision making during emergencies such as natural disasters or social unrest. Training procedures and levels of competence have been discussed (Rychen and Salganik, 2003; Kikuchi 2018). Learning progress in the development of CTD ability using online discussion forums during courses has been studied in previous research (Ekahitanond, 2013; Trehan et al., 2017). The authors also have been analysing the contribution of online discussion activity to measuring CTD ability levels (Nakayama et al. 2021, 2022a, 2022b). In regards to the effectiveness of online discussions (Kusumi and Tanaka, 2008; Leh et al., 2012), registered students were encouraged to join the sessions. As the characteristics of online discussion participants and non-participants were significantly different, simple invitations to join may not contribute to successful development of participant's abilities. However, the effectiveness that is expected from students who join has not yet been confirmed. As this effectiveness may differ according to the characteristics of participants, a detailed analysis will be required.

In this paper, characteristics of students according to degree of participation in online discussions boards are analysed. The following topics will be addressed:

- (1) The contribution of student's characteristics to frequency of participation in online discussion boards was examined by comparing individual factor scores of the metrics surveyed.
- (2) Effectiveness of student's characteristics and the contribution of frequency of participation in online discussion boards toward individual learning performance were evaluated. Also, causal regression of student's characteristics related to learning performance was analysed.

In order to analyse the relationships, the latest survey data from a Japanese university class was introduced.

2. Method

The development of critical thinking disposition was observed during a regularly scheduled on-demand style fully online course at a university in Japan (Nakayama et al., 2021).

2.1 Learning settings

The course was entitled The Psychology of Natural Disaster Mitigation and Prevention, and consisted of 15 sessions. Learning performance of participants was evaluated using several activities, such as weekly confirmation tests and report assignments.

The course has been fully online since 2020. The lecturer recorded videos of his lectures in advance, and the video clips for each session were delivered using an LMS. The main learning assessments during the course were online tests, and report and comment essay writing. The report essay was the main task and was used to evaluate their understanding of critical thinking ability for their final grade.

The participant's essay reports were evaluated by the course lecturer using a rubric which was presented to participants in advance, in order to assess students fairly. The targeted essay assignment was an overall assessment task.

The number of registered students was above 450. The valid number of report essay submissions was 440.

In order to encourage better understanding of the subject matter, all participants were invited to participate in online discussions. Online discussion boards were available throughout the course, and participants could obtain additional marks which contributed to their final mark.

This opportunity represented a significant incentive for students.

2.2 Survey metrics

In order to extract the characteristics of participants in the class, the following inventories were surveyed during the course. Most metrics were measured continuously (Nakayama et al. 2021, 2022b), and some were introduced for the current research purpose.

2.2.1 Personality (Big5)

Scores of participant's personalities were measured using a shortened version of the Big5 inventories, which consists of 10 question items (Kawamoto et al. 2015). The factors which were extracted were Extroversion (P1), Conscientiousness (P2), Neuroticism (P3), Openness (P4), and Agreeableness (P5). The factor scores of the Big5 use 7-point scales (1-7).

2.2.2 Literacy of science and technology (LST)

Kawamoto et al (2013) developed an inventory of science and technology literacy which is based on a survey of scientific literacy. It consists of 10 questions, from which four factors were extracted from the answers: Life-centered (LST-1), Sciencephile (people who are interested in science and technology) (LST-2), Logic-oriented (LST-3), and Authoritarian (LST-4). The LSTs were scored using a 4-point scale (1-4). Four clusters of LSTs were also defined in order to compare behavioural attitudes toward Social science issues using the four dimensional factor scores (Kawamoto et al. 2013).

2.2.3 Critical thinking disposition (CTD)

Hirayama and Kusumi (2004) developed a Japanese inventory of behaviour exhibited during development of critical thinking. Four factors from the inventory were extracted: Awareness of logical thinking (CTD-1), Inquiry-mindedness (Inquisitiveness) (CTD-2), Objectiveness (Objectivity) (CTD-3), and Evidence-based judgment (CTD-4). These CTDs were scored using a 5-point scale (1-5). These metrics were surveyed twice across the course during the first and the second halves. The differential scores between the two surveys are also used in the following analysis, and the sum of the four factor scores is referred as the meta metric of CTD.

2.2.4 Disaster-prevention consciousness (DPC)

These inventories were developed to measure attitude toward disaster-prevention consciousness, and consisted of 20 question items using a 6-point Likert scale (1-6) (Ozeki et al. 2017). The total score is defined as the summation of scores for the 5 aspects (imagination for disaster situations, a sense of crisis about disasters, directivity to others, interest in disaster, anxiety), with the minimum score being 20 and the maximum score being 120. This metric was also surveyed twice during the course, and the two scores were compared.

2.2.5 Weekly test scores (WTS)

The lecturer recorded videos of his lectures in advance, and the video clips for each session were delivered using the university LMS (a Moodle learning management system). All communications such as assignment submissions, online tests, essay report reviews and follow-up surveys were conducted using the LMS. Learning performance was evaluated using online tests such as short written tests which asked about course session topics (WTS).

2.2.6 Essay Report and Comments

All participants were asked to present two types of essays, such as a report essay or a comment essay about a talk given by an invited lecturer (Nakayama et al. 2022a). An essay report task was assigned in order to evaluate student's in class performance, and was to be marked as part of their overall final grade assessment. Another comment task was to summarise their comprehension of the guest lecturer's oral presentation, which consisted of providing information about current communication resources used in natural disaster mitigation. These essays were submitted via the LMS platform, and the lecturer's assessment scores were feedback returned to individual contributors via the LMS system.

Though the length of the essays and styles of presentation differed between individuals, these features were compared and the differences between extracted texts compared as a group.

3. Results

3.1 Levels of participation in online discussions

Unfortunately, the number of online discussants was limited despite of the efforts of the lecturer. In a sense, participation is an indication of individual learning motivation and activity throughout the course. The results show that 127 out of 440 students participated in the discussions. This means that 29 percent of the registered participants joined the online discussions.

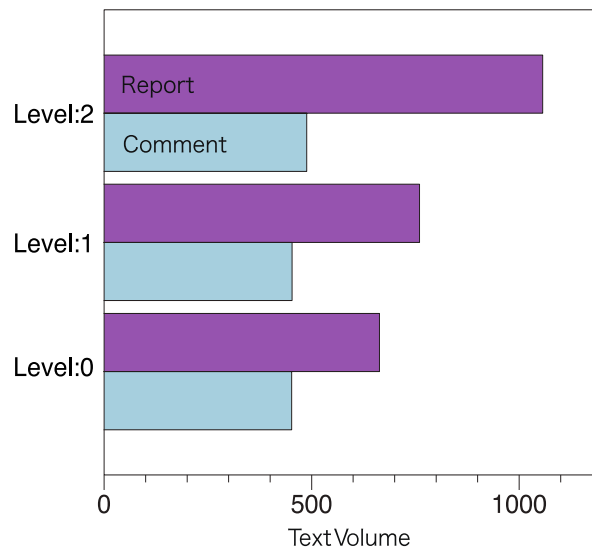


Figure 1. Mean essay volume submitted by students (Report essay and Comment essay) in three levels of online discussion participation

Of those, 64 students posted only once. The remaining 63 students posted an average 3.8 times. Therefore, their motivation for joining may be different from the two other groups. The former group (who posted once) might have joined in order to receive additional marks. The messages sent during the online discussions were analysed, and the lengths of the messages posted by the two groups were comparable. Therefore, it does not seem easy to classify discussant behaviour using only submitted texts. Since the posting frequency was so varied, participants were classified into levels 0, 1 or 2, representing no postings, 1 posting, or frequent postings, respectively.

As an index of learning activity, essay writing may represent in this course. In regards to this hypothesis, the length of report and comment essay texts of participants in the three levels are compared. The results are summarised in Figure 1. There are significant differences in the lengths of report essays submitted by students in levels 0 and 2 ($p < 0.01$), but no significant differences for levels 0 and 1. Regarding comment essays, there are no significant differences between the three levels.

This result suggests that student's attitude toward participation in online discussions may influence their learning activity.

3.2 Characteristics of online discussants

The above result suggests that student's characteristics may influence their participation in online activity such as discussion boards.

Means of factor scores of the surveyed metrics for the three levels of participation are compared. The results are summarised in Table 1. Some of factor scores increase as the level of participation in online discussion increases, such as from level:0 to level:2. One-way ANOVA tests are applied to the scores of survey items. F-values in bold represent significant differences in the three levels, such as Conscientiousness, Openness, and DPC1. Also, knowledge learning performance, known as WTS, and the scores of reports and comment type essay assignments deviated significantly with the level of participation in online discussions. The results confirm that paying attention to online discussion board activity affects a participant's proactive learning.

Table 1. Comparison of factor scores by degree of online discussion participation

Student's characteristics	level:0	level:1	level:2	F-value
PS1: Extroversion	3.77	3.88	4.24	1.76
PS2: Conscientiousness	3.15	3.50	3.58	3.56
PS3: Neuroticism	4.55	4.74	4.72	0.67
PS4: Openness	3.84	3.53	4.24	4.06
PS5: Agreeableness	2.83	2.92	2.97	0.51
KG1: Life-centered	3.57	3.61	3.76	1.25
KG2: Sciencephile	3.65	3.66	3.38	0.31
KG3: Logic-oriented	3.31	3.30	3.33	0.03
KG4: Authoritarian	3.16	3.33	3.22	1.41
CTD1: Critical Thinking Disposition-1st survey	14.3	14.3	14.2	0.03
CTD2: Critical Thinking Disposition-2nd survey	14.1	13.9	23.8	0.41
DPC1: Disaster-prevention Consciousness-1st survey	79.2	83.2	83.3	7.67
DPC2: Disaster-prevention Consciousness-2nd survey	80.8	82.7	83.4	2.24
WTS: Weekly Test Score	746.0	835.9	820.6	8.09
Report essay score	76.4	77.6	81.4	13.2
Comment essay score	82.3	82.7	83.9	3.86

Table 2. Correlation coefficients between factor scores and DPC1(Disaster-prevention Consciousness)

	Overall	level:0	level:1	level:2
PS1: Extroversion	0.28	0.18	0.36	0.49
PS2: Conscientiousness	-	-	-	-
PS3: Neuroticism	-	-	-	-
PS4: Openness	0.15	-	-	0.27
PS5: Agreeableness	-0.20	-0.27	-	-
LST1: Life-centered	0.44	0.46	0.41	0.36
LST2: Sciencephile	-	-	-	0.32
LST3: Logic-oriented	0.22	0.17	-	0.37
LST4: Authoritarian	-	-	-	-

3.3 Contribution of student's characteristics toward attitude

Since some scores for student's characteristics may affect their participation in online discussions, the contribution of attitude toward disaster-prevention consciousness (DPC) is evaluated. Simple correlation coefficients of personality (PS1-PS5) and literacy of S&T (LST1-LST4) with DPC1 are summarised and compared with participation levels in online discussions in Table 2. Here, only significant coefficients are displayed. In PS1: Extroversion, the coefficients increase with the level of participation, while the coefficients of LST1 (Life-centered) stay at the same level of correlation across the three levels of participation, however. Their relationships are summarised in Figures 2 and 3. In Figure 2, the slopes of DPC1 for PS1 increase with the level of participation in online discussions, but the slopes of DPC1 for LST1 shift upward with the level of participation.

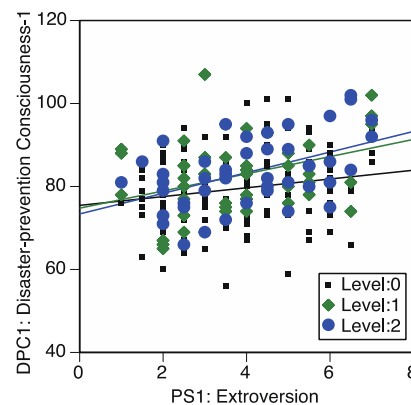


Figure 2. Scattergram of Factor scores of Extroversion and Disaster-prevention Consciousness

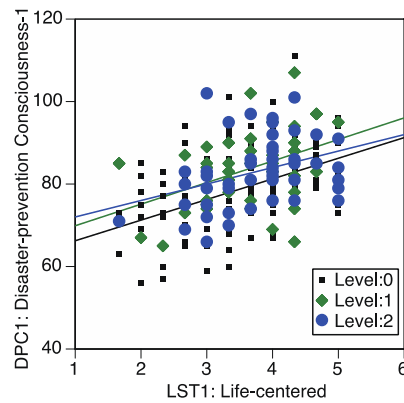


Figure 3. Scattergram of Factor scores of Life-centered and Disaster-prevention Consciousness

These results show the selective contribution of student's characteristics toward targeted learning performance.

3.4 Causal relationship

The relationships between student's characteristics and performance may differ with the type of learning activity during the course. The changes in contributions to the relationships can be extracted using path analysis between the scores of survey items. Similar analysis of online participants and non-online participants was conducted (Nakayama et al. 2022). The degree of participation is introduced into three levels using the same procedure as with the previous model. Therefore, a structural equation modelling technique was applied and the results evaluated using a causal relationship between them (Nakayama et al. 2021, 2022).

The causal relationships were evaluated using indices of the fitness of the model (the GFI: Goodness of Fit index, AGFI: Adjusted GFI and RMSEA: Root Mean Square Error of Approximation) (Toyoda, 2007). The contributions of some factor scores were checked to optimise the model.

As a result, a possible causal path was extracted, as shown in Figure 4. The model was significant in regards to the evaluation indices (GFI=0.82, AGFI=0.75, RMSEA=0.044). The same model was approved by these indices. In this survey, as a DPC metric has been introduced recently, it cannot be implemented in the model. Though there are significant correlation relationships between DPC and CTD scores, their contribution value may be different. Since three participation level groups were introduced, path coefficients between the levels were not tested. Also, the path coefficients of participation level:1 (who posted once on the discussion board) should be examined to determine whether these participant's attitudes are similar to or independent of those of other participation levels. Most coefficients for participants are similar to those for non-participants (level:0) or multiple-time participants (level:2), though some coefficients are independent of these relationships. For example, the coefficient of level:1 for path to "report essay assessment" drops in comparison with other groups.

Further analysis will be a subject of our further study.

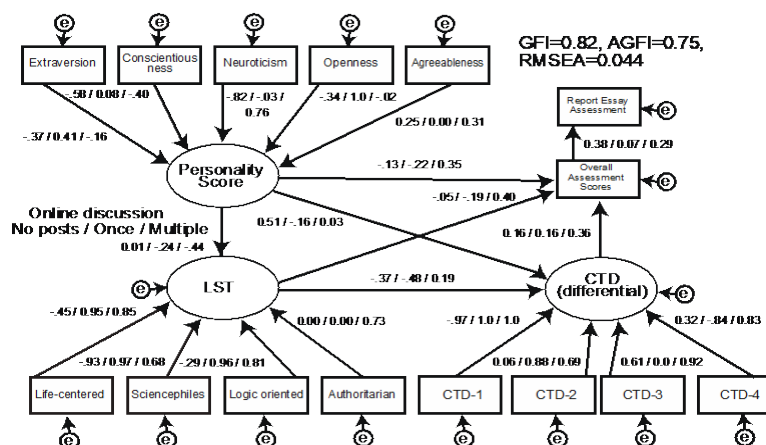


Figure 4. Causal relationship between student characteristics (Personality and Literacy of Science and Technology) and development of critical thinking disposition with levels of participation for discussions.

4. Summary and discussion

This paper presents the contribution of student's characteristics toward degree of participation in online discussion boards and evaluates learning performance during a fully online course using surveyed metrics. Student's characteristics and learning performance were measured during a course which aimed to develop a better attitude toward effective natural disaster prevention and mitigation. An online discussion board was organised by the lecturer, and student's degree of participation was sorted into three levels. The effectiveness of the level of participation in online discussions was evaluated using factor scores of the student's characteristics.

First, some characteristics of students, such as personality traits related to consciousness and openness contributed to their degree of participation in online discussions. Also, scores of disaster-prevention consciousness (DPC) also increased with the level of participation. Learning performance also advanced with the level. Targeted abilities such as DPC also correlated with the scores for characteristics of some students.

Second, the ability and attitude of the participants who were invited to join online discussions (level:1) were examined using a causal relationship analysis. In regards to specific causal path coefficients, only a few irregular values were observed. It may be necessary to continuously invite participants to join the online discussions throughout the course as a means of ensuring sufficient levels of participation.

A detailed analysis of this will be the subject of our further study.

Acknowledgement

This research was partially supported by the Japan Society for the Promotion of Science (JSPS), Grant-in-Aid for Scientific Research (KAKEN, 21K18494: 2021-2023).

References

- KIKUCHI, S. (2018) "HOW TO RECOGNIZE COGNITIVE BIASES IN RISK PERCEPTION IN CASE OF DISASTERS -APPLYING COGNITIVE PSYCHOLOGY TO REDUCE DAMAGES IN DISASTERS", *JOURNAL OF THE JAPAN LANDSLIDE SOCIETY*, 55(6), Pp. 286-292.
- EKAHITANOND, V. (2013) "PROMOTING UNIVERSITY STUDENTS' CRITICAL THINKING SKILLS THROUGH PEER FEEDBACK ACTIVITY IN AN ONLINE DISCUSSION FORUM", *ALBERTA JOURNAL OF EDUCATIONAL RESEARCH*, 59(2), Pp. 247-265.
- HIRAYAMA, R. AND KUSUMI, T. (2004) "EFFECT OF CRITICAL THINKING DISPOSITION ON INTERPRETATION OF CONTROVERSIAL ISSUES: EVALUATING EVIDENCES AND DRAWING CONCLUSIONS", *JAPANESE JOURNAL OF EDUCATIONAL PSYCHOLOGY*, 52, Pp. 186-198.
- KAWAMOTO, S., NAKAYAMA, M. AND SAIJO, M. (2013) "USING A SCIENTIFIC LITERACY CLUSTER TO DETERMINE PARTICIPANT ATTITUDES IN SCIENTIFIC EVENTS IN JAPAN, AND POTENTIAL APPLICATIONS TO IMPROVING SCIENCE COMMUNICATION", *JCOM*, 12(1), Pp. 1-12.
- KAWAMOTO, T., OSHIO, A., ABE, S., TSUBOTA, U., HIRASHIMA, T., ITO, H., AND TANI, I. (2015) "AGE AND GENDER DIFFERENCES OF BIG FIVE PERSONALITY TRAITS IN A CROSS-SECTIONAL JAPANESE SAMPLE", *THE JAPANESE JOURNAL OF DEVELOPMENTAL PSYCHOLOGY*, 26(2), Pp. 107-122.
- KLINE, R.B. (2005) *PRINCIPLES AND PRACTICE OF STRUCTURAL EQUATION MODELLING, SECOND EDITION*, THE GUILFORD PRESS, NEW YORK.
- KUSUMI, T. AND TANAKA, Y. (2008) "A DEVELOPMENT OF CRITICAL THINKING ABILITY DURING A CLASS OF ENGLISH FOR SPECIFIC PURPOSE", *JAEP ANNUAL MEETING*, PF2-35.
- LEH, ASC., KREMLING, J., NAKAYAMA, M (2012) "EFFECTS OF THE USE OF THE BLOG AND DISCUSSION BOARD ON ONLINE TEACHING AND LEARNING", *SOCIETY FOR INFORMATION TECHNOLOGY & TEACHER EDUCATION INTERNATIONAL CONFERENCE*, 574-579.
- NAKAYAMA, M., UTO, M., KIKUCHI, S., AND YAMAMOTO, H. (2022A) "EVALUATION OF ESSAYS AND COMMENTS FOR DEVELOPING THINKING ABILITY DURING A UNIVERSITY COURSE", *IN PROC. PSYCHOLOGY LEARNING TECHNOLOGY IN NOVEMBER, 2022*, Pp.1-16.
- NAKAYAMA, M., KIKUCHI, S., AND YAMAMOTO, H. (2022B) "DEVELOPMENT OF CRITICAL THINKING DISPOSITION USING AN ONLINE DISCUSSION BOARD DURING A FULLY ONLINE COURSE", *PROC. OF ECEL 2022*, Pp. 295-301.
- NAKAYAMA, M., KIKUCHI, S., AND YAMAMOTO, H. (2021) "THE DEVELOPMENT OF CRITICAL THINKING DISPOSITION DURING TWO ONLINE STYLES OF LEARNING", *PROC. OF ECEL 2021*, Pp. 314-320.
- OZEKI, M., SHIMAZAKI, K. AND YI, T. (2017) "EXPLORING ELEMENTS OF DISASTER PREVENTION CONSCIOUSNESS: BASED ON INTERVIEWS WITH ANTI-DISASTER PROFESSIONALS", *JOURNAL OF DISASTER RESEARCH*, VOL.12, NO.3, Pp. 631-638.

- RYCHEN, D.S. AND SALGANIK, L.H. (2003) *KEY COMPETENCIES FOR A SUCCESSFUL LIFE AND A WELL-FUNCTIONING SOCIETY*, HOGREFE & HUBER PUBLISHERS, BOSTON, USA.
- TOYODA H. (2007) *KYO BUNSAN KOUZOU BUNSEKI [AMOS HEN]*, TOKYO SYOSEKI, TOKYO, JAPAN.
- TREHAN, S., SANZGIRI, J., LI, C., WANG, R., AND JOSHI, R.M. (2017) "CRITICAL DISCUSSIONS ON THE MASSIVE OPEN ONLINE COURSE (MOOC) IN INDIA AND CHINA", *INTERNATIONAL JOURNAL OF EDUCATION AND DEVELOPMENT USING INFORMATION AND COMMUNICATION TECHNOLOGY (IJEDICT)*, 13(2), PP. 141-165.

Student Perspectives on WhatsApp Support for Developing School Experience e-Portfolios on Google Sites

Vuyisile Nkonki, Nobulali Tsipa-Booi, and Bongo Mqokuse

Teaching and Learning Centre, University of Fort Hare, South Africa

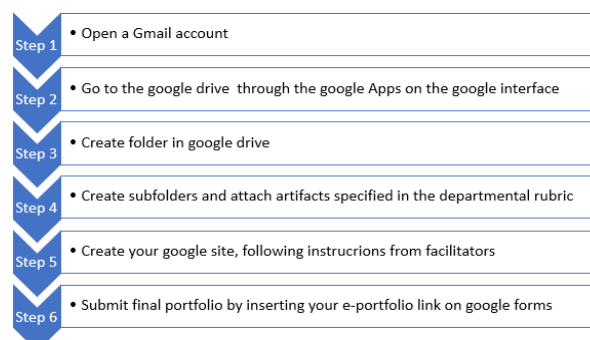
Abstract: This paper sought to reflect on the task of putting together an e-Portfolio of evidence under conditions of imposed emergency remote online teaching and learning with WhatsApp support. Student teachers in one institution had to undergo their school experience and practice teaching under emergency remote online teaching and learning. Further, these students had to produce and submit portfolios of evidence in an electronic format. Given that there were no contact lectures and tutorials during this period, WhatsApp support had to be relied on to assist these students with the development of their school experience portfolios. Informed by the e-learning ecologies framework, this study analysed the affordances of WhatsApp support in the development of e-Portfolios by student teachers in one university. First and fourth-year education students on school experience provided data through a qualitative survey in which their accounts and evaluations of interactions and support through WhatsApp were expressed narratively. Meaning units were extracted through content analysis and allotted to themes and categories suggested by the affordances framework. This study reports on the usefulness of the framework to evaluate WhatsApp support as well as the affordances that are most and least served by WhatsApp support on the development of an e-Portfolio of evidence on practice teaching. Recommendations on the efficacious use of WhatsApp support for e-Portfolio development, the practices that would foster the realisation of all the affordances, and enhancement of e-Portfolio development for the school experience are furnished.

Keywords: WhatsApp, School Experience, e-Portfolio, e-Learning Ecologies, Affordances

1. Background

The Portfolio Development team from the Teaching and Learning Centre of a University from which this study is conducted, introduced e-Portfolios of Fort Hare in 2019. The pilot was done with the Faculty of Education School Experience students. The faculty was at that time, receiving bulky hardcopy portfolios from students, and as a result, they had a challenge with storage space of these hard copy portfolios. The introduction of ePortfolios for school experience students was done, first and foremost, to provide a more practical and substantial solution to the storage challenge. This initiative changed the way of doing things as their portfolios were developed and submitted online. The rollout was in 2020 to all first and fourth-year education students on school experience. This rollout happened at the peak of the COVID-19 pandemic where there were no face-to-face or contact lectures or training sessions. The training sessions for this group of students were conducted online through Blackboard Collaborate, an official Learning Management System (LMS) that the University subscribes to. This LMS provides a function or the ability to have interactive online sessions where one can project and train students on how to develop their e-Portfolios on Google sites.

The two training sessions conducted with school experience students sought to address the following issues: (1) What is a Portfolio in general, and what an e-Portfolio is, (2) How to design and develop an e-Portfolio, (3) How to evidence an e-Portfolio, and how to align the required evidence to the School Experience rubric, (4) How to submit and publish the e-Portfolios to the assessors. These two sessions were followed by a mop-up session looking at the students' first draft of e-Portfolios and checking if they were able to apply the knowledge acquired in the first two training sessions. During these training sessions, there were no face-to-face sessions or consultations to supplement the training provided. It was, therefore, important that a different form of support for students be established. The support was to assist students with the daily challenges they face when developing their e-Portfolios through Whatsapp. A step-by-step process was developed to guide school experience students in the building up of their e-Portfolios. These steps are enumerated in a table format below:



Putting together an e-Portfolio is a complex, challenging, and daunting task. Thus, a WhatsApp group was then utilised as a means to establish a community of practice where consultants would assist students with their challenges. In contrast, at the same time, the students learn from each other and share experiences and expertise. WhatsApp was seen to be the best possible option to support learning as all students have access to it, provides instant messaging, low mobile data costs, groups can have multiple active members, can easily track messages and respond to them, and students can send both voice and text messages. Al-Mothana (2017) states that WhatsApp is a commonly available, popular, and affordable electronic tool. The writer further states that it has been integrated into university students' learning in different ways to accomplish diverse educational tasks. It provides several educational advantages for university students. WhatsApp has sought to simplify the way instruction is given to students and how they receive it. It enabled the keeping-with-times approach and allowed students to work comfortably using the platform and devices they use daily. Martins and Gouveia (2018) state that when WhatsApp is used in an educational context, it can be used in a variety of ways, such as (1) environment for discussing subjects, (2) solving problems, (3) clarifying doubts and taking courses, (4) presenting several advantages such as increased motivation and interactivity, and improvement in student-teacher relations. WhatsApp has provided an environment where discussions can happen at any given period and allow students to be free and comfortable while learning also takes place. It is a platform that students can use to maximise their interactions, anytime and anywhere.

The school experience students who are teacher trainees attend their practice teaching at various schools situated in rural and urban areas of the Eastern Cape province in South Africa. Upon return from their practicals, the students need to submit portfolios of evidence in an electronic format. The problem which was identified, before COVID-19, was the storage of a number of hard-copy portfolios. The reason behind the study is that school experience students were submitting hard copy portfolios, the COVID-19 further imposed emergency remote online teaching and learning. This situation further accelerated the need and the resultant upscaling of e-Portfolios. Due to the above-mentioned imperative, a mechanism had to be put in place to support students remotely, to ensure they submit their electronic portfolios. WhatsApp support was then initiated as an e-learning platform that would allow students to develop e-Portfolio narratives, upload their lesson notes and videos of their teaching practices, as well as submission of their evidence of practice teaching to their lecturers and the school experience co-ordinator. The objective of this paper is, therefore, to evaluate demonstrable WhatsApp affordances in the development of e-Portfolios on Google sites by student teachers on school experience. Hence, the study makes use of the affordances theoretical framework. Below, is the research question that guided the study.

- What are the affordances of WhatsApp support in the development of e-Portfolios by Fourth-year B.Ed and PGCE school experience students?

2. Literature Review

2.1 WhatsApps and Mobile Technologies

Over the years we have seen the rise in the use of mobile devices for social activity and keeping with times and threads. Mobile devices have many features that can be used for teaching and learning. It is only in recent years that we see the introduction of mobile technologies to teaching and learning. During the COVID-19 pandemic, universities a drastic shift in teaching and learning making use of online tools to save the "academic year", even the non-techno-savvy academics had no choice but to join the new normal way of teaching and learning. Mobile learning makes learning to be easily accessible anytime and anywhere. Caudill (2007) looks at the use of mobile technologies and the advantages they possess, he states learners can have the opportunity to review course materials or correspond with instructors or colleagues while sitting in a restaurant or waiting for a bus; they are not made immobile by the restrictions of desktop computer technology. Intezari, Campbell & Harmer (2015) indicate that the diffusion and appropriation of mobile technologies have made it possible for information, knowledge, and service industry work to be performed from almost anywhere and at any time. WhatsApp affords students such an opportunity to instant interaction or correspond with fellow students in the comfort of their own spaces. For this to be realised students are required to have mobile devices that have access to the wireless internet and are compatible with WhatsApp.

The internet has been incorporated into all facets of life recently, including work, play, health, and education. The COVID-19 scenario and mobility constraints resulted in a noticeable rise in all four areas of mobile internet utilization connection to video games, social networks, and instant messages in the form of WhatsApp. There

has been a noticeable increase in the use of smartphones among these gadgets, which have taken over as people's preferred method of communication, employment, and pleasure.

The educational value of WhatsApp, its wide usage, and the variety of its applications are well documented in the literature. This is because of its immediate, fast, affordable, ease of use as a means of communication, connection and the fostering of a sense of belonging (van den Berg, et al, 2022). Studies show that WhatsApp has supported teaching and Learning immensely as a communication tool and for learner-centred teaching. Other researches show that it supported certain modes of teaching and learning such as blended learning and flipped classroom. Since it allows for the sending of text messages, pictures, audio and video files WhatsApp serve an important function of augmenting reality in education as it also offers the possibility of gamification in teaching and learning (Khodabandah, 2023). Other assessed possibilities with WhatsApp include the fostering of a community of inquiry where presence is felt irrespective of where students and teachers are (Zulkanian, et al, 2020).

The research by Suarez-Lanton, (2022) found that the use of mobile tools was directly associated with student achievement, and the relationships formed in the WhatsApp group enhanced students' performance. Additionally, every single student concurred that the group talks enhanced their learning. This author made the point that using WhatsApp as a teaching tool made it easier to teach and study technical subjects such as chemistry. Additionally, efficiency, time management, active learning, decision-making, and motivation all reported significant improvements (Suárez-Lantarón, 2022)

2.2 e-Learning Ecologies and the e-Learning Affordances Theoretical Framework

The e-Learning ecologies framework is deployed as a tool to evaluate the range of possibilities and opportunities with WhatsApp which Cope and Kalantzis (2017) term affordances with technology tools and applications. The concept of "affordance" is central in the analysis of the properties of technology tools and applications that enable and/or enhance the possibility for action. The threshold criteria for an affordance are the (1) feature of technology, (2) outcome of technology use and (3) variability in the visibility of the proposed affordance. The e-Learning ecologies framework has been applied to evaluate the affordances of a number of technologies. These include smart classrooms (Montebello, 2018), digital media or new media (Montebello, et al 2018), and MUVE (Mantziou, 2018). Its applications are across disciplines and fields such as studies conducted in Computer-Mediated Communication research (Evans, et al 2017), analysis of digital language practices such as techno-discursive practices (Farias, 2021), and social media interventions for adolescent health (Moreno and D'Angelo, 2019).

Cope and Kalantzis (2017) suggest seven (7) pedagogical affordances of e-Learning, namely:

- (1) **Ubiquitous Learning:** Learning is described as occurring anywhere and anytime.
- (2) **Active Knowledge Learning:** This affordance described learning as an enabled process of designing meaning and making connections.
- (3) **Multimodal meaning-making:** In this affordance e-learning tools and platforms expand tools for knowledge representation. These include texts, images, sound, data and embedded files.
- (4) **Recursive Feedback:** Technology and/or e-learning tools enable formative assessment, timeous feedback, peer feedback, and successive and repeated support.
- (5) **Collaborative Intelligence:** Digital tools and platforms afford opportunities for multiple collaborations, synchronous and asynchronous, support and teamwork opportunities.
- (6) **Metacognition:** The digital tools and platforms afford opportunities for students to discuss their thoughts, self-assessment, strengths and weaknesses.
- (7) **Differentiated Learning:** this affordance speaks about the technology tools and platforms enabling students to learn following their interests and needs, personalization of their learning experiences, whilst progressing at their own pace.

The actor-network theory has been used to critique the concept of affordance (Wright and Parchoma, 2011). They argue that trying to understand all possible affordances leads to a logical impasse since there exists a relationship between them and the actor. They are also critiqued for having a positivist origin, unclear usage, and logical inconsistencies. They argue that the properties that enable and enhance the possibility for action are relational and not deterministic. Nevertheless, the framework is widely used in the evaluation of the affordances

of e-Learning across disciplines. The possibility for agential action, variability within each specific affordance, and the persistence of these merit its use in the evaluation of WhatsApp support for e-Portfolio development.

3. Methodology

3.1 Research Design

The study employed a qualitative survey design to canvas the views of school experience students on their experiences of WhatsApp support in the process of developing their school experience ePortfolios. Qualitative surveys consist of open-ended questions administered in a fixed and standard order to all participants. They prioritise qualitative research values since they solicit data on the participants' subjective experiences, narratives, practices, positions, and discourses. The use of a qualitative survey is justified by the fact that they enable wide, affordable and quick access to a dispersed population (Braun, et al. 2020) as is the case with education students undertaking teaching practice in different schools and across geographic districts. The students shared the results of their engagements with the ePortfolio development tasks and elaborated on interactions with other students, documents and resources, as well as with other media. Students' narrative expressions, that is, their own words served as a source of data which was later analysed quantitatively. Qualitative survey designs involve the collection of narrative data and the transformation of qualitative data into figures (Nardo, 2003). During this process, meanings and experiences are described and quantified to establish significant variations, dimensions, and values within a larger sample, a qualitative survey is most suitable (Jansen, 2010). In this research, the researchers set out to lift the affordances and possibilities that WhatsApp support accorded school experience students in the development of ePortfolios.

3.2 Sampling

The sample consisted of 111 BEd 1st and 4th-year students who participated in the e-Portfolio development workshop using Google Sites. The participants who constituted the sample were conveniently included based on their availability and ease of access since they were workshop participants. According to Onwuegbuzie and Collins (2007), convenience sampling is the purposeful selection of settings, individuals and groups based on their availability and willingness to participate in the study. They further assert that it applies to qualitative and mixed modes of inquiry.

3.3 Data Collection

Data was collected through an online questionnaire using google forms. The questionnaire has structured questions for the demographic profile of the school experience students as well as open-ended questions on WhatsApp support. Due to practical constraints imposed by the fact that e-Portfolio development workshops were conducted online, as the participants were busy with school experience and not on campus, it was practical to canvass views on the affordances of WhatsApp support online. Creswell (2013) maintains that online data collection provides participants with time, space, and flexibility to consider and respond to requests for information in a convenient, comfortable, and non-threatening environment.

3.4 Data Analysis

The study employed a qualitative survey questionnaire. With this approach, data were first analysed narratively. The analysis steps included the identification of statements and meaning units significant to the analytic framework. This was followed by the clustering of themes and textual description of extracted data (Creswell, 2013). These were then summarised into etic categories suggested by the e-Learning affordances framework. This enables one to see the functions that are better served by WhatsApp support from the representative quotes embedded in the narrative of themes.

4. Results and Discussion

4.1 Ubiquitous Learning

The WhatsApp digital platform allows for learning to occur anywhere and anytime. Given that the e-Portfolio development workshops were conducted when students were on school experience (teaching practice) in different locations, and could not be on campus, it was felt that WhatsApp should be used to support the

process. The sentiments expressed by the students show that WhatsApp enabled them to access materials and support anytime and anywhere. For example, one of the students opined that *"The WhatsApp support I got has helped me a lot because anytime I needed help, I could ask for help and get help immediately"*. The learning occurs irrespective of the place is underscored in the following experience of the student, namely: *"The support that I got made it easy for me to be able to answer all the portfolio questions very easily with just using the WhatsApp that is on my phone, instead of using a laptop that needs a WiFi because i'm not always on Campus for the WiFi, so I just use data"*.

The WhatsApp affordance of learning wherever and whensoever is validated by one of the students who revealed that *"Links were sent through WhatsApp so that it will be easier for everyone to submit even if he/she is not at school"*. One student indicated that *"When we had to create our portfolios, some of us did not know how to do it but because of the whatsapp platform we got people in the group who offered to help. Also when we had to send it, we helped each other on whatsapp, we didn't have to meet. Whatsapp made everything easy and now we are more enriched and developed"*.

4.2 Multimodal Meaning

In the e-Portfolio development process, WhatsApp demonstrated its ability to expand tools for knowledge representation. These include texts, images, sound, videos, data and embedded files. In addition, the development of multiple literacies was found to be one of the affordances of WhatsApp. For example, one of the students opined that *"communication skills and teamwork skills as we learnt to ask for help and help each other"*. The other student mentioned, *"a bit of computer skills because I didn't know anything about creating an e-Portfolio and managing it"*. One of the literacies acquired using WhatsApp for e-Portfolio development is captured in the following passage *"I developed correct use of spelling through autocorrect on WhatsApp. WhatsApp enabled me to share my ideas with my colleagues easily and enhanced good skills of working with people"*. Some of the skills and literacies acquired through WhatsApp support include information processing and the use of the Internet. For example, one of the students related that *"It has enabled us to understand and share information, it has developed the mind of understanding, and it has enriched us to the level of being able to use internet device"*. As regards the multiple tools for knowledge representation one of the students mentioned that *"At times the help given on the WhatsApp groups was really helpful as there were even pictures of demonstration"*. The use of embedded files in the development of e-Portfolio with WhatsApp support is captured in the following sentiment *"It was an easy way of accessing links using WhatsApp web"*.

4.3 Recursive Feedback

The recursive feedback concerns formative assessment, timeous feedback, peer feedback and learning support. The students' responses suggest that WhatsApp allowed them to get instant and developmental feedback from their peers. One of the students remarked that *"The WhatsApp support I got has helped me a lot because anytime I needed help I could ask for help and get help immediately"*. The feedback received was able to point out what the students needed to do differently and thus directing the students to the appropriate course of action in the e-Portfolio development process as expressed by the following sentiment: *"[WhatsApp] kept me updated and guided me on what I do wrong. For example, I re-did my portfolio because I did it incorrectly the first time"*. This feedback came mostly from the peers thus fostering peer-to-peer learning as illustrated in the following excerpt from one of the students, *"It was developing and enriching as everyone would throw in support and comment on parts where others felt confused. Sometimes the coordinators would be busy but among us students, some would answer in helping others. Enabling good communication skills and teamwork in helping each other"*. Similarly, one of the students opined that *"It was developing and enriching as everyone would throw in support and comment on parts where others felt confused. Sometimes the coordinators would be busy but within us students some would answer in helping others thus enabling good communication skills and teamwork in helping each other"*. The above sentiments expressed show the successive or repeated feedback and support sessions offered by peers through the WhatsApp platform and the significant learning that occurs each time a comment is made on the work of others.

4.4 Collaborative Intelligence

This affordance concerns multiple collaborators, synchronous and asynchronous, support and teamwork opportunities. Through WhatsApp the students were able to work collaboratively, drawing on each other's strengths. The benefit to come from this working together is captured in the following sentiment *"It's easy when*

we work in groups rather than individuals, I developed fast as I got assistance". In addition, achieving the outcome of developing an e-Portfolio in the shortest period, the development of skills such as collaboration, communication and interaction were mentioned. Some of the students made videos of themselves whilst busy with the processes of developing their e-Portfolios and these were very helpful for some of the students as is illustrated in the following excerpt *"I have gained a lot of help through my WhatsApp because some of the skills I know I got them on WhatsApp, things like how to submit the portfolio because some of my colleagues would make videos while doing the process"*. Thus, transactional learning and transfer of skills and the development of other attributes are gained through WhatsApp support.

4.5 Metacognition

This affordance deals with opportunities for students to discuss their thoughts, carry out self-assessments, and reflect on their strengths and weaknesses. Though not much was said about this affordance, a few students mentioned self-study and independent learning as some of WhatsApp's affordances in the e-Portfolio development process. For example, one of the students remarked that *"We developed being independent, doing work on your own... and improved it [e-Portfolio]"*. Another student remarked about the intellectual stimulation associated with WhatsApp support by expressing that *"The details needed are provided in steps, in a manner that is understandable... This develops us as students intellectually. It makes us pay more attention to what we're doing and focus"*. Thus, it can be said that WhatsApp support enabled some of the students to marshal their thoughts as regards the processes involved in the development of e-Portfolios.

4.6 Differentiated Learning

This affordance is concerned with learners' interests and needs, the personalization of learning experiences, and students' progress at their own pace. The sentiments expressed show that some of the students were able to display their unique personal touch in the development of e-Portfolios. For example, one of the students remarked that *"I got ideas on how to develop my portfolio and make it more attractive from the group members"*. The fact that some of the students developed their e-Portfolios at their own pace is discerned from the following comment from one of the students: *"I acquired the skill of being a fast learner and my multitasking skills were nurtured through WhatsApp"*. This differentiated learning affordance allowed students to be more expressive of their creative abilities and capacities.

The results of this particular study on the students' perspectives on the affordances of WhatsApp support for the development of e-Portfolios on Google Sites, confirm the applicability and the usefulness of the Affordances Framework across platforms, applications and disciplines (Montebello, et al 2018; Mantziou, 2018; Moreno and D'Angelo, 2019; Farais, 2021). As students have suggested, the differentiation and personalisation functions (differentiated learning) through WhatsApp were played out in the e-Portfolio development process. The self and independent learning (metacognition), as well as the sharing of ideas, resources, and resourcefulness as students draw on each others' strengths, is testimony to collaborative intelligence fostered by WhatsApp. This finding corroborates van der Berg, et al (2022) and Zulkanian, et al (2020) findings on WhatsApp ability to foster a community of inquiry and a sense of belonging. In the same manner, that WhatsApp was found to be affording instant, formative and interactive feedback (recursive feedback). The multimodal messages through texts, images, sound, videos, data and embedded files, as well as learning anywhere and anytime (ubiquitous learning) enabled by WhatsApp is in line with the findings of Khodabandah (2023) assertion that through WhatsApp the augmentation due to collation and integration of text, pictures, audio and videos. The manifestations of these affordances, though in varying degrees of intensity, in the development of e-Portfolios through WhatsApp support, corroborates and confirms the use-value of WhatsApp in supporting the development of e-Portfolios on Google Sites.

5. Conclusion

Having analysed data, the variability and persistence of the visibility of the affordances of WhatsApp support for e-Portfolio development was observed. In particular, ubiquitous learning, multimodal meaning-making, recursive feedback, and collaborative intelligence were very much intensive leading us to conclude that WhatsApp allows for learning and development of competencies to occur anytime and anywhere. It allowed for the use of multiple modes of learning delivery with repeated and timely feedback and collaboration among and between students. We conclude that WhatsApp support for e-Portfolio development is active to a limited extent on the aspects relating to personalisation of learning experiences, reflective and high-level thinking as

well as active knowledge learning and independent thought as reflected by limited visibility of students' narratives that address active knowledge learning, metacognition, and differentiated learning.

6. Recommendations

The affordances of WhatsApp in the learning and execution of complex tasks have been assessed in the development of e-Portfolios on Google Sites for school experience students and found to be effective. This paper recommends the scaling up of WhatsApp support for the development of e-Portfolios, the execution of other complex tasks, and the showcasing and evidencing of other Work Integrated Learning (WIL) practices, activities and engagements. This particular study on the affordances of WhatsApp support can be extended to other disciplines that make use of portfolios such as the Health Sciences and Social Work, especially those that are yet to transition to e-Portfolios. Careful attention and effort need to be expended on the affordances that are reported to be less served by WhatsApp support whilst consolidating those that are better served. The contemplative capacities of students engaged in professional development need to be tapped into through the use of WhatsApp for journaling purposes and active knowledge through drawing connections and meanings from their interactions with practice. The potential uses of WhatsApp for personalisation need to be deliberately and purposefully explored through further studies, particularly those that consider one affordance at a time.

References

- Al-Mothana, M.G. (2017). "University Students' use of WhatsApp and their perceptions Regarding its Possible Integration into their Education", *Global Journal of Computer Science and Technology*, Vol. 17, No.1.
- Braun, V., Clarke, V., Boulton, E., Davey, L. and McEvoy, C. (2020). The online survey is a qualitative research tool. *International Journal of Social Research Methodology*, DOI: 10.1080/13645579.2020.1805550.
- Caudill, J.G. (2007). "The Growth of m-Learning and the Growth of Mobile Computing: Parallel developments", *International Review of Research in Open and Distance Learning*, Vol. 8, NO. 2, Grand Canyon University: USA, ISSN: 1492-3831
- Cope, B and Kalantzis, M. (2017). *E-Learning Ecologies: Principles for New Learning and Assessment*. Routledge Taylor and Francis Group: New York and London. ISBN: 978-1-315-63921-5
- Cetinkaya, L. (2017). "An Educational Technology Tool That Developed in the Natural Flow of Life Among Students: WhatsApp", *International Journal of Progressive Education*, Vol. 12, No.2.
- Creswell, J.W. (2013). *Qualitative Inquiry and Research Design: Choosing Among Five Approaches*. 3rd Edition. London: SAGE Publishers.
- Evans, S.K., Pearce, K.E., Viitak, J., Treem, J.W. (2017). Explicating Affordances: A Conceptual Framework for Understanding Affordances in Communications Research, *Journal of Computer-Mediated Communication*, 22, pp. 35-52.
- Farias, J. (2021). Technodiscursive Affordances in Innovative E-Learning Ecologies: Analysing Digital Language Practices of/on the Web. *Digital Pedagogies and the Transformation of Language Education*, pp. 149-164, DOI: 10.4018/978-1-7998-6745-6.ch008
- Hui, L., Ippolito, K., Sarsfield, M. and Charalambous, M. (2023). Using a self-reflective e-Portfolio and feedback dialogue to understand and address problematic feedback expectations. *Assessment & Evaluation in Higher Education*. pp. 1-13. <https://doi.org/10.1080/02602938.2023>.
- Martins, ER. and Gouveia, LMB. (2018). "Flipped Classroom Applied To High School with WhatsApp Aid", *International Journal of Humanities and Social Science* Vol. 8, No. 10, pp. 138.
- Montebello, M. (2018). Enabling a smart classroom through new e-learning affordances, *13th International Conference on e-Learning – ICEL*, 249-255.
- Montebello, M., Cope, B. and Kalantzis, M. (2018). Deepening e-Learning through Social Collaborative Intelligence. 2018 IEEE Frontiers in Education Conference (FIE), 2018, pp. 1-4, DOI: 10.1109/FIE.2018.8658779.
- Moreno, M.A. and D'Angelo, J. (2019). Social Media Intervention Design: Applying an Affordances Framework, *Journal of Medical Internet Research*, 29(3):e11014, DOI: 10.2196/11014. PMID: 30912754, pp. 1-9.
- Pauleen, D., Campbell, J., Harmer, B., and Intezari, A. (2015). "Making Sense of Mobile Technology: The Integration of Work and Private Life", *SAGE Open April-June 2015: 1–10*, DOI: 10.1177/2158244015583859
- Pickard, M.J. (2007). "The New Bloom's Taxonomy: An Overview for Family and Consumer Sciences Education", *Journal of Family and Consumer Sciences*, Vol. 25, No. 1, pp. 45-55.
- Van den Berg, G. and Mudau, P.K. (2022). Postgraduate Students' views on the use of WhatsApp groups as an online communication tool to support teaching and learning. *Perspectives in Education*. 40 (1): 112-128. DOI: <http://dx.doi.org/10.18820/2519593X/pie.v40.il.7>
- Wright, S. and Parchoma, G. (2011). Technologies for learning? An actor-network theory critique of 'affordances' in research on mobile learning. *Research in Learning Technology*, 19 (3). <https://doi.org/10.3402/rlt.v19i3.17113>.
- Zulkanain, N.A., Miskon, S. and Syed, A.N. (2020) An adapted pedagogical framework in utilising WhatsApp for learning purposes. *Educational Information Technology*, 25, 2811-2822. <http://0-doi.org.warm.seals.ac.za/10.1007/s10639-019-10096-0>

Using Gamification to Develop Students As Strategic Thinkers: A Qualitative Perspective

Michael P. O'Brien and Yvonne Costin

University of Limerick, Castletroy, Limerick, Ireland

michaelp.obrien@ul.ie

yvonne.costin@ul.ie

Abstract: The use of gamification as an instructional strategy has gained significant attention in recent years as a way of increasing student engagement and motivation. Gamification involves the application of game design principles to non-game contexts, such as higher education. One area in which gamification has shown particular promise is in developing students' strategic thinking abilities. This qualitative study explores university students' post-module reflections on their experience of working in teams over the course of a seven-week intensive postgraduate business analytics simulation module. Reflections were analysed using thematic analysis to identify common themes and patterns with respect to students' strategic thinking in terms of decision-making. The study findings strongly suggest that gamification, particularly the use of business simulations, can be an effective tool for developing students' strategic mindsets, in terms of the process for decision-making, impact of critical incidents, the lessons they learned and corrective action taken, along with the role of the team itself.

Keywords: Gamification, E-Learning, Simulation, Higher Education, Decision-Making, Strategic Thinking

1. Introduction

This paper explores the potential benefits and considerations of using simulations to foster strategic thinking abilities in students across various educational settings. The use of business simulations in higher education has gained traction in recent years as a way to simulate real-world scenarios and provide students with a more dynamic and "real" experience in (team-based) strategic thinking and decision-making (Chernikova et al., 2020). Strategic thinking is defined as an individual, open-ended, intuitive, creative, and synthetic way of thinking, in opposition to strategic planning, which is perceived as somewhat analytical, collective, detailed, and sequential (Graetz, 2002; Liedtka, 1998). Simulations offer a realistic and immersive learning experience that can help students understand complex strategic concepts in a more practical and hands-on way. Moreover, it provides students with the opportunity to evaluate and reflect on the consequences of their actions, and allows them the agency to take appropriate corrective action. In doing so, they provide an opportunity to practice and develop a range of cognitive and non-cognitive competencies skills, not limited to managerial and leadership skills in strategic thinking, objective setting, decision-making, strategy implementation, teamwork, interpersonal skills, budgeting and cash-flow management and delivering customer value.

Simulations involve creating a realistic environment in which students can practice making strategic decisions. Simulations offer a realistic and immersive learning experience that can help students understand complex strategic concepts in a hands-on way. Coupled with this is the provision of a "safe" learning environment to practice decision-making and evaluate the consequences of their actions, thus empowering students to become more confident and competent strategic thinkers. By incorporating game design principles into educational activities, students can become more engaged and motivated to learn, while also developing important competencies and skills necessary for success in the workforce.

One of the primary advantages of gamification in higher education is its ability to boost student motivation and engagement (Dicheva et al., 2015; O'Brien & Costin, 2022). By incorporating game elements such as challenges, goals, rewards, and progress tracking, gamified learning creates a sense of excitement and purpose. Students are more likely to actively participate, explore course content, and invest greater effort when learning becomes enjoyable and meaningful. Gamification taps into students' intrinsic motivation, driving them to pursue learning objectives with enthusiasm and perseverance. It also encourages active learning by requiring students to participate, solve problems, and make decisions. This active involvement promotes critical thinking and problem-solving skills, as students analyse situations, consider multiple perspectives, and strategise to achieve desired outcomes. Through gamified activities, students are challenged to apply theoretical knowledge to real-world scenarios, fostering a deeper understanding of complex concepts and enhancing their ability to think critically and creatively (Dicheva et al., 2015; Costin et al, 2018; O'Brien & Costin, 2022).

Gamification further facilitates the provision of immediate feedback, enabling students to monitor their progress and adjust their learning strategies accordingly (Karamert & Kuyumcu Vardar, 2021). Real-time feedback helps

students identify areas for improvement, reinforces positive behaviours, and motivates them to strive for continuous growth. By visualising their progress through game mechanics like experience points, levels, or badges, students gain a sense of achievement and accomplishment, which further enhances their engagement and satisfaction with the learning process. Gamification also promotes collaboration and social interaction among students (Alzahrani & Alhalafawy, 2022). Many gamified educational platforms incorporate multiplayer features, encouraging students to work together, communicate, and share knowledge. Through team-based challenges and competitions, students develop cognitive competencies in the essential elements of teamwork, communication, and leadership skills (O'Brien & Costin, 2022).

2. Considerations for Effective Simulation-Based Learning

Effective simulation activities should align closely with the desired learning objectives and outcomes (Brazhkin & Zimmerman, 2019) and so educators must carefully design or select simulations that address specific strategic thinking competencies, ensuring relevance and applicability to the targeted domain or discipline. Clear articulation of learning goals and outcomes will guide the selection of appropriate simulations and facilitate the assessment of student progress. The availability of accessible and user-friendly simulation platforms is crucial for seamless integration into educational settings. Institutions should invest in appropriate technologies and resources to support simulation-based learning initiatives. User-friendly interfaces and intuitive controls enable students to focus on the strategic thinking aspects of the simulation rather than grappling with complex technical issues.

Effective facilitation and debriefing are essential components for consideration in simulation-based learning. Educators play a crucial role in guiding students through the simulation process, setting expectations, and providing necessary guidance and support (O'Brien & Costin, 2022), moving from the *"sage on the stage, to the guide on the side"*. Post-simulation debriefing sessions allow for reflection, discussion, and the extraction of valuable insights from the experience. Facilitators can help students connect their simulation experiences to real-world contexts and reinforce strategic thinking concepts. Simulations should be scalable and adaptable to accommodate diverse educational contexts and student populations and should be flexible enough to cater to different levels of complexity and accommodate various group sizes.

3. Gamification as a Mode for Developing Strategic Thinking

A number of authors (Washbush and Gosen, 2001; Faria et al., 2009; Wood et al., 2009; Williams, 2011; Costin et al, 2018; O'Brien & Costin, 2022) advocate the use of simulation games as an innovative pedagogical approach to teaching entrepreneurial competencies thus developing a more strategic mindset. Simulations offer students the opportunity to engage in *experiential learning*, where they actively participate and learn through direct experience (Kolb, 2015). By simulating real-world situations, students can explore complex problems, experiment with different strategies, and observe the outcomes of their decisions in a controlled environment. This hands-on approach enhances their understanding of cause-and-effect relationships, helping them develop a deeper appreciation for strategic thinking (Kolb, 2015). Fox et al., (2018) reports that simulation games engage students in realistic activities designed to increase knowledge, improve skills, and enable positive learning outcomes, which in turn promote learning. Further, simulations reflect and mirror the imperfect nature of business environments- a useful resource for entrepreneurial learning.

Simulations often require students to *collaborate and work in teams*, mirroring real-world collaborative settings (Chernikova et al., 2020; O'Brien & Costin, 2022). Through teamwork, students develop essential skills such as communication, negotiation, conflict resolution, and leadership. Collaborative simulation exercises enable students to understand the complexities of working with others, appreciate diverse viewpoints, and leverage collective intelligence to develop effective strategic plans. Furthermore, simulations provide a structured framework for reflection and feedback, facilitating the integration of theory and practice. After completing a simulation, students can analyse their decisions, evaluate their outcomes, and reflect on their strategic thinking processes. Instructors or peers can provide constructive feedback, highlighting strengths and areas for improvement. This reflective feedback loop enables students to refine their strategic thinking skills over time and enhance their decision-making abilities. Simulation games allow for an embedded approach to entrepreneurial learning, fostering students to become more skills-oriented, thus encouraging them to develop entrepreneurial competencies such as *passion* and allowing them and opportunity to develop their unique entrepreneurial identity (Costin et al, 2018).

Simulation also features a team-based approach, a focus on value creation, connecting students to the outside world and letting students act on their knowledge and skills, resulting in deeper learning. Such pedagogy extends the notion of real-world learning and immerses students in the realities of managing the interlinked functions of starting and managing a business, managing people and resources and applying leadership and role of strategies in uncertain and unpredictable environments, and the associated cognitive and non-cognitive competencies necessary for success.

Business Simulations are a useful mechanism to provide practical and immersive experiences to develop their conceptual understanding in cross-functional decision-making and analytical thinking abilities (Costin et al., 2018; O'Brien & Costin, 2022). Business simulations are advocated as an important catalyst and an effective pedagogy to enable the development of entrepreneurial competencies by providing opportunities for multiple cross-functional assessments and personal reflection to perform in an entrepreneurial/manager role.

4. The Research Approach

Business simulation games are representations of real business situations in a virtual environment/world. Business simulation games enhance learning experiences (Matute & Melero, 2016) by providing a context in which students *learn by doing* (Caulfield et al, 2012). The following two sections describe the background context of the study, the simulation game used, along with how the data were both collected and analysed.

4.1 Context of the Study

The Business Simulation module is a capstone module designed for postgraduate students completing a taught MSc degree in Business Analytics. For the most part, these students come from non-business backgrounds. The module is designed to reflect the reality of all the issues linked to entrepreneurial start-up and business growth and emphasises the development of critical thinking, decision-making and problem-solving skills. Students are challenged to think and navigate their way through all the problems and constraints presented within the game to integrate concepts successfully, cross-functionally, and from financial and non-financial perspectives.

The simulation game used for this research is 'SimVenture Evolution' (see Fig. 1). SimVenture Evolution requires logical reasoning to unravel many complex scenarios, while at the same time enabling students to monitor their progress through appraisals, as well as saving and loading simulations. The game facilitates the development of analytical thinking skills by making demands on students in a captivating and real-world manner. Instructors facilitate rather than teach to foster an inquisitive, creative and analytical mind-set, building self-confidence, and promoting teamwork.

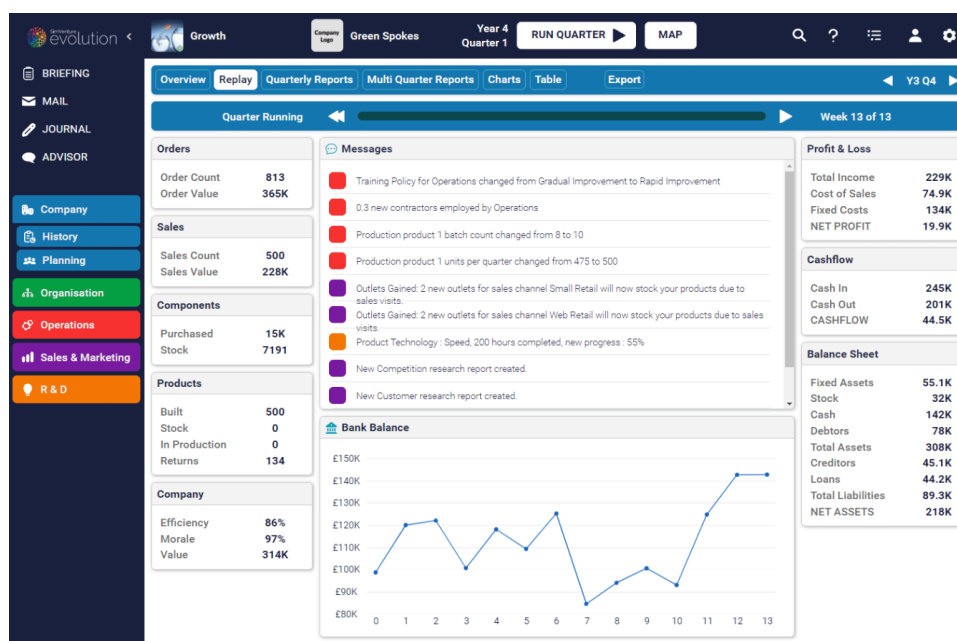


Figure 1: The SimVenture Evolution Interface

The game enables users to setup and run their own virtual company and test their knowledge about all aspects and functions of a business. At the heart of the game are the decisions made on the part of the student. The reality of the simulation combined with the on-screen information makes it a rich learning resource. In SimVenture Evolution, the user (student) is essentially an entrepreneur assembling and selling bicycles. The game commences at a pre-determined month, when the business is already several months in operation. It is the job of the student/student teams to generate a profit and a sustainable strategy for the company going forward. The core areas of the business are Sales and Marketing, Research & Development, Operations, Finance and Organisation. When a team plays the game, it is ultimately the team's responsibility to identify individual strengths and weaknesses and allocate roles accordingly. On completion of the game, the intention is that students should be able to demonstrate the ability to select and apply appropriate analytical decision-making techniques in an integrative manner, against a simulated complex business environment.

4.2 Data Collection & Analysis

A major part of the assessment for this module was a team reflection where students were required to consider and address the following themes:

1. Process for decision-making.
2. Critical incidents.
3. Lessons learned and corrective actions.
4. The Role of Team.

A qualitative research approach was carried out in the form of content analysis to identify the significant issues that arose under the key themes in the team reflections.

5. Research Findings

This section presents an analysis of the student (team) reflections within the framework of the four themes outlined in Section 3.2. By examining the data through a meticulous lens, it aims to offer meaningful interpretations, observations and conclusions based on the students' perspectives and experiences.

5.1 Theme 1: Process for Decision-Making

The findings highlight that the process for decision-making did not remain static through the student's progression in the simulation. At the outset, students observed that they had made "*knee-jerk*" and "*simplistic*" decisions, "*not giving enough thought*" to all the variables at stake and not taking into account the impact and the "*domino effect*" these decisions would have on the business. Having acknowledged this, it appeared that students experienced a very steep learning curve and made a team decision to put a process in place in terms decision-making, with some going as far as documenting the various stages the team should consider going forward. One team commented that

"a decision-making process should be followed to clearly understand all the outcomes a decision may have. After trialling different processes, a process was agreed upon due to its simplicity and effectiveness".

Alike, another team reported that their "*decision-making process is broken down into four cyclical steps: plan, prepare, simulate, and improve. We are happy to report that by following this decision-making process, the company produced excellent results*".

Coupled with this were students' realisation that they needed to "*maintain an unclouded vision of the business*" and this could only be achieved through "*a decision-making process that depended on understanding all aspects of the business to understand the consequences of our decision-making*". This was echoed by others who admitted that they "*needed to develop their decision-making skills and gain a more holistic view of the simulation*". Using and leveraging data analytics, and conducting in-depth research on both internal (e.g. sales and marketing) and external issues (i.e. competition in the market) was realised by students as issues that require consideration, and were influential in them in making more objective, strategic and non-bias decision, with one team enforcing that

"it all comes down to the numbers....our new decision-making process requires us to download tables to excel and analyse trends within the data such as sales. This allowed us to have non-biased data which can highlight positive or negative trends and the impact they will have on our decisions".

Others cited that

"While prior experience was a key component in our decision-making process we downloaded quarterly reports of company metrics.....this rapidly became our favourite and most utilised feature, allowing us to leverage data analytics to visualise data and execute decisions based on data, rather than intuition".

Similarly another group reported that

"the combination of extensive market research, data driven analysis, and research by the team turned out to be the leading resource in our successful decision-making".

This sentiment was reinforced across the cohort of students where others commented that one should *"Never rush in making decisions and invest in time for learning"* and *"Do not guess- research is necessary"* evidently showing students had developed their critical-thinking skills and had moved away from impulsive and rushed decisions.

5.2 Theme 2: Critical Incidents

Research findings highlight that the occurrence of critical incidents had an impact on students strategic thinking capability and brought them to the realisation that decision-making is not a seamless and linear process. At the outset, the data shows that students appeared to be very much in their *"comfort zone"* and they *"were doing perfectly fine and the decisions they were making were working really well"*. Respective teams reported they were making decisions on *"product improvements and modifications"*; *"introducing new products"*, *"improving our technology"*; *"we were able to fully take control of economies of scale, decreasing time in production with automation and large numbers of batches"*, however this positive attitude and confidence was short-lived as teams were challenged by a critical incident, in the form of introducing competition and competitive strategies to the game. The students were challenged to react and make tactical and strategic decisions about the business' competitive position, taking into account the competitive landscape. This brought to the fore varied and mixed feelings and responses from student teams. Some teams felt *"stupid that they didn't see this coming"*, *"it was all going to well!!....we should have known"*. It was interesting to note that some student teams had a defeatist attitude at this point and *"were lost"* and were *"doubting everything they had done to date"*, and didn't seem sure how to progress, *"don't know where to go from here"*, however others displayed a more positive attitude and commented that this *"was just a micro failure"* and addressed it by *"organising a meeting to improve their strategy and implement new decisions based on the changes in the marketplace"*. Others indicated that

"This is the first time our company made the wrong decision so we were disappointed and confused.....nevertheless, we were determined to locate the root of the problem".

In addition, the findings highlight perhaps a level of naivety and misplaced confidence amongst the students with regard to the level of consideration they gave to the influence of external factors as having an impact on their decisions. Student reflections demonstrated that they *"were so busy looking at sales"* they *"never stopped to think what competition was doing"*, others indicated they *"forgot about the external factors and based all their decisions on internal issues like training our people and bringing down the price"*. This critical incident highlighted to students that the business landscape is volatile, dynamic and uncertain and even when a decision-making process is in place, unplanned and uncontrollable critical events can disrupt even the most researched decisions. While this can be deemed a negative experience for students, the critical incidence developed their strategic thinking capability, making them aware that in making decisions, there are numerous factors at play, both controllable and uncontrollable, that need to be considered, echoed by a team that *reported that "now we know that "keeping up with the competition is an absolute must and we need to readjust our marketing strategy which is key to keeping the business afloat"*.

5.3 Theme 3: Lessons learned and corrective actions

As expected numerous lesson were learned across various levels in the simulation and positively influenced impacted on the corrective action taken by the teams, clearly evidencing progression in how students made strategic decisions. Evidently students had developed in terms of their critical thinking skills and had gained the knowledge and insights necessary to make sound and more insightful strategic decisions evidenced through their various reflections. One team in particular indicated that they *"became aware of numerous on-going issues and we were unable to pinpoint what exactly the root of the problem was"*. They tackled this by have completing *"detailed analysis"*, *"holding lengthy discussions"* and discovered that:

"the issue surrounding inadequate demand must lie within the sales and marketing department.....As a result, we decided to take a more aggressive strategic approach towards our sales channels, promotions, and branding to stimulate demands".

They also decided to *"minimise risk associated with a shortages and we to put our remedies to the test"*. Through student reflections, a logical and more in-depth train of thought is depicted resulting in a positive change in the organisation and appropriate corrective action being taken. This particular team highlighted that *"Within one quarter of making the desired changes, we noticed an instant improvement in all financial/performance outputs"*.

Experiencing and dealing with failure emerged as a key lesson learnt. When students initially engaged with simulation, there was a sense of *"frustration"* and *"discontent"* and they seemed quite *"disheartened"* when their decisions did not work. Nonetheless, the students transitioned from this state and came to an acceptance of failure and moved beyond it very quickly, showing a new confidence and resilience, reflected by one group, *"this was a game failure as a team and although we were shut down by the bank, we took many positives from this and we improved drastically as a result of next decisions....feeling more confident"*. Similarly another team reported that *"failing, presented us with opportunities to learn from our mistakes by means of preventing them in the future as well as making more informed business decisions. It wasn't a coincidence when our best company performances were directly after carefully deciding game rewinds as a result of disappointing failures"*.

The simulation also allowed the students to engage in experiential learning, experiencing the *"lived"* business world of entrepreneurs in making decisions, albeit in a simulated world, echoed in their observations,

"the simulation was a very good exercise to understand a real business scenario and practice decision-making essential for operating a company. It offered a very deep perspective into the challenges of business growth and would be an aid while practicing in the industry".

Similarly another group cited that,

"It has given more lessons than any theory could possibly give..... lessons were not only limited to running a company but also working with different individuals to realise a common goal".

The lessons learned and corrective actions theme also highlighted students understanding of how decisions are interlinked and have both direct and indirect effects across all functional areas of the business, *"no decision is ever made in isolation – everything has knock-on effects"* again benefitting and developing them as strategic thinkers. Observations from teams highlighted that *"we quickly determined that running out of space often had the most detrimental consequences on the business. Not only did it prove to lead to massive inefficiencies in each department, but it also incurred a noticeable financial cost....and so was a key part in maintaining production to meet demand"*, while another team highlighted the connection between quality, sustainability, cash flow, employee morale and stakeholder satisfaction clearly demonstrating their understanding of the connected and integrated nature of their decisions, reflected through the following observation,

"In terms of location, quality and sustainability, we always choose excellent quality, as we believe that keeping our employees in the best working environment possible will increase morale, and in turn their overall capability...also it makes the most financial sense to focus on sustainability as we discovered later, employee morale and sustainability directly influence stakeholder satisfaction with the company".

Interestingly, the topical and contemporary issue of sustainability featured again as a lesson learnt for students, with emphasis placed on its importance in terms of building and growing a business-

"The firm has built itself a reputation of being an ethical and sustainable company which employees strive to work for, other companies aim to work with, and customers want to buy from. As a result, this image is imperative to keep up, so ensuring the premises, suppliers and new designs never compromise in sustainability is essential".

The benefit of hindsight also emerged as part of the students development of as strategic thinkers, and added to this perhaps the acknowledgment and admittance that they had made incorrect decisions. Nevertheless, the learning experience was positive and students had gained the necessary knowledge and experience to make better and more informed future decisions, reflected by one team who admitted that

"while we were "aware that enough workspace, quality facilities, manufacturing capacity, batch size, and sufficient training are important factors in achieving higher efficiency values, we discovered that, due to our overly ambitious nature, we designed a new product (that was never launched) in the market;

however, to manufacture that new product, we overloaded our resources, lowering our efficiency level..... If we do get the chance to correct this, we will strive to make better decisions so that unwanted innovation is avoided and employees are not overworked, allowing for increased efficiency”.

5.4 Theme 4: The Role of Team

Research findings also point to the significant role and influence of the team in strategic decision-making. The critical success factors of the team included “collaboration”, “cooperation”, “consistent communication”, “inclusivity”, and “group and shared centred decision-making”. There was a realisation from all the student teams that all these elements were “crucial” to the projects’ success, with some teams adopting a formal approach to team management:

“At the outset, we drafted a team charter with a code of conduct and participation, communication, and problem-solving expectations that we all agreed to follow”.

Additionally, students provided all individual team members the opportunity to share their opinions and their rationale for their choices, with reflections highlighting that “it was crucial for us as a Team that everyone got the chance to voice their concerns” and “at no point was an opinion discarded, much like an open forum it was worked through and taken on board for future decision-making”. Team efforts were made to have “balanced debates on the strategic decisions being taken” and for some, “the key to a success is not just individual gut-based decisions but more informed and carefully thought-out team plans”. Clear and consistent communication was also very important “ensuring that everyone knew exactly what was happening” demonstrating high levels of commitment and cooperation within the team, with one team showing how they would “as a team discuss and develop an overall strategy while constantly having mini brainstorm sessions to iron out kinks and improve the overall efficiency of the firm”. This was echoed by others who indicated that “throughout the simulation the team dynamic was one of open discourse and discussion....disagreements were encouraged to provide alternative opinions and experiences. Students also realised that

“running a business is not an easy task and so multiple minds are required to manage different areas.....difficult for just a single person to manage and so collaboration helps us all to address those gaps and provide different advice to each other in a supportive manner”.

6. Conclusion

Simulation games have gained significant popularity in recent years as a powerful tool for learning and development. These games provide a virtual environment where individuals can engage in various scenarios and make decisions that impact the outcomes. One area where simulation games have shown remarkable effectiveness is in developing strategic thinkers.

Strategic thinking is the ability to analyse complex situations, anticipate future outcomes, and make decisions that align with long-term objectives. It requires a combination of critical thinking, problem-solving, and decision-making skills. Simulation games offer a unique platform for individuals to practice and enhance these abilities in a dynamic and engaging manner.

Through simulation games, players are exposed to a wide range of variables and uncertainties, forcing them to think critically and strategically. They must analyse information, assess risks, and consider multiple perspectives to make informed decisions. This cultivates a habit of thinking strategically and encourages individuals to adopt a holistic view of the situation, considering both short-term gains and long-term consequences. Moreover, simulation games promote collaboration and teamwork, which are essential components of strategic thinking. Many simulation games are designed for multiplayer experiences, requiring players to communicate, coordinate, and collaborate with others to achieve shared objectives. This fosters skills such as negotiation, consensus-building, and adaptability, which are vital in strategic decision-making processes.

Furthermore, simulation games often incorporate dynamic and evolving environments, reflecting the ever-changing nature of real-world challenges. Players must adapt their strategies in response to unexpected events and shifting circumstances. This develops resilience and flexibility, key attributes of strategic thinkers who can adjust their plans and approaches to achieve their goals in dynamic and uncertain environments. The benefits of using simulation games to develop strategic thinkers extend beyond individual skill development. Organisations can leverage these games for team building, leadership development, and strategic planning exercises. By simulating realistic scenarios, teams can collaboratively explore different strategies, test assumptions, and identify potential pitfalls before implementing them in the real world.

In conclusion, as demonstrated in this study, gamification offers a powerful tool for developing strategic thinkers. Simulation games provide an experiential learning environment where individuals can practice strategic decision-making, learn from their actions, and adapt their approaches. The immersive nature of such games, coupled with their ability to simulate complex and dynamic scenarios, enhances critical thinking, problem-solving, and decision-making skills. Moreover, the collaborative and team-based nature of simulation games cultivates skills in communication, negotiation, and adaptability. As organisations continue to recognise the value of strategic thinking, simulation games offer a compelling and effective means to develop this crucial skill set.

References

- Alzahrani, F.K.J. and Alhalafawy, W.S. (2022) "Benefits And Challenges Of Using Gamification Across Distance Learning Platforms At Higher Education: A Systematic Review Of Research Studies Published During The COVID-19 Pandemic". *Journal of Positive School Psychology*, Vol. 6, No. 10, pp 1948-1977.
- Brazhkin, V. and Zimmerman, H. (2019) "Students' Perceptions of Learning in an Online Multi-round Business Simulation Game: What Can We Learn from Them?" *Journal of Innovative Education*, Vol. 17, No. 4, pp 363-386.
- Caulfield, C. Maj, S. Xia, J. and Veal, D. (2012) "Shall we play a game?" *Modern Applied Science*, Vol. 6, No. 1, pp 2-16.
- Chernikova, O., Heitzmann, N., Stadler, M., Holzberger, D., Seidel, T. and Fischer, F. (2020) "Simulation-Based Learning in Higher Education". *Review of Educational Research*, Vol. 90, No. 4, pp 499-541.
- Costin, Y., O'Brien, M.P. and Slattery, D. (2018) "Using Simulation to Develop Entrepreneurial Skills and Mind-Set: An Exploratory Case Study". *International Journal of Teaching and Learning in Higher Education*, Vol. 30, No. 1, pp 136-145.
- Dicheva, D., Dichev, C., Agre, G. and Angelova, G. (2018) "Gamification in Education: A Systematic Mapping Study". *Educational Technology & Society*, Vol. 18, No. 3, pp 75-88.
- Faria A. J., Hutchinson D., Wellington W. J. and Gold S. (2009) "Developments in business gaming: A review of the past 40 years". *Simulation & Gaming*, Vol. 40, pp 464-487.
- Graetz, F. (2002) "Strategic thinking versus strategic planning: towards understanding the complementarities", *Management Decision*, Vol. 40, No. 5, pp 456-462.
- Karamert, Ö. and Kuyumcu Vardar, A. (2021) "The effect of gamification on young mathematics learners' achievements and attitudes". *Journal of Educational Technology & Online Learning*, Vol. 4, No. 2, pp 96-114.
- Kolb, D. (2015) *Experiential Learning: Experience as the source of learning and development*. 2nd ed. Pearson Education, Inc.
- Liedtka, J.M. (1998) "Strategic thinking: can it be taught?", *Long Range Planning*, Vol. 31, No. 1, pp 120-129.
- Matute, J. and Melero, I. (2016) "Game-based learning: Using business simulators in the university classroom". *Universia Business Review*, Vol. 13, No. 3, pp 72-91.
- O'Brien, M.P. and Costin, Y. (2022) "Social Interaction in Virtual Teams – An Exploratory Study of Students Undertaking a Business Simulation Module". *Proceedings of the 21st European Conference on E-Learning (ECEL)*, University of Brighton, UK, pp 323-330.
- Washbush, J. and Gosen, J. (2001) "Learning in total enterprise simulations". *Simulation & Gaming*, Vol. 32, pp 281-296.
- Williams, D. (2011) "Impact of business simulation games in enterprise education". Paper presented at the 2010 University of Huddersfield Annual Learning and Teaching Conference, University of Huddersfield, Huddersfield, UK, pp 11-20.
- Wood, R.E., Beckmann, J.F. and Birney, D.P. (2009) "Simulations, Learning and Real World Capabilities". *Education and Training*, Vol. 51, No. 5, pp 491-510.2

Challenges for Implementing Design Thinking for Social Innovation: Case Study During Online Learning

Fazlyn Petersen and Matthew Liam Killian

Department of Information Systems, University of the Western Cape, Bellville, South Africa

fapetersen@uwc.ac.za

3658437@myuwc.ac.za

Abstract: Students can play a meaningful role in solving developmental challenges. Through online learning, Third-year Information Systems students were taught Stanford's five-phase design thinking (empathise, define, ideate, prototype and test). The process helps students develop solutions to assist with the South African electricity crisis. The case study identified the challenges of implementing design thinking to build mobile application prototypes to assist with Sustainable Development Goal 7: affordable and clean energy challenges during the COVID-19 pandemic. The case study used mixed methods. Qualitative and quantitative data were collected from 28 Information Systems students using an online survey. Quantitative data were analysed using descriptive statistics. Qualitative data were analysed using content analysis. During the empathise phase, challenges were due to a lack of meaningful communication: 57% of students indicated that defining the problem was a challenge. During the ideate phase, 68% of the students stated that they struggled to create a solution. Students were required to use the Justinmind tool to develop their prototypes. However, 91% of students indicated that they struggled using Justinmind. During the final testing phase, 49% of students indicated that obtaining and incorporating user feedback was problematic. The research will provide insights and recommendations for improving the use of design thinking for social innovation during online learning.

Keywords: Sustainable Development Goal (SDG) 7; design thinking; social innovation; Information Systems students; online learning

1. Introduction

"Students have the potential to play a meaningful role in contemporary society now (empowering the innovation processes that active minorities are generating) while simultaneously equipping themselves to be the leading designers of the future (when the problems, opportunities and design modalities that are emerging today will become the new standards)" (Manzini, 2011).

The world is faced with various complex challenges including increasing poverty, food insecurity, a lack of inclusive quality education and a lack of affordable and clean energy (UN General Assembly, 2015). Electricity is a basic service required for the wellbeing of citizens (Statistics South Africa, 2018). Black African-headed households, however, have lower electricity access levels than other South African population groups (Statistics South Africa, 2019). South Africa is experiencing an energy crisis that negatively affects meeting human needs and economic growth (Salvia and Brandli, 2020). Extensive scheduled electricity cuts in South Africa, known as load shedding (Czerniewicz *et al.*, 2020), negatively impact Sustainable Development Goal (SDG) 7: access to affordable and clean energy for all.

Sustainable development goals (SDGs) are a blueprint for achieving a better and more sustainable future for all. SDGs in their recent form are a universal set of goals, targets and indicators that UN member states will use to frame their agendas and policies over the next 15 years (Hák, Janoušková and Moldan, 2016). There are challenges for achieving SDGs, in particular SDG 7: affordable and clean energy. The achievement of SDG 7 requires innovative approaches to deliver reliable and sustainable energy to Africa, especially to those with low socio-economic status (Conway *et al.*, 2019). The generation of electricity also aggravates environmental issues such as climate change and poor air quality (Mccollum *et al.*, 2017).

These challenges cannot be addressed only by government interventions (Aksoy *et al.*, 2019). Social innovation is a concept significant in scientific research, business administration, public debate and ethical controversy. Research acknowledges that only a little is known about which SDGs social innovation already addresses (Gupta, Kumar and Karam, 2019). Even with limited research, social innovation has flourished recently as a promising mechanism. Social innovation tackles the inefficiency of the existing policies and models targeting the most pressing global issues (Hagedoorn *et al.*, 2022). The literature indicates that the public sector (Rizzo, Deserti and Cobanli, 2017) and tertiary education can contribute to this cause (McCowan, 2019).

Using technology, social innovation can focus on structural changes within a social context (Satalkina and Steiner, 2022). There is a growing need, then, for university Information Systems (IS) students to develop

problem-solving and co-design skills as these skills can assist in using technology for solving these challenges (Tschimmel, 2012). Understanding contexts and user needs are likely to lead to better-designed products such as mobile applications (De La Harpe, Korpela and Van Zyl, 2015).

Design thinking uses co-design principles where users are involved in designing solutions (Pieniazek, 2016). Design thinking has been used for social innovation to design innovations and solve societal problems (Sosa, 2015). Existing literature indicates that co-design can be used in IS and Computer Science courses (De La Harpe, Korpela and Van Zyl, 2015; Snow *et al.*, 2019). The implementation occurred during traditional face-to-face classroom sessions. Covid-19 forced tertiary institutions to shut down and switch to online learning (Mhlanga and Moloi, 2020) and therefore more research is required in this context.

The research question for this study is: What are the challenges of using design thinking for social innovation during online learning?

2. Research Model

The literature highlights that design thinking can help professionals solve complex problems (Overmyer and Carlson, 2019). Placing users at the centre of the design process improves the understanding of user experience. Testing ensures that users can discover errors and retain control over solving them (Paracha *et al.*, 2019). Research shows that user participation is increasingly important to design culture and appears to heighten user satisfaction and product success (Sánchez de la Guía, Puyuelo Cazorla and de-Miguel-Molina, 2017).

As displayed in **Figure 1**, the design thinking model developed by Stanford (d.school, 2013) was used as the basis for teaching social innovation online.

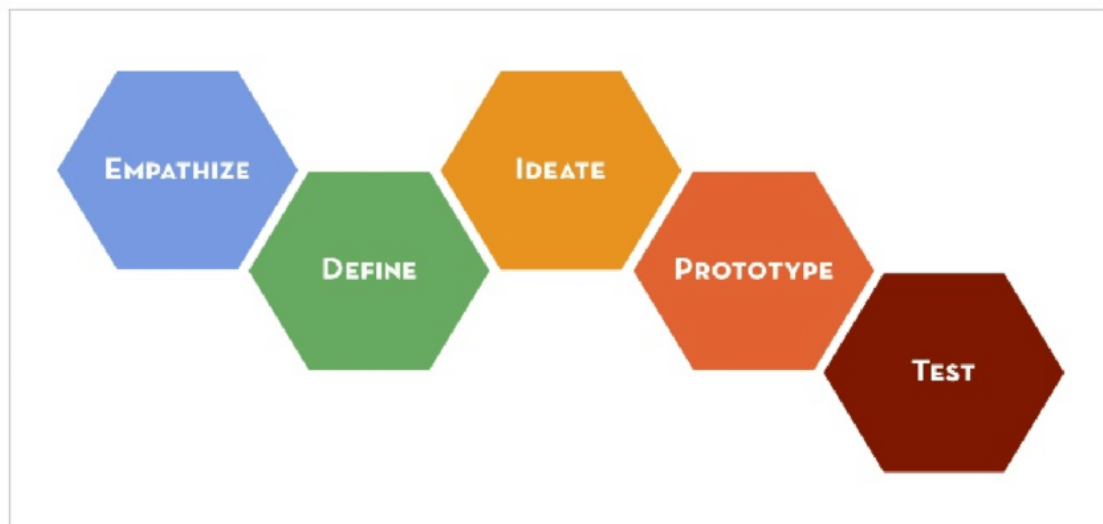


Figure 1: Design thinking (d.school, 2013)

Design thinking consists of five phases, as per the Stanford model (d.school, 2013):

1. *Empathise* – Students worked in groups of five using the institutional electronic learning management system based on the Sakai platform. Students were encouraged to recruit users from their households, as load shedding impacts most families. Empathy maps were created to identify how users feel, what they think, and what their challenges are. Students used this information to identify opportunities to meet their users' needs.
2. *Define* – Using an empathy map, students defined the scope of their project. The scope is succinctly described in a point of view (POV) statement. The POV statement serves as the basis for designing better solutions.
3. *Ideate* – Ideation means moving from obvious ideas to innovation. Students were encouraged to brainstorm to generate as many ideas as possible. Brainstorming can involve the use of sticky notes for writing ideas if conducted in a physical class. During online learning, however, students were encouraged to use a virtual board, Google Jamboard, to post electronic sticky notes.

4. *Prototype* – Unlike ideation, judgement is applied in this phase. This phase allowed students to select and develop ideas from the ideate phase that their users felt may work. The objective is to build a fast, low-cost version of the product so that if it fails, it will ‘fail fast and fail cheap’. Prototyping prevented teams from spending significant time or money in efforts that do not meet their user requirements.
5. *Test* – Testing allows users to provide feedback on the prototypes developed. Feedback allowed prototypes to be improved through an iterative process. Changes to prototypes can be made quickly and with little cost.

The five design thinking phases are more likely to occur iteratively than sequentially. For example, after obtaining feedback from users in testing, students may go back to the ideation phase to create better ideas.

3. Research Method

This case study was used to identify the challenges of implementing design thinking to develop solutions for SDG 7: affordable and clean energy challenges. The case study was conducted at a historically disadvantaged tertiary institution in South Africa during the COVID lockdown. Students at the institution are predominantly students of colour from lower socio-economic status (University of the Western Cape, 2021). The tertiary institution was not able to conduct face-to-face lectures due to COVID-19 social distancing restrictions. Virtual classes via Zoom were limited due to the high cost of data. The lecturer encouraged the use of WhatsApp or the data-free Moya instant messenger so that group members could work together, despite data challenges. The third-year Information Systems students were encouraged to incorporate the use of mobile applications or technology as part of their social innovation. This is due to increasing number of South Africans having access to mobile phones (Statistics South Africa, 2019). Technology could also be used to overcome social distancing restrictions during COVID-19.

Qualitative data were collected using open-ended questions. Content analysis was used to analyse the qualitative data. Qualitative and quantitative data were collected via an online survey from 28 third-year Information Systems students.

Content analysis is a research method used to systematically analyse qualitative data to identify patterns, themes, and categories within the data. The following steps were used:

- **Data Preparation:** The qualitative data collected from the online survey used open-ended questions that were compiled and organised for analysis.
- **Familiarisation:** Researchers familiarized themselves with the data by reading through the responses multiple times. This helped gain a comprehensive understanding of the students' perspectives and experiences regarding the challenges faced during the design thinking process.
- **Coding:** Researchers then applied codes to the data by using a predefined code book. The code book involved assigning labels to specific portions of the data that correspond to certain concepts, ideas, or themes. In this case, the codes were related to the challenges encountered during each phase of the design thinking process (empathise, define, ideate, prototype, and test).
- **Categorisation:** Once the coding process was complete, researchers organised the coded segments into broader categories or themes. These categories represent higher-level concepts that emerged from the data, capturing the main challenges students faced during each phase of the design thinking process.
- **Data Analysis:** Researchers analysed the categorised data to identify patterns and trends. They examined the frequency of different codes or categories to determine the prevalence of specific challenges. Descriptive statistics was used to summarise the findings.

Quantitative data were collected via a 5-point Likert scale from unimportant to very important. Descriptive statistics were used to analyse quantitative data. Ethical considerations from the University of the Western Cape were observed. Students had to provide consent for their data to be used for research purposes. Unique identifiers, such as student names and numbers, were removed to ensure anonymity. Data was stored in a secured file. The file was only shared with the research team to maintain data privacy.

4. Results and Discussion

The demographic analysis in **Figure 2** indicates that most respondents were male (82%) while 18% were female.

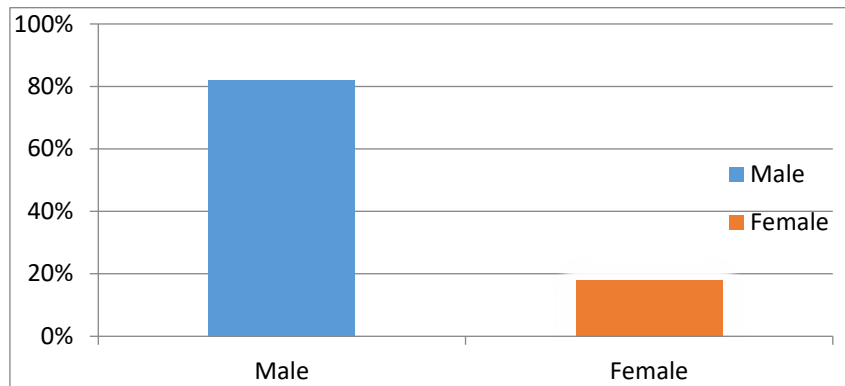


Figure 2: Student demographics

4.1 Empathise Phase

Based on the quantitative data, most students (92%) indicated that the empathise phase is an important (35%) or very important (57%) part of the design thinking process for a successful social innovation outcome. The remaining 8% of students were neutral.

Content analysis indicated that students faced many challenges during this phase. The largest percentage of students (32%) indicated that communication with users was a challenge for them. Responses to accentuate this included: *“Not being able to physically interview the user to get a better understanding of their thoughts and feelings”* (female student) and *“The design process was a bit of a struggle as we are currently in lockdown and people who we actually wanted to get information from could not be contacted due to data concerns”* (male student).

Other challenges included choosing which questions to ask users (43% of students). Getting user feedback was also indicated as a challenge by 14% of students; and 3% of students highlighted logistics and that meeting all project requirements was challenging. The literature indicates that taking the initiative to contact potential users and observing them was difficult initially (Fabri, 2015). However, this study was not conducted during a stage when social distancing was required.

The qualitative data also evidenced what students believed worked well during the empathise phase. **Figure 3** highlights that 39% of students believed that the interview worked well. Half the students (50%) indicated that it allowed them to understand their users better. This finding is supported by the literature (Wolcott *et al.*, 2021): the empathise phase allows students to understand the user experience.

A smaller number of students (7%) stated that communication with users worked well. The smallest number of students (3%) indicated that data gathering worked well during this phase.

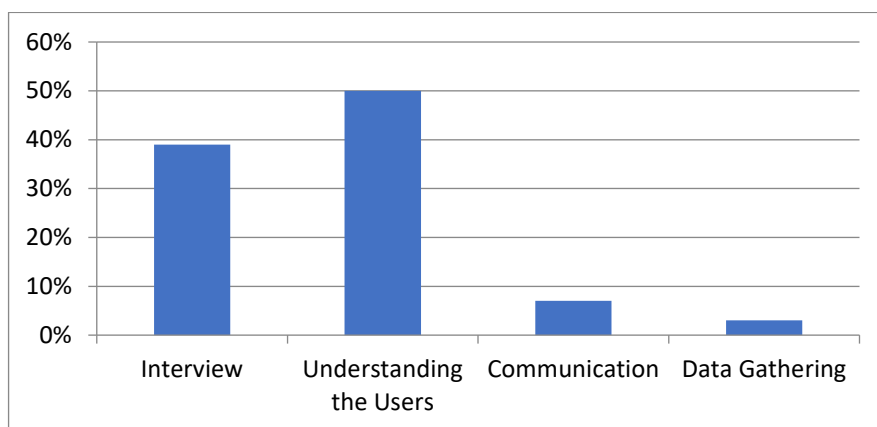


Figure 3: What worked during the empathise phase

The students provided suggestions to improve the empathise phase: 32% stated that they would prefer to have face-to-face communication with their users. The literature supports the need for open communication (Corbera, 2018). A few students (3%) indicated that they needed more time during this phase. The same percentage of students (3%) indicated that they needed more help constructing a proper empathy map and that there should be more group meetings.

4.2 Define Phase

Most of the students (89%) highlighted that the define phase is a very important or important part of the design thinking process for a successful social innovation outcome. A small percentage of students (11%) were neutral.

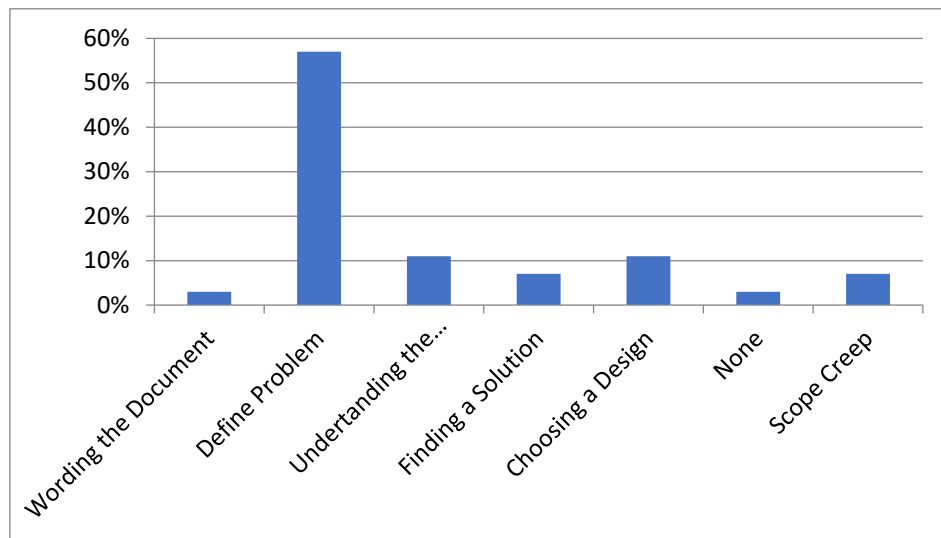


Figure 4: Define phase challenges

As displayed in **Figure 4**, about half the students (57%) highlighted challenges during this phase, including defining the problem. This was evident in responses like, *“Coming to a joint consensus of what we believed to be the most effective and accurate POV (point of view) for our collection of users, this was a challenge as in all group things when trying to reach a consensus more time is required than if one were to have full control as an individual”* (male student) and, *“Defining the problem and figuring out solutions. It was a challenge to connect clean energy, load shedding and coronavirus”* (male student).

According to 11% of the students, choosing a design was a challenge and understanding the questions that were asked in the assignment was a challenge. Scope creep and finding a solution were challenging for 7% of students; 3% indicated that wording the document correctly was a challenge; and 3% had no challenges.

Students also identified what worked well during this phase, with 86% indicating that defining the users’ problem worked well. A small percentage of students (3%) stated that the following worked well:

- Delegating member roles,
- Choosing a design,
- Group communication and
- Data analysis.

Students offered several suggestions to improve this phase: 11% recommended that user needs must be properly understood and that students should focus on more than one user; and 7% of students suggested the following:

- Focus on one issue,
- Add one more step in the define phase and
- Have more than one solution.

Only a few students (3%) stated that the layout of the define phase in the assignment should be improved. Another 3% indicated that a tutorial should be added on how to do this phase correctly. Another 3% recommended that focus be on more than one issue.

4.3 Ideate Phase

Responses on the importance of the ideate phase as part of a design thinking process for a social innovation outcome were mostly positive (71%). Many students (57%) expressed that this phase was very important; 21% stated that it was important; and the remaining students were neutral.

As per **Figure 5**, students faced several challenges during this phase. Interestingly, 68% of the students highlighted that they struggled to come up with a solution. This finding is supported by the following response: *“Creating various viable solutions to make sense and solve the problem as well as asking the user the right questions and making them understand it. The challenge was communicating our ideas and solutions to the user”* (male student). The literature emphasises that generating new ideas is a critical part of social innovation (Goi and Tan, 2021).

Only 3% of students stated that the mind map was the most challenging part, while 7% indicated that they struggled with communication and completing the opportunity analysis canvas.

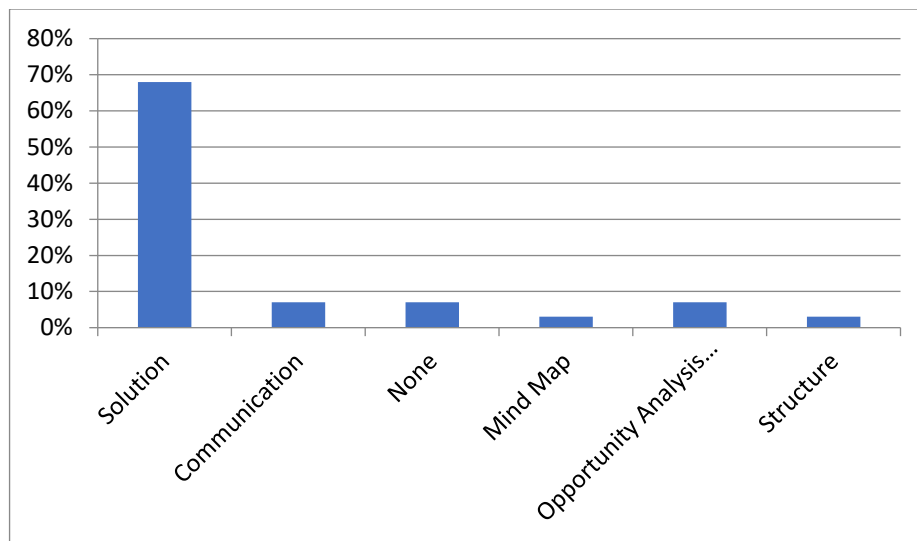


Figure 5: Ideate phase challenges

However, some items worked very well during this phase. Just over half (54%) stated that coming up with a solution worked well during this phase. As brainstorming serves idea generation (Fabri, 2015), 36% indicated that brainstorming worked during this stage. Only a small percentage (7%) indicated that mind maps worked well. The opportunity analysis canvas was used to identify opportunities and constraints. The idea is to select ideas that are more suitable for implementation. However, only 3% said that the opportunity analysis canvas worked well during this phase.

Students provided suggestions to improve the ideate phase: 11% indicated that the instruction was inadequate for doing this part properly, so more instruction should be provided. Students expressed their desire for more face-to-face communication during this phase; 18% suggested that there be a limit to the number of ideas one can generate; and 7% of the students provided multiple suggestion:

- There should be more than one idea.
- Users should be involved more during this phase.
- Brainstorming in this phase would be beneficial.
- Applying the ‘keep it simple stupid’ (KISS) principle during this phase would simplify the work.

4.4 Prototype Phase

Prototyping is identified as a method to generate and test innovative ideas (Braz *et al.*, 2019). There was little consensus on the importance of this phase of the design thinking process: 68% said it was very important; 18% said it was important; 3% were neutral; and 11% indicated that it was unimportant.

As per **Figure 6**, students faced one major challenge: 91% stated that they struggled to use the required prototyping tool, as highlighted by the following quote: *“Just let us use any prototyping tool that we may without having to justify why we used a different prototyping tool so there can be more freedom in the designing of the*

prototype, as this would've saved time during this stage instead of spending so much time in figuring out Justinmind and struggling with internet or just give us a free prototyping tool that won't give problems" (male student).

Minor challenges were raised by 3% of students:

- They struggled to come up with a solution.
- They struggled to obtain proper user feedback.
- They struggled with time management in this phase.

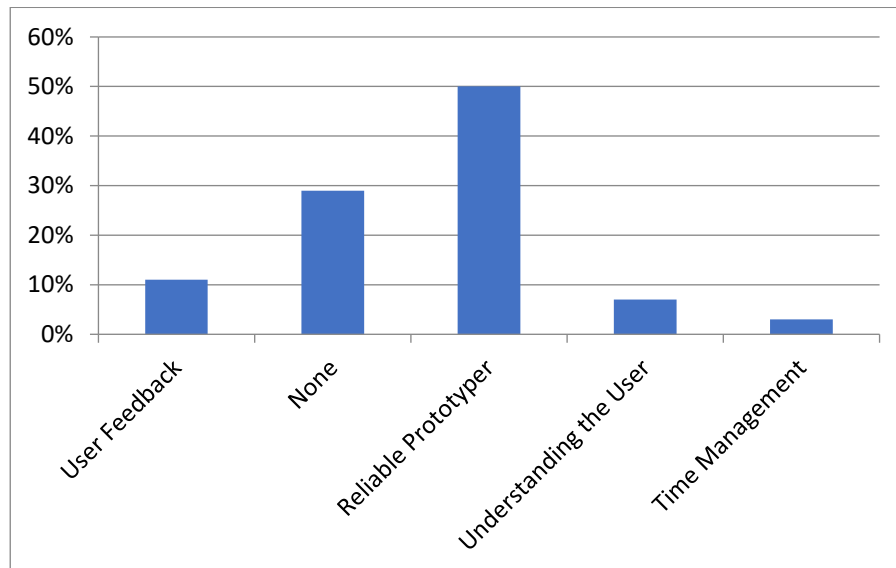


Figure 6: Recommendations to improve the prototype phase

According to the students, there were a few things that worked during this phase: 14% indicated that finding a solution during this phase worked well; 67% stated that using a reliable prototyping tool worked well for them during this phase; and a small number of students (3%) indicated that communication worked for them. Another 3% admitted that critical thinking worked well for them during this phase. But only 3% indicated that the execution of the project worked and defining group member roles during this phase worked well for them.

Students provided interesting suggestions to improve this phase: 50% suggested that a better prototyping tool should be given to them to use, or they should be able to select the one to use; 11% indicated that user feedback should be prioritised during this phase, expressing that users were not given enough time to use the prototypes before sending in their responses. A small percentage of students (7%) indicated that understanding the user should be a priority during this phase, while 3% needed more time to complete this phase. However, 29% said that the phase is fine the way it is, offering no suggestions for improvement.

4.5 Test Phase

Data indicate that the test phase was the most important of all the phases. The responses as to the importance of this phase were very good: 75% stated that it was very important and 25% stated that it was important. Testing can prepare Information Systems students for user testing in their future careers (Paracha *et al.*, 2019).

User feedback during this phase was very well received by the students: 86% highlighted that user feedback worked very well during this phase, and 14% indicated that the technical overview worked very well and helped them during this phase.

About half the students (49%) highlighted that getting and using user feedback was a challenge for them. According to one student, *"The feedback helped but some points made by the users were vague"* (male student). This comment is supported by another male student: *"We couldn't understand user's suggestions because they weren't clear enough"*.

The technical overview was a challenge for 14% of the students during this phase, with 7% stating that using the prototyping tool they were assigned was a challenge for them. Only 3% of the students indicated the following

challenges: adding new features to the prototype and finding their target market for their prototype. However, a larger percentage (21%) expressed that they faced no challenges during this phase.

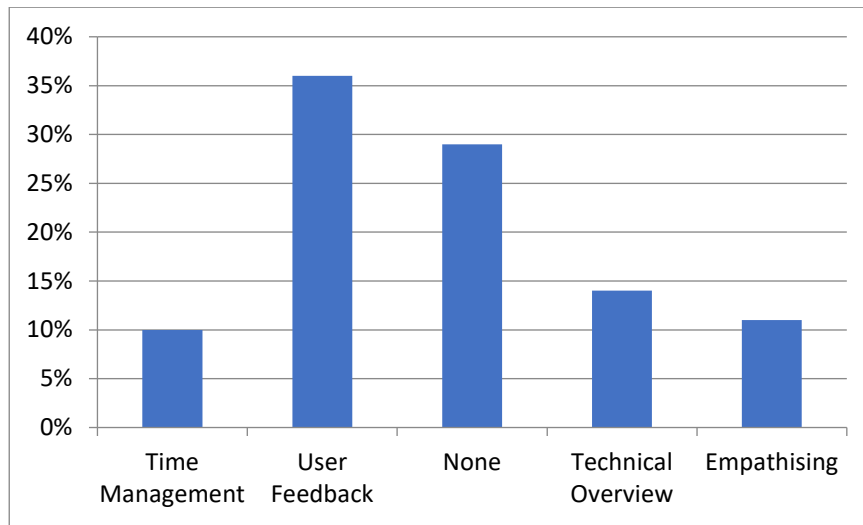


Figure 7: Suggestions to improve the test phase

As per **Figure 7**, suggestions were provided to improve this phase: 36% believed that understanding the user should be prioritised during this phase; 10% stated they should be given more time during this phase; 14% believed that the technical overview should be explained better and in more detail; 11% indicated that empathising with the users is important and should be prioritised during this phase. However, 29% were happy with this phase and gave no suggestions.

5. Conclusion

To objectives of this study were to identify the challenges of implementing design thinking for social innovation during online learning. The study also makes recommendations to improve design thinking to ensure a successful social innovation outcome.

This study found that students believe that all steps of the design thinking process are important, helping students to implement a successful social innovation outcome. The study also confirmed the importance of communication with teams and users during the design thinking process. A lack of communication, especially with users, dampened the level of experience during some of the phases of the design thinking process. Students faced several common challenges, with most of the challenges encountered during the prototype phase.

The study showed that the test phase was the phase most enjoyed by the students, verifying the eagerness of students to implement the final product of their designs. Most students agreed that design thinking is an effective approach for social innovation. Students confirmed that the development of their social innovation output was successful.

The study contributes to identifying challenges for using design thinking for social innovation for achieving SDG 7. Due to the limited sample size, more research should be completed to allow for greater generalisability.

References

- Aksoy, L. *et al.* (2019) 'Transforming Business Education through Social Innovation: from Exalting Heroes to Engaging our Humanity', *Humanistic Management Journal*, 4(2), pp. 239–259. Available at: <https://doi.org/10.1007/s41463-019-00068-4>.
- Braz, R. dos S. *et al.* (2019) 'Design Thinking and Scrum in Software Requirements Elicitation: A Case Study', in *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*. Springer Verlag, pp. 179–194. Available at: https://doi.org/10.1007/978-3-030-23570-3_14.
- Conway, D. *et al.* (2019) 'Exploring hybrid models for universal access to basic solar energy services in informal settlements: Case studies from South Africa and Zimbabwe', *Energy Research and Social Science*, 56, p. 101202. Available at: <https://doi.org/10.1016/j.erss.2019.05.012>.
- Corbera, G. (2018) *Design Thinking and Conservation in the Era for Sustainable Development: Global Interpretations of Conservation*.

- Czerniewicz, L. et al. (2020) 'A Wake-Up Call: Equity, Inequality and Covid-19 Emergency Remote Teaching and Learning', *Postdigital Science and Education*, 2(3), pp. 946–967. Available at: <https://doi.org/10.1007/s42438-020-00187-4>.
- d.school (2013) 'Design Thinking Bootleg'. Stanford University, p. 90. Available at: <https://dschool.stanford.edu/resources/design-thinking-bootleg>.
- Fabri, M. (2015) 'Thinking with a new purpose: Lessons learned from teaching design thinking skills to creative technology students', in *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*. Springer Verlag, pp. 32–43. Available at: https://doi.org/10.1007/978-3-319-20886-2_4.
- Goi, H.C. and Tan, W.-L. (2021) 'Design Thinking as a Means of Citizen Science for Social Innovation.', *Frontiers in sociology*, 6, p. 629808. Available at: <https://doi.org/10.3389/fsoc.2021.629808>.
- Gupta, S., Kumar, V. and Karam, E. (2019) 'New-age technologies-driven social innovation: What, how, where, and why?' Available at: <https://doi.org/10.1016/j.indmarman.2019.09.009>.
- Hagedoorn, J. et al. (2022) 'Social innovation, goal orientation, and openness: insights from social enterprise hybrids', *Small Business Economics* [Preprint]. Available at: <https://doi.org/10.1007/s11187-022-00643-4>.
- Hák, T., Janoušková, S. and Moldan, B. (2016) 'Sustainable Development Goals: A need for relevant indicators', *Ecological Indicators*, 60, pp. 565–573. Available at: <https://doi.org/10.1016/J.ECOLIND.2015.08.003>.
- De La Harpe, R., Korpela, M. and Van Zyl, I. (2015) 'Co-design for development: Lessons learnt from an information systems project in underserved communities', in *Lecture Notes in Business Information Processing*. Springer Verlag, pp. 61–74. Available at: https://doi.org/10.1007/978-3-319-21783-3_5.
- Manzini, E. (2011) 'Design schools as agents of (sustainable) change: A Design Labs Network for an Open Design Program', in *Researching Design Education 1st International Symposium for Design Education Researchers CUMULUS Association//DRS SIG on Design Pedagogy.*, pp. 9–16. Available at: <http://www.nutrireilano.it> (Accessed: 26 March 2020).
- McCollum, D. et al. (2017) *SDG7: Ensure access to affordable, reliable, sustainable and modern energy for all*. Available at: <http://pure.iiasa.ac.at/id/eprint/14621/1/SDGs-interactions-7-clean-energy.pdf> (Accessed: 24 November 2020).
- McCowan, T. (2019) *Higher Education for and beyond the Sustainable Development Goals Introduction*. Cham: Springer International Publishing (Palgrave Studies in Global Higher Education). Available at: <https://doi.org/10.1007/978-3-030-19597-7>.
- Mhlana, D. and Moloi, T. (2020) 'COVID-19 and the digital transformation of education: What are we learning on 4ir in South Africa?', *Education Sciences*, 10(7), pp. 1–11. Available at: <https://doi.org/10.3390/educsci10070180>.
- Overmyer, T. and Carlson, E.B. (2019) 'Literature Review: Design Thinking and Place', *Journal of Business and Technical Communication*, 33(4), pp. 431–436. Available at: <https://doi.org/10.1177/1050651919854079>.
- Paracha, S. et al. (2019) 'Co-design with Children: Using Participatory Design for Design Thinking and Social and Emotional Learning', *Open Education Studies*, 1(1), pp. 267–280. Available at: <https://doi.org/10.1515/edu-2019-0021>.
- Pieniazek, M. (2016) 'Design thinking for social innovation', in C. Durkin and R. Gunn (eds) *Social Entrepreneurship: A Skills Approach*. Second. Policy Press, University of Bristol: Bristol, UK, pp. 65–70. Available at: <https://doi.org/10.2307/j.ctt1t8917t.13>.
- Rizzo, F., Deserti, A. and Cobanli, O. (2017) 'Introducing Design Thinking in Social Innovation and in the Public Sector: a design based learning framework', *European Public & Social Innovation Review*, 2(1), pp. 1–17. Available at: <https://doi.org/10.31637/epsir.17-1.9>.
- Salvia, A.L. and Brandli, L.L. (2020) 'Energy Sustainability at Universities and Its Contribution to SDG 7: A Systematic Literature Review', in *World Sustainability Series*. Springer, pp. 29–45. Available at: https://doi.org/10.1007/978-3-030-15604-6_3.
- Sánchez de la Guía, L., Puyuelo Cazorla, M. and de-Miguel-Molina, B. (2017) 'Terms and meanings of “participation” in product design: From “user involvement” to “co-design”', *Design Journal*, 20(sup1), pp. S4539–S4551. Available at: <https://doi.org/10.1080/14606925.2017.1352951>.
- Satalkina, L. and Steiner, G. (2022) 'Social Innovation: A Retrospective Perspective', *Minerva* [Preprint]. Available at: <https://doi.org/10.1007/s11024-022-09471-y>.
- Snow, S. et al. (2019) 'Design jam as a pedagogy: Teaching design thinking to computer science students at scale', in *ACM International Conference Proceeding Series*. ACM, pp. 128–137. Available at: <https://doi.org/10.1145/3369457.3369468>.
- Sosa, R. (2015) 'Beyond “Design Thinking”', in *IASDR International Association of Societies of Design Research*. Available at: https://www.researchgate.net/publication/283856180_Beyond_Design_Thinking.
- Statistics South Africa (2018) 'General Household Survey, 2018', *Statistical Release P0318* [Preprint], (May). Available at: <http://www.statssa.gov.za/publications/P0318/P03182018.pdf>.
- Statistics South Africa (2019) *Inequality Trends in South Africa*. Pretoria. Available at: <https://www.statssa.gov.za/publications/Report-03-10-19/Report-03-10-192017.pdf> (Accessed: 6 September 2022).
- Tschimmel, K. (2012) 'Design Thinking as an effective Toolkit for Innovation', in *Proceedings of the XXIII ISPIM Conference: Action for Innovation: Innovating from Experience*. Barcelona.
- UN General Assembly (2015) 'Transforming our world : the 2030 Agenda for Sustainable Development', *UN General Assembly* [Preprint]. Available at: <https://doi.org/10.1080/02513625.2015.1038080>.
- University of the Western Cape (2021) *Institutional operating plan 2021-2025*. Cape Town. Available at: <https://n2r6x9i3.stackpathcdn.com/files/files/UWC-IOP-Full-rev3.pdf>.

Wolcott, M.D. *et al.* (2021) 'Using Design Thinking to Explore Rural Experiential Education Barriers and Opportunities.', *Journal of medical education and curricular development*, 8, p. 2382120521992333. Available at: <https://doi.org/10.1177/2382120521992333>.

Boosting Digital Entrepreneurship in European Union Higher Education

Ioana Crina Pop-Cohuț and Anca Otilia Dodescu

University of Oradea, Faculty of Economic Sciences, Oradea, Romania

ipop@uoradea.ro

adodescu@uoradea.ro

Abstract: Digital entrepreneurship creates varied options and new development perspectives for entrepreneurs, connects entrepreneurship with technological development, creativity, innovation, the accumulation of digital skills and more. Within it, e-business represents one of the fastest growing phenomena in the business world. Digital entrepreneurial education represents a new important challenge in education to prepare youth for technological changes, new requirements and digital skills necessary for choosing a career and finding a job. Nowadays, the development of technology-based entrepreneurship education programs is essential. To face new challenges, students must use digital tools to accumulate entrepreneurial skills. Starting from the priorities of The Digital Education Action Plan (2021-2027) of the European Commission, the article aims to investigate whether digital entrepreneurship education keeps pace with the pace of development of digital entrepreneurship. It presents the current state of the academic educational offer in the EU in the field of e-business and e-commerce and proposes a conceptual model of driving forces for boosting digital entrepreneurship education. This study can be of interest both for decision-makers in the field of education, researchers, teaching staff in the sense of proposing and developing new educational programs, as well as for youth who want to know the academic options for choosing a career in the context of the digital economy.

Keywords: Digital Skills, Digital Entrepreneurship, Digital Entrepreneurship Education, E-Business Program, E-Commerce Program, European Union.

1. Introduction - The European Framework for Digital Entrepreneurship Education

Digital transformation of the European Union by 2030, as a priority objective set by the Digital Decade policy agenda (European Commission, 2021a), requires, in an open and interconnected world, the creation and implementation of sustainable, people-centered digital policies that empower people and businesses (European Commission, 2021b). Europe needs digitally capable citizens, a digitally skilled workforce and many more digital experts than today (European Commission, 2021c).

In this context, was developed the Digital Education Action Plan (2021-2027) (European Commission, 2021d), which aims to make effective use of digital learning technologies and resources in education and training, places particular emphasis on the importance of including digital learning which can provide more personalized, interactive and learner-friendly learning (European Commission, 2021d).

1.1 Digital Skills and Traditional versus Entrepreneurship Education

Although over the last 4 years the level of digital skills has continued to rise slowly in the EU (54% of people with basic digital skills, 26% with higher basic digital skills) (European Commission, 2022a), digital skills indicators are strongly influenced by socio-demographics (e.g., 79% of highly educated people, 77% of students, and 71% of youth possess at least basic digital skills) (European Commission, 2022a). The situation is different for the age category 13-14 years, more than 33% do not possess the most elementary level of digital competence (Fraillon et al, 2020). A survey of more than 5,700 respondents aged 16-25 (71% aged 16-18), conducted in 17 countries, shows that education that builds future-oriented skills is more important than traditional school (69%) want more opportunities for career development and entrepreneurship and 67% want programs that develop digital literacy (Advani, 2021).

To meet the needs of the knowledge society and to use technology effectively to design rich and engaging learning experiences for young people, teachers need to develop their digital skills, and universities need to reshape their curricula, organizational structures and pedagogical practices (Islam et al 2018).

1.2 EntreComp and DigiComp can and Must create Entrepreneurial Digital Learning Environment

Entrepreneurship depends on creating cultural, social or economic value and encompasses a broad typology of entrepreneurship such as: inclusive entrepreneurship, social entrepreneurship, green entrepreneurship and digital entrepreneurship (European Commission, 2016a). EntreComp reflects the complexity of the field of entrepreneurial competences, and can be used as a reference for curriculum design in the formal education and

training sector, for activities and programs in non-formal learning contexts.

Entrepreneurial and digital skills (European Commission, 2016b) can be developed through entrepreneurial education and training that focuses on designing an entrepreneurial mindset and entrepreneurial behavior. The entrepreneurial learning environment needs to be complemented with digital tools that build digital skills. This creates an Entrepreneurial Digital Learning Environment, which can be used in both formal and non-formal learning and includes components such as: web platforms, MOOCs, e-testing, webinars, e-books, video sequences, business games and simulations, podcasts and social networks. (Malach and Kylis, 2019).

2. Purpose, Research Questions and Research Methodology

Taking into account, on the one hand, the EU general framework for digital education and entrepreneurship education, and on the other hand, the state of digital literacy and educational preferences of young people, the main objective of the article is to analyze the offer of university programs associated with digital entrepreneurial education in the EU universities, with the aim of proposing a conceptual model of the driving forces that can lead to the promotion and development of digital entrepreneurial education.

The article is structured as follows: digital entrepreneurship - theoretical back-ground, which, in addition to the concept of digital entrepreneurship, summarizes the main research fields identified in academic publications; follows the analysis of academic digital entrepreneurship from the perspective of digital entrepreneurial education with an emphasis on the formation of new digital skills; then identifying the pioneers of digital entrepreneurial education in the field of e-business and e-commerce to see examples of good practice from other universities in the world; the status of the e-business and e-commerce educational offer in Europe. Follows the conceptual model of the driving forces that could determine the development of digital entrepreneurial education in the EU. In the last part of the article, findings are followed by discussions, conclusions and future research directions.

Research questions

In order to achieve the above objectives, the following research questions (RQ) were formulated:

RQ1 Digital entrepreneurship research resources are used in the rethinking of digital entrepreneurial education?

RQ2 Are there specific university programs in EU that support digital entrepreneurship education?

RQ3 What are the main driving forces that could determine a boost of digital entrepreneurship education in the EU?

Research methodology

In order to get an overview of the current progress in digital entrepreneurship research and digital entrepreneurship education, we used bibliometric analysis through academic research databases and the most used search methods used by young people.

3. Digital Entrepreneurship – Theoretical Background

3.1 Digital Entrepreneurship – Typology and Research Areas

Digital entrepreneurship stimulates innovation, shapes consumer values, opens markets, reduces transaction costs, intensifies economic and social interactions through digital technologies, increases welfare, increases labor productivity and the efficiency of innovative entrepreneurial activities (Kraus and Marchenko, 2021).

Digital entrepreneurship can generally be defined as any entrepreneurial action that converts a physical asset, a digital service, or a significant portion of the firm. By bringing businesses online and using electronic means of communication to run them, digital entrepreneurship thereby fills the gap between traditional entrepreneurship and the digital domain.

An analysis of the number of studies on digital entrepreneurship conducted by Long. D et al (2022) shows an increase in researchers' attention to this area of study. Between 2003 and 2017, with an average of 2 papers published per year, digital entrepreneurship research began to grow in vitality, reaching 184 papers in 2021 (Long et al, 2022). There has been a lot of concern in the scientific literature in recent years about the study and conceptualization of digital entrepreneurship. The typology of digital entrepreneurship is outlined by Hull et al 2007, and includes: mild digital entrepreneurship (involves venturing into the digital economy as a supplement

to more traditional venues), moderate digital entrepreneurship, (focus on digital products, digital delivery etc.), extreme digital entrepreneurship (the entire venture is digital, including production, the goods or services themselves, advertising, distribution, and the customers) (Hull et al 2007). Studying how digital technology characteristics influence digital entrepreneurship (Nambisan, 2017), as well as analyzing and identifying themes related to digitization, namely - openness, affordance and generativity (Nambisan et al 2019), digital entrepreneurship needs to be investigated from the perspective of digital technologies as a facilitator, outcome or context of entrepreneurial actions (Recker and von Briel, 2019; Baskerville et al 2020, Giones and Brem, 2017). Digital entrepreneurship studied from the perspective of The New Venture Idea, Digital Artifacts (for software-based products and objects such as apps, artificial intelligence and machine learning, etc. and secondary software products such as media and other digital content) and Digital Platforms (software-based systems designed to host complementary offerings, matching between vendors and consumers) (Nambisan, 2017; Buckley et al 2022).

Based on a review of the scientific literature, Kraus et al (2018) analyses new digital business models and their success factors and propose a digital entrepreneurship research map. Entrepreneurship education and digital ecosystem are considered relevant research directions alongside digital business models and platform strategies (Kraus et al, 2018; Healy, 2021). Furthermore, we complement studies in digital entrepreneurship with those that propose a new framework for the digital entrepreneurial ecosystem, which integrates digital ecosystem literatures and entrepreneurial ecosystem literature (Sussan and Acs, 2017), extending this system to digital platforms and supporting digital innovations (Li et al, 2017).

3.2 Digital Entrepreneurship and Digital Platforms

The use of digital platforms in digital entrepreneurship is another distinct line of research identified, which examines the conceptual framework and quantifies the economy of the digital platform from the perspective of three interrelated concepts: digital technology infrastructure, multi-faceted digital platforms and platform-based ecosystems (Acs et al, 2021), digital platforms including social media channels, e-business, e-commerce websites and other similar information technology-based businesses (Sussan and Acs, 2017; Song, 2019; Oteng et al, 2021). The core digital platform trends that an entrepreneur needs to identify: platform-centric software, software and apps, database management through third-party servers, digital partnerships (Kooskora, 2021), Internet of Things (IoT) and business models, etc. (Grewal et al., 2020).

In the context of the current research, the question that arises is whether these digital entrepreneurship research resources: conceptualization, classification, analysis of functionalities, typology, development of new interconnection systems, new business models etc., are used in the rethinking of entrepreneurial education, more specifically of digital entrepreneurial education, in the creation and implementation of new curricula and new pedagogical methods to help the formation of future-oriented skills and abilities.

4. Academic Digital Entrepreneurship and Digital Entrepreneurship Education

Conceptualizing academic digital entrepreneurship includes: activities aimed at entrepreneurial education, incubators for students and start-ups, business plan competitions for students, the entrepreneurial garage, activities involving a wide variety of digital technologies (e.g., Mooc, MIT Fab Labs Fablab, Stanford Fab lab, Business analytics, Liveplan, business plan software, built for Entrepreneurs Patsnap, cloud platforms, big data, 3D printing); as well as activities that quantify the outcomes of university entrepreneurship, such as spinoffs and graduate start-ups, and various forms of entrepreneurial education development (not only digital) (Rippa and Secundo, 2019).

In this article we will only address academic digital entrepreneurship from the perspective of entrepreneurship education, more specifically digital entrepreneurship education.

Entrepreneurship education is a series of education and training activities that seek to develop the intention of entrepreneurial behavior, implement entrepreneurship among participants and promote some factors of entrepreneurial intention (Kakouris and Liargovas, 2021).

Digital entrepreneurship education can provide students with entrepreneurial knowledge, train them in the use of new technologies, increase the professionalism of digital entrepreneurship courses and help students identify entrepreneurial and employment opportunities offered by the online environment (Yu et al, 2022). Through specialized modules on digital entrepreneurship, digital transformation and entrepreneurship development, young people can acquire digital entrepreneurial skills, and are able to focus on identifying and pursuing digital

opportunities (Geissinger et al, 2019; Ratten and Jones, 2021; Secundo et al, 2021; Yu et al, 2022). However, many entrepreneurship education programs in Europe continue to ignore the idea of digital entrepreneurship (Shamsrizi et al, 2021).

5. Digital Entrepreneurship Higher Education Programs in EU - Current Status and a Conceptual Model of Driving Forces for Boosting Digital Entrepreneurship Education

5.1 Pioneers of Digital Entrepreneurial Education Programs

Many universities have implemented innovative teaching and learning methods in entrepreneurship education since the first digital entrepreneurship education programs were initiated in the early 2000s. The world's first e-commerce bachelor's degree program was offered by Acadia University, Canada in September 2000, whose philosophy was based on the fact that e-commerce requires an equal combination of business and computer science training; the University of California, San Diego was the first to offer a master's degree in e-commerce in 1998 (Weinstein, 1998). An interesting strategy is the adoption of e-commerce implementation strategy in Chinese universities, which basically comprises four stages in line with the pace of Internet popularization since 1995: Stage 1: Exploratory Stage (1995-1997); Stage 2: Piloting Stage (1998); Stage 3: Formalizing Stage (2001-2003) and Stage 4: Popularizing Stage (din 2003) (Zhang et al, 2005). As early as 2001, 13 e-commerce programs have been implemented in China's 597 universities (Huo et al, 2021). These programs have multiplied by 2019 to a total of 328 e-commerce programs offered by 831 universities, an impressive increase from 2001 (2.17% of all universities offered e-commerce programs) to 2019 (39.47%, 328 out of 831) (Huo et al, 2021).

In Europe, the first undergraduate program in e-Business was offered by The Management School of Liverpool University, UK, in 2001 (Wu et al, 2016), however, in 1999 the University of Portsmouth Business School, initiated the Master of Marketing with e-Commerce (Wu et al, 2016). Recently, we have identified an inventory of courses related to digital entrepreneurship in Europe, which includes programs, in various formats virtually live, synchronous, processed through the Zoom or Go-Live platform, or online in asynchronous format (Vorbach et al, 2019).

5.2 Curent Status of Digital Entrepreneurship Education Programs in Europe

In our attempt to establish the current status of digital entrepreneurship education offered by universities, we sought to identify the educational offers of universities in the European Union with bachelor's and master's programs in the field of business administration. We especially looked for programs specialized in e-business and e-commerce. The research methodology is direct documentation using search methods, namely Google, Bing, Bing AI, and ChatGPT search engines. The main reason for choosing this way of research was determined by the fact that young people who want to find out about potential study options use these search engines.

Table 1: Universities in Europe offering bachelor and master programmes in Digital Entrepreneurship

Country	University	Program	Degree
Denmark	Copenhagen Business School	Business Administration and Digital Business	Bachelor
	Copenhagen University	Analysis of Digital Media Faculty of Humanities	Course Bachelor
Netherlands	University of Twente	Digital Business & Analytics	Master
Germany	Technical University of Munich	Management for Digital Business Models	Bachelor
Sweden	Stockholm School of Economics	Digital Transformation	Course Master
Ireland	Dublin City University	Digital Business and Innovation	Bachelor
United Kingdom	University of Warwick	e-Commerce and Digital Analytics e-Business Management	Master
Switzerland	University of St. Gallen	Business Innovation	Master
	Geneva Business School	Entrepreneurship	Bachelor
Italy	Milano University (IT)	Entrepreneurship lab	Bachelor

Country	University	Program	Degree
	Facoltà di Scienze Politiche, Economiche e Sociali		
Germany	Tomorrow University	Responsible Entrepreneurship	Bachelor
		Sustainability, Entrepreneurship, and Technology	Master
	SRH Berlin University of Applied Sciences	Entrepreneurship	Master
		Sustainable Innovation and Entrepreneurship	MBA
France	KEDGE Business School	Entrepreneurial School	Bachelor
	MARSEILLE	Digital & Data Marketing Training	Bachelor
France	Grenoble Ecole de Management	Digital Business	Course Bachelor
	Sorbonne University	Student Entrepreneur Diploma	Bachelor
		CELSA Entreprendre	Master

Source: made by author

As can be seen, the career option for a young person by enrolling in a bachelor and master degree program in Europe in the field of digital entrepreneurship, especially in the field of e-business, is very limited or even non-existent if we try to identify strictly this field.

However, we have to acknowledge that there is an upward evolution of MOOCs (Massive Open Online Courses) on entrepreneurship, which contribute to the development of digital entrepreneurship education (Vorbach et al, 2019), e.g., EdX, Coursera which allow access to a wide range of information, support, facilitators and content, but in our opinion can only initiate, complement or up-date a basic training in the field.

5.3 A Conceptual Model of Driving Forces for Boosting Digital Entrepreneurship Education

Following the above results, we propose a conceptual model to clearly illustrate the driving forces that can determine an increase in the educational offer in digital entrepreneurship (Figure 1).

A conceptual model of driving forces for digital entrepreneurship education

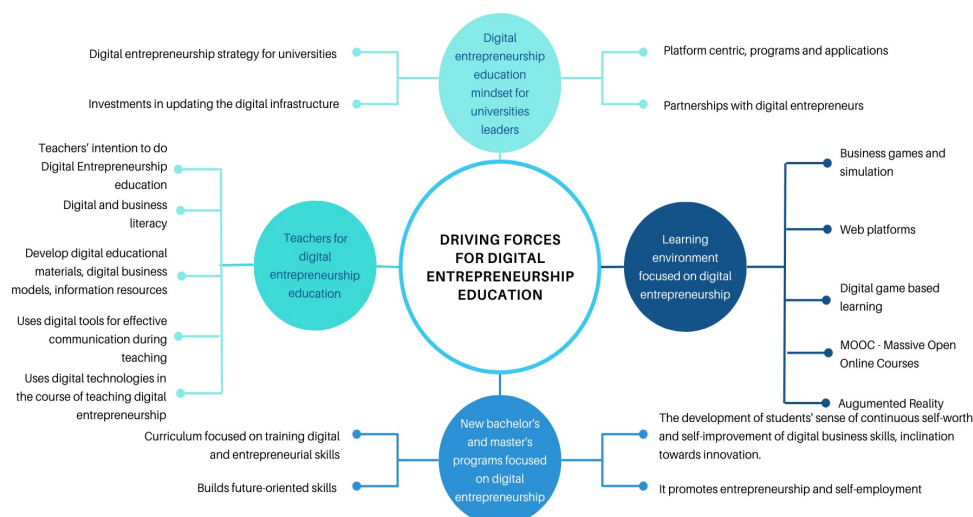


Figure 1: A conceptual model of driving forces for digital entrepreneurship education

Component 1 - Digital entrepreneurship education mindset for university leaders - which must take into account the evolution of the socio-economic and cultural environment, the requirements related to digitization, and the global evolution of businesses based on platforms and not only. Attention to these developments could change the outlook for educational offers, which can be more adapted and respond to the training of future-oriented skills. Component 1 - may include: Digital entrepreneurship strategy for universities; Investments in updating

the digital infrastructure; Platform centric, programs and applications; Partnerships with digital entrepreneurs etc.

Component 2 - Teachers for digital entrepreneurship education. Young people easily develop their digital skills, new technologies are easily used, therefore teachers must also keep up with the continuous formation and development of their digital skills. The technology exists, the digital economy has already demonstrated its functionality, therefore, the use of the newest teaching methods through the integration of digital technologies are strictly necessary, both to form digital skills and to develop digital entrepreneurial education. For this component, we consider the following: teachers' intention to do Digital Entrepreneurship education; teachers must continue to improve digital and business literacy; develop digital educational materials, digital business models, and information resources; must use digital tools for effective communication during teaching; use digital technologies in the course of teaching digital entrepreneurship.

Component 3 – New bachelor's and master's programs focused on digital entrepreneurship. Designing an attractive educational curriculum oriented towards the development of new skills. In this sense, we propose a curriculum focused on training digital and entrepreneurial skills, building future-oriented skills, developing students' sense of continuous self-worth and self-improvement of digital business skills, and inclination towards innovation, promotes entrepreneurship and self-employment.

Component 4 - Learning environment focused on digital entrepreneurship. In the teaching process, teachers must integrate learning by using components such as interactive whiteboard, business games and simulation, web platforms, such as: Adobe Connect, Zoom, Microsoft Teams, Google Meet, etc., platforms that allow simulations or the use of free modules, for example, WordPress for creating online stores, digital game-based learning; MOOC's, for example EdX; Augmented Reality (Camara et al, 2021, Sungkur et al, 2016), for example MergeCube, Immersive Learning Initiative, pioneering new approaches to learning and research for management and business (Kooskora, 2021).

6. Findings and discussions

The increased interest in research in this field in the last five years ensures a solid research base, including numerous scientific articles, studies and books published on the topic of digital entrepreneurship and digital entrepreneurial education. The answer to our first research question (RQ1), is that these documentation resources cover topics such as conceptualization, classification, analysis of functionalities, typology, development of new interconnection systems, new business models, etc., can be used for re-thinking of entrepreneurial education, more specifically for digital entrepreneurial education, for design and implementation of new curricula and new pedagogical methods to help the formation of future-oriented skills and abilities. Given that Generation Z has a strong desire for a new educational model that includes a combination of virtual and personal learning, through this article, we wanted to identify the academic programs in the field of digital entrepreneurship offered by universities in the EU. We investigated if European universities have similar concerns as Asia universities regarding Digital Entrepreneurship Education, especially for e-business and e-commerce (RQ2). We found that in the universities of the EU, there are no similar strategies to the universities from China. Given the formal framework supporting digital education, we found that there are very few university programs that can be assimilated to digital entrepreneurship education: 9 programs offered at bachelor level; 7 programs at master level and 4 training courses (of which 2 for undergraduate students).

Considering this fact, we have built a conceptual model that includes the driving forces that could determine the development of digital entrepreneurship education (RQ3).

7. Conclusions

Certainly, in the context of digital transformations, the use of artificial intelligence, the constant concern to integrate digital skills into professional activity in order to develop, increase productivity and employability, digital entrepreneurship and especially e-business and e-commerce has become an extremely important field for researchers, educators, investors and public administrations alike.

We believe that it is necessary for universities, to diversify much more their range of programs in the field of digital entrepreneurship and, to adapt their methods and tools for teaching entrepreneurship, but not only, to the new technological and economic reality. Although in the scientific literature we have identified European good practices in teaching digital entrepreneurship, the EU strategic context in the field of EntreComp and DigiComp, we consider these concerns to be rather timid. However, we admit that we may not have found all

the courses or bachelor's and master's programs available in European universities in the field of Digital Entrepreneurship.

Universities must pay attention to training in digital entrepreneurship primarily for teachers who must have entrepreneurial thinking and teaching skills and be promoters of entrepreneurship/digital entrepreneurship as well as innovators of creativity. Teachers need to follow training programs in digital entrepreneurship which will help them to understand the need, role, and responsibilities in teaching digital entrepreneurship through the integration of technology, innovation in teaching practice, and cooperation with professionals in the field. (Medrek, 2018; Keyhani, 2020; Kooskora, 2021; Rattes and Jones, 2021; Yu et al, 2022).

We are aware that, the article has limitations, first of all, for theoretical documentation our search has been limited to articles published in academic journals written in English, with access to full-text pdf, therefore the contributions of specialists who have published in other languages have not been studied. In order to identify programs in the field of digital entrepreneurship, e-business, e-commerce we limited our search to the use of keywords in English using: Google, Bing, Bing AI and ChatGPT, although there are other search engines. The explanation, although not justified according to the scientific methodology, is related to the fact that we wanted to "search" these programs from the perspective of a young person concerned with the choice of career path.

Future research directions in the field of digital entrepreneurship education focus on the design and implementation of a digital entrepreneurship program specializing in e-commerce at a university, development of an e-business and e-commerce laboratory.

References

- Acs, Z., Song, A., Szerb, L., et al. (2021) "The evolution of the global digital platform economy: 1971–2021," *Small Business Economics*, V. 57, pp. 1–31.
- Advani, A. and Teigland, J. L. (2021) "Gen Z is poised to reframe the future, but are business and education ready?", EY Ripples and JA Worldwide.
- Baskerville, R. L., Myers, M. D. and Yoo, Y. "Digital First: The Ontological Reversal and New Challenges for Information Systems Research", *MIS Quarterly*, V. 44, No. 2, 2020, pp. 509–23.
- Camara B., Cirillo, A., Ćwiklicki, M., et al. "Teaching guidelines for digital entrepreneurship," 2021.
- Buckley et al. (2022) "The developmental trajectories of children's reorientation to global and local properties of environmental geometry", *Open Science Framework*.
- European Commission (2021a) "The Digital Compass", *European Commission*.
- European Commission (2021b) "Proposal for a Decision of the European Parliament and of the Council establishing the 2030 Policy Programme 'Path to the Digital Decade'".
- European Commission (2021c) "Digital Skills - Part of 2030 Digital Compass: Your Digital Decade".
- European Commission (2021d) "Digital Education Action Plan (2021-2027)".
- European Commission (2022a) "Digital Economy and Society Index Report 2022 — Human Capital".
- European Commission, Directorate General for Education, Youth, Sport and Culture (2022b) "Progress towards the achievement of the European Education Area: communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions," *LU, Publications Office*.
- European Commission. Joint Research Centre (2016a) "EntreComp: the entrepreneurship competence framework," *LU, Publications Office*.
- European Commission. Joint Research Centre (2016b) "DigComp 2.0: the digital competence framework for citizens," *LU, Publications Office*.
- Fraillon, J., Ainley, J., Schulz, W., et al. (2020) "Preparing for Life in a Digital World: IEA International Computer and Information Literacy Study 2018 International Report," *Cham, Springer International Publishing*.
- Geissinger, A., Laurell, C., Öberg, C., et al. (2019) "How sustainable is the sharing economy? On the sustainability connotations of sharing economy platforms," *Journal of Cleaner Production*, V. 206, pp. 419–29.
- Giones, F. and Brem, A. (2017) "Digital technology entrepreneurship: A definition and research agenda," *Technology Innovation Management Review*, V. 7(5), pp. 44–51.
- Grewal, D., Hulland, J., Kopalle, P. K., et al. (2020) "The future of technology and marketing: a multidisciplinary perspective," *Journal of the Academy of Marketing Science*, V. 48, No. 1, pp. 1–8.
- Healy, D., Flynn, A., Conlan, O., et al. (2021) "Older Adults' Experiences and Perceptions of Immersive Virtual Reality: A Protocol for a Systematic Review and Thematic Synthesis," *International Journal of Qualitative Methods*, V. 20, p. 160.
- Hull, C. E., Hung, Y. T. C., Hair, N., et al. (2007) "Taking advantage of digital opportunities: a typology of digital entrepreneurship," *International Journal of Networking and Virtual Organisations*, V. 4, No. 3, p. 290.
- Huo, W., Wu, M., and Soar, J. (2021) "Internationalization of China's E-Commerce Higher Education: A Review between 2001 and 2019." In: M.X. Wu, R., Mircea, M., eds. *E-Business - Higher Education and Intelligence Applications*. IntechOpen.

- Islam, M. S., Ali, A. J., Khaleel, M., et al. (2018) "Promising digital university: a pivotal need for higher education transformation," *International Journal of Management in Education*, V. 12, No. 3, p. 264.
- Kakouris, A. and Liargovas, P. (2021) "On the About/For/Through Framework of Entrepreneurship Education: A Critical Analysis," *Entrepreneurship Education and Pedagogy*, V. 4, No. 3, pp. 396–421.
- Keyhani, N. and Kim, M. S. (2020) "The aspiring teacher entrepreneur's competencies and challenges in an informal STEM environment," *Entrepreneurship Education*, V. 3, No. 4, pp. 363–91.
- Kooskora, M. (2021) "The Role of an Entrepreneurial Mindset in Digital Transformation-Case Study of the Estonian Business School." In: Soltanifar, M., Hughes, M., Göcke, L., eds. *Digital Entrepreneurship*. Cham, Springer International Publishing, pp. 143–64.
- Kraus, N. and Marchenko, O. (2021) "Innovative-Digital Entrepreneurship as key link of Industry X.0 Formation in the Conditions of Virtual Reality," *Baltic Journal of Economic Studies*, V. 7, No. 1, pp. 47–56.
- Kraus, S., Palmer, C., Kailer, N., et al. (2018) "Digital entrepreneurship: A research agenda on new business models for the twenty-first century," *International Journal of Entrepreneurial Behavior & Research*, V. ahead-of-print.
- Li, W., Du, W. and Yin, J. (2017) "Digital entrepreneurship ecosystem as a new form of organizing: the case of Zhongguancun," *Frontiers of Business Research in China*, V. 11, No. 1, p. 5.
- Long, D., Xie, Y., Wei, Y., et al. (2022) "Where Does Digital Entrepreneurship Go? A Review Based on a Scientific Knowledge Map," *Mobile Information Systems*, V., pp. 1–15.
- Malach, J. and Kysil, N. (2019) "Application of Digital Tools for the Development of Entrepreneurship Competencies." *Proceedings of the 18th European Conference on e-Learning. ACPI*, p. 47.
- Medrek, M. (2018) "Use of Agile Methods in e-Business and e-Commerce Education." Valencia, Spain, pp. 5144–52.
- Nambisan, S. (2017) "Digital Entrepreneurship: Toward a Digital Technology Perspective of Entrepreneurship," *Entrepreneurship Theory and Practice*, V. 41, No. 6, pp. 1029–55.
- Nambisan, S., Wright, M. and Feldman, M. (2019) "The digital transformation of innovation and entrepreneurship: Progress, challenges and key themes," *Research Policy*, V. 48, No. 8, p. 103.
- Oteng Fredrick Agyeman, Zhiqiang Ma, Mingxing Li, et al. (2021) "A Literature Review on Platform Business Model: The Impact of Technological Processes on Platform Business," *EPRA International Journal of Economics, Business and Management Studies*, pp. 1–7.
- Ratten, V. and Jones, P. (2021) "Entrepreneurship and management education: Exploring trends and gaps," *The International Journal of Management Education*, V. 19, No. 1, p. 1004-31.
- Ratten, V., da Silva Braga, V. L., and da Encarnação Marques, C. S. (2021) "Sport entrepreneurship and value co-creation in times of crisis: The covid-19 pandemic," *Journal of Business Research*, V. 133, pp. 265–74.
- Recker, J. and Von Briel, F. (2019) "The Future of Digital Entrepreneurship Research: Existing and Emerging Opportunities", Conference: 40th International Conference on Information Systems At: Munich, Germany.
- Rippa, P., and Secundo, G. (2019) "Digital academic entrepreneurship: The potential of digital technologies on academic entrepreneurship," *Technological Forecasting and Social Change*, V. 146, pp. 900–11.
- Secundo, G., Mele, G., Vecchio, P. D., et al. (2021) "Threat or opportunity? A case study of digital-enabled redesign of entrepreneurship education in the COVID-19 emergency," *Technological Forecasting and Social Change*, V. 166, p. 120.
- Secundo, G., Rippa, P. and Cerchione, R. (2020) "Digital Academic Entrepreneurship: A structured literature review and avenue for a research agenda," *Technological Forecasting and Social Change*, V. 157, p. 120.
- Shamsrizi, M., Pakura, A., Wiechers, J., et al. (2021) "Digital Entrepreneurship for the 'Decade of Action': How Entrepreneurs Can Impact Our Race Towards the Sustainable Development Goals." In: Soltanifar, M., Hughes, M., Göcke, L., eds. *Digital Entrepreneurship*. Cham, Springer International Publishing, 2021. pp. 303–27.
- Song, A. K. (2019) "The Digital Entrepreneurial Ecosystem—a critique and reconfiguration," *Small Business Economics*, V. 53, No. 3, pp. 569–90.
- Sungkur, R. K., Panchoo, A., and Bhoyroo, N. K. (2016) "Augmented reality, the future of contextual mobile learning," *Interactive Technology and Smart Education*, V. 13, No. 2, pp. 123–46.
- Sussan, F., and Acs, Z. J. (2017) "The digital entrepreneurial ecosystem," *Small Business Economics*, V. 49, No. 1, pp. 55–73.
- Vorbach, S., Poandl, E., and Korajman, I. (2019) "Digital Entrepreneurship Education - The Role of MOOCs," *International Journal of Engineering Pedagogy (IJEP)*, V. 9, No. 3, p. 99.
- Weinstein, B. (1998) "California University Is First to Offer Master's Degree in E-commerce," *Boston Globe*, No. May, 31.
- Wu, M., Wang, M., Soar, J., et al. (2016) "China's E-Commerce Higher Education: A 15 Years Review from International Viewpoint," *Open Journal of Social Sciences*, V. 04, No. 10, pp. 155–64.
- Yu, T.-K., Chao, C.-M., and Wang, Y. (2022) "Factors Influencing the Teaching Intention of Business College Teachers to Fulfill Digital Entrepreneurship Courses," *Frontiers in Psychology*, V. 13, p. 860.
- Zhang, X., Li, Q., and Lin, Z. (2005) "E-Commerce Education in China: Driving Forces, Status, and Strategies," *JECO*, V. 3, pp. 1–17.

Curriculum Design in Higher Education: A Reflection

Kemlall R Ramdass and Kgabo Mokgohloa

University of South Africa, Johannesburg, South Africa

ramdacr@unisa.ac.za

mokgok@unisa.ac.za

Abstract: The ideology of curriculum design is believed to be the core of teaching and learning, yet it is in direct opposition to current notions of curriculum development. The contextual factors that underpin teaching and learning are derived from curriculum design. The principal factors that influence what is being taught may be categorised into three levels: the macro, meso and micro. At the macro level, there are national and international influences such as globalisation, massification, and marketization. Also, socio-economic, and political influence may be included. At the meso-level the Department of Higher Education and Training (DHET) and institutional level influence is forthcoming. Issues such as policies, culture, location, student profile and so forth are examined. Also, external influence from employers, professional bodies, accreditation bodies, quality agencies as well as political redress is evaluated. The micro-level examines individual academics and support staff concerning personal theories, beliefs, and professional knowledge. Systems theory in the educational context views the institution as a system where there is an interaction of variables of input, process and output that enable learning to take place. Because of the complexity and nature of curriculum design, there is limited change in this critical sphere of the education system. This paper reflects on the design and development of a curriculum in an open distance learning higher education institution.

Keywords: Curriculum Design; Re-Engineering; Higher Education

1. Introduction

The digital era is bringing about fundamental changes in all aspects of education experienced throughout the world. It is changing the role of teachers who were the primary source of content knowledge and the role of students who were taught to be ardent listeners. Technology enables both the teacher and the learner to discover new sources of knowledge that have become more accessible from authentic sources. There is a real potential for ICT to add value to the education system. New methods and models of learning and innovation, entrepreneurship, creativity, and collaboration both nationally and internationally are enabled through ground-breaking technological advancement. It is important to note that this applies to all educational institutions, both ODL and face-to-face institutions. A holistic overview of the nature of the organisation as a comprehensive, flexible and accessible (in terms of enabling students to study) open distance learning public higher education institution in South Africa. In terms of institutional differentiation, the organization is a comprehensive university that practices ODL pedagogy through a blended approach. Structure, culture, and agency are fundamental prerogatives in the implementation of the curriculum provide a critique of the qualification: Diploma in Engineering Technology and the practices in the institution through key concepts and theories as well as the relationship between disciplinary structures and curriculum development.

2. Literature Review

Curriculum design is the core and basis of teaching and learning, yet it is in direct opposition to current notions of curriculum development where there are no discussions regarding this very important topic. The contextual factors that underpin teaching and learning are derived from curriculum design. The principal factors that influence what is being taught may be categorised into three levels: the macro, meso and micro which are discussed below.

- Macro - National and international influences such as globalisation, massification, and marketisation. Also includes socio-economic and political influence.
- Meso-DHET and Institutional level influence include issues such as policies, culture, location, and student profile. Also include external influence from employers, professional bodies, accreditation bodies, and quality agencies as well as political redress.
- Micro - Individual academics and support staff concerning personal theories, beliefs, and professional knowledge.

The question is what does the teacher teach without a curriculum? D'Andrea and Gosling (2005) view the teaching and learning process as a relationship between students, teachers and support functions. It is important to note that all three variables contribute significantly to an enabling environment for teaching and learning to be successful in ODL. Biggs (1999) postulates the interactive systems approach in teaching and

learning. The systems approach in the educational context views the institution as a system where there is the interaction of variables of input, process and output that enable learning to take place. Given the complexity and nature of this curriculum, there has been limited change over the years. The curriculum is driven by systems theory and administered by policies to structure the process of curriculum design. The introduction of national notions for curriculum development postulated by the CHE before elaborating on the organisations' stance is elaborated.

Structure, Culture and Agency Applied

The Council of Higher Education's underlying principles on curriculum

The CHE proposed curriculum structure is underpinned by principles that imbibe the full student learning experience in the transformation of higher education that is responsive, appropriate and consistent; these principles are outlined below.

- **Fitness for purpose:** The focus here is on access to success through additional formal time that meets the requirement of providing a supportive and preparatory role in bridging the gap between secondary and higher education. The second issue is mastery of curriculum and learning experiences that add breadth to the enhancement of graduate attributes;
- **Flexibility:** The objective in this instance is the accommodation of diversity in the educational context. The curriculum design advocates flexible parameters in terms of starting points and progression pathways due to the divergent levels of preparedness among students;
- **Diversity of pathways and duration:** Formal time in undergraduate qualifications must be specified in terms of academic years to meet funding and planning imperatives as well as the variation in the levels of preparedness among students;
- **Design based on the needs of the majority of students:** The view here is based on increasing formal time by one year where equity, success and throughput would be improved as confirmed by curriculum analysis;
- **The curriculum must accommodate different levels of preparedness:** The notion here is the accommodation of the divergent levels of preparedness among students through flexibility and comparability in the structure of programmes in terms of national and international benchmarks;
- **Flexibility in institutional implementation within a common adoption of the proposal:** Flexibility in the structure would address the variant needs of students as well as equity of outcomes and graduate quality;
- **Extra curriculum space to be used for augmentation, not increasing the volume of content:** The focus here is on flexibility as institutional accountability in terms of output and outcomes;
- **Curriculum enhancement must be provided for:** This looks at the efficiency and effectiveness of curricula in the enhancement of graduate attributes;
- **Putting student learning first:** Student-centered curricula through flexibility should enhance the student experience in terms of outcome quality (CHE, 2013). I then contextualise the curriculum policy.

Luckett and Shay's (2020) model provide clear articulation in terms of knowledge progression in a South African context in higher education where it is developed through experiences of an epistemically diverse curriculum. The building blocks of knowledge start from a disciplinary context and lead progressively to epistemic knowledge building which is of extreme importance in the engineering discipline. It may be seen as progressive and aligns students and lecturers as agents in the process of re-contextualisation. The process of knowledge building enables (re)interpretation, reconstruction, and re-contextualisation through cultures, power relations and socialisation in the curriculum. Luckett's view of the curriculum as a supplement to Toohey (1999) in the 5-step process that entails the discipline-based approach, performance and systems-based approach, personal relevance approach, cognitive approach, and the socially critical approach (Toohey, 1999). Toohey (1999) mentions in his final stage of development that the goal of graduates is to attain a level of self-realisation in a social context. This entails that student should reflect, critique, develop arguments and defend positions. The aim is to take autonomous action to eradicate social disparities. The organisation draws on Luckett and Toohey's models on the social character of knowledge assimilation as the focus on the epistemology of curriculum provision (Luckett 2009;2016; Toohey 1999).

Effective curriculum development requires a systematic understanding of the strengths and weaknesses of students that come from a diverse range of backgrounds. In ODL, students are given more time (in years) to

complete their qualifications. It is observed from this evaluation that the curricula are overloaded with disciplinary content which is counterproductive in engineering programmes. In this case, regular evaluations need to be conducted to determine the relevance of the curriculum. It is important to note pedagogical development has relevance from an ODL perspective in structural changes to curriculum reform. It was observed that existing curricula presume that students possess the background knowledge to be successful in their studies. Curriculum designers find themselves facing challenges to be innovative in maintaining curriculum coherence at Unisa as our major challenge is our pass rates, especially in the engineering programmes (Scott et al, 2007).

Literature suggests that one size does not fit all as students come from varied backgrounds which ground how they understand concepts in the context of teaching and learning. Literature from several authors converges on the need to streamline curriculum to innovatively respond to realities faced by society, the need for agility and fitness of purpose cannot be over-emphasized.

3. Research Methodology

Al Zefeiti and Mohamad (2015) suggest that research methodology is a framework of a research strategy that outlines the manner a study is to be undertaken. It covers an arrangement of principles and philosophical worldviews which grounds the research questions and influences the research methods to be executed. Kothari (2004) suggests that research is a systematic inquiry into suitable material in the area under consideration. Saunders et al. (2009) coined the research onion approach to research methodology with the first layer as the philosophical worldview, followed by the research approach, then research strategy, research methodological choice, time horizons and lastly, data collection procedure and analysis tools. The onion research framework is depicted in Figure 1.

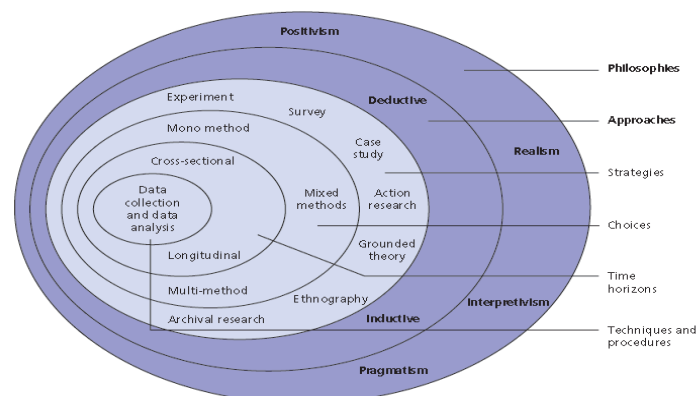


Figure 1: The research onion (Saunders et al.)

This study adopted an interpretivist philosophical worldview which grounded the study to follow an inductive approach. A case study research strategy was adopted because the phenomenon under study required a reflective approach to the qualitative data at hand. Academicians are presumed to be competent in their field of expertise, which is inclined towards their area of research. It is imperative to be able to reflect not only on practical aspects of research but also from a cognitive mental state that enables the construction of meaning through practice. Reflection provides an environment where one can participate in learning through thoughtful relationships with everything around it and is practiced in qualitative research. Data were assimilated through academic literature and reflection on the practices of teaching and learning in the organization as well as through meetings and discussions.

4. Discussion and Findings

4.1 The Curriculum Policy

The Curriculum Policy (Curriculum Policy, 2010) provides the framework for all curriculum-related matters in the University. As a point of departure, the researcher offers an interpretivist definition of curriculum from a reflective point of view and defines it as “As a set of learning experiences constituting a qualification or module” and includes key aspects of teaching and learning such as:

- What is learnt – content
- Why is it learnt – rationale and underlying philosophy
- How it is learnt – the process
- When it is learnt – the structure of the learning process
- How the learning will be demonstrated in creative ways and achievement similarly assessed.

In the context of the organization curriculum is planned learning experiences in which the student is exposed to content through a structured process. The outcome of learning is demonstrated via assessment methodologies. The curriculum is aligned with both national and international benchmarks in terms of policy requirements.

4.2 Principles Guiding Curriculum Development

Essentially the curriculum is developed by the academic with input from the Directorate for Curriculum and Learning Design (DCLD) considering all essential stakeholders. In this section, a synopsis of the points that are considered in curriculum development is considered. The points are considered important and also clearly visible in the operations of the institution. It may be observed that the curriculum policy is aligned with the CHE imperatives.

- **Responsiveness** – In context, the notion of responsiveness is used in a descriptive sense and refers to the awareness of societal expectations given national and international contexts that universities are required to respond to (Moll, 2004). The curricula are developed taking several variables into account, namely national context, CHE context, international context, professional body context, socio-economic context, industry context, and disciplinary and student context. The internal mechanisms that monitor these contexts are the Directorate for Curriculum and Learning Design (DCLD). The planned curricula are nationally and internationally recognized and structured to ensure a reasonable chance of success.
- **Student-centredness** – the student is the centre of the entire learning process and becomes an ambassador for the institution through feedback on curriculum experiences carried out through research. Students are invaluable in the development of curricula as current epistemologies and prior learnings as well as cognisance of experiences and expectations are an integral part of curricula. Invariably economic responsiveness is gained through students' engagement with the economy through their labour and entrepreneurial activities (Moll, 2004). In addition, Luckett (2010) postulates that students achieve agency through new ways of thinking, acting and being in the learning process that enables self-transformation.
- **Accountability** – The academic department is accountable to Unisa for the adherence to policy and processes prescribed for academic integrity and teaching and learning quality. Higher education policies allude to academic accountability in curriculum design, which at Unisa is administered through the (DCLD). Unfortunately, staff qualifications at DCLD are varied and I think it would be important for them to pursue a course such as the PG Dip in HE. Curriculum design is not part of the Centre for Professional Development at Unisa which is a concern for me. The engagement of DCLD, CPD and QA is imperative to enhance the status of curriculum design (CD) at Unisa. In addition, there is a need to base curriculum development on the reflective and responsible judgement of academics (Luckett, 2001).
- **Curriculum structure** – The development of curricula in an ODL context also considers notional hours and credits through institutional guidelines. All formal qualifications are approved by the CHE and registered with SAQA, therefore cognizance is taken of the portability of qualifications and learning pathways. Articulation is an important facet of curriculum development. Curriculum review and the review cycle consider comparability, response to HEQF, benchmarks, professional bodies, SETAS, student and employer feedback and market trends. Unisa follows a team approach (discussed later) in curriculum development with consultation from all internal and external stakeholders. A range of resources are provided to enable students to be successful in their studies. Curriculum implementation evaluates the financial viability, alignment to the vision and mission and market penetration as well as the pedagogy and technology applicable for the qualification. Unisa's RPL policy provides guidelines on the recognition of prior learning. The WIL (work-integrated learning) policy is also an integral part of curriculum development at Unisa.
- **Quality assurance** – The institutional audit and programme accreditation aim to assure the quality of qualifications with the objective of continuous improvement, but the progress is limited. The responsibility for QA is distributed to all the relevant **structures** such as programme coordinators,

DCLD, academics, HOD, School Directors, and executive deans of colleges. College tuition and learning committees evaluate the appropriateness and readiness of proposals for curriculum design (CD) that are signed off by all the respective departments mentioned above. College Boards approve CD proposals and submit them to the Senate Tuition and Learning Committee for final approval based on the College's academic and strategic plan.

- **Envisaged Impact** – The curriculum policy (structure) aims to ensure a coherent transformative impact in the development of curricula in its endeavor to affect the effectiveness of the process of delivering responsive education to students. The policy is aligned with the tuition policy, assessment policy and other policies to a greater or lesser degree (Curriculum Policy, 2010). The DCLD is part of DISS and is a support function.

In addition, the policy addresses the following key variables as stipulated by the Higher Education Qualifications Sub-Framework (HEQSF) which are:

- Appropriateness of qualification types
- Coherence and consistency in designation and credit value
- Articulation pathways between undergraduate and postgraduate qualifications
- Appropriateness of the number of postgraduate qualifications
- The extent to which qualifications support expanded access (Van Niekerk, 2013).

4.3 Curriculum Development and Monitoring

To adhere to the curriculum policy for the development and review of the curriculum the university has provided the relevant structures and agency for the implementation of the curriculum policy. This structured approach enables accountability and responsibility to ensure that the highest authority in the academic environment – the VP academic ensures a diligent process.

The structural and agential focus is based on the framework for a team approach in the development and implementation of curriculum and learning development. Thus, the team includes a senior academic appointed by the chair of the department (COD), lecturer of the programme, department of curriculum and learning design (DCLD), department of quality assurance and promotion (DQAP), directorate of instructional support and services (DISS), department of career counselling and development (DCCD), department of programme accreditation and registration (DPAR). The deliverables of the team approach are to develop ODL curricula, evaluate programme design, curriculum planning of modules, learning design, and learning development. A certificate of due diligence is completed by all involved to ensure that the framework is implemented as per the principles of curriculum development of Unisa as well as the Council on Higher Education.

In addition, the Strategic Plan 2015 revisited point 1 and focuses on the revitalization of the PQM in conjunction with teaching and learning which covers the following issues:

- The simplification and streamlining of the PQM
- The review and development of curricula that promotes creativity, innovation and 'graduateness.'
- The development of an integrated student support model
- The revision of assessment processes and practices that creates a balance between formative and summative assessment in the view of constructive alignment

The conceptualisation and contextualisation in the implementation of an ODL teaching and learning model (Strategic Plan, 2015).

4.4 Programme Selection and Evaluation

A programme that was introduced in 2017 by the College of Science, Engineering and Technology called the Diploma in Engineering Technology: Industrial. As the task calls for critique, an evaluation of the programme highlighting enabling and constraining factors in the practices, theories and concepts concerning the programme are considered. Attention is drawn to Lockett's model of an epistemically diverse curriculum to provide a critical analysis of the programme. The 4 spheres of knowing, namely foundational competencies which concerns the knowing of disciplinary knowledge, practical competence which entails knowing how – the application of disciplinary knowledge, personal competence which concerns learning through reflexivity, and reflexive competence, which entails the development of meta-cognition through thinking epistemically, contextually and systemically in the resolution of engineering problems (Lockett, 2001).

Luckett's model provides clear articulation in terms of knowledge progression in a South African context in higher education where it is developed through experiences of an epistemically diverse curriculum. The building blocks of knowledge start from a disciplinary context and lead progressively to epistemic knowledge building which is of extreme importance in the engineering discipline. It may be seen as progressive and aligns students and lecturers as agents in the process of re-contextualisation. The process of knowledge building enables (re)interpretation, reconstruction, and re-contextualisation through cultures, power relations and socialisation in the curriculum. Luckett's view of the curriculum as a supplement to Toohey (1999) in the 5 step process that entails the discipline-based approach, performance and systems-based approach, personal relevance approach, cognitive approach, and the socially critical approach is considered (Toohey, 1999). Toohey (1999) mentions in his final stage of development that the goal of graduates is to attain a level of self-realisation in a social context. This entails that student should reflect, critique, develop arguments and defend positions. The aim is to take autonomous action to eradicate social disparities. Unisa draws on Luckett and Toohey's models on the social character of knowledge assimilation as the focus on the epistemology of curriculum provision.

Effective curriculum development requires a systematic understanding of the strengths and weaknesses of students that come from a diverse range of backgrounds. In ODL, students are given more time (in years) to complete their qualifications. It is observed from this evaluation that the curricula are overloaded with disciplinary content which is counterproductive in engineering programmes. In this case, regular evaluations need to be conducted to determine the relevance of the curriculum. It is important to note pedagogical development has relevance from an ODL perspective in structural changes to curriculum reform. It was observed that existing curricula presume that students possess the background knowledge to be successful in their studies. Curriculum designers find themselves facing challenges to be innovative in maintaining curriculum coherence at Unisa as our major challenge is our pass rates, especially in the engineering programmes (Scott et al, 2007).

The evaluation of this programme suggests that there is a relationship between the object of the study and the form of knowledge that is produced. Thus, the knowledge comes from the knower with incremental changes through new experiments and justifications. Extrinsic pressures ensure that the curriculum is internationally competitive and that there is no compromise in any way (Luckett, 2010).

Knight (2001) mentions that curriculum should take on the process approach due to its complexity. The process approach is a strategy that evaluates the components of input, process and output to determine their value in the transformation process. In this scenario, the quality of input, the efficiency and effectiveness of the transformation process and the quality of the output are important variables. Curriculum design and development play a major role in the calibre of students that emanates from the transformation process. The relationship between the student and facilitator is very interactive through ODL technologies, however, the student needs to be proactive to facilitate the learning.

The point made articulated is that the curricula in this programme is coherent and progressive and is appropriate to novices. There seems to be a malalignment between the outcomes and content. Due to the very nature of the development of outcomes, the focus is often lost as to the core of the curriculum. Thus, "the process approach puts the casuistry and hypotheticals of outcomes in their place and brings questions about good learning to the fore" while aiding good teaching and learning in the field of engineering (Knight, 2001:370).

The curriculum structure is seeking to create balance in content, assessment and envisioned learning outcomes through interaction with the subject matter with a view of encouraging insights and reflection (Hussey and Smith, 2003). The elements of the curriculum influence and interact with each other through the notion of constructive alignment and synergy that links the constructivist understanding of students in appropriate learning activities (Biggs, 1999). In addition, it has been noted that soft skills have become a prerogative in the workplace and are considered part of the curriculum. Key competencies are becoming fundamental to curriculum development which is prominent in this qualification (Priestley, 2011). Baskar's critical realism theory advocates the development of heuristics and its application in the engineering environment that faces continuous change. It enables the tracking of changes through epistemological means.

The 360 credits diploma programme is at NQF level 6 and is consonant and responsive to the institution's mission, forms part of institutional planning and resource allocation meets national requirements, and the needs of students and other stakeholders, and is intellectually credible. It is designed coherently and articulates well with other relevant programmes, where possible.

4.5 Curriculum Responsiveness in the Context of the Programme

The qualification is responsive to the economy and society as it addresses some of the training needs indicated in the Higher Education & Training Framework for the National Skills Development Strategy (NSDSIII). Also, the qualification adheres to HEQSF in terms of appropriateness, coherence and consistency, articulation pathways and facilitates equity of access in higher education as gleaned from the document which is not publicly viewable at present (McGrath and Lombard, 2014).

Skilled engineering technicians are required to meet the developmental needs of the country in all service, manufacturing, and industrial production fields. Responsiveness to local context considers skills development, diversity, equity, redress and increasing access and the extended curriculum. The programme is responsive to international regulatory requirements through ECSA and recognized by the Dublin Accord. The Dublin Accord is an agreement for the international recognition of Engineering Technician qualifications.

This qualification is primarily vocational, or industry oriented, characterised by the knowledge emphasis, general principles and application through technology transfer. The qualification provides students with a sound knowledge base in industrial engineering and the ability to apply their knowledge and skills to a career in industrial engineering while equipping them to undertake more specialised and intensive learning. Holders of this qualification are usually prepared to enter a specific niche in the labour market. The programme is articulated to NQF level 10 so that it provides lifelong professional development as students are required to engage with complexity and changing technology in the engineering environment in our newly constructed laboratories. The qualification is economically responsive to the economy and society as it addresses some of the training needs indicated in the Higher Education & Training Framework for the National Skills Development Strategy (NSDSIII). Skilled engineering technicians are required to meet the developmental needs of the country in all service, manufacturing and industrial production fields.

In terms of cultural responsiveness, ELO 6 (engineering learning outcome) in the Form 1 document concerns the ability of engineers to communicate effectively, both orally and in writing within an engineering context. They should also demonstrate knowledge and understanding of the impact of engineering activity on society, the economy, the workplace and the physical environment, and address issues by defined procedures. The 27-credit module is included in year one in the section of complementary studies specifically dealing with aspects related to the ability to communicate effectively at all levels both inside and outside the organization and be sensitive to cultural issues when dealing with a society which would be done in the laboratory through role plays and through team-based learning which involves simulation. The outcome is assessed through both summative and formative assessments. The process of knowledge transfer in a language that is suitable to all groups and where everybody reflects the same meaning is imperative.

The diploma in engineering technology is responsive to the knowledge discipline through the engagement of students in “systematised forms of enquiry” that considers Lockett’s model that is broken into 4 spheres and alludes to discipline-specific knowledge to knowledge application. The academic staff possesses the disciplinary qualification and expertise for the programme, and many are engaged with the scholarship for teaching and learning through research engagements. Students are facilitated online in the way knowledge is produced in this discipline and the teaching-learning environment and pedagogy. There is a high degree of practical application of theoretical concepts in laboratories, simulated and real work environments. However, it is unclear as to the extent to which students understand and develop competence in discipline-specific knowledge. The development of research skills is lacking until the third and four years of study in which students are expected to do research projects. I firmly believe that research skills should be introduced in the first year of study and act as a scaffold in all years of study as per Lockett’s model. Moll’s suggestion of “close coupling between the way knowledge is produced” in the discipline and the way students are educated in the discipline would enable new knowledge in the field of engineering (Moll 2004).

At this stage, language may be a constraining issue, but it is believed that proficiency in English would enable a student to be able to communicate in a global arena. At this stage, experiments are being conducted to translate study materials into other languages. Professional bodies play a major role in curriculum development in engineering and enable the development of communities of practice that are in place in the engineering field such as the South African Institute of Industrial Engineers (SAIIE).

The diploma provides a foundation that enables Mode 1 knowledge as described by Toohey (1999) as key concepts where students should develop a representative knowledge of the field; breadth rather than depth as well as propositional knowledge as per Lockett (2001). The purpose and range statements allude to position

teaching and learning where the student receives information and knowledge from the lecturer. This is based on traditional cognitive learning that is discipline-based that enables students to construct their understanding from content. The discourse changes in the 3rd and 4th-year levels to enable students to apply themselves in practice through practical projects.

This new programme design serves the organisation's objective to sustain the development of academic programmes following the new standard set by the professional body, a result of the new HEQSF and aligned to the framework. The 360 Diploma in Engineering Technology: Industrial supports the improvement of the stature and quality of the scientific and technology programmes offered. As an ODL institution, the programme will be part of a group of new Diplomas in Engineering Technology that will increase the institutional reputation and attract more international students. The qualification provides aspiring industrial engineering technicians with the knowledge to operate and improve industrial engineering processes in an efficient, safe and profitable manner. The qualification addresses the objectives of the NQF by providing the technician qualification at NQF level 6.

Professional Engineering Technicians apply established and newly developed engineering technology to solve well-defined problems and develop components, systems, services, and processes. They provide leadership in the application of technology in commercially effective operations. They work independently and responsibly, applying judgement to decisions arising in the application of technology to problems and associated risks.

Because the organisation is dealing with an international audience, the "Africanisation" of content is a difficult challenge, especially in the engineering discipline. As the programme in question requires international standing through ECSA, it is required to meet the respective guidelines on curriculum offerings.

There are formative assessments in the form of portfolios and assignments and summative assessments in the form of examinations. This may change in the years to come as new developments are being considered. The final assessments of modules are through examinations which are required by the professional body. However, more discourses in the area of alternative assessments through engagement with the professional body would assist in terms of student proficiency.

The understanding is that the diploma curriculum provides a platform that enables students to acquire diverse kinds and complexities of knowledge and competency. This is achieved through the different years of study. It embodies Lockett's and Toohey's model of knowledge development through the various quadrants for an epistemically diverse curriculum.

4.6 Institutional QA principles and processes

The organisation is required, as part of its statutory obligation to the CHE (HEQC) to deliver on its mandate in the provision of quality education through ODL. Therefore, modules are required to be evaluated in terms of disciplinary changes as well as responsiveness to all stakeholders to address deficiencies. In this endeavour, the Directorate for Strategic Planning and Quality Assurance (DSPQA) in conjunction with the Bureau of Market Research (BMR) designed an inclusive quality evaluation instrument to primarily evaluate students learning experience from an ODL perspective.

An integrated approach was used in response to accountability to stakeholders such as students, lecturers, moderators, markers, tutors and student support in all its facets through dimensions, criteria and standards relating to teaching and learning at Unisa. Student support included the following:

- Student support (Dean of Students, Student Funding, ARCSWID, Student Development, Regions, DISS, Library, DCCD, RPL, WIL, Invigilators, Student Admissions and Registration (DSAR), Graduations and Records Management, Student Assessment Administration (DSAA), Accreditation, CCM)
- Primary academic support (Academic Planner, Tuition and Facilitation of Learning, Research Department, DCLD, ICT, Despatch, Planning and Coordination of Study Material, Print Production, Language Services, Unisa Press, Sound, Video and Photography)
- Institutional support (DSPQA, HR, Estates, Protection Services, Finance, Procurement, Legal Services, Risk Management, Employment Equity and Transformation, Internal Audit, Foundation, CPD).

The organization is guided by the Tuition Policy, the Framework for the Implementation of a Team Approach, and the ODL Policy in its endeavours for curriculum change with the university. The external stakeholders would

be the HEQC and ECSA as the two main bodies that can bring about change in the curriculum as well as the strategy of benchmarking. The evaluation of curricula is governed by the DSPQA which obtains feedback as to the performance of curricula. Ultimately, the chair of the Department (CoD) and the lecturers may make minor changes to the curriculum as required. Curricula are evaluated on a seven-year cycle throughout the university and changes are made accordingly.

It may be noted that **curriculum** is the “driver” of educational development in both basic and higher education in South Africa and requires rigorous engagement from all stakeholders. Constructive attempts are required for a transformational impact on the curriculum in South Africa.

5. Conclusion

The curriculum policy and its tenets which encompass curriculum development framework, curriculum development guidelines, curriculum development and monitoring, programme selection and evaluation, curriculum responsiveness in the context of the programme, and institutional QA principles and processes were presented. There is a need to drive curriculum through both theoretical underpinning as well as discipline-specific knowledge, and it is believed that organisational key players bring these parties together where there is an active reflection that promotes continuous improvement (Biggs, 1999; Diamond, 1998; Knight, 2001). In this process, student perceptions, teaching and learning in ODL, as well as assessment practices, be discussed. In addition, the roping in of alumni, industry and Seta’s would provide valuable input. In moving forward, it is believed that process mapping in curriculum rejuvenation should encompass what is called “division of labour” in Industrial Engineering. That is, breaking the job into manageable parts. In this case, it is proposed that:

- Curriculum visioning that would encompass the assessment of the curriculum
- Curriculum development using SWOT analysis as a starting point
- Curriculum alignment in terms of alignment of the complete programme (Wolf, 2007)

References

- Al Zefeiti and Mohamad, “Methodological considerations in studying transformational leadership and its outcomes,” *Int. J. Eng. Bus. Manag.*, vol. 7, no. 1, pp. 1–11, 2015, doi: 10.5772/60429
- Council on Higher Education, 2013. A proposal for undergraduate curriculum reform in South Africa: The case for a flexible curriculum structure. *Report of the Task Team on undergraduate curriculum structure*.
- D'Andrea, V. and Gosling, D., 2005. EBOOK: Improving Teaching and Learning in Higher Education: A Whole Institution Approach. McGraw-Hill Education (UK).Biggs (1999)
- De Beer, S.F. and Van Niekerk, A.S., 2017. Transforming curricula into the next century: Doing theology collaboratively with local communities. *Verbum et Ecclesia*, 38(4), pp.213-302.
- Hussey, T. and Smith, P., 2003. The uses of learning outcomes. *Teaching in higher education*, 8(3), pp.357-368.
- Knight, P.T., 2001. Complexity and curriculum: A process approach to curriculum-making. *Teaching in higher education*, 6(3), pp.369-381.
- Kothari, Research Methodology: Methods and Techniques. New Delhi: New Age International (P) Limited Publishers, 2004.
- Lockett, K. and Shay, S., 2020. Reframing the curriculum: A transformative approach. *Critical Studies in Education*, 61(1), pp.50-65.
- Lockett, K., 2016. Curriculum contestation in a post-colonial context: A view from the South. *Teaching in higher education*, 21(4), pp.415-428.
- Lockett, K., 2009. The relationship between knowledge structure and curriculum: A case study in sociology. *Studies in higher education*, 34(4), pp.441-453.
- Priestley, M., 2011. Whatever happened to curriculum theory? Critical realism and curriculum change. *Pedagogy, culture & society*, 19(2), pp.221-237.
- HEQSF McGrath, P. and Lombard, H., 2014. Consequences of the higher education qualifications sub-framework (heqsf) on workplace-based learning (wpl) in the south african context. In *INTED2014 Proceedings* (pp. 3367-3373). IATED.
- Saunders, Lewis, and Thornhill, Research methods for business students, Fifth Edit. New York: Pearson Educational Limited, 2009.
- Scott, D.J., Goova, M.T. and Tesfay, S.T., 2007. A cost-effective proficiency-based knot-tying and suturing curriculum for residency programs. *Journal of Surgical Research*, 141(1), pp.7-15.
- Toohy, S., 1999. *Designing courses for higher education*. McGraw-hill Education (UK).
- Wolf, P., 2007. A model for facilitating curriculum development in higher education: A faculty-driven, data-informed, and educational developer-supported approach. *New Directions for Teaching and Learning*, 2007(112), pp.15-20.

Knowledge Building Through Academic Development

Kemlall R Ramdass

University of South Africa, Johannesburg

ramdacr@unisa.ac.za

Abstract: In order to counter-act obsolescence, an important aspect of organisational well-being in turbulent times, is the collective responsibility and capability of all workers to co-create organisational knowing -- in other words, what constitutes quality in the open distance learning (ODL) context. This implies a culture of innovation in an environment that is continuously changing. In this context where social change is the norm the organisation cannot depend on existing practices. Rather, it requires the ability to re-invent the collective understanding of the organisation; this is known as contextual knowledge building. Knowledge building is the creation of ideas and the improvement of ideas that have a life out in the world where they are subject to social processes of evaluation, revision and application. Within such an organisational culture, learning refers to ongoing reflective work which brings innovation closer to the central work of the organisation. This, in turn, leads to a shared community in which an individual contributes to the shared intellectual property of the organisation as a whole. Therefore, learning is necessitated by this process and integral to it. The resulting community knowledge is a form of new information that other community members can all build on together. There is continual movement beyond current understanding and best practice toward "lifelong innovativeness". Thus, capacity development and knowledge building involve everyone in the institution, not only the academic staff. The paper reflects the importance of academic development in a continuously changing environment through a reflective case study analysis.

Keywords: Academic Development, Knowledge Building, Socialisation

1. Introduction

In view of continuous change in higher education, it is imperative to start conceptualizing a framework for the development of academic developers systematically. The field of academic development (AD) has grown to become recognized in higher education. It is suggested that a formal induction course be created for developers (Quinn and Vorster, 2014). Quinn and Vorster (2014) mention's that most academic developers are 'migrants' from other departments and disciplines with valuable knowledge, experience and skills but lack the practical experience in AD and this is experienced at the organization. It is time that the university develops a formal, coherent strategy to address newcomers into AD (Quinn and Vorster, 2014).

Boughey (2007) argues that AD requires contextualisation that would contribute to differentiated learning in a differentiated system. The positioning of AD and its linkage with QA would enable programmes that are fit for purpose, value for money and address the transformational agenda as envisaged by the HEQC through strategic positioning. This relocation offers validation of AD work that enables the strengthening of a field that would resolve much of the quality assurance and enhancement issues of teaching and learning suffered by the current system (Boughey (2007).

2. Literature Review

Knowledge building, according to Scardamalia & Bereiter (2010) is the conceptualization of innovative ideas that stimulate and generate socialisation. Further, Boughey (2013) argues the scholarly approach to academic development in terms of structure, culture and agency where infrastructure may be used as a vantage point to position academic development under the domain of the Vice Principal academic. In this structure, academic development is well positioned in terms of the introduction of AD qualifications such as the Post Graduate Diploma in higher education (HE) as well as the development of support for staff and students in teaching and learning.

Bradley and Cooper (2002) offers' a pragmatic eclectic approach to academic development that requires academic development practitioners to have a "scholarship approach" that would enable them to be part of the academic community. As active members of the academy, they would be able to contribute actively to all teaching and learning discourses in contrast to current experiences of indifference and disregard towards AD in the institution.

One of the fundamental issues as highlighted by Webb (2012) is the concern that staff/academics regard being developed as impertinent. At this stage of the organisation overt attempts are being made by management through the Integrated Performance Management System (IPMS) for academics to attend development programmes managed by the Centre for Professional Development (CPD).

Brew and Peseta (2008) summarise the precarious existence of the academic development unit through a description of the justification of the existence of such a unit through its complexity, ambiguities, and contradictions. In view of continuous engagement and learning taking place which may be referred to as “lifelong learning” the academic development department (CPD) regenerates itself through research and practice in a continuously changing environment. Progress in teaching and learning in terms of “structure” in the form of policies and committees are valid, however theoretical and cultural underpinning are limited in teaching and learning as may be experienced. Significant progress has been made in terms of communities of practice such as HELTASA in establishing AD as a driving force for teaching and learning in higher education.

Within such an organisational learning culture, learning refers to ongoing reflective work which brings innovation closer to the central work of the organisation. This, in turn, leads to a shared community in which an individual contributes to the shared intellectual property of the organisation as a whole. Therefore, learning is necessitated by this process and integral to it. The resulting community knowledge is a form of new information that other community members can all build on together. Thus, capacity development and knowledge building involve everyone in the institution, not only the academic staff (Shay, 2012).

Academic development is an integral component of the teaching and learning process in higher education and takes place all the time: within the department, in professional networking sessions, in research, in student engagements, chatting with colleagues, resolving problems. However, this may not provide the attributes required for being a “good teacher.” Therefore, academic development, especially with older colleagues moving out of the system, needs to be formalised within the organisational structure where it is visible and has the greatest impact. The justification for this is that academic identity is enhanced through organised development. It needs to be conceptualised as a process of socialisation and peer learning in the workplace (Boud, 1999). Academic development can add value and optimise the use of resources through the following:

- Improving student access, success and throughput rates
- Address the “gap” between equity of access and equity of outcomes
- Developing systems to evaluate student progress and address the requirement for student support.
- Provision of support in respect of socialisation, culture and agency through discourses
- Professional development of academic staff

It is imperative that management of institutions understand the importance of such a department and strive to position it effectively.

3. Research Methodology

Al Zefeiti and Mohamad (2015) suggest that research methodology is a framework of a research strategy that outlines the manner a study is to be undertaken. It covers an arrangement of principles and philosophical worldviews which grounds the research questions and influences the research methods to be executed. Kothari (2004) suggests that research is a systematic inquiry into suitable material in the area under consideration. Saunders et al. (2009) coined the research onion approach to research methodology with the first layer as the philosophical worldview, followed by the research approach, then research strategy, research methodological choice, time horizons and lastly, data collection procedure and analysis tools. The onion research framework is depicted in Figure 1.

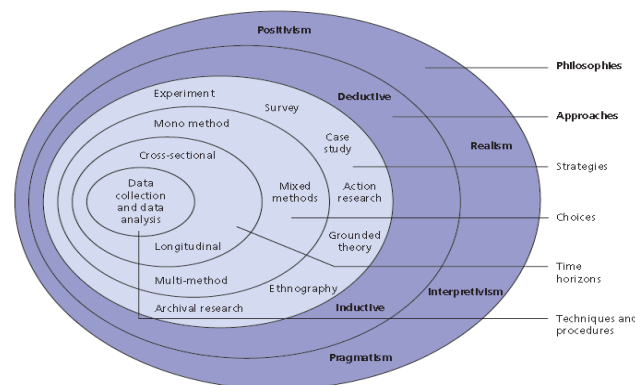


Figure 1: The research onion (Saunders et al.)

This study adopted an interpretivist philosophical worldview which grounded the study to follow an inductive approach. A case study research strategy was adopted because the phenomenon under study required a reflective approach to the qualitative data at hand. Academicians are presumed to be competent in their field of expertise, which is inclined towards their area of research. It is imperative to be able to reflect not only on practical aspects of research but also from a cognitive mental state that enables the construction of meaning through practice. Reflection provides an environment where one can participate in learning through thoughtful relationships with everything around and is practiced in qualitative research. Data were assimilated through academic literature and reflection on the practices of teaching and learning in the organization as well as through meetings and discussions.

4. Reflection of Academic Development as a Driver for Continuous Enhancement

4.1 Changing Social Demands

In order to avoid obsolescence, the organization is required to adapt to the challenging social demands by fostering a culture of organisational learning and knowledge building. Thus, planned academic development is necessary because change is inevitable (Quinn and Voster, 2014).

4.2 Positioning of the Centre for Professional Development (CPD)

The current positioning of academic development is constrained within the Directorate of Instructional Support and Services (DISS) which is not under the Vice Principal Academic. This poses tremendous challenges as management within this domain do not understand the importance of academic development and do not provide the leadership that this function deserves. Therefore, it is recommended that this should be restructured and report directly to the Vice Principal Academic. This would prevent the current challenges experienced in terms of structure, culture and agency where the CPD is not recognized for the work that is done. In addition, there is regular conflict between the manager of DISS and CPD due to the lack of understanding of the function of CPD. The amalgamation of the Quality Department currently under the auspices of The Directorate of Strategic Planning with Academic development would enable powerful teaching and learning strategies to emerge and would resolve many of the problems currently experienced. D'Andrea and Gosling (2005) espouse the quality development model (QD) which proposes key dimensions:

- curriculum development; pedagogical process; teaching and learning; and SoTL
- The focus on the T&L interface as central to quality
- A non-burdensome process

The central theme of the model is development and proposes the integration of three areas, ie. Academic development, learning development and quality development that holistically focuses on educational development. In addition, the process is about continuous evaluation and research that add value to the student experience. There is more emphasis on the development of knowledge, skill and attributes of all stakeholders through systematic reflection. This developmental process encourages the development of trust in academics. The developmental approach will consume more time and energy but would definitely lead to change for those who believe in it and strive to make it work (D'Andrea and Gosling, 2005).

4.3 Academic Development Reflection in positioning

The Centre for Professional Development was in its developmental stage with low impact to the academic community in its infant stage. The team engaged with the development of the rationale that outlined the purpose, objectives, and function of the CPD. It is not an official document therefore no reference is made of it.

4.4 Professional Identity

Higher education in South Africa is complex and changing continuously. Thus, the academic's professional identity is complex and molded by circumstantial factors. Clark et al (2020) mention that there is insufficient research on professional identity in higher education. Also, there is no clear definition of professional identity. In order to get a better understanding, one needs to study the relationships, conditions and experiences in an organization that is multi- disciplined. Clark, Hyde and Drennan (2013) categorized professional identity into sections: "1. Bounded professionals who perform clear and prescribed roles. 2. Cross Boundary professionals

who perform transactional functions and contribute to capacity building. 3. Unbounded professionals who contribute to projects across the university and 4. Blended professionals who contribute to both professional and academic areas.” The categorization of people into these four simple areas simplifies the complexity of professional identity in higher education. Thus, professional identity may be seen as an ongoing developmental process similar to life-long learning that is a never-ending journey of development. Professional identity is molded by structure, culture, and agency throughout the lifespan of the individual and the sociological factors that surround the individual.

4.5 The Centre for Professional Development (Academic Development)

The Centre for Professional Development (hereafter known as CPD) makes use of a comprehensive and integrated approach to provide continuous professional development for the teaching community in a open distance learning (ODL) environment. The purpose is to address the need for a balance between building organisational capacity as well as satisfying the career needs of individual members of this community.

The current method of functioning is through communicate of invitation via the intranet to the community to attend CPD offerings. The challenge faced is the low number of people attending, as well as cancellations just before a workshop can start. This places strain on the CPD in terms of resources for 1 or two people attending and also the waste of catering. There is very little in terms of relationships with the colleges. This may be addressed through roadshows as well as collegial relationships with the deans of the colleges.

The CPDs offerings are informed by and grounded in current research on professional learning in higher education. Learning at work is often informal and the CPD believes its role is also to create conditions and spaces where collegial conversations may occur. Therefore, these offerings will be situated in authentic work-based contexts, with participants often working in teams. For this reason, the CPDs initiatives would be flexible and provide access to offerings ranging from short learning programmes to open and informal programmes, to stand-alone tutorials.

The CPD proposes an integrated and comprehensive approach for continuous professional learning for all academic staff of the university. This approach places professional development at the centre of organisational capacity development, academic community building, and the development of insight into the complexities of the ODL environment.

4.5.1 Rationale for Introducing CPD

In this section current trends in the field of professional development in the context of higher education is discussed. At the same time a brief overview will be given of those theoretical developments in the domain of professional development of academics that have informed critical decisions behind this ‘Menu of Services’ (offerings of CPD). As a point of departure, it is accepted that CPD is an underpinning mechanism for organisational as well as individual capacity development in order to drive productive institutional change and innovation.

4.5.2 Continuous Professional Learning

One of the most common definitions used to describe Continuous Professional Learning comes from Day in her writing about preparing teachers for professional careers in education. In Day’s words, continuing professional learning, “is the process by which alone and with others, teachers review, renew and extend their commitment as change agents to the moral purposes of teaching; and by which they acquire and develop critically the knowledge, skills and emotional intelligence essential to good professional thinking” (Day and Hadfield, 2020).

Although the definition of Day and Hadfield can be helpful, one needs to acknowledge the full complexity of working as an academic in the context of higher education and specifically in an ODL environment. Therefore, in addition to those dimensions identified by Day and Hadfield, there needs to be consideration of the variety of roles that academics have to perform at a professional level that require expertise and skills in areas that extend beyond the academic’s specific area of scholarly expertise; some examples of new roles would be management of distance learning provision, the design and development of learning environments, learning experiences and resources, as well as learning technologies and subsequent research. Furthermore, Day’s definition focuses specifically on the teaching dimension and therefore the teachers. In the research on organisational learning in the higher education domain, however, there is a clear shift to broaden the scope of traditional staff development to include other institutional workers as well. This is especially vital in ODL

institutions where specialisation of purpose is the norm across academic, professional and support departments. Therefore, in the context of ODL higher education, continuing professional learning involves more than only the teaching staff; it involves all academic workers (which includes academics, professional and support staff).

4.5.3 *Continuous Professional Development (CPD)*

Primarily, CPD is a process of dynamic socialisation embedded in individual and organisational relationships and the shaping of individual professional and organisational identity and agency. As a natural result leading off from Day's definition of continuous professional *learning*, continuous professional *development* (CPD) is much more than just increasing the competencies of employees in service of organisational goals. While CPD focuses on the well-being of the individual, it is also crucial that the organisation takes responsibility for the support that it can offer. In this way, both the individual and organisation benefit.

Another important distinction is that CPD also targets *all* academic workers within an educational institution. Therefore, the provision of quality CPD is applied to academics, professional and support personnel in the institution, in an on-going, sustained manner through conferences, workshops, discussions and presentations by colleagues from CPD and from other institutions.

4.5.4 *Capacity Development*

Capacity development is the process by which individuals, and the organisation develop the appropriate capabilities (individually and collectively) to perform functions, solve problems, and set and achieve objectives/goals. To improve the capacity of organisations to perform well, the notions of capable and capability are important. Capable people are more likely to be able to deal effectively with the turbulent and complex environment in which they live. They are more than competent because they are able to see beyond the 'normal' solutions to think creatively and innovatively on a daily basis. Capability and capacity are also more than knowledge and skills and is defined in the following way:

"Capability is the confident and mindful application of both current and potential ability (competence and capacity) and values within varied and changing situations to formulate problems and actively work towards solutions as a self-managed process" (Malloch, Cairns, & Hase, 1998: 9).

The development of a capable organisation and capable individuals requires a holistic systemic approach in the development of strategies and interventions in capacity development that would impact academic development in all its contexts, thereby contributing to organizational effectiveness.

4.5.5 *Conceptualization of Academic Development*

Gravani's (2007) theory mentions a shift from the conventional delivery of courses to an understanding of systemic social processes by which professional learning is developed. Structure, culture and agency in education systems are continuously changing and this environment enables lifelong learning to counter the rapid pace of change. The teacher is the adult professional learner and there needs to be continuous professional development in a "knowledge-based society that requires lifelong learning" (Gravani 2007: 687).

In this context there are two models of consideration that are of crucial importance: the traditional training model and professional learning system. At this stage, the traditional training model informs CPD activities. The professional learning system has enabled rigorous discourses on quality teaching practices through continuous debates on the delivery of teaching and learning.

The traditional training model enables teaching and learning to evolve as a craft. In this model a repertoire of skills or competencies are gleaned over time. The perspective of continuous professional development as a professional learning system is built on the assumptions of complexity theory, the premises of which are that reality is dynamic and continuously changing. The professional learning model interrelates as a system in which the structure, culture and agency are intertwined in molding teacher competencies. The following dimensions espouse the conditions as the basis:

- It should be acknowledged that there is a synergy between the macro-, the meso- and micro-levels of teaching and learning in a particular context. Therefore, the symbiotic relationship between the professional development "needs" of individual academics and academic departments, the development of the institution, as well as the socio-political realities influencing the higher education context should inform professional development strategies.

- Teaching should be approached as an art and a profession, therefore every teaching situation should be perceived as unique, and should be approached considering multiple perspectives and imagining multiple possibilities. Thus, lecturers should be prepared to apply professional knowledge differently in each situation.
- Professional practice is required to accompany a reflexive appraisal of each activity. Lecturers are required to negotiate within educational settings and apply themselves accordingly.

Critical to the success of this approach is the organisational conditions that promote learning for teachers:

“Such organizational conditions include resources, time and structural conditions that facilitate teachers to have space and energy to devote to their professional development, as well as the culture and ethos of the organization that genuinely support teacher professional development” (Tang & Choi 2009:2).

4.5.6 *Socialisation: a Critical Aspect of Organisational Learning Theory*

A systemic understanding of professional development has contributed to a strong focus on socialisation as a critical dimension of organisational development and professional learning. The definition of socialisation provided by Ajjawi and Higgs (2008), promulgates socialisation as continuous life-long learning through engagement of academics across boundaries that share and reflect on all teaching and learning aspects.

Danielson (2004: 369) posited a conceptual model based on organizational renewal through the process of ongoing socialization. Danielson proposed that “boundary changes resulting from changing contexts are catalysts for the next iteration of the socialization cycle.” Trowler and Knight (1999:185) strengthen the argument by alluding to academics as agents of change who are in a battle with the construction of identity in a changing environment especially in terms of induction processes. They also mention that in order to better understand socialization, there needs to be an awareness of different needs in the career stages of academics.

According to Broadbent (2002) socialization and induction require entanglement, and believe that organisational socialisation is a complex process when compared to conventional induction, and define it as “the accommodative process which takes place when new entrants to an organisation engage with aspects of the cultural configuration they find there”. The research by Ajjawi and Higgs (2008) concludes that the induction of new academics requires reconceptualization as current practices are poorly planned and ineffective.

4.6 The Need for a Professional Qualification in Higher Education

Under the increasing pressure for accountable, quality teaching in higher education, the spontaneous reaction of many countries was to introduce a compulsory, formal qualification supported by further qualification pathways. As a result, the ‘professionalisation’ of teaching in higher education institutions through formal degree programmes has become one of the most dynamic fields of research in the higher education domain. For example, at the Universities of Stellenbosch and Cape Town, there is a Diploma in Higher Education for their academic communities.

It is important to be aware of current developments with regards to the ‘professionalisation’ of academics in the context of higher education in South Africa. On many occasions Dr. Blade Nzimande, the Minister for Higher Education and Training, reinforced the need for university lecturers to be taught how to teach (e.g. Higher Education Learning and Teaching Association of Southern Africa [Heltasa] Conference in Tzaneen, Nov 2012). This message is also reinforced by other academics: “How can Heltasa influence the government towards regulating that all university teachers are professionally qualified as educators?” (Kilfoil, 2015).

These developments have a radical impact on CPD initiatives in the future. It may be beneficial if the organisation could follow these developments very carefully and even find ways in which to contribute to these very important processes.

It is believed that academics should be able to fulfil all the demands of their jobs in order to be considered Higher Education professionals in the context of ODL. This belief is based on several premises that govern the thinking behind the Centre for Professional Development. The justification for such a department can be espoused by the following principles.

4.6.1 *First Premise: an Interrelated Systemic Approach*

The first premise that underpins the view of the task at hand is that professional learning is an interrelated system in which the personal, social and contextual conditions of professional learning are intertwined. Therefore, building capacity for academic professionals in the context of the organization is much “more than merely teaching ‘technical skills’” (Gravani 2007:689).

While traditional staff training has usually focused on giving ‘trainees’ a generic repertoire of skills or competencies, these initiatives were usually totally out of context and staff members attended to gain knowledge about these skills in short, generic workshops (Knight, 2002). The systemic approach, however, takes cognisance of the professional identities of individual academics, as well as the complexities of the roles and responsibilities of higher education academics in their various contexts. Professional development programmes are flexible and adaptable to fit various demands – to benefit academics, while complying with institutional strategic visions.

4.6.2 *Second Premise: Complex Range of Roles and Responsibilities*

A second premise that governs the view of professional development is that it must encompass the whole of the wide, complex range of tasks involved in teaching, learning and research. ODL academics need to perform a variety of diverse roles. Within these roles, academics deal with routine tasks, as well as uncommon and unknown situations; therefore, the need to be versatile, flexible, and innovative within the systems of an ODL institution. Such roles were identified which informed decisions around strategy:

- **Mediator of learning** at a distance within a particular subject field, with sensitivity to diverse student populations.
- **Assessor and moderator**, planning and using assessment strategies reflectively to support learning, and then doing the requisite moderation of the existing practices and procedures.
- **Designer and developer of learning programmes** in the complex ODL context.
- **Reflective practitioner** concerned with pedagogical problems, contributing to research, and the improvement of ODL practices.
- **Leader of pedagogical conversations** in rapidly changing learning contexts and working environments (Ramdass, 2016).

4.6.3 *Third Premise: Ongoing Socialisation*

A third premise that informs strategy is that of the ongoing socialisation of staff in the institution. This is the process through which members in an organisation move along various pathways in the institution – weaving their way through various tasks and challenges, crossing the professional boundaries of rank and departmental structures, confronted by new professional roles and added responsibilities. This process allows new members access to the internal workings of the organisation. This is in contrast to the out-dated ‘skills and competencies approach’ which presumes that once professionals have been trained, they will be able to be effective as long as they have to do a particular job. Socialisation processes are well planned, because they are critical for maintaining a loyal workforce, for the wellbeing and growth of the whole organisation. These processes also reduce uncertainty and role ambiguity and provide a sense of how a particular role contributes to the overall organisation.

4.7 The Different Stages of an ODL Academic’s Career Path

The premises make it clear that professional development activities in an institution are not completed in just one or two years, but carry on, over the whole of the academic career of the academic.

Three distinct target groups who are in the following stages in their careers were identified:

- **Newcomers:** These are usually new academics, or simply academics that are new to the context of ODL. They are usually hired for their subject matter expertise but may have little or no experience in higher education.
- **More experienced academics:** These are academics who have been in their job for a while, but who are now faced with other roles and responsibilities with accompanying challenges. At the same time this group of academics are faced with new challenges as the organisation moves forward in terms of new pedagogies (Ramdass, 2016).

- **Pedagogical leaders:** These are academics who have reached a point in their academic careers where they are moving into roles of management, governance, and leadership, and who therefore need professional development support in these areas.

It was acknowledged that there may be a need for appropriate professional development support at each of these stages in an academic's career. This means that the CPD should provide a wide variety of offerings to meet the various needs of this complex target group.

4.8 Different Purposes

In the context of the organisation, there is a need for coherent strategies to convert academics into teachers in their respective subject fields. When teaching staff are appointed, they are usually judged on their qualifications as subject matter experts. Yet they are expected to meet the heavy demands of teaching and assessing their students – for which they are sometimes not at all prepared. In order to fill this gap in teaching competence, the CPD is prepared to provide various initiatives that will help academics all along the way – from newcomers, to designers and authors of study materials, to researchers, to leaders in their departments.

The CPD designed a **Menu of Services** to capture professional development interventions, allowing for different purposes:

- **Formal qualification** – Towards a professional qualification for those who are pursuing a possible career in higher education.
- **Non-formal short learning programmes/courses** – A basket of modules, clustered around key performance roles and responsibilities. These can be compiled into various credit-bearing certificate qualifications or taken as single modules for non-degree purposes, depending on the specific needs of the academics.
- **Informal offerings** – These are designed to respond to the emerging needs of the institution, a department, or the academic community at large. They are very flexible and open to a wider audience. Because of their immediacy, they can be put in place quickly and meet urgent needs. At the same time, these informal offerings may be a place to pilot-test materials that will feed into the non-formal and formal offerings.

The reason behind such thinking was developed from Entwistle's (2000) theory of learning which considered reproduction of knowledge, conceptions of learning and the transformation process in developing a person.

5. Conclusion

Continuous professional development for academic excellence and quality in the provision of higher education is a long-standing goal of the organisation. The knowledge building through proposed programmes and socialisation by professionals is linked to the knowers of academic development. Therefore, the courses recommended should provide cumulative learning for both academics and academic development practitioners over time where knowledge and pedagogy shape professional identities. For AD to be successful, it needs to be strategically positioned and requires the commitment from top management. Structurally, it is believed that the department is located in an area of minimal impact where culture and agency is constrained. Should this change, the impact of the CPD would definitely be enhanced.

In conclusion this paper is mapped by the complexity of the academic task, and mapping the morphogenesis that may occur should academics follow the professional paths at the various stages of their careers. At the same time, there are various ways and means to address the demands of academics' jobs and tasks through formal, non-formal and informal means. The paper positions the CPD in the context of the organisation and is open to new trends and emerging needs as they arise in the institution, in the broader community and in the South African higher education landscape.

References

- Quinn, L. and Vorster, J.A., 2014. Isn't it time to start thinking about 'developing' academic developers in a more systematic way?. *International Journal for Academic Development*, 19(3), pp.255-258.
- Boughey, C., 2007. Marrying equity and efficiency: The need for third generation academic development. *Perspectives in Education*, 25(3), pp.1-11.
- Scardamalia, M. and Bereiter, C., 2010. A brief history of knowledge building. *Canadian Journal of Learning and Technology/La revue canadienne de l'apprentissage et de la technologie*, 36(1).

- Boughey, C., 2013. What are we thinking of? A critical overview of approaches to developing academic literacy in South African higher education. *Journal for Language Teaching= Ijenali Yekufundzisa Lulwimi= Tydskrif vir Taalonderrig*, 47(2), pp.25-41.
- Bradley, C. and Oliver, M., 2002. The evolution of pedagogic models for work-based learning within a virtual university. *Computers & Education*, 38(1-3), pp.37-52.
- Webb, G., 2012. *Understanding staff development*. Routledge.
- Brew, A. and Peseta, T., 2008. The precarious existence of the academic development unit.
- Shay, S., 2012. Educational development as a field: Are we there yet?. *Higher Education Research & Development*, 31(3), pp.311-323.
- Boud, D., 1999. Situating academic development in professional work: Using peer learning. *The International Journal for Academic Development*, 4(1), pp.3-10.
- D'Andrea, V. and Gosling, D., 2005. *EBOOK: Improving Teaching and Learning in Higher Education: A Whole Institution Approach*. McGraw-Hill Education (UK).
- Drennan, J., Clarke, M., Hyde, A. and Politis, Y., 2020. Academic identity in higher education. In *The international encyclopedia of higher education systems and institutions* (pp. 35-40). Dordrecht: Springer Netherlands.
- Day, C. and Hadfield, M., 2020. Metaphors for movement: Accounts of professional development. In *Changing Research and Practice* (pp. 149-166). Routledge.
- Malloch, M., Cairns, L. and Hase, S., 1998. Learning in the Workplace: Implications of the Capability Learning Model.
- Gravani, M.N., 2007. Unveiling professional learning: Shifting from the delivery of courses to an understanding of the processes. *Teaching and teacher education*, 23(5), pp.688-704.
- Tang, S.Y.F. and Choi, P.L., 2009. Teachers' professional lives and continuing professional development in changing times. *Educational review*, 61(1), pp.1-18.
- Ajjawi, R. and Higgs, J., 2008. Learning to reason: a journey of professional socialisation. *Advances in health sciences education*, 13, pp.133-150.
- Danielson, M.M., 2004. A theory of continuous socialization for organizational renewal. *Human Resource Development Review*, 3(4), pp.354-384.
- Broadbent, C., 2002. *Impact of change on university academics* (Doctoral dissertation, University of Tasmania).
- Kilfoil, W.R. ed., 2015. *Moving beyond the hype: A contextualised view of learning with technology in higher education*. Pretoria: Universities South Africa.
- Gravani, M.N., 2007. Unveiling professional learning: Shifting from the delivery of courses to an understanding of the processes. *Teaching and teacher education*, 23(5), pp.688-704.
- Knight, P., 2002. A systemic approach to professional development: learning as practice. *Teaching and teacher education*, 18(3), pp.229-241.
- Entwistle, N., 2000, November. Promoting deep learning through teaching and assessment: conceptual frameworks and educational contexts. In *TLRP conference, Leicester* (Vol. 1, p. 12).
- Malloch, M., Cairns, L. and Hase, S., 1998. Learning in the Workplace: Implications of the Capability Learning Model.

A Comprehensive Analysis of Student Behaviour in Open.uom.lk: A Large-scale Asynchronous Open Online Platform

Eshana Ranasinghe, Vishaka Nanayakkara, Buddhika Karunaratne, Malik Ranasinghe, K.A.B.J.W Gunarathna, Sumudu Jayathissa and Tiloka de Silva

The Centre for Open and Distance Learning, Moratuwa, Sri Lanka

enranasinghe1@gmail.com

vishaka@cse.mrt.ac.lk

buddhika@cse.mrt.ac.lk

malikr.uom@gmail.com

buddhinig@uom.lk

chathurani.jayathissa8@gmail.com

tiloka.desilva@gmail.com

Abstract: The open learning platform (open.uom.lk) of the University of Moratuwa, Sri Lanka has attracted over 180,000 registered students in just over one year of its launch. This platform offers the Trainee Full Stack Developer (TFSD) programme, enabling the participants to enter the Information Technology (IT) industry to address the much needed human resources for the growing IT industry of the country. The programme consists of six courses related to IT covering Python Programming, Web Development and Professional Practice in Software Development. The platform operates with minimal restrictions for registrants and has students from all parts of the country with some foreign students with an equitable gender distribution. The steady growth of the registration numbers shows a high level of enthusiasm from the community to explore the potential opportunities in the IT industry. While the platform is being used actively by thousands of participants and new users are registered on a daily basis, it is also observed that some of the participants have shown slow progress at different stages. This study presents analyses performed at different stages of the programme to study the student behaviour and identify the possible causes for the participants not being able to achieve steady progress. The findings of the study indicate that the participants generally find it difficult to get through the programming exercises and assignments. Correlating learning patterns of the students help understanding the overall learning strategies which can be adopted by developers of similar asynchronous learning programmes. Furthermore, the study goes on to suggest and discuss possible solutions to clear the bottlenecks identified at different stages of the programme. The subsequent analyses allow the prediction of completions by participants leading to a machine learning based model for predictive analytics.

Keywords: E-Learning, Online Asynchronous Learning, Student Behaviour, Predictive Analytics

1. Introduction

During the Covid-19 pandemic online education was widely utilised and has proven to be both effective and essential, allowing students to gain knowledge and skills in a more accessible manner. A study by Hayashi et al. (2020) found that over 90% of state and non-state higher education institutes in Sri Lanka had carried out remote learning as of June 2020 which was mostly online. During the pandemic Internet service providers in Sri Lanka provided free access to university servers until August 2020 to boost online learning exemplifying Sri Lankan society's attitude towards education and how important they think access to education is. Online education, especially asynchronous online courses can be used as an effective way to provide education to a large number of people with little need for maintenance after the course is created by using automated grading and not limiting the number of registered students at a time.

The Sri Lankan IT industry faces a severe shortage of skilled workers. While previously the industry recruited IT degree holders, the supply of graduates produced each year has been insufficient to meet its needs ("National IT-BPM Workforce Survey 2019 - ICTA."). The Centre for Open and Distance Learning (CODL) of the University of Moratuwa (UoM), in consultation with members of the IT industry determined that the people entering the IT industry needed to possess adequate coding knowledge and the correct attitude to work in the industry and not necessarily a university degree.

During 2021, the CODL in collaboration with the Faculties of Engineering and IT, created Trainee Full-Stack Developer (TFSD) course. Trainee Full-Stack Developer is an asynchronous online course which covers python programming, web development and professional practices. Its primary goal was to provide IT education to students who completed their Advanced Level examination but have yet to or were unsuccessful in enrolling in university, to increase number of people who could enter the IT industry. It also aims to increase the coding and computer skills of the Sri Lankan population at large, given that the course is open to anyone and is completely free-of-charge.

The Trainee Full-Stack Developer course is made up of six courses; two courses in Python programming, three courses in web development and one course which include lectures in professional practices and the capstone

project. When a student registers they are automatically enrolled into introductory courses in Python programming and web development. Once a student completes the first course on a particular topic they are automatically enrolled in the subsequent course. Students are only permitted to attempt the capstone project once all the courses in Python programming and web development are completed.

The rigor of the course was determined with the goal of creating skilled workers who could be employable in the IT industry. This implies that there will be students for whom the course will be difficult to complete. From the open.uom.lk usage data it was immediately evident that most students were not able to advance past the first two courses. Python for Beginners and Web Design for Beginners had a completion rate of 8% and 5% respectfully. Moreover, even six months after the capstone project module was released only 0.03% of registered users completed the course. However, given the industry-based requirement for initiating the course, there is a need to predict with a reasonable degree of accuracy how many trainees would successfully complete the programme within a certain time period as well the likelihood of a given student to complete the programme.

This paper will cover detail analysis of the students' progress through the six courses and identify where and what is causing these low completion rates. Once identified steps will be taken to improve the completion rate and the quality of the courses overall. Demographic will be gathered and analysed which in the future will be used in combination with the user data the create machine learning based algorithms to make accurate predictions of course completions in future.

2. Literature Review

In a study by Hayashi et al. (2020) of Sri Lankan university students it was found that while students overall preferred face-to-face classes and practical training, students from architecture, computer science/ Information technology, law, education and arts preferred to have 50% of their classes online rather than have 100% face-to-face classes. Computer science and Information technology courses have a distinct advantage over other fields as their practicals are performed on computers making the switch to online learning easier than for other courses which demand in-person practical training.

Despite the benefits and many advantages of online courses they have a high dropout rate especially compared to traditional in-person courses. According to studies a total of 40%-80% of students drop out of fully online classes (Smith, 2010; Jordan, 2016). According to a study by Levy (2007) students who are at an early point in their program are more likely to drop out. Students who have put in more time and effort into the course are more likely to complete the course, while those who are unprepared for how difficult the course is and are unwilling to put in more effort have a greater chance of dropping out. According to a study by Willging and Johnson (2009) students were less likely to drop out of a course if they invested more time in it however there is still a chance of dropping out at any point in the course. While there is no main cause of a student dropping out, it can vary from personal reasons, job-related reasons or reasons related to the course itself. It is important for institutions to take continuous steps to reduce the dropout rate.

While there is a lot of focus on motivation and behaviour of students, studies suggest that the greatest indicator of online course completion is their prior educational experience. A study by Emanuel (2013) found that most of the participants in MOOCs are already well educated, many having post-secondary education or already being employed. Emanuel posits a better basic education and overall greater access to technology would be required to fully meet the goals of online courses to provide education to those who would otherwise be unable to access it. In a study by Koller & Ng (2013) it was found that the demographics of the students who participated in Coursera were that over 75% had bachelors' degrees and most students were between the years of 20-39. These studies suggest online courses are being mainly used by those who already have an education but want further knowledge and qualifications in a new field or their chosen field.

Online courses are also largely self-driven and depend on the student's ability to manage their time and be dedicated to their academic pursuits. There are fewer supports than in-person classrooms and students will have to face solving complex problems alone. If students do not have academic discipline or are not used to self-learning they will likely become de-motivated and quit. (Bawa, 2016). The access to technology and internet is one of the greatest limiting factors when it comes to widespread adoption of online learning. According to the World Bank (2023) 67% of the Sri Lankan population uses or has access to the internet. This is doubled from 2017 where only 32% of the Sri Lankan population used the internet. The dramatic growth in internet usage by the population suggests an increase in the availability and adoption of internet in rural areas in the future. At the same time, statistics from the Sri Lanka Labour Force Survey suggest that only 34.4% of the Sri Lankan

population was computer literate, of which 40.3% were fluent in Sinhala, 37.5% were fluent in Tamil and 76.3% were fluent in English. This shows a correlation between English fluency and computer literacy, suggesting a lack of English fluency may be limiting who can gain computer literacy and IT education.

Completion rates (defined as the percentage of enrolled students who completed the course) vary from 0.7% to 52.1%, with a median value of 12.6% (Jordan, 2015). Since their inception, enrolments on MOOCs have fallen while completion rates have increased. Completion rates vary significantly according to course length (longer courses having lower completion rates), start date (more recent courses having higher percentage completion) and assessment type (courses using auto grading only having higher completion rates).

3. Methodology

3.1 Data

Open.uom.lk is built on Modular Object-Oriented Dynamic Learning Environment (MOODLE) which is an open source Learning Management System (LMS) which records user data and records it in logs and reports. For the purpose of this study, the primary reports used were activity logs for individual activities (lecture videos, quizzes, assessments) and activity completion (overview of an entire course). The activity completion report shows the completion of activities by each student and includes information such as date and time of activity completion. Data were downloaded and analysed using Excel. The period covers from February 2022 to April 2023, and over 190,000 students.

From the activity completion report it is possible to identify the students who successfully completed each course and the entire Trainee Full stack Developer program. As such, surveys were administered on three categories of students: students who started but did not finish course 1 Python for Beginners; those who finished course 1; and those who finished the entire program. The survey included questions about demographic background such as age, sex, and education, as well as information relevant to how likely they were to complete the course, such as their prior coding experience and English language proficiency.

3.2 Identifying Bottlenecks in Course

The total number of students who are enrolled for a course, number of students who completed each lesson, and number of students who completed the entire course was determined. Completing a lesson or course automatically allowed students access to the next lesson/course, so the number of qualified students for each lesson can be presumed to be the number of students who successfully completed the prior lesson. The size of the difference between the number of students who qualified for each lesson and the number of students, who completed each lesson, is chosen as a measure of how difficult a lesson or assessment was. Specifically, the drop out was calculated as:

$$\text{DropoutRate} = \frac{(\text{Qualified} - \text{Completed})}{(\text{Qualified})} \times 100$$

High dropout rates correspond to more significant bottlenecks in the course as the course is structured such that a student cannot progress to the next lesson until they have completed the assessment of the previous lesson.

Once these bottle necks were identified remedial action was taken to encourage more students to overcome these difficult lessons.

3.3 Language Support

Steps were taken in order to make the course more accessible to those who spoke English as a second language and were not very fluent or not confident in their English. The lectures videos transcribed into English scripts. These transcripts were then translated into Sinhala and Tamil. The transcripts in all three languages were added beneath the lecture video so that they could be referenced by students to make it easier to follow the lecture video.

4. Results and Discussion

4.1 Identifying Bottlenecks in Course

Figures 1, 2 and 3 shows how the students progress through the six courses. The figures illustrate the dropout rate of students at various stages in the course and allows for the identification of bottlenecks in the course. Each data point in the bar charts corresponds to a lesson in a course. The courses are structured such that a student cannot progress to the next lesson until they have watched the lecture video and completed the assessment in the previous lesson. Lessons or assessments which are especially difficult would have a larger discrepancy between the number of students qualified and the number of students who completed the lesson.

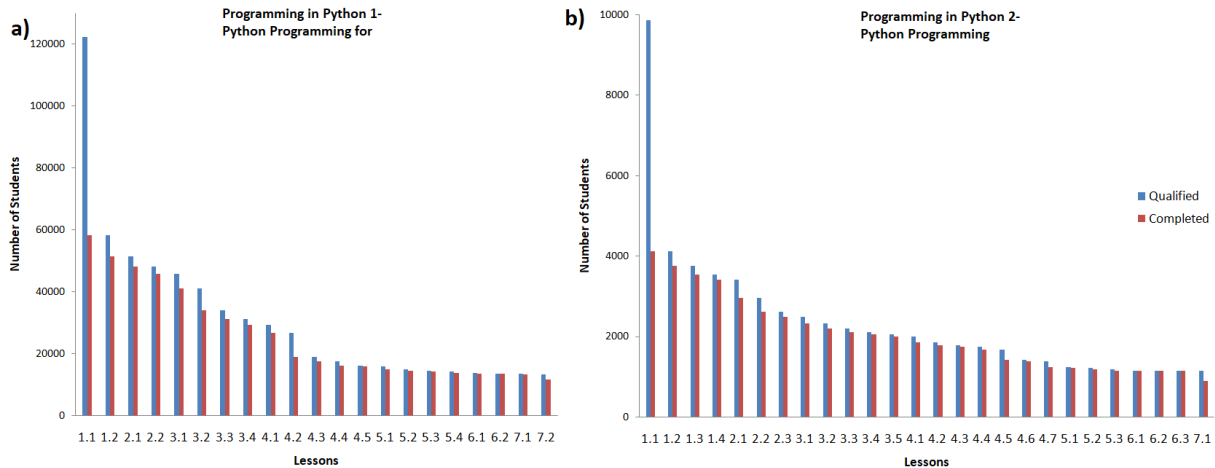


Figure 1 Number of students who qualified and completed each lesson in the Python Programming courses a) Python for Beginners, b) Python Programming

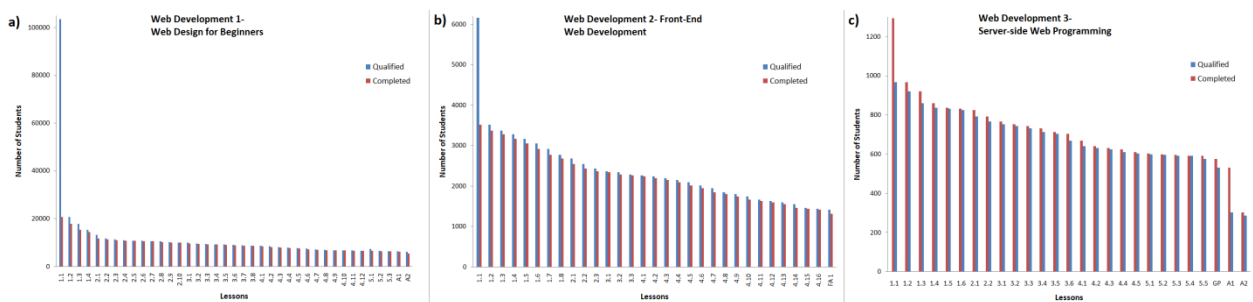


Figure 2 Number of students who qualified and completed each lesson in the Web Development Courses a) Web Design for Beginners, b) Front-End Web Development, c) Server-side Web Programming

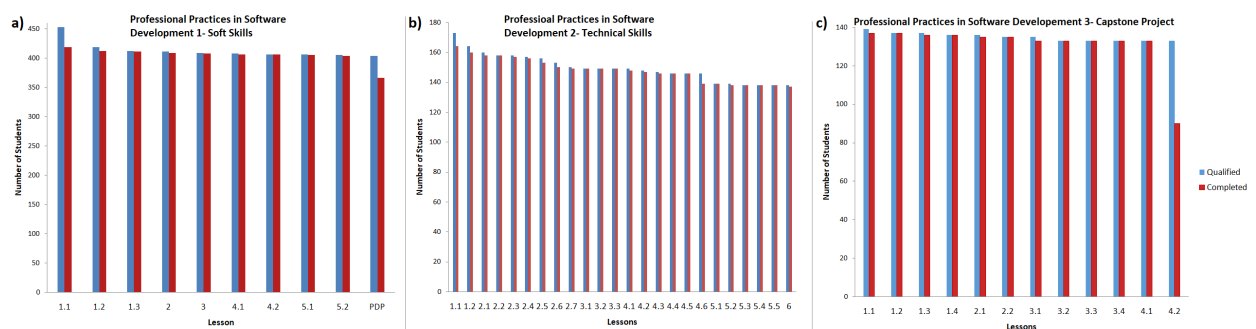


Figure 3 Number of students who qualified and completed each lesson in the Professional Practices in Software Development Courses a) Soft Skills, b) Technical Skills, and c) Capstone Project

Figure 1 illustrates the progress of students through the courses Python for Beginners and Python Programming. The graphs have similar structure with large difference between qualified and completed numbers which gradually reduces further into the course. The largest difference was in the first lesson of both courses, this is probably due to students who were enrolled in the course but never accessed it. According to the platform records, as of the 13th of April 2023, of the 122291 students enrolled in Python for Beginners 19178 students never accessed it. There is also a chance the students started lesson 1.1 but did not finish it, not because it was

difficult but because they were disinterested. Python for Beginners has a completion rate of 8% and Python programming has a completion rate of 9%.

Similar trends can be seen in Figure 2 for the graphs of Web Development Courses: Web Design for Beginners, Front-End Web Development, and Server-side Web Programming. This is likely also due to student being automatically enrolled once they completed registration or the previous course but decide not to start the course for various reasons. The pass rates of Web Design for Beginners, Front-End Web Development, and Server-side Web Programming are 5%, 21% and 22% respectively.

This behaviour, to some extent, is expected given free online courses typically have high attrition rates (Jordan, 2016) with most of the attrition occurring in the beginning of the course (Levy, 2007). However the Professional Practices in Software courses do not display these trends as students are only enrolled in the Professional Practices course after completing both of the Python Programming courses and all three Web Development courses (figure 3). The students who are enrolled in this course have already put in a considerable amount of time and effort into the programme and are likely motivated to finish it. This behaviour is consistent with studies done by Willging and Johnson's (2009) which suggest students were less likely to drop out of a course if they invested more time in it. The pass rates of Soft Skills, Technical Skills, and the Capstone Project are 80%, 79% and 64% respectively. The high pass rates of the Soft skills and Technical Skills component of course 6 can be attributed to the assessments all being the form of multiple choice questions as well as the course material being comparatively easier to the previous courses. The Capstone project is very challenging as it contains a lot of coding and is a culmination of all the technical knowledge the student has gained over the course, so it is likely the students who make it so far are the ones who are dedicated and are motivated to finish the course as it is nearly completed.

Figures 4-6 show the dropout rates of the students of each lesson over the six courses. The dropout rates reflect the number of students who could not complete the lesson as a proportion of the students who completed the previous lesson. The graph for Python for Beginners in Figure 4 shows that aside from the initial dropout from enrolled students not participating in the course, the greatest dropout rates were at lessons 3.1 (10%), 3.2 (17%) and 4.2 (29%) which corresponds to the lessons which had assessments in the form of coding exercises.

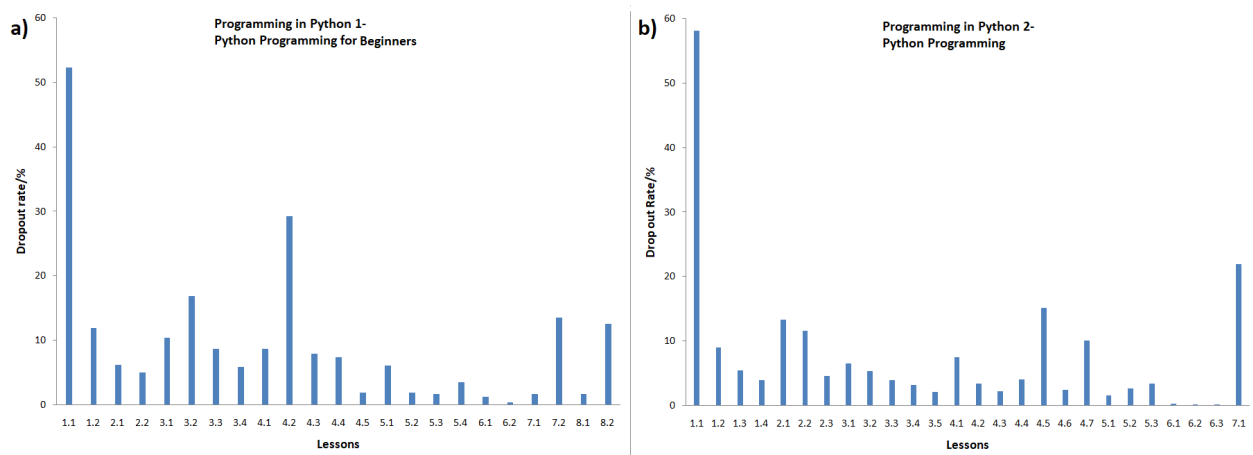


Figure 4: Dropout rate for each lesson in the Programming in Python Courses a) Python for Beginners, b) Python Programming

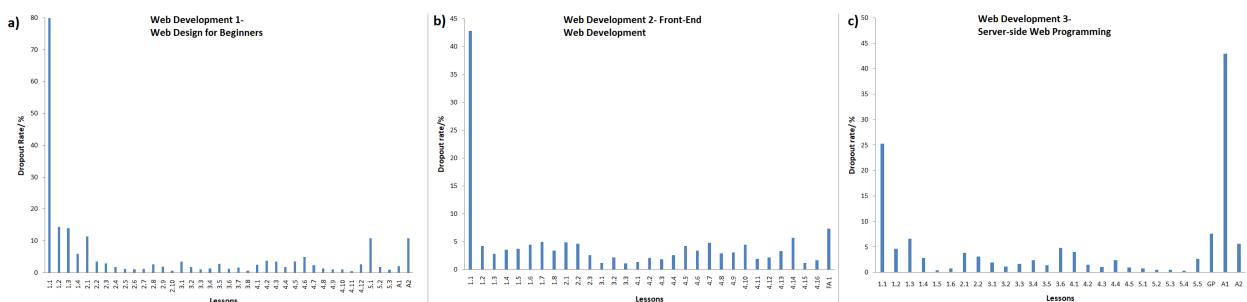


Figure 5: Dropout rate for each lesson in the Web Development Courses a) Web Design for Beginners, b) Front-End Web Development, c) Server-side Web Programming

The graph of dropout rates in Web Design for Beginners as shown in figure 5 shows that aside from the initial dropout there is no particular lesson that the students found especially difficult, the dropout out rate remaining at around 10%. Rather than trying to find a way to make it easier for students to complete this course it is more important for students to participate in it.

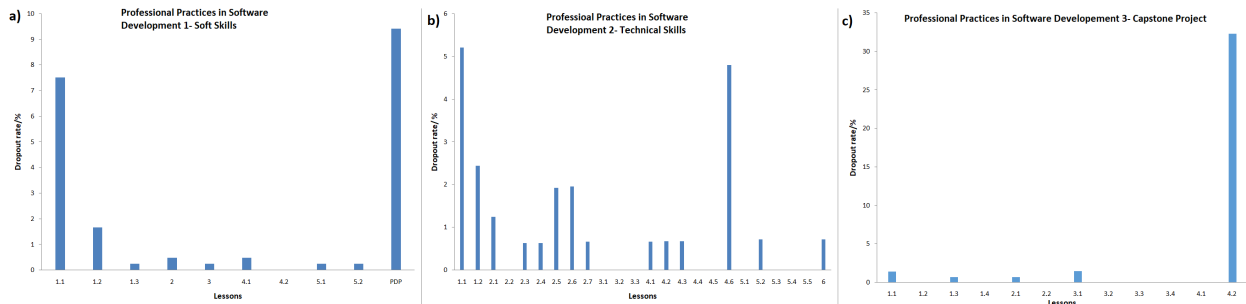


Figure 6: Dropout rate for each lesson in the Professional Practices in Software Courses a) Soft Skills, b) Technical Skills, c) Capstone Project

It was evident that the further the students progressed through the courses the lower the dropout rate was. This is likely due to the more skilled and more motivated students being filtered out through the course. The most significant attrition occurred in Python for Beginners and Web Design for Beginners, therefore moving forward these courses were focused on to reduce the dropout rates.

In Web Development for Beginners it was hypothesised that the low participation rate was due to confusion in the course name. Initially the Python for Beginners was titled course 1 and Web Design for Beginners was titled course 2. Although students could start either of them once they were successfully registered due to the naming of them as course 1 and 2 it might have led students to assume they must complete Python for Beginners before attempting Web Development for Beginners. To amend the confusion the courses were renamed as Programming in Python - 1 Python for Beginners and Web Development - 1 Web Design for Beginners.

4.2 Remedial Actions Taken to Increase Completion Rates

Initially there were no coding exercises in Python for Beginners until lesson 4.2. However after several months, the completion data of Python for Beginners was analysed and the dropout rate chart was plot as shown in Figure 7. From this it was clear there was a bottleneck in lesson 4.2 and lesson 4.3 which have a dropout rate of 22.7% and 23.9% respectively. These bottlenecks were attributed to the coding assessment in these lessons which is the first instance in the course where the students had a coding exercise as an assessment as opposed to purely multiple choice questions for assessments. It was hypothesised that introducing easier coding exercises earlier in the course will give students more coding practice and they would therefore find the coding exercises in lesson 4.2 and 4.3 easier to complete.

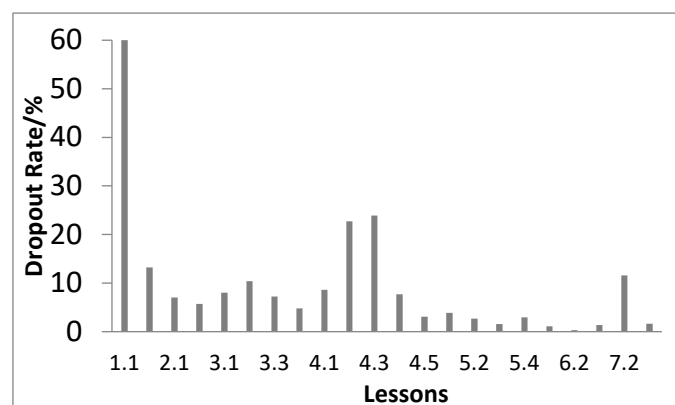


Figure 7: Dropout rate of each lesson in Python for Beginners prior to August 27

Coding exercises were added to lesson 3.1, 3.2, 3.3 and 3.4 on August 27 2023. To analyse whether the hypothesis was correct another dropout rate graph was plot comparing the dropout rates and progress through the course of students who did the new coding exercises in lesson 3 against the students who completed lesson 3 before the coding exercises were added as shown in Figure 8.

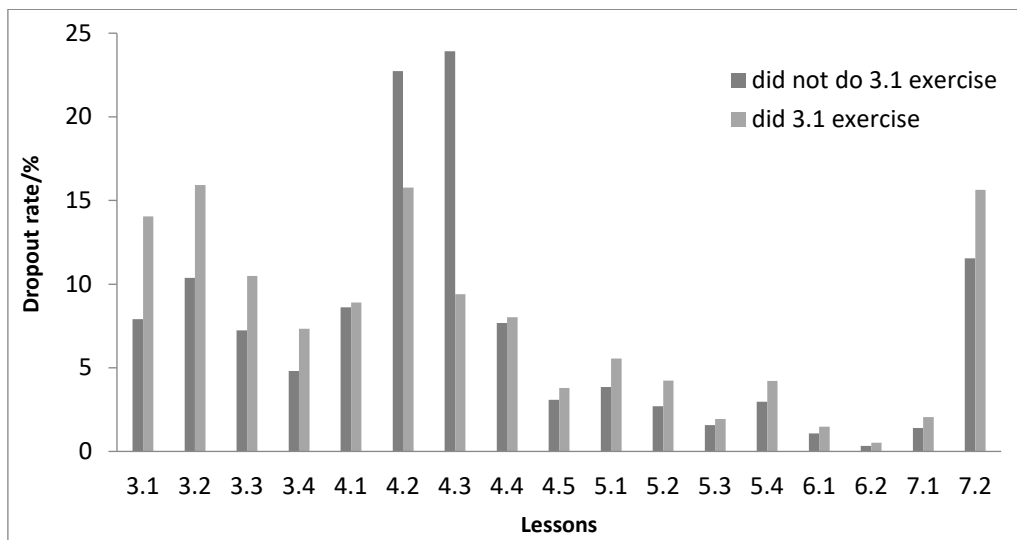


Figure 8: Dropout rate of each lesson in Python for Beginners before and after coding exercise in 3.1 was introduced

From the graph it is evident that intruding coding exercises earlier in the course did reduce the number of dropouts at lesson 4 but the dropout rates at lesson 3 as well as every other lesson increased slightly. When comparing the students who completed lesson 3.1, students who had to do the coding exercises earlier compared to those who did not have to do the coding exercise until later, they had a greater likelihood of completing the entire Python for Beginners course with the pass rate increasing from 26.4% to 28.9%. When assessing the likelihood that students who qualified for lesson 3.1 would finished the entire Python for Beginners course, the pass rate reduced from 26.5% to 24.9%. This suggests that introducing coding exercises earlier meant students got stuck at an earlier point in the course where they either could not complete the exercise or quit the course because it was difficult. In this case it maybe more reasonable to only introduce practical coding exercises later in the course once the students gains more theoretical coding knowledge.

4.3 Language Support

The additions of the translated lecture video transcripts were generally well received. However the rest of the course including lecture notes and assessments were only in English.

The idea to translate the lecture notes and the assessments were rejected after discussing with consultants from the IT industry. It would be detrimental to the students if they were too dependent on the translations as it would be essential for students to be fluent in English for them to be employed in the IT industry. Hopefully with the help of the Sinhala and Tamil transcripts students who are not fluent in English would be able to improve their English proficiency as they follow the course.

4.4 Collecting Demographic Data to be Used in Machine Learning Model

In order to collect demographic data surveys were sent to the students who had started Python for Beginners (Course 1) but had not finished the course, students who completed Python for beginners and students who completed the entire TFSD programme. The response rate of students who had not complete Python for Beginners was 1.8% (1959 of 110938), students who completed Python for Beginners had a response rate of 6.4% (634 of 9879) and students who completed the entire TFSD programme was 47.8% (64 of 134).

In addition to typical demographic data such as age, gender, and occupation, more specific questions such as their coding experience prior to participating in TFSD, their English proficiency, and their level of education, as these would have the greatest impact on their ability to complete the programme.

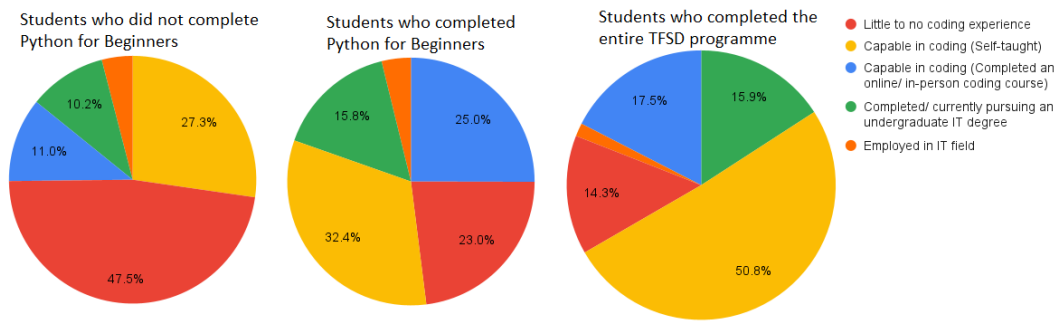


Figure 9: Students self-assessment of their coding proficiency prior to participating in the TFSD Programme

Of the students who completed the entire TFSD programme 85.7% were capable of coding to some degree prior to participating in the programme, this is greater than students who did not finish Python for Beginners and students who completed Python for Beginners of which 52.5% and 77% respectively were capable in coding to some degree prior to participating in the course. Students with prior coding experience are more likely to complete the programme of which those who are self-taught are more likely to complete the course than other students as evident in Figure 9. Only 14.3% of students who completed the TFSD programme had no coding experience prior to participating in the programme, which means while less likely it is still possible to complete the course without any prior coding knowledge. This suggests that students who have in the past taught themselves some coding are more comfortable with self-learning and have the right habits to complete TFSD.

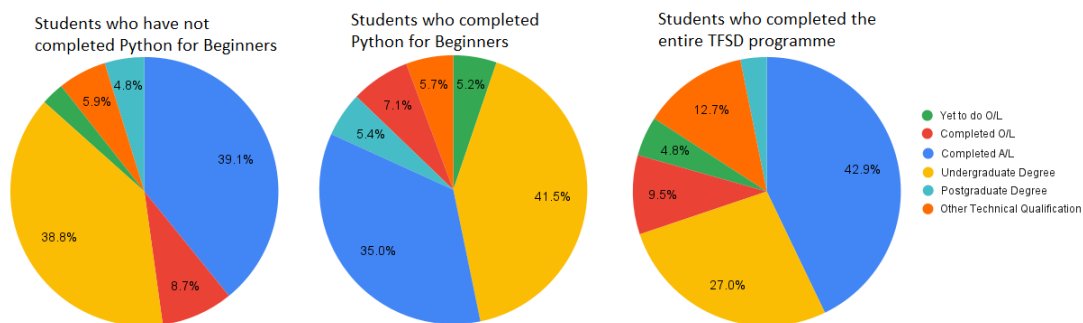


Figure 10: Students highest level of education

Figure 10 shows the highest level of education of the students who have not completed Python for Beginners, students who completed Python for Beginners and students who completed the entire TFSD programme. The largest demographics who participated in TFSD were students who have their A Level qualifications and those who already have an undergraduate degree. Although of the students who completed Python for Beginners 47% had an undergraduate degree, of those who completed the TFSD programme only 30% had undergraduate degrees. This difference may reflect these students lack time rather than interest as participants with undergraduate and postgraduate qualifications have a high degree of participation in MOOCs (Emanuel, 2013). These results show the majority of participants in the programme were school and university students who likely have the interest, ability and time to complete the programme. TFSD was created with aim to teach students who have finished their A-Levels.

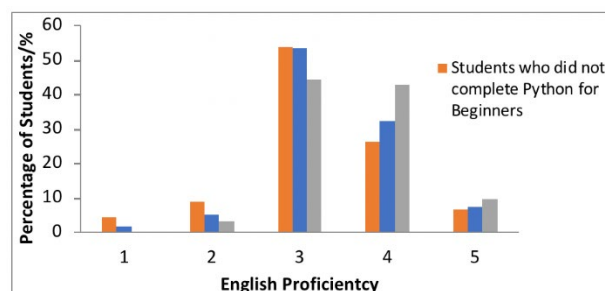


Figure 11: Students self-assessment of their English Proficiency on a scale of 1-5

The number of students was normalised by taking the percentage of the total number of students who responded to the survey. The average the students who did not complete Python for Beginners, students who completed Python for Beginners and students who completed the entire TFSD programme had an average language proficiency rating of 3.2, 3.4 and 3.6 respectfully. The students who completed the entire programme have a relatively higher proficiency in English or at least a greater confidence in their English fluency. This is their perceived language proficiency has a great impact on their completion rate. If the students' confidence in their English ability were improved it may help them complete the course rather than getting de-motivated and giving up.

5. Conclusion

The usage data from the open.uom.lk platform was analysed and successfully used to identify the bottlenecks in the courses which corresponded to the largest dropout rates. It was identified that a majority of the dropouts occurred in the first two courses and steps were taken to amend this. As the dropout rates in Python for Beginners was highest for the lessons which first introduced coding exercises it was hypothesised that by introducing easier coding exercises earlier in the course will give students more coding practice and they would therefore find the coding exercises later in the course easier therefore reducing the dropout rate. However, it is observed that the addition of these coding exercises slightly decreased the pass rate.

6. Future work

An algorithm was created to record the number of registered students and students who completed each course everyday at the same time. This data was used to plot the increase in registered users and the increase in the number of participants who complete the entire course.

Data recorded from the open.uom.lk platform was used to plot figure 12 which shows the number of students who registered on the open.uom.lk platform over time from February 2022 to April 2023 and figure 13 which the number of students who completed the Trainee Full-stack Developer Programme over time. Figure 12 shows there was an initial rapid increase in number of registrations which grows but the rate of growth decreased overtime. Figure 13 show that there is a steady increase in the number of students who complete the TFSD programme and does not necessarily correlate to the increase in registration number.

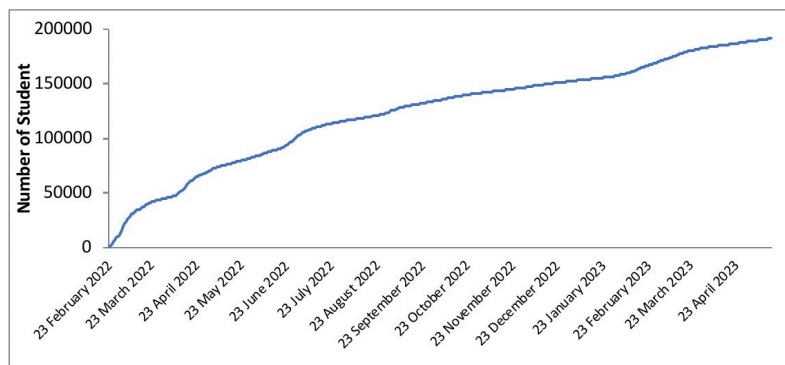


Figure 12: Number of student registered in the Trainee Full-stack Developer Programme over time

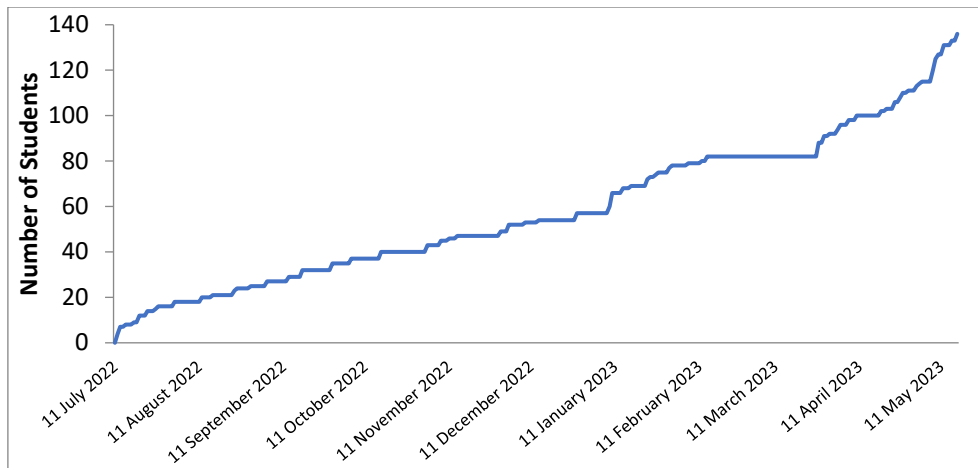


Figure 13: Number of Students who completed the Trainee Full-stack Developer Programme over time

As shown by the results we see a steady progress of completions. However, what is essential for the local IT industry is to have a prediction of the number of candidates who will be available for recruitment after completing all courses. With the usage data derived from the MOODLE platform and the demographic results of the student surveys we plan to use machine learning based algorithms to make accurate predictions of completions in future. This requires a sufficient number of students completing all 6 courses for our models to have accurate ground truth data.

References

- Bawa, P. (2016) "Retention in Online Courses: Exploring Issues and Solutions—A Literature Review" SAGE Open January-March 2016: 1–11
- Emanuel, E. J. (2013). Online education: MOOCs taken by educated few. *Nature*, 503(342).
- Hayashi, R., Garcia, M., Maddawin, A., Hewagamage, K. P. (2020) "Online Learning in Sri Lanka's Higher Education Institutions during the COVID-19 Pandemic" ADB Briefs No.151 <http://dx.doi.org/10.22617/BRF200260-2>
- Jordan, K. (2015) "Massive Open Online Course Completion Rates Revisited: Assessment, Length and Attrition" *International Review of Research in Open and Distributed Learning* Volume 16, Number 3
- Koller, D., & Ng, A. (2013). The online revolution: Education for everyone. Seminar presentation at the Said Business School, Oxford University, 28th January 2013. Retrieved from <http://www.youtube.com/watch?v=mQ-K-sOW4fU&feature=youtu.be>
- Levy, Y. (2007). Comparing dropouts and persistence in e-learning courses. *Computers & Education*, 48, 185-204
- "National IT-BPM Workforce Survey 2019 - ICTA." <https://www.icta.lk/projects/national-it-bpm-workforce-survey-2019/>. Accessed 26 Jun. 2022.
- Sittarage N. P. K. (2018) "English Language Education in Sri Lanka Link with the Learners' Motivational Factors" *Humanising Language Teaching*, August 2018 - Year 20 - Issue 4, ISSN 1755-9715
- Smith, B. (2010) "E-learning technologies: A comparative study of adult learners enrolled on blended and online campuses engaging in a virtual classroom (Doctoral dissertation)" Retrieved from ProQuest Dissertations and Theses database.
- Sri Lanka Labour Force Survey Annual Report – 2021
- Willging, P. A., & Johnson, S. D. (2009). Factors that influence students' decision to dropout of online courses. *Journal of Asynchronous Learning Networks*, 13(3), 115-127
- World Bank Data "Individuals using the Internet (% of population) - Sri Lanka" <https://data.worldbank.org/indicator/IT.NET.USER.ZS?locations=LK> (accessed May 20 2023)

Does “One Size” Fit All? Comparing Video-Feedback in Different Courses

Ole Jørgen S. Ranglund^{1,2}, Tone Vold¹ and Monica J. Lervik¹

¹Inland Norway University of Applied Sciences, Rena, Norway

²Østfold University College, Fredrikstad, Norway

Ole.ranglund@inn.no

Tone.vold@inn.no

Monica.lervik@inn.no

Abstract: Several surveys show that students appreciate feedback on their assignments in order to learn more, and to understand more about their academic progress. In order to personalize the feedback, this has been recorded on video and distributed to the students. In video-feedback, we as lecturers can stress certain messages in a different way than in written feedback. It is also possible to communicate a lot more in a 3-5-minute video.

In this paper, we compare the students' opinions about video-feedback. In one course, the students received both video-feedback and written feedback as a follow up on the same assignment, and in two other courses they only received video-feedback. Through interviews, we have investigated two different approaches. This has allowed us to look into two different approaches, and how students perceive this. In the course with the video-feedback and the written feedback, the students prefer the written feedback, and in the two courses with video-feedback only, the students are very positive and report on learning outcomes from the feedback in addition to them also wanting video-feedback in other courses as well. The results were surprising, as theory explains why video-feedback should be preferred.

Keywords: Video-Feedback, Personalized Feedback, Reflection, Supporting Learning Outcome

1. Introduction

Feedback on assignments is highly rated by students (Haave, Hole, & Vold, 2016). In fact, in investigations done at The Inland Norway University of Applied Sciences, it is one of the actions that provide the students with the highest experienced learning outcome (Haave, Hole, & Vold, 2016). According to Ramaprasad (1983), feedback is “information about the gap between the actual level and the reference level of a system parameter, which is used to alter the gap in some way” (Ramaprasad, 1983, p. 4). Hence, the function of the feedback is to provide the students with indications of how to improve, develop and reach their “zone of proximal development” (Vygotskij, 1978). According to Hattie and Timperley (2007), it is also supposed to enable the students to evaluate how they are doing, and how they can improve.

This can be viewed as a way of improving the quality of higher education. We have introduced the “flipped classroom” in many courses, in order to improve the quality of the education and support the student's learning outcome from the courses. The “flipped classroom” is about making lecture material available prior to meeting peers and lecturers, such as streaming video, allowing working with the theory during class instead of being lectured over it in the physical meeting (Bishop & Verleger, 2013; Vold, 2014).

In order to continuously improve the learning opportunities for the students, we decided to test out video-feedback and compare how they perceive this to support their learning outcome, compared to the written feedback.

Assessing students' works is a powerful tool for influencing the way students behave and respond to courses (Gibbs, 1999, 2005). Feedback is important for the students' development of their written academic work (Wolsey, 2008).

Assessments can be made in different ways, from pass/fail to very detailed comments. However, There is not always enough time allocated to develop a very thorough formative assessment (Mathisen, 2012). Although formative assessment has proven beneficial towards student's learning (Cunningham, 2019b), it is difficult in a large class to offer individual feedback (Higgins, Hartley, & Skelton, 2002). Still, the feedback given is necessary for the students' understanding of how to improve, as well as to develop and understand their own strengths and weaknesses. Therefore, to establish an effective learning situation, it is necessary to present to the students how to improve and provide directions for their development. The feedback may also aid in the process of establishing a relationship with the lecturers and the students (Mathisen, 2012). According to Wolsey (2008), this relationship has had a positive impact on learning.

There are different types of video-feedback. One way of providing video-feedback is to record a screencast where it is possible to point to the different areas in the students text (Lee and Chan, 2007; Mathisen, 2012; Turner and West, 2013; Ali, 2016; Cunningham, 2019b, 2019a). This may scaffold the learning as it provides both textual and visual feedback. The other way is to record a short video in the form of a video-podcast (Crook *et al.*, 2012; Turner and West, 2013; Henderson and Phillips, 2015).

Hattie and Timperley (2007) claim that the quality of the feedback is important, and is necessary to answer the questions of direction (where am I going?), the quality of work (how am I going) and pointing forward (where to next?). It is also important that the feedback is clear, informative, personal (Henderson and Phillips, 2015), and that it states how to improve, what the learning objectives are, and the focus for learning more (Crook *et al.*, 2012; Cunningham, 2019b). This will support the student's development, and is important to experience autonomy and self-discipline (Gamlem, 2022).

According to Borup, West and Thomas (2015), written feedback can be efficient and organized. However, even if a lecturer believes to have been clear about improvement points, it can be *interpreted* as ambiguous, and leave the learner uncertain about the improvement options (Daft & Lengel, 1986). In order to facilitate for less ambiguity or equivocality, the use of a rich media to present the information is preferred. Daft and Lengel (1986) define information richness as "the ability of information to change understanding within a time interval" (Daft & Lengel, 1986, p. 560). Consequently, a rich media enables complex messages to be communicated in an understandable way, while the media of a low richness holds fewer cues on how to interpret the messages. Nonetheless, if the message is, for example, a "pass" or "fail" for the media of low richness, such as a written comment, this may be sufficient.

The feedback provided to support adult learning processes should also pay attention to how adults learn. According to Cercone (2008), adults need scaffolding in order to be self-reliant. Furthermore, it is beneficial to their learning process to build on their previous experiences, as well as supporting their understanding of how the new knowledge and/or skills may be utilized in their organization.

Knowles (2015) presented the term "andragogy" about adult learning, which contains some assumptions about adult learners. For example, they are self-directed, that the learning builds on previous experience, that they have personal goals for their learning and need to know why they are to learn something, and why this is beneficial for them, and that they have an internal motivation for learning. Mezirow (2010) presented the theory of perspective transformation, which includes critical reflection. It is about being critically aware of how one's past, and how one perceives what is learned is colouring how one perceives, understands and feels about the surroundings.

Palloff and Pratt (2003) also claim that students need the ability to reflect in order to learn, and that they are different with different approaches to learning and with different learning styles. Hence, the need for a personal approach. Frey and Alman (2003) also recognize the individuality of the learner's background and learning styles, and suggest to address learning and feedback to the learners as "first person".

1.1 Research Question

We decided to investigate how students perceived video-feedback, and what they emphasized regarding learning outcome from them. Hence, our research question is:

How does video-feedback support the learning outcome of adult students?

To help answer this, we developed the following questions:

Question 1:

How personalized do they find the video-feedback?

This was asked to indicate if they felt that the video-feedback was individual/group-based, and therefore directed directly toward them and their assignments.

Question 2:

What was the learning outcome of the video-feedback they received?

Question 3:

How did the video-feedback affect how they could improve their assignments?

These questions would provide information about how they have reflected on their learning outcome, and the potential for development and change.

1.2 The Study

The study was undertaken in three different settings: one in Østfold University College, Norway, and two in the Inland Norway University of Applied Sciences, Norway. One of the courses was offered to members of the Norwegian Union of Municipal and General Employees (NUMGE), and one was a part of a master's degree programme, see Table 1 below.

The students in the Bachelor study in economics were given both video-feedback, and the same feedback as written feedback, in order to investigate whether the students preferred written to oral, or vice versa. In the two other courses (HRM), the students were only provided with video-feedback, and were to compare this to other written feedback they previously received, or in other subjects/courses.

Table 1: Overview of respondents

Students at:	Type of course	Method of Inquiry	Number of respondents	Type of feedback
Østfold University College 2-year Bachelor study programme in work and welfare issues	HRM (15 ECTS)	Group interviews	35	Video-feedback
Inland Norway University of Applied Sciences: Students from: Norwegian Union of Municipal and General Employees (NUMGE)	HRM and digital transformation (7.5 ECTS)	Group interviews	82	Video-feedback
Inland Norway University of Applied Sciences: Bachelor study in economics	Qualitative research methods (7.5 ECTS)	Group interviews – responses per interviewee/respondent	7	Video-feedback and written feedback

The students are adult students, and from the NUMGE, the students are in a work-life.

2. Method of Inquiry

The data have been collected via interviews, both individual and in groups (Dalen, 2011). This qualitative research method allows for digging into the nuances and was chosen to enable searching for subtleties regarding learning outcome and perceptions (Denzin Lincoln, 2005; Dalen, 2011; Jacobsen, 2015). Also, this has been treated as case studies (Remenyi, 2012; Yin, 2014). However, the case studies are not to be generalized, but instead to compare and investigate the differences for improvement purposes.

We have used a strategic selection of our own full-time and part-time students at the bachelor and master level for the interviews in this project.

We have used a strategic selection of our own fulltime and part-time students at bachelor and master level for the interviews in this project.

3. Findings

Here, we will present the findings, and we have divided the findings into two separate categories: the responses from the ones with video-feedback only, and one with both forms present.

3.1 Video- and Written Feedback

Overall, the students who received the video- and written feedback (7 respondents) seems to find written feedback just as informative and supportive of their learning outcome. In fact, most of the respondents preferred the written feedback as it was felt to be more informative, and that they could read it over and over again. One of the respondents explained: "I catch it better and it helps me stay focused to catch the essence" (respondent 6).

Regarding learning outcome, the students refer to both the written and video-feedback and claim that they have learned from both. Mostly, they refer to the confirmation of how well they have done. An example of this is: "We get a confirmation about our understanding" (respondents 4 and 5).

They were asked about how they could use their learning: work, school and exam. Their responses were about how to utilize it for their exams. "The feedback on the assignment and about the most important issues helped me a lot, and I will use it when preparing for the exam" (respondent 5).

To spot any changes in their behaviour regarding preparing for the exam, all of the respondents claim it has not changed the way they will prepare. As respondent 6 said: "I got a confirmation about being on the right track, so I will not change how I prepare for the exam" (respondent 6).

Regarding being personal, the respondents are also unanimous about it being personal, as they are named in the video. "I felt it was personal because it was addressing my assignment, me as a person, and it was to the point" (respondent 7) "The fact that you mentioned my name made it personal" (respondent 1).

They were also asked if they would prefer receiving video-feedback in other courses. Here, most of the respondents reply that it would be a supplement, but they prefer the written feedback. "Yes, I would like that, but only as a supplement to the written feedback" (respondent 1). Similar statements are also from respondents 3, 5, 6 and 7.

3.2 Video-Feedback Only

Here, the students are unanimously positive toward the video-feedback. The students claim that it was engaging, as it made the feedback understandable, and it helped them to understand how to improve. In particular, they mention concrete examples given in the feedback. The tone of voice and mimicry support and enhance the feedback.

They also refer to the points of improvement given. Examples of such statements are: "It was both supportive and challenging, not only hearing about the good things in the assignment, but also lifting us higher by telling us how to improve", "It is great to receive concrete input on where to look in the curriculum", "We sense that you want us to improve. The feedback is detailed, and you spend the time explaining it, and then I feel that [the lecturer] wants me to succeed."

To approximately half of the students, the lecturer addressed the students by name, whilst in the other half, he did not. In the video files where the names were mentioned the respondents claim that this makes it feel personal. This is confirmed by statements like: "I like the fact that you mentioned my name", and "It felt personal as you mentioned my name and talked to me directly." Nevertheless, there are other parameters as well that support the feeling of being personal. Statements such as: "I felt you were talking to me, as you described what was in my assignment", and "You showed me how to improve directly, which was specifically for my assignment", show that naming examples from their particular assignments also make it personal to them.

Regarding changing behaviour, some of the students claim that it has made it easier to know what to focus on and get started. This is shown in statements such as: "You made it clear what I had to improve and motivated me to start there regarding preparing for the exams", and "The feedback motivated me to start working with my group on going through parts of the curriculum again."

Another issue that arose during the data collection was that the students started comparing feedback among themselves. "He did not mention this to me, but what does that mean?", and "This is similar to what we received, maybe we should team up and work on this?", are statements that seem to have encouraged a collaborative approach to further learning.

3.3 Summing Up

Both video/written feedback and video-feedback are considered to be personal when names are mentioned. This, and pointing to particular features in their assignments, are meant to personalize the learning, to meet what Palloff and Pratt (2003) claim are about all adults being individuals with somewhat different needs and motivation. As suggested by Knowles (2015) and Mezirow (2010), this is also promoting some type of reflection.

Moreover, they all claim to have learned from the feedback, and to a large extent are able to answer what they have learned, which corresponds with it supporting the learning outcome. By the reply, it seems that the lecturers have been able to meet what Hattie and Timperley (2007) refer to as the quality of the feedback, which is important for their learning. It seems to be answering the crucial questions of “Where am I going?”, “How am I going?” and “Where to next?”. It also seems that they are somewhat autonomous regarding engaging in preparations for their exams, which is also important for the outcome, according to Hattie and Timperley (2007) and Gamlem (2022).

The feedback have also supported the relationship between the students and the lecturer, as Mathisen (2012) Crook et al. (2012), Henderson and Phillips (2015) and Turner and West (2013) claim is important for the learning, as they claim they perceive the lecturer to be supportive of their learning and scaffold their learning process (Cercone, 2008). This relationship seems to have a positive impact on learning that Wolsey (2008) refers to, as they seem motivated to learn more and to re-enter the curriculum for preparations for their exams.

However, the findings point out that written feedback is also welcome. As Borup, West and Thomas (2015) claim, the written feedback can be organized to be unambiguous and clear, which seems to be the case with the respondents receiving both written and video-feedback. Indeed, they all *prefer* the written to the video-feedback, and only view the video-feedback as a *supplement*, which somewhat contradicts the idea of media richness being important for their learning outcome (Daft & Lengel, 1986).

4. Conclusion

The ones who only received video-feedback are unanimously positive towards this as a way of being motivated, and to engage with the curriculum in order to prepare for exams. They find that the lecturers' use of their names is experienced as personal, and personally directed to them as learners.

The ones who received both video-feedback and the same written feedback seem to prefer the written but view the videos as a supplement.

In general, the feedback seems to be of a quality that supports their learning process, and that it is also directed to the individual to meet the individual needs for scaffolding in their development process; hence, one size does not fit all – there has to be individual adaptations, but they may be in addition to more generic feedback.

4.1 Further Research

In order to investigate this further, we will investigate this with new students in some of the same courses. We will also seek to dig more deeply into the differences between the written feedback and the video-feedback, as well as the impact they have on the learning outcome, by extending the investigations with a mixed-methods approach.

Moreover, it may be interesting to support the coming students to the course in qualitative methods at the master's study programme with only video-feedback to investigate whether these students will respond in the same way. Is it only in the case of obtaining both video and written feedback that they prefer the written? When they only receive the video-feedback, will they promote this as their preferred way of receiving feedback?

The issue that arose regarding the somewhat unexpected result of one of the group interviews were the students starting to compare feedback: Is it also worth pursuing? If this may lead to collaborations among the students, this may be worth exploring. One way of testing this is to actively ask them in their feedback to compare their feedback with others.

References

- Ali, A. D. (2016) 'Effectiveness of Using Screencast Feedback on EFL Students' Writing and Perception.', *English Language Teaching*, 9(8), pp. 106–121.
- Bishop, J. L. and Verleger, M. A. (2013) 'The flipped classroom: A survey of the research', in *ASEE national conference proceedings*, Atlanta, GA, pp. 1–18.
- Borup, J., West, R. E. and Thomas, R. (2015) 'The impact of text versus video communication on instructor feedback in blended courses', *Educational technology research and development*, 63(2), pp. 161–184.
- Cercone, K. (2008) 'Characteristics of adult learners with implications for online learning design', *AACE review (formerly AACE Journal)*, 16(2), pp. 137–159.
- Crook, A. et al. (2012) 'The use of video technology for providing feedback to students: Can it enhance the feedback experience for staff and students?', *Computers & Education*, 58(1), pp. 386–396.

- Cunningham, K. J. (2019a) 'How language choices in feedback change with technology: Engagement in text and screencast feedback on ESL writing', *Computers & Education*, 135, pp. 91–99.
- Cunningham, K. J. (2019b) 'Student perceptions and use of technology-mediated text and screencast feedback in ESL writing', *Computers and Composition*, 52, pp. 222–241.
- Daft, R. L. and Lengel, R. H. (1986) 'Organizational information requirements, media richness and structural design', *Management science*, 32(5), pp. 554–571.
- Dalen, M. (2011) 'Intervju som forskningsmetode [Interview as a research method]', *Oslo: Universitetsforlaget*.
- Denzin, N. K. and Lincoln, Y. S. (2005) *The Sage handbook of qualitative research*. 3rd ed. Thousand Oaks, Calif: Sage.
- Frey, B. A. and Alman, S. W. (2003) 'Applying adult learning theory to the online classroom', *New Horizons in Adult Education and Human Resource Development*, 17(1), pp. 4–12.
- Gamlem, S. T. M. (2022) *Tilbakemelding og vurdering for læring*. 2. utgave., *Feedback and assessment for learning and development (In Norwegian: Tilbakemelding for læring og utvikling)*. 2. utgave. Edited by S. T. M. Gamlem. Oslo: Gyldendal.
- Gibbs, G. (1999) 'Using assessment strategically to change the way students', *Assessment matters in higher education*, p. 41.
- Gibbs, G. (2005) *Improving the quality of student learning*. University of South Wales (United Kingdom).
- Haave, H. M., Hole, Å. S. and Vold, T. (2016) 'Educating Managers in Knowledge Intensive Organizations', in. Academic Conferences and Publishing International.
- Hattie, J. and Timperley, H. (2007) 'The Power of Feedback', *Review of Educational Research*, 77(1), pp. 81–112. doi: 10.3102/003465430298487.
- Henderson, M. and Phillips, M. (2015) 'Video-based feedback on student assessment : scarily personal', *Australasian Journal of Educational Technology*, 31(1), pp. 51–66. doi: 10.14742/ajet.1878.
- Higgins, R., Hartley, P. and Skelton, A. (2002) 'The conscientious consumer: Reconsidering the role of assessment feedback in student learning', *Studies in higher education*, 27(1), pp. 53–64.
- Jacobsen, D. I. (2015) *How to conduct research: introduction to social science research methods (Translated from Norwegian: Hvordan gjennomføre undersøkelser? : innføring i samfunnsvitenskapelig metode)*. 3. utg. Oslo: Cappelen Damm akademisk.
- Knowles, M. S., Holton III, E. F. and Swanson, R. A. (2015) *The Adult Learner: The definitive classic in adult education and human resource development*. London: London: Routledge. doi: 10.4324/9781315816951.
- Lee, M. J. W. and Chan, A. (2007) 'Reducing the effects of isolation and promoting inclusivity for distance learners through podcasting', *The Turkish online journal of distance education TOJDE*, 8(1), pp. 85–104.
- Mathisen, P. (2012) 'Video Feedback in Higher Education – A Contribution to Improving the Quality of Written Feedback', *Nordic journal of digital literacy*, 7(2), pp. 97–113. doi: 10.18261/ISSN1891-943X-2012-02-02.
- Mezirow, J. (2010) 'Transformative learning in practice : insights from community, workplace, and higher education'. Edited by E. W. (Edward W. Taylor. San Francisco: Jossey-Bass.
- Palloff, R. M. and Pratt, K. (2003) *The virtual student: A profile and guide to working with online learners*. John Wiley & Sons.
- Ramaprasad, A. (1983) 'On the definition of feedback', *Behavioral science*, 28(1), pp. 4–13.
- Remenyi, D. (2012) 'Case study research: The quick guide series', in. Academic Conferences Limited.
- Turner, W. and West, J. (2013) 'Assessment for "digital first language" speakers: Online video assessment and feedback in higher education'.
- Vold, T. (2014) 'How can the concept of "Flipped Classroom" support the development of reflective practitioners in higher education?', in *2014 Information Technology Based Higher Education and Training (ITHET)*. IEEE, pp. 1–3.
- Vygotskij, L. S. (1978) *Mind in society : the development of higher psychological processes*. Edited by M. Cole et al. Cambridge, Mass: Harvard University Press.
- Wolsey, T. D. (2008) 'Efficacy of Instructor Feedback on Written Work in an Online Program', *International journal on e-learning*, 7(2), p. 311.
- Yin, R. K. (2014) *Case study research: design and methods*. 5. edition. Los Angeles: Los Angeles: SAGE.

Impacts of COVID-19 on Higher Education in Developing Countries and the Strategy of Using ICTs for e-Teaching from the Catholic University of Mozambique

Domingos Rhongo and Bianca Gerente

¹Faculty of Tourism and Informatics Management, Catholic University of Mozambique, Pemba, Mozambique

drhongo@ucm.ac.mz

bgerente@ucm.ac.mz

Abstract: COVID-19 has tested the organizational capacity of the education system in Mozambique, including the higher education level when it became mandatory to close all face-to-face teaching activities. To respond to this challenge and continue with the noble mission of teaching, the Catholic University of Mozambique implemented a hybrid model, specifically through digital platforms, even though it was aware of the various resource limitations on the part of teachers and students. This strategy would be determinant for a successful path to the purpose of "never stop teaching and learning." This paper attempts to answer questions that arose at introducing this new teaching model during the COVID-19: (i) What skills did teachers have to respond to ICT-mediated teaching? (ii) What strategies were used to circumvent the difficulties arising from COVID-19 for Teaching and Learning? (iii) What kind of skills, difficulty, and behaviour characterized the students to correspond to a 100% online teaching system? and (iv) What platforms and instruments were used to respond to this teaching model? The paper first seeks answers from exploratory interviews with teachers about the use of ICTs in teaching and learning and subsequently presents some challenges in three dimensions (institutions, teachers, and students) of which their consideration can lead to a path in the immersion of the technologization of teaching. In methodological terms, a qualitative approach was used, where interviews were conducted with a sample of teachers from this university who were part of the frontline of the process. The results show that for the case study, it was possible, to teach and learn through Moodle platforms, Google Classroom, interacting through Zoom, Google Meet, and using Skype as a communication tool with students.

Keywords: Higher education, e-learning, digital platforms, and COVID-19.

1. Introduction and Background

In Mozambique, the first case of coronavirus (COVID-19) was registered on March 22, 2020 (Mapote, 2020; Silva et al., 2020). In the beginning, there were so many doubts and uncertainties about the future, some hypotheses pointed to a possible worldwide collapse due to the rapid spread of the pandemic, so many countries were following the World Health Organization (WHO) guidelines of taking measures of social distancing and isolation to safeguard people's lives; around all these several questions were arising such as: how would services be offered and accessed? This is how the world reinvented itself like a phoenix, migrating many services and events to the online modality. This apocalyptic scenario reached the education sector in particular in higher education. According to UNESCO, with the social detachment, the continuation of learning activities required a financial effort from higher education institutions, a didactic change from teachers and students that in some situations would be for the first time using a digital platform (UNESCO, 2020). This scenario was more impactful in developing countries, particularly in Africa where there are infrastructure and connectivity problems and the percentage of homes with an internet connection is around 17% (Rhongo et al., 2018; UNESCO, 2020).

In the international context as a way to contain COVID-19, higher education was forced to fully migrate from the traditional classroom model to the online modality so as not to stop with the teaching and learning process (Bao, 2020).

Higher education in Mozambique in 2020 was composed of a total of 53 educational institutions, among 19 Universities, 27 Institutes, 4 Schools, and 3 Academies. There were 22 public and 31 private, and a total of 230,000 students, with 14,000 teaching staff (CNAQ, 2020; MCTESTP, 2020). In Mozambique, some initiatives such as tv schools, Radio-School were promoted at the beginning of the pandemic as a way to make up for the absence of face-to-face teaching in the secondary education (TVM, 2020) and digital platforms in higher education; however, the work focuses on higher education due to the environment of ICT use at this level, contrary to the resistance and difficulties of acceptance found in secondary education (Caldeira, 2011; TVM, 2018).

1.1 Context of e-Learning at the Catholic University of Mozambique

Against the backdrop of COVID-19, on March 20, 2020, the Catholic University of Mozambique suspended all classroom teaching activities (dispatch 0016/2020/UCM/GR) in response to the presidential decree on the state of emergency and to respond to the teaching and learning process, the institution guided the use of the Moodle platform for the provision of didactic material, interaction with students (feedback of work) and video conferencing emphasizing Microsoft Teams, Google Meet as well as others that could ensure the registration of evidence (dispatch).

The issue of using digital platforms is not something new, it has been discussed for many years as a methodology to develop skills and competencies through electronic learning (e-learning) mainly in distance learning, as stated in (Rhongo et al., 2020), which substantiates the possibility of learning and educating without people sitting in a conventional classroom, but geographically dispersed. These findings support that this was perhaps the only teaching alternative before COVID-19.

The Catholic University of Mozambique has extensive experience in distance education through the Institute of distance education. Since 2003 it has administered and developed competencies in this modality, having advanced with a 100% online course in which students from mobile and computing devices access varied platforms (Moodle, Google Apps educational and WebEx) for online sessions (Rhongo et al., 2020).

2. The Problem Statement, Aims and Objectives

Considering that the Mozambican population faces numerous deficiencies such a) technological support to teachers and students; b) difficulties in e-Pedagogy; c) difficulties in accessing the Internet; and d) lack of computational tools (Rhongo et al., 2020), given this scenario the country has opted for a strategy of implementation and integration of ICTs in schools and communities through SchoolNet and Digital Resource Centres (CPRD) accompanied by the technological plan of Education as a way to enable all students in the use of essential technologies (Educacao, 2011; O. M. Matusse & Fofonca, 2017; R. Matusse, 2013).

Therefore in Mozambique for the continuity of the classes during COVID-19, the Ministry of Science and Technology and higher education directed the Universities to use digital platforms to support the teaching and learning process as a way to enable the teaching and learning process (MCTESTP, 2020). In this context, not all higher education institutions were able to effectively conduct lectures using e-learning; for the case of the Catholic University of Mozambique, even with so much experience in e-Learning, which is about 20 years, it was equally challenging in the initial phase, where the professors played an important role.

Hence this paper raises the following questions: (i) What skills did teachers have for ICT-mediated teaching? (ii) What was the strategy used by UCM to circumvent the difficulties arising from the consequences of COVID-19 for education? (iii) What kind of skills, difficulty, and behaviour characterized students to match a 100% online teaching system? and (iv) What kind of platforms and instruments that were used to match the online teaching model?

Therefore, this paper explores the process of using teaching and learning technologies in higher education at the Catholic University of Mozambique during COVID-19. Specifically: 1) the pandemic context and its implications in higher education in Mozambique are analysed in a general way; 2) the platforms used in higher education during the pandemic period (COVID-19) are characterised; 3) the organizational strategy of Catholic University of Mozambique to sustain the face-to-face classes is explored, as well as the main practices experienced and challenges faced by teachers/students from an exploratory survey; and at the end 4) A humble contribution is made to minimize the challenges for both institutions, teachers as well as students considering the educational context in higher education in Mozambique.

3. Literature Review

3.1 E-Learning and Learning Platforms

Modern education has been improved with various technologies incorporated in both distance and face-to-face education; to this has been added the internet and other platforms related to social networks that, because of their ease of use, add the possibilities of effectively implementing teaching mediated by technologies; this process has begun to take shape and discussion among academics.

3.1.1 Moodle

Moodle is a free platform for distance learning, whose acronym stands for Modular Object-Oriented Dynamic Learning Environment (Lisbôa, Jesus, Varela, & Teixeira, Gláucia Helena Sales; Coutinho, 2009; Sabbatini, 2007). It was developed by Prof. Martin Dougiamas, at Curlin University in the United States (Nasrin, n.d.). Its implementation took into consideration all teaching characteristics and a hierarchical structure of universities, colleges, courses, disciplines or learning modules (Mura & Rhongo, 2018).

3.1.2 WhatsApp

Social media has become quite popular in the academic context, for different purposes including communication and content exchange. In the study by Gasaymeh, (2017), he mentions that there are several pieces of evidence of the use of communicational platforms in universities (e.g. 92.6% of university students in Jordan use Facebook, 89% of students in a university in Kuwait use Twitter, 100% of students in universities in the United States and Europe have smartphones and access social media platforms through them).

WhatsApp is generally installed in 99% of smartphones.

In Hong Kong, it was revealed that in the university students had experience with the formal use of WhatsApp to support their learning, and thus in academia this tool has proven useful in the teaching and learning process and its use includes: facilitating communication between students and teachers, giving quick feedback, making learning more flexible (Gasaymeh, 2017). WhatsApp enables asynchronous communication with a direct impact on student participation, due to the provision of the possibility of retrieving messages sent when students were offline, in remote areas without network coverage or when their devices were turned off (Susilo, 2008).

3.1.3 Zoom

The Zoom platform is part of most used in the teaching and learning process. One of the most used tools nowadays to bridge the physical absence in companies and the school context as a consequence of COVID-19, teachers started using Zoom. For its use, it seemed to be an amazing and scary resource, but deep down when you create confidence with it, you find a very simple and free access platform in the basic version with a 40 min limit, where more than one participant can access it (Fink, 2020). This platform has an excellent quality because videoconferencing is almost a replica of the face to face interaction, wherein in a Zoom class, you hear the voices and see the faces of the participants just like in a classroom, and you can build extremely active and participatory sessions making the classes less teacher-centred (Fink, 2020).

3.2 Use of online platform in higher education in Mozambique

In Mozambique, during the pandemic, HEIs adopted several platforms as an alternative means to supply face-to-face interaction. In the study presented by CNAQ, WhatsApp and skype stand out as the most used platforms (figure 2), followed by Google classroom, email, Zoom and Moodle AQ, 2020).

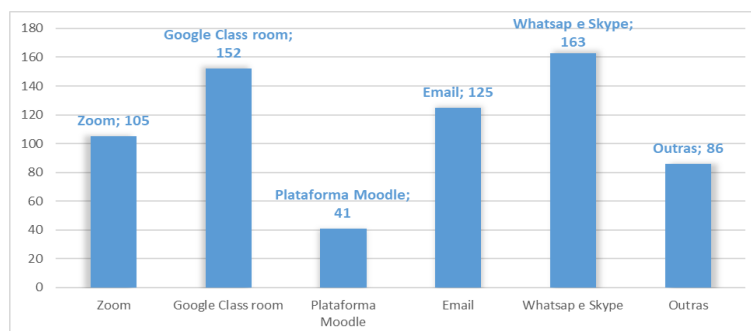


Figure 1: Use of online platform in teaching in Mozambique

Source (CNAQ, 2020)

4. Methodology Approach

In terms of configuration, this article was developed based on the qualitative approach, using a case study. The data collection and acquisition strategy was carried out through semi-structured interviews with 10 Professors

of the Catholic University of Mozambique, specifically in five Faculties: Faculty of Tourism and Informatics Management (FGTI-Pemba), Faculty of Social and Political Sciences (FCSP-Quelimane), Faculty of Forestry and Fauna Resources Management (FGRF-Lichinga), Faculty of Natural Resources Management and Mineralogy (FAGREM-Tete), Faculty of Economics and Management (FEG-Beira) and Faculty of Health Sciences (FCS-Beira). All participants are course coordinators, and the strategy of interviewing the coordinators was driven by their involvement in the teaching and learning process as well as their domain, knowledge and monitoring of the classes during the period of the pandemic. In APA standards we can cite the interviews as personal communication or recordings (Bloom, 2018), for the case, we present the data as personal communication and six of these interviews were conducted through telephone means and the rest face-to-face.

The study focused only on the first half of the year 2020, as a way to understand the events that took place in this period considered crucial. In addition to the information gathered through the interviews with the Teachers, documents, bibliographies, and Television were used using a systematic review. The strategy for selecting the material was initiated by defining keywords (teaching and learning, e-learning, digital platforms, higher education, COVID-19); after selecting the texts through the titles; methodologically followed by reading the abstracts to explore the content and the relationship with the research, and in this way, only the articles whose abstract was within the scope of the Research were selected. In terms of secondary sources were the Ministry of Science, Technology and Higher Education, Dispatches of the Catholic University of Mozambique, Television of Mozambique (TVM), Sociedade Independente de Comunicação (SOICO), UNESCO and electronic journals.

5. Results and Findings

As a way to better present the interviews and dialogue with the participants, here is the characterization of the participants taking into account the participant's condition, the college of provenance and the date of the interview.

ML from FGTI on August 18, 2020; KB from FCSP on August 18, 2020; AG from FGTI, on August 19, 2020; CA from FGTI on August 19, 2020; VR from FEG on August 26, 2020; EM from FAGREM on August 26, 2020; TP from FGTI on August 27, 2020; AC from FCSP on August 27, 2020, and EA from FCS August 28, 2020. To answer the objectives, we ask some questions about the main teaching practices during the period under analysis: *(a)What were the initial difficulties for teachers and students, and how were they overcome? (b)What tools were used to bridge the interaction in face-to-face sessions? (c)Which evaluation strategies (assignments, defences and exams) were used successfully? (d)What strategies were most assertive in overcoming digital literacy difficulties in the class? (e)What are the main lessons of the pandemic to academia?*

Given this and according to an analysis of the transcripts of the teachers' interviews we have the following answers:

A. *What were the initial difficulties for teachers and students, and how were they overcome?*

Regarding this question, the results show that "The main difficulties were inherent to connectivity because the internet in the area where I live has a very weak signal" (AG) and many others likewise due to the deficiency of signal, it was difficult to upload video lessons. Others believe that there was a certain overload of the telecommunications infrastructure, for example, "the signal is very slow because many people at that time were using virtual platforms, I believe that the internet was so overloaded that at some point it made the interaction process difficult..." (AG). Because of these difficulties, solutions to the problem were being adopted and many resorted to lighter platforms that allow working asynchronously with platforms such as WhatsApp, email, and SMS. Besides the infrastructure problems there were problems related to discipline on the part of students, "There were students that in WhatsApp only said hello and did not participate and only marked presence ...sometimes when I launched questions they did not answer, but I saw that he read the question and then I called him by name, so the presences were marked by participation during classes" (TP). There were also economic problems that contributed negatively to the course of the lessons or to low student participation in the sessions, "...few could get into a session or stay in class the whole time, sometimes a class of 25 students only eight would get in" (AC). To get around the issue of the free version of Zoom that every 40 minutes ended the session, many migrated to Google Meet. In the opinion of one of the interviewees "with Google Meet I could teach online at will, for as long as I wanted, and it was not necessary to install it on the device because it came from the email connected to Gmail" (AG). This platform was being used recurrently in competition with Zoom.

B. *What tools were used to bridge the interaction in face-to-face sessions?*

One of the problems that marked higher education arising from COVID-19 and that affected the process as a whole was the impossibility of holding face-to-face classes. To this end, the question arose as to what platforms were used to replace physical presence, and participants reported a gradual implementation in the face of the enormous challenge and test of resilience. For the case of the teachers who participated in this study, there was initially an approach to the Skype platform, but this was not very convenient in the teaching context due to the requirements such as 32MB just to name one example.

C. What assessment strategies (assignments, defences, and exams) were used successfully?

The Catholic University of Mozambique, after the course of the classes, provided guidelines on assessment, urging that the tests could be in the form of investigative work, while the exams should be held on Moodle platform, and, according to the characteristics of the subject could be explored the resources of the same either in open questions, questionnaire and multiple choice. This orientation was followed as described "The question of exams we used the Moodle platform and I used direct questions from the platform" (CA). The challenge was huge and some colleagues still had difficulties in taking and administering the exams even after a month of training, "the difficulties of the group that worked with email were reflected in the exam" (CB). This group of students that did not have computer resources, much less a cell phone with internet access, had an inclusive treatment by the teachers by sending the contents via email. Some subjects of a practical nature deserved another type of treatment and as mentioned before given the adversities, it required a lot of creativity from the teachers. One of the teachers says: "to make a balance or demonstration of results they had to do the tests on a sheet of paper and upload the photo of the resolution on the platform and the defences of these works were initially done in the Zoom, but due to the difficulties of the students we had to do in some cases in WhatsApp in which students shared their slides and in parallel made audios of their presentations and then colleagues had the opportunity to ask questions and participate through audios in WhatsApp and made the capture of the screen with the arrows to indicate the doubts" (PT).

D. What strategies were more assertive to overcome the difficulties of digital literacy in the class?

The measures taken by teachers were first the WhatsApp training, as they report "Initially I used WhatsApp because it was more comprehensive and students were more comfortable using it and not other platforms... WhatsApp also had an informational function ...for example, when I put an assignment while everyone was offline, I would send a message on WhatsApp so they could log in to Moodle and they did"(ML).

Other strategies include promoting and stimulating interest in the use of the platforms, "First I think that the centre of all this is the interest of this activity by the stakeholders, because having that the process becomes simpler because the person has the will and will be able to do everything to overcome the difficulties" (AG), substantiated by another respondent " I also think that illiteracy I think lack of interest on the part of some students who are reluctant to change, do not want to learn, because the methodology that we used as WhatsApp was accessible and hence they had no way to feel excluded, for this reason, that was the lack of interest.... many have it in their heads that they are not for distance learning...so the strategy to rescue this lack of interest is sensibilization" (TP). This phenomenon is called the change of mentality, "There must be the change of mentality... This investment should not only be made by institutions but also by individuals, the time has come to include in personal expenses a device capable of accessing the Internet and having mobile data capable of entering the virtual world for at least two hours a day" (EM). (AC).

E. What are the main lessons of the pandemic to academia?

The Pandemic resulted from COVID-19 besides bringing consequences to the whole fabric of higher education, there was the opportunity to take some lessons from the high education institutions, professors and students, and these lessons have to do with the individual or institutional structure.

In this sense, "It is good that comes with bad, the pandemic had its consequence but also brought other benefits and new experiences, and it should be necessary to bet on the use of ICT in the process of EA ... the education system should change, there should be more investment in technology, as well as on the part of teachers and students ... and in curricular terms should be strengthened the technological inclusion taking into account the context and socio-economic conditions ... should use a model of hybrid education as a way to reconcile the face-to-face and virtual ... it is necessary to test new models and follow the world dynamics! "(CB), this position is substantiated by (MA, VR and EM).

In the interviewees' answers the belief is highlighted, "the first lesson of all is to believe that it is necessary to change when there is a need, to believe that it is possible to use online platforms as an alternative means, not

only when we have problems like this and because these platforms are not there to make life difficult for us, they are there to facilitate in fact..." (MA), learn to be hybrid in methodology, "it is necessary the diversification of teaching methods, to program so that many tasks are also performed in both media..." (AG).

With all this, something came to stay, "the pandemic may have taken away a lot of things, but the technology remains and especially the digital platforms such as Moodle, Zoom, WhatsApp and others used in the process of EA, I just learned that there was the classroom because of the coronavirus" (MA). Conventional solutions also remained, as mentioned in the report "the other informal alternatives that we used were to do exercises in the notebook and take pictures and send on WhatsApp..." (TP), it was the solution of more immediate things and to work offline... (AG).

6. Discussion

COVID-19 caused the closure of a large number of educational establishments; the United Nations statistics through the Organization for Culture, Science and Education estimate that 1198 million students were affected, and the same organization issued recommendations for the potentization of distance learning strategies (Ferreira et al., 2020). This panorama combined with economic challenges, lack of technological infrastructure, as well as a formal education in digital resources, brought disastrous consequences, even though Mozambique has a theoretical history of Information Communication technology (ICT) that began in the year 2000 with the approval of the informatics policy and materialization of communication via internet in 1996 (Rhongo et al., 2018), a fact that would not only allow to assimilate a wide experience but also to give significant advances in the education segment and in particular in e-learning, as well as increasing the flexibility of the educational fabric and innovation in education (Milani & Malagolli, 2019). A more practical analysis shows that investment in ICTs in higher education is considered only as a requirement for opening it and not as an auxiliary model for an appropriation of an information society, where teaching opportunities can be expanded, accompanied by respective pedagogical, methodological, technological and communicational resources necessary for the teacher to prepare a class and administer it in a 100% digital environment.

The results showed that few teachers had technological competence, as a result of the daily use of computers and cell phones, but this knowledge was not pedagogical, because the Universities had never considered a massive context of distance education important, much less a pandemic that could distance people.

The report published by CNAQ shows that facing the COVID-19 pandemic many Higher Education Institutions in Mozambique were severely affected. Some developed some actions, such as investment in ICTs and training of the teaching staff as a way to prepare for the offer of classroom courses in the non-contact modality. But on the other hand, these actions were not carried out linearly, and some difficulties were noted, namely:

- A. *Faculty difficulties that are not only inherent to distance teaching and learning but to psycho-pedagogical training; students revealed a poor mastery of independent study methods and techniques, something that is useful not only for online classes but for lifelong learning.*
- B. *Just over 20% of the teachers did not effectively orient the teaching and learning processes due to difficulties in accessing ICTs (equipment and internet), equally 25% of the students did not access the online learning platforms due to the same problems as the teachers.*

In general, faced with COVID-19 many institutions opted for complete paralysis of classes due to the lack of technical, infrastructural, structural, economic, and technical-pedagogical conditions to make classes viable in this modality; In terms of indicators of those who have advanced with the process of distance education at the national level only 3% of teachers and student purchased Mega Bites individually, 7% of institutions distributed refills for teachers, as well as workers, 6% recorded video lessons for distribution on the internet, 23% trained teachers in the use of ICTs for distance learning (CNAQ, 2020).

The Catholic University of Mozambique started to use Moodle in 2013, but the results of the interviews point to low use of this platform due to lack of obligation; some who had already used it refer that it was in other contexts as training, as Master's or Doctoral students and not as a teacher who should manage the process.

The first strategy of the Catholic University of Mozambique was to guide the use of the official platforms which held the respective licenses in a harmonized manner, and the second was to give freedom and space so that, according to each context, other platforms of individual initiative could be used (Dispatch 0016/2020/UCM/GR, 2020), it was in this context that many teachers used several platforms of free access, easy to use as a means to

interact with students, but not all actors (teachers and students) had mastery of these ICTs, so each one used the one that suited them and that was mainly the students' domain as a mechanism of inclusion.

In the context of higher education in Mozambique, WhatsApp and Skype were highlighted in 163 organic units, Google Classroom in 152, email in 125, zoom in 105 and Moodle in 41 organic units (CNAQ, 2020). This result presents an important analogy that shows that there was a concern for sending material to students. This factor may have been determined on one hand due to ease of use, but on the other hand since they are free platforms (Fink, 2020; Mura & Rhongo, 2018).

Due to its popularization in the social context and being pre-installed on most smartphones, WhatsApp was the communication tool the most used at the beginning of the pandemic, a fact confirmed by the trend from the outside world as well as from our interviewees. This Application was quite formally used in the university context before the pandemic, where teachers and students had used it as a pedagogical support tool in the communication aspect, feedback synchronously and asynchronously depending on the state of connectivity of the interlocutors (Gasaymeh, 2017; Paiva, 2020; Susilo, 2008), which leads us to consider that small resources that can do great jobs, especially in the bet of cell phones that it is believed that almost 100% of students in higher education have at least one, and according to (Arruda, 2020) in higher education there is less resistance to the implementation of digital technologies in the teaching and learning process.

Traditionally the mediation of a class requires the presence of the teacher in front of the students, and in the online modality it tries to be done through platforms, but not everything is a bed of roses, in an attempt to supply the face-to-face classes through a conferencing tool, many schools have used Zoom and it has been an absolute success in learning given its technical feature; For the context of UCM this platform was widely used by the interviewees since it presented itself relatively easy to use and with few demands/requirements. But like all online platforms the issue of fatigue and stress in successive classes can bring poor results, as one teacher reports in Fink (2020):

"The first day I took two Zoom classes in a row, I ended up bleary-eyed and exhausted. I sat and watched something silly on Netflix, drank a glass of wine, and did nothing productive until I finally managed to fall asleep. I had had numerous Zoom meetings previously, many of which I had hosted..." (Fink, 2020, pag. 1).

This section does not take away the merit of the platforms in meeting the needs of interaction, but only alerts to the need for careful planning of classes in this modality, considering all issues that may arise as consequences and that may probably jeopardize physical/mental health as well as the quality of perception and assimilation of the classes.

The other notable absence in terms of a faithful instrument to the teacher in classes through online platforms, according to the interviewees is the whiteboards; this instrument was not used by the majority because teachers were unaware of tools such as cam, digital desk, to replace the whiteboard that is usually used in conventional classroom (Helena et al., 2020).

To minimize this, there were initiatives from the private sector, specifically the operators tried to support higher education through subsidized rates for unlimited Internet access, under very low payment conditions (Vodacom free, TMcel and Movitel at 100 Mts/month so that all Students, Teachers/ Researchers and Technical-Administrative Staff can enjoy open and exclusive access to academic content (MCTESTP, 2020; Nhantumbo, 2020). But even so, reality has shown that these contents have not been fully accessed.

In the case of the Catholic University of Mozambique, even with so much experience in teaching and learning it was challenging in the initial phase, but gradually it was assimilated by the actors and aligned in all aspects (teaching and evaluation). This achievement was praised by the Minister of Science and Technology, Higher and Technical-Professional Education (MCTESTP) at the time, Gabriel Ismael Salimo, saying he was pleased by the level of readiness and response of the UCM on the COVID-19 pandemic (UCM, 2020).

This University saw ICTs enabling the teaching and learning process in the face of a lethal and aggressive COVID-19 in terms of contamination, to the extent that classes were administered, and tests and exams were also conducted via the platform.

7. Conclusions and Recommendation

This paper explores the practices and experiences that day-to-day characterized the teachers at the Catholic University of Mozambique, even recognizing their limitations in teaching skills in an online environment where

it is difficult to promote critical, investigative and individual learning. The COVID-19 pandemic has shown that many public and private higher education institutions have opened their courses and attached computer labs, but have forgotten to build a pedagogical approach oriented and assisted by ICTs. Online teaching has become the "new normal" (Fink, 2020), an expression that has been widely used to refer to the new teaching and learning practices and habits arising from COVID-19, so institutions of higher education and communication companies must greatly improve connection and connectivity; about this aspect, the interviewees presented the concern of internet slowness, which demands the improvement and increase of broadband capacity in the country to respond with such desired hybrid teaching.

After the pandemic, teaching will never be the same, schools are called to a vision in which incoming teachers must have mastery of ICTs for teaching as a requirement, and their students must also face ICTs with a different attitude, especially when it comes to information and services.

References

- Arruda, E. P. (2020). EDUCAÇÃO REMOTA EMERGENCIAL: elementos para políticas públicas na Educação Brasileira em tempos de covid 19. *Revista de Educação a Distância*, 7(1), 257–275.
- Bao, W. (2020). COVID -19 and online teaching in higher education: A case study of Peking University . *Human Behavior and Emerging Technologies*, 2(2), 113–115. <https://doi.org/10.1002/hbe2.191>
- Bloom, L. (2018). *How to Write an Interview in APA Format*. Conducting Interviews. <https://work.chron.com/write-interview-apa-format-6612.html>
- Caldeira, A. (2011, August 22). Ensino a distância sem aceitação em Moçambique. *Jornal Verdade*. <http://www.verdade.co.mz/soltas/21702-ensino-a-distancia-sem-aceitacao-em-mocambique>
- CNAQ. (2020). *Resultados preliminares do inquérito sobre e-learning em tempos de COVID-19*.
- Educação, M. da. (2011). *Plano Tecnológico da Educação*.
- Ferreira, A. M. dos S., Príncipe, F., Pereira, H., Oliveira, I., & Mota, L. (2020). COVimpact: pandemia COVID-19 nos estudantes do ensino superior da saúde. *Revista de Investigação & Inovação Em Saúde*, 3(1), 7–16. <https://doi.org/10.37914/riis.v3i1.80>
- Fink, K. (2020). *Zoom for Teachers*. <https://www.weareteachers.com/zoom-for-teachers/>
- Gasaymeh, A.-M. (2017). University Students' use of Whatsapp and their Perceptions Regarding its Possible Integration into their Education. *Global Journals of Computer Science and Technology: G Interdisciplinary*, 17(1).
- Helena, D., Ferreira, L., & Sugahara, C. R. (2020). Atividades remotas no Ensino Superior em tempo da pandemia. *Revista Praxis*, 12(1), 19–28.
- Lisbôa, E. S., Jesus, A. G. de, Varela, A. M. L. M., Teixeira, G. H. S., & Coutinho, C. P. (2009). LMS em Contexto Escolar: estudo sobre o uso da Moodle pelos docentes de duas escolas do Norte de Portugal. *Educação, Formação & Tecnologias-ISSN 1646-933X*, 2(nº1), 44–57. <http://eft.educom.pt>
- Mapote, W. (2020, April 13). COVID-19: mantém-se 21 casos confirmados no país. *O PAIS - SOICO*. <http://opais.sapo.mz/-covid19-mantemse-21-casos-confirmados-no-pais>
- Matusse, O. M., & Fofonca, E. (2017). perspectivas do centro de recurso de Maputo , Moçambique A literacia digital e as estratégias para o desenvolvimento de competências na aprendizagem em EAD : *Comunicacao & Educacao*, 2.
- Matusse, R. (2013). *História da Informática em Moçambique* (CIEDIMA).
- MCTESTP. (2020). *Comunicado de imprensa sobre o ponto de situacao de operacionalizacao das medidas de prevencao a pandemia do covid-19 nos subsistemas de ensino superior e tecnico profissional* (pp. 1–10).
- Milani, J. V. Z., & Malagolli, G. A. (2019). A internet em relação ao crescimento do PIB. *Interface Tecnológica*, 78–89.
- Mura, S., & Rhongo, D. (2018). Análise da utilização da plataforma Moodle nos cursos de Doutoramento : estudo de caso da Universidade Católica de Moçambique. *Educação a Distância*, 8(1), 25–46. <https://clareiano.edu.br/revista/169/revista-educacao-a-distancia>
- Nasrin, N. (n.d.). *University on Web : a Case Study of Using Moodle for Course Work*.
- Nhantumbo, T. L. (2020). Capacidade De Resposta Das Instituições Educacionais No Processo De Ensino-Aprendizagem Face À Pandemia De Covid- 19 : Impasses E Desafios. *Revista EDUCAmazônia - Educação Sociedade e Meio Ambiente*, XXV(2), 556–571.
- Paiva, F. (2020). *WhatsApp alcança presença recorde em 99% dos smartphones no Brasil*. Mobile Time. <https://www.mobiletime.com.br/noticias/27/02/2020/whatsapp-alcanca-presenca-recorde-em-99-dos-smartphones-no-brasil/>
- Rhongo, D. L., Almeida, A. De, & David, N. (2018). eGovernment in Mozambique : Past , Future and New Prospects. *IST Africa, 2018(E-Government)*, 1–8.
- Rhongo, D., Mura, S., & Da Piedade, B. (2020). The e-learning environment in developing countries : case of Catholic University of Mozambique. In M. E. A. et al. (Eds.). I. 2019 (Ed.), *Springer Nature Switzerland AG 2020* (Vol. 1, Issues 25-28 September). Springer International Publishing. <https://doi.org/10.1007/978-3-030-40271-6>
- Sabbatini, R. (2007). Ambiente de Ensino e Aprendizagem via internet: a plataforma moodle. *Instituto EduMed*, 7, 36. <http://www.renato.sabbatini.com/papers/PlataformaMoodle.pdf>

- Silva, C. A. da, Monie, F., & Mulhaisse, R. A. (2020). Pandemia De Coronavírus/Covid-19 Em Moçambique: Desafios De Reflexão Sobre Os Contextos Territoriais E Socioeconômicos Da Política De Saúde. *Geosaberes*, 11(November), 674. <https://doi.org/10.26895/geosaberes.v11i0.1101>
- Susilo, A. (2008). *Exploring Facebook and Whatsapp As Supporting Social Network Applications For English Learning In Higher Education*. 10–24.
- TVM. (2018). *4000 vagas para Ensino à Distancia na cidade de Maputo*.
- TVM. (2020, March 20). *TVM em parceria com MINEDH retoma o programa Telescola a partir de terça-feira*. https://www.tvm.co.mz/index.php?option=com_k2&view=item&id=6615:tvm-em-parceria-com-minedh-retoma-o-programa-telescola-a-partir-de-terca-feira
- UCM. (2020). *Ministro da Ciência e Tecnologia, Ensino Superior e Técnico-Profissional satisfeito pelo nível de prontidão e resposta da Universidade Católica de Moçambique (UCM)*. 30 de Julho. <http://ucm.ac.mz/index.php/pt/eventos/noticias/383-ministro-da-ciencia-e-tecnologia-ensino-superior-e-tecnico-profissional-satisfeito-pelo-nivel-de-prontidao-e-resposta-da-universidade-catolica-de-mocambique-ucm>
- UNSECO. (2020). *COVID-19 and higher education: Today and tomorrow*.

Can Academic Librarians as Data Scientists Revolutionise User-Centric E-learning?

Haziah Sa'ari^{1,2}, Anne Goulding¹ and Mohd Dasuki Sahak³

¹School of Information Management, Victoria University of Wellington, New Zealand.

²School of Information Science, College of Computing, Informatics and Mathematics, Universiti Teknologi MARA, Negeri Sembilan, Malaysia.

³Sultan Abdul Samad Library, Universiti Putra Malaysia, Serdang, Malaysia.

[haziah095@uitm.edu.my](mailto: haziah095@uitm.edu.my)

[anne.goulding@vuw.ac.nz](mailto: anne.goulding@vuw.ac.nz)

[dasuki@upm.edu.my](mailto: dasuki@upm.edu.my)

Abstract: This investigation illuminates the vital contributions of academic librarians (ALs) functioning as data scientists (DSs) within the e-learning landscapes of Malaysian public universities. Derived from comprehensive interviews with ten experience ALs, this study distinguishes three key areas of contribution towards user-centric and effective e-learning: bolstering user experience and usability; endorsing continuous improvement and professional development; and stimulating interdepartmental collaboration and innovation. Despite the significant progress made by ALs, the study acknowledges the formidable challenges faced by these professionals in their capacity as DSs, specifically in areas of professional growth and evaluation. The paper presents strategic recommendations to overcome these obstacles, such as amplifying ALs' data science competencies, advocating for ongoing professional development, and endorsing the validation of their expertise through accreditation. By highlighting the essential role and proactive contributions of ALs as DSs, this study offers valuable insights and guidelines towards cultivating a robust and influential e-learning environment. Concluding with suggestions for future research, this study aims to propel the progression of academic librarianship and the enhancement of e-learning outcomes.

Keywords: Academic Librarian as Data Scientist, E-learning Environment, User-Centric Learning, Continuous Professional Development, Technology Integration.

1. Introduction

The dynamic nature of the e-learning landscape demands that academic librarians undergo a profound redefinition of their roles, transcending conventional boundaries to optimize the learning experience in conjunction with remote instruction. This study is very important given the remarkable development of the Open Science Platform (MOSP) in Malaysia, a strategic initiative spearheaded by the Ministry of Science, Technology, and Innovation (MOSTI) aimed at strengthening the nation's open science ecosystem. MOSP's provision of a wide range of resources, including user guides, capacity-building programs, and a research data-sharing infrastructure, clearly lines up with the FAIR (Findable, Accessible, Interoperable, and Reusable) principle, thus cementing its status as an instrumental and pivotal component within Malaysia's research landscape while concurrently paving the way for future advancements (The Star, 2023). In conjunction with this, in the dynamic e-learning landscape, academic librarians (ALs) assume a vital role in navigating transformative trends. Their active engagement with MOSP empowers them to champion open science principles and collaborate closely with researchers, ultimately enhancing the learning experience and contributing to research advancement in the digital era.

This paper explores how ALs as data scientists (DSs) contribute to enhancing e-learning in Malaysian public universities and investigates the impact of user-centric and efficient e-learning environments on their changing roles and contributions. The paper includes an introduction and a literature review on ALs' roles in e-learning, focusing on their involvement in data science. It discusses the challenges faced by ALs as DSs in the e-learning environment. The results and research methodology are analysed, and a conceptual framework highlights the significance of the data science contributions by librarians in improving e-learning. The paper concludes with recommendations for future research in this important area.

2. Literature Review

2.1 Roles of ALs as DSs in E-Learning and the Application of User-Centric Design (UCD)

The UCD approach is highly applicable to ALs functioning as data scientists within the realm of e-learning, as it underscores the paramount importance of simplicity, usability, aesthetics, and alignment with user needs (Courage & Baxter, 2005). ALs assume a critical role in ensuring unfettered access to high-quality digital resources, fostering information literacy, and crafting instructional content of exemplary standards (Taylor & Thompson, 2018). However, a discernible knowledge gap persists regarding ALs' perception and enactment of their ever-evolving role as data specialists within the e-learning domain, thereby warranting meticulous investigation to bridge this scholarly chasm (Lynch, 2017; Cox & Verbaan, 2018). In this context, it becomes indispensably imperative for ALs to expand their professional repertoire, encompassing technological prowess, instructional design acumen, project management proficiency, and adeptness in advocating for and promoting library resources within academic circles, all in a concerted effort to efficaciously navigate the ever-shifting tides of their multifaceted responsibilities (Walter, 2016; Connor, 2020).

Data science, as an expansive discipline, incorporates manifold perspectives and approaches, serving as a paradigm that profoundly shapes our comprehension of data-driven practises (Kelling et al., 2009; Kitchin, 2014). In the specific context of academic librarianship, data science delineates the purview of ALs, who adroitly extract cogent insights from data via the application of sophisticated statistical and machine learning techniques (Hayes, 2014). Furthermore, ALs actively collaborate with esteemed faculty members, harmoniously integrating diverse educational resources into meticulously crafted curricula, orchestrating curated online tutorials, and, commendably, fostering a vibrant culture of active learning through an array of cutting-edge digital platforms (Mune, 2015).

Despite the pivotal role that ALs play in the expansive landscape of e-learning, a palpable dearth of knowledge persists vis-à-vis their continually transforming roles and the requisites indispensable for their successful adaptation to these transformative shifts (Lynch, 2017; Cox & Verbaan, 2018). Consequently, it becomes unequivocally evident that a comprehensive exploration, replete with scholarly rigour, is an essential prerequisite to unravelling the intricate tapestry of ALs' dynamic roles within the e-learning sphere, thereby facilitating a holistic comprehension of their lived experiences, effectively addressing challenges, and seizing the multitude of opportunities intrinsically embedded within this ever-evolving professional milieu (Xing & Du, 2018; Siemens & Baker, 2012). Notably, the deployment of predictive modelling techniques aptly fuels the trajectory of personalised learning, albeit accompanied by the complexities of ethical considerations, prompting an urgent need for meticulous safeguarding of student privacy and confidentiality (Drachsler & Greller, 2016). In addition, the advent of epochal forces such as big data, artificial intelligence (AI), and machine learning (ML) presents a pantheon of unparalleled opportunities alongside the concomitant complexities surrounding data management and processing, thereby warranting prudent deliberation (Picciano, 2012; Zhou & Brown, 2018).

To encapsulate, the application of the user-centric design (UCD) approach profoundly resonates with the professional aspirations of ALs functioning as DSs within the expansive domain of e-learning, firmly accentuating the inexorable significance of harmonising educational practises with the varied and nuanced needs of users. Librarians, equipped with data-driven tools, adroitly steer the course of instructional design, deftly personalising learning experiences, and enhancing educational outcomes through the judicious application of data science methodologies (Zhou & Brown, 2018). The acquisitive journey towards knowledge, coupled with the astute utilisation of data science frameworks, becomes an indispensable conduit that empowers ALs to successfully navigate the myriad complexities embedded within their rapidly evolving roles within the dynamic and ever-expanding realm of e-learning.

2.2 Theoretical Frameworks Guiding Librarians' Integration of Data Science in E-Learning

The role of ALs as DSs in e-learning contexts is characterised by a range of scholarly frameworks and models, despite lacking a specific theory to encapsulate it. Baker and Siemens (2014) lay the foundation for applying data and analytics in education, while Dede, Ho, and Mitros (2016) emphasise their role in e-learning. Martin and Ndoye (2016) exemplify data science in e-learning, using learning analytics to evaluate student progress. ALs can use the Community of Inquiry framework and social network analysis for data-driven enhancements (Garrison, Anderson, & Archer, 2000; Haythornthwaite, 2002). The Information Literacy Framework (ACRL, 2016) and Bruce's Seven Faces of Information Literacy (Bruce, 1997) highlight the evolving role of librarians in an evolving information landscape. Ray and Brown (2019) and Stephens et al. (2018) emphasise librarians as data mentors

and educators in e-learning, emphasising data literacy's importance.

Tijerina and Erdmann's influential report "Data Science in Libraries" (2017) forms the foundation of our examination of ALs as DSs. This report serves as a critical reference, particularly for emerging research environments such as exists in Malaysia, underscoring the need for more exploratory studies. Within the scholarly discourse, there exists significant divergence regarding the nomenclature, objectives, components, criteria for advancing to subsequent studies, and reporting practices associated with exploratory investigations (Lancaster, 2015). The report elucidates the fusion of data science and librarianship, demonstrating how librarians, as data curators and information specialists, can contribute to academic learning and research. Libraries are proposed as hubs for data science activities, with opportunities to enhance data literacy among learners through workshops and hands-on experiences. In an e-learning context, the report's implications are profound. Librarians, equipped with data science skills, can optimise the use of online learning platforms by analysing user behaviour and learning outcomes, leading to course improvements. They can also personalise learning experiences, provide targeted support, and utilise machine learning and data visualisation techniques.

2.3 A Challenge-Ridden Pathway for ALs

ALs face obstacles as they navigate the e-learning landscape as DSs. These challenges include privacy, security, and ownership concerns related to big data (Zimmer, 2022). Inconsistent data ownership policies among platforms and libraries compound the problem. Acquiring specialised data science skills is a significant barrier due to limited funding and access to training (Haddow & Mamtara, 2021). Inconsistencies in library data science practises, communication with stakeholders, data quality, and interoperability further impede progress (Jones, 2021; Al-Aufi & Houghton, 2021). Librarians must continuously update their skills due to the evolving nature of data science (Kitchin, 2022). Scaling from small-scale to large-scale applications presents data management challenges (Luo & Clarke, 2022). Finally, librarians must be mindful of algorithmic bias in machine learning to avoid skewed or unfair outcomes (Mittelstadt et al., 2019).

3. Study Methodology

The research design employed in this study employed stringent measures to establish credibility and validity, commencing with a comprehensive literature review (Leite, Padilha, & Cecatti, 2019) that informed the research problem and design (Yin, 2009). A phenomenological approach was deliberately adopted, targeting esteemed ALs hailing from prestigious Malaysian research universities (RU). These distinguished individuals boasted 10–15 years of professional experience, held the esteemed grade of S41, and fell within the age range of 40–45 years. The selection process meticulously considered their active involvement in diverse e-learning and innovation projects conducted under the aegis of top management.

Given the specific context of the research landscape in Malaysia, characterized by a limited number of five RU, regrettably, only two institutions evinced willingness to participate. Consequently, the scarcity of respondents in this study can be ascribed to the constrained availability of potential participants. The two participating RU, as evidenced in Table 1, were judiciously chosen based on their eminence and extensive involvement in e-learning and innovation endeavors.

While a larger sample size would have been ideal to enhance statistical generalizability, qualitative research often prioritizes depth and richness of data over the sheer magnitude of the sample. In this study, the emphasis was placed on obtaining invaluable insights from esteemed senior ALs possessing considerable expertise and actively engaged in e-learning and innovation projects within the participating RU. Their erudition and perspectives furnish significant contributions to the research objectives.

Data collection was meticulously undertaken through focus group interviews, ensuring scrupulous adherence to ethical considerations and securing prior consent from chief librarians and informants. The study encompassed the inclusion of ten senior ALs from the participating RU, as detailed in Table 1. Although the number of respondents may appear relatively limited due to the paucity of RU willing to partake, the inclusion of these highly experienced senior ALs facilitates a comprehensive exploration of their nuanced perspectives. Throughout the interviews, the utmost level of professionalism and respect was meticulously upheld, with audio recordings captured in MP3 format to facilitate detailed transcription and comprehensive data analysis.

Table 1: Demographic Profile

Elements of Sampling	Case A		Case B	
Academic library location in public university with RU granted	Centre of Peninsular Malaysia		Southern Peninsular Malaysia	
Overall library staff strength	170-180		170-180	
Working experience	Multiple Department (rotation basis)		Multiple Department (rotation basis)	
Number of participants	5		5	
Gender	Female	Male	Female	Male
	3	2	3	2
Key performance index in % (for 3 years directly)	90-95		90-95	
Years of experience	10-15		10-15	
Age range	40-45		40-45	
Qualifications				
Degree in Library Science	3		3	2
Degree In Islamic Studies		1		
Degree in Botany	1		5	
Masters in Information Management/ Library Science	5			
Current position	Senior Librarian		Senior Librarian	

4. Discussion of the Findings

This section provides a comprehensive discussion of the findings by integrating the insights from both Case A and Case B. The discussion is supported by relevant source citations, with CSA serving as the source citation, Q2 specifying the specific question related to the domain, and AL-C representing the cited AL.

4.1 Contributions

4.1.1 Enhancing User Experience, Optimising Usability and Evaluating and Enhancing Electronic Resources

Within the domain of library website usability, ALs play a vital role in enhancing user experiences and optimising usability. AL-C emphasises their commitment to user-centric design, stating, "We prioritise user-centric design principles to ensure seamless access and intuitive navigation" (CSA, Q2, AL-C). For instance, ALs have implemented intuitive search functionalities and personalised recommendation features, enhancing the overall user experience.

Similarly, AL-E recognizes user-centric design. They focus on employing appropriate terminology, instilling user confidence, and establishing a well-structured information architecture and site navigation. By evaluating electronic resources for relevance, AL-E ensures they meet user requirements. AL-E states, "We empower researchers and professionals to easily access and utilise valuable agricultural resources. Our user-friendly interfaces, guided tutorials, and intuitive navigation enhance the overall user experience, enabling informed decision-making and promoting sustainable practises" (CSA, Q2, AL-E). For example, tooltips and contextual help features have been implemented to enhance users' understanding and utilisation of resources.

AL-D emphasises the commitment to continuous improvement, empowering users to navigate resources seamlessly and excel academically. AL-D states, "By continually refining and enhancing library websites, we empower users to navigate resources seamlessly, interact with content proficiently, and excel in their academic pursuits" (CSB, Q2, AL-D).

4.1.2 Dedication to Continuous Improvement, Skills in Using Web-Based Tools and Continuous Professional Development

The informants acknowledge that they leverage data visualisation to enhance students' understanding by presenting complex data in visually engaging formats. AL-C emphasises this process, stating, "The process of visualising complex data bolsters learners' comprehension and fosters a deeper appreciation of the subject matter" (CSB, Q2, AL-C).

Effective data communication plays a crucial role in empowering both educators and learners. AL-B asserts,

"Presenting data insights in a clear, comprehensible manner serves as a linchpin in converting raw data into valuable knowledge. This approach empowers both educators and learners, enabling informed decision-making and driving progress within the e-learning environment" (CSA, Q2, AL-B).

ALs demonstrate their dedication to continuous improvement and professional development. They constantly update their skills in using web-based tools to enhance e-learning processes and promote productivity. As stated by AL-D, "We are steadfast in our pursuit of continuous improvement, constantly updating our skills in using web-based tools to enhance e-learning processes and promote productivity" (CSB, Q2, AL-D).

Furthermore, ALs' deep understanding of big data, data-driven decision-making, and data security plays a vital role in shaping instructional design, optimising resource allocation, and ensuring the privacy and security of user information. AL-A affirms, "Through diligent analysis, we can reveal insights that inform instructional design, tailor learning experiences, and optimise resource allocation" (CSB, Q2, AL-A). AL-E adds, "Analysis of data trends, user behaviour, and learning outcomes assists in the formulation of strategic plans, elevates the e-learning experience, and optimises resource usage" (CSB, Q2, AL-E).

4.1.3 Interdepartmental Collaboration, Innovation and Partnerships

Insights from the cases highlight the profound impact of collaboration among ALs on productivity and creative thinking within library functions. Collaborative efforts mitigate redundancy, streamline processes, generate new ideas and expand the reach and relevance of library institutions. Consolidating cataloguing and acquisition divisions proved productive, fostering creativity among ALs. AL-A emphasises the strength that arises from difficult situations, stating, "We challenge each other to come up with even better ideas and solutions" (CSA, Q3, AL-A). In addition, AL-C emphasises the need for effective communication and collaboration as essential for organisational success and heightened productivity.

AL-E of Case B shared their experience of ALs collaborating through activities such as exchanging cataloguing records, building complementary collections, and utilising interlibrary loan and document delivery services. This collaborative approach enhances the availability and cost efficiency of resources while effectively supporting the teaching, learning, and research needs of the academic community. ALs go beyond their traditional role of information provision and demonstrate their competency in collaboration, leveraging networking opportunities to foster global knowledge growth. A notable example of successful collaboration is the Union Catalogue of Malaysia (KIK), which involves 128 libraries and facilitates interlibrary loan transactions. With its web-based database containing 5,688,235 bibliographic records, KIK optimises the utilisation of resources in the e-learning environment. The effective collaboration among ALs contributes to efficient, cost-effective, and innovative library operations in support of e-learning.

Based on the findings, we present Figure 1, which portrays the transformative nature of a paradigm shift towards user-centricity, underscoring the pivotal role played by ALs as DSs in revolutionising e-learning contributions. Through their expertise in harnessing data-driven insights, these librarians enhance the user experience and drive innovation within the realm of e-learning, leaving a lasting impact on the field.

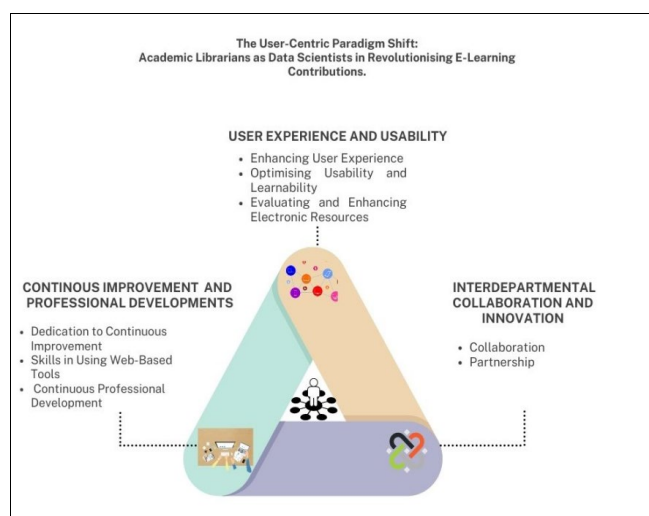


Figure 1: The User-Centric Paradigm Shift: The Vital Role of ALs as DSs in Revolutionising E-Learning Contributions.

4.2 Challenges

4.2.1 Performance Evaluations and Job Expectations

ALs often feel excluded from accountability and assessment conversations, hindering their ability to demonstrate their value in e-learning initiatives. As articulated by AL-B, "We are being omitted from the accountability and assessment conversation, which sometimes fails to recognize what they are not being asked to do" (CSA, Q1, AL-B). Furthermore, ALs face increasing job demands, particularly in relation to RU granted. This includes the need to align with the RU parameter measuring innovation within the cluster of information services or engagement in knowledge-intensive activities. These increasing job expectations have led ALs to bring work home, resulting in a work-life imbalance. AL-C highlights the challenges of multiple competing projects, the unpaid work brought home, and the increased pressure faced by ALs.

4.2.2 Data Science Proficiency Gap and Copyright Literacy Deficit

The informants admit to a lack of a solid foundation in data science, which hinders their effectiveness in utilising data-driven approaches for e-learning. As AL-E emphasises, "Data Science courses organised by MOSTI require submitting assignments within designated timelines. While attendance is not mandatory, ALs who have completed the courses now have a solid grounding in the subject and exhibit exceptional performance in assigned tasks" (CSB, Q1, AL-E). Moreover, AL-D highlights the complexity of copyright issues in academic libraries, where librarians must navigate the role of "information police" while facilitating access to information. AL-D states, "ALs find themselves caught between the demands of copyright law and the expectations of users, publishers, and creators. It is crucial for librarians to stay vigilant, constantly learning and adapting to the ever-changing legalities of copyright law" (CSB, Q1, AL-D). For instance, the ambiguity surrounding the digitization of only 24 pages in the information repository system exemplifies the need for careful copyright management.

4.2.3 Insufficient Motivation and Assistance for e-Learning Innovation

In terms of motivating and supporting e-learning innovation, ALs face obstacles. Existing reward systems are ineffective at motivating employees, which inhibits innovation. AL-B identifies the problem, stating, "Staff are rewarded under the Service Excellence Award based on rotation rather than their innovative accomplishments, which is unfair and biased" (CSA, Q1, AL-B). This inhibits their willingness to share ideas and to promote innovation. Moreover, leadership does not provide the necessary support and guidance to ALs. AL-C emphasises the significance of a supportive environment and clear incentives for innovation, stating, "Leadership encouragement and management support are vital to foster a culture of innovation and provide the necessary resources for e-learning innovation" (CSA, Q1, AL-C).

4.2.4 Pressure on Accreditation and Responsibilities

ALs face the additional challenge of meeting accreditation requirements in the context of e-learning and data science. AL-D highlights the current situation, stating, "For the time being, if you want to add your accreditation, it's under TS (Technology Specialist), a recognition issued by the Malaysia Board of Technologists (MBOT), which is the professional body that gives professional recognition to technologists and technicians in related technology and science. But librarianship is a unique field, and we are not really sure which area we fall under as the fields listed in MBOT are limited. In the context of DS, there should be a special stream for librarians, either recognised by MBOT or Persatuan Pustakawan Malaysia (the Malaysian Librarian Association). We are performing the tasks of a DS, but no official recognition is given to us for this duty" (CSA, Q2, AL-D).

ALs must also balance multiple responsibilities, such as research, technology adoption, and meeting accreditation requirements. This is made more complicated by the lack of recognition within the librarian profession for their roles as DSs. "Institutions and professional associations should provide appropriate recognition and support to ALs performing data science duties, aligning their accreditation requirements with the evolving needs of e-learning and data-driven practises" (CSA, Q2, AL-D).

Figure 2 highlights the main challenges faced by ALs in the context of e-learning initiatives, as derived from findings



Figure 2: Challenges Faced by ALS in e-Learning Initiatives

4.3 Recommendations

The findings of this study identified several key recommendations for enhancing the contributions of ALS as DSs in the Malaysian e-learning context. These recommendations, derived from the challenges and unique requirements of the e-learning environment, provide valuable insights into promoting effective data-driven practises.

Competency Development: ALS should develop comprehensive competencies to effectively fulfil their roles in the e-learning environment. This includes acquiring expertise in data visualisation and communication, utilising various visualisation and analytical tools, and having a strong understanding of e-learning systems, instructional design principles, and curriculum development.

Communication: Strong communication skills are essential for ALS to convey research findings effectively to stakeholders in the e-learning environment. ALS should prioritise the development of clear and concise presentation skills to facilitate informed decision-making and promote the adoption of best practises.

Big Data Management: ALS should possess a deep understanding of big data concepts and demonstrate proficiency in managing and analysing large datasets. By effectively utilising big data, ALS can contribute to data management processes and enable data-driven decision-making in the e-learning context.

Data Security and Privacy: Ensuring data security and privacy is crucial in the e-learning environment. ALS should stay up-to-date on data security principles, implement appropriate safeguards, and adhere to relevant data protection regulations to protect student data and digital resources.

Continuous Improvement and Professional Development: ALS should embrace a culture of continuous improvement and actively engage in professional development. This commitment allows ALS to stay updated on emerging technologies, methodologies, and trends in e-learning, enabling them to adapt to evolving challenges and contribute effectively to the field.

Future Research: Further research is crucial to enhance the contributions of ALS as DSs in the e-learning environment. Key areas for investigation include:

- Impact of ALS' data-driven practices on student learning outcomes and academic success in e-learning;
- Effectiveness of different data visualization techniques in conveying information to diverse stakeholders in e-learning;
- Role of ALS in promoting data literacy among students and faculty, and its influence on data-driven decision-making and research productivity;
- Efficacy of training and professional development programs for ALS in acquiring data science skills for e-learning;
- Ethical considerations and challenges in data collection, storage, and usage in the e-learning environment; and
- In advancing knowledge in these areas, rigorous methodologies should be employed, such as mixed-method approaches integrating qualitative and quantitative techniques. Longitudinal studies can track the

long-term impact of ALs' interventions on student outcomes and institutional practices. Collaboration among scholars, ALs, and educational institutions is vital to facilitate data access and enhance the utility of findings.

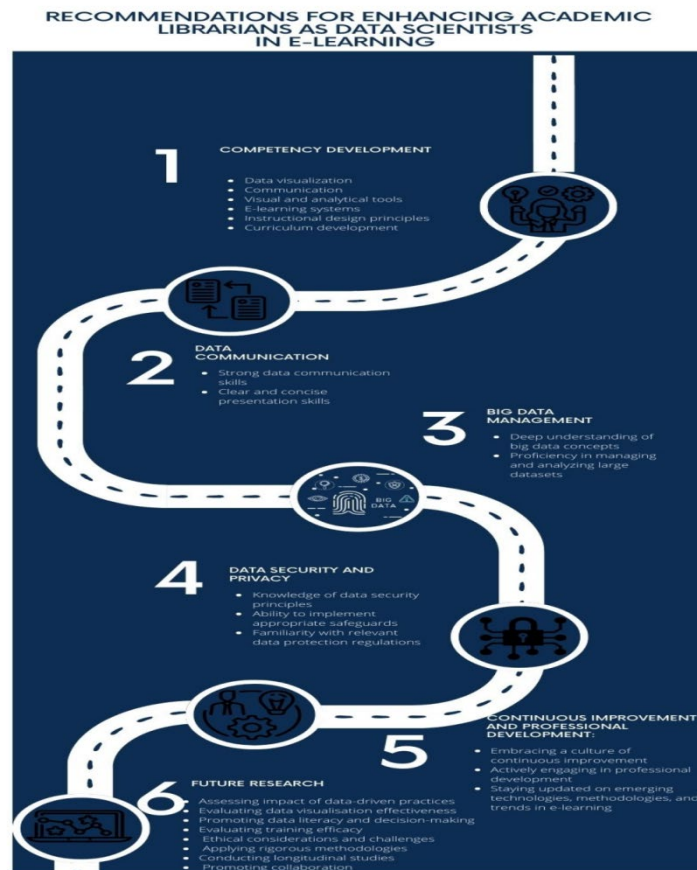


Figure 3: Recommendations for Enhancing ALs' Contributions as DSs in e-Learning

5. Conclusion

The urgent need for adaptable educational platforms amidst the COVID-19 crisis has accelerated the integration of e-learning into Malaysia's educational landscape. ALs, functioning as DSs, play a pivotal role in optimising resource allocation and enhancing e-learning initiatives through data analysis, visualisation, and their contribution of thought-provoking topics that stimulate further academic debates. Their expertise cultivates data literacy, informed decision-making, critical thinking, and intellectual engagement among students and faculty, fostering a culture of data-driven learning and scholarly discourse. ALs, with their comprehensive research and subject knowledge, actively contribute to academic debates by introducing topics that elicit diverse viewpoints, generate thoughtful discussions, and invite scholarly deliberation. This contribution serves to enrich the discourse, expand knowledge boundaries, and foster intellectual growth within the academic community. Positioned to spearhead global advancements in e-learning practises, ALs contribute to Malaysia's aspiration to become an international education hub through extensive research collaborations, continuous innovation, and their active engagement in promoting topics for academic debates. By fostering intellectual exchange and providing platforms for robust discussions, ALs facilitate the development of innovative ideas, foster collaboration, and push the boundaries of knowledge in the field of online education. Recognising the irreplaceable significance of ALs, stakeholders, including educational institutions and policymakers, must wholeheartedly support their involvement in both data analysis and the promotion of topics for academic debates. It is crucial to provide ample resources, professional development opportunities, and platforms for intellectual exchange to further nurture the transformative potential of ALs in fostering academic debates and advancing knowledge in the field. By harnessing the invaluable contributions of ALs in data analysis, active participation in academic debates, and their role as DSs, Malaysia can effectively navigate ongoing challenges and exploit the opportunities presented by data-driven practises in e-learning. Building Malaysia's position as a

leading force in online education requires not only embracing data-driven practises and fostering a culture of innovation but also creating an environment that encourages intellectual discourse and the exploration of topics for further academic debates. Initiatives like the MOSP play a vital role in strengthening the research landscape by offering comprehensive guidelines, capacity-building programmes, and state-of-the-art research data-sharing infrastructure. Embracing data-driven practises, open science principles, and actively promoting topics for academic debates solidifies Malaysia's trailblazing status in online education. To summarise, the successful incorporation of e-learning into Malaysia's educational framework relies on the crucial involvement of ALs functioning as DSs, engaging in data analysis and visualisation, and actively promoting topics for academic debates. Their expertise propels resource optimisation, continuous refinement of e-learning practises, intellectual growth, and the cultivation of critical discussions. Recognising their significance, stakeholders must provide unwavering support and embrace the transformative potential of ALs in both data analysis and fostering academic debates. Through these concerted efforts, coupled with a commitment to innovation, intellectual exchange, and the development of a thriving scholarly discourse culture, Malaysia will ascend to the pinnacle of online education. Initiatives like the Open Science Platform will fortify the research landscape and usher in unprecedented advancements. Malaysia shall rightfully assume its preeminent stance as a formidable force in the realm of online education through these collective undertakings, encompassing the active participation of ALs in data analysis, promoting topics for academic debates, and their resolute role as DSs.

Acknowledgement

The authors would like to extend their heartfelt appreciation to the Malaysian Ministry of Higher Education (MOHE) and Universiti Teknologi MARA (UiTM) for their valuable support and funding of the research conducted under the postdoctoral program. The authors wish to express our profound gratitude to Stan Skrzyszewski for his invaluable comments and meticulous proofreading, which have substantially augmented the quality and lucidity of the paper.

References

- Al-Aufi, A., & Houghton, L. (2021). Librarians' perception of institutional repositories in higher education: Challenges and opportunities. *Journal of Librarianship and Information Science*, 55(1), 45-59.
- Antons, D., & Breidbach, C. F. (2018). Big data, big insights? Advancing service innovation and design with machine learning. *Journal of Service Research*, 21(1), 17-39.
- Association of College & Research Libraries. (2016). *Framework for Information Literacy for Higher Education*. Retrieved from <http://www.ala.org/acrl/standards/ilframework>
- Baker, R. S., & Siemens, G. (2014). *Educational data mining and learning analytics*. In R. K. Sawyer (Ed.), *The Cambridge handbook of the learning sciences* (2nd ed., pp. 253-274). Cambridge University Press.
- Bruce, C. (1997). *The seven faces of information literacy*. Auslib Press.
- Courage, C., & Baxter, K. (2005). *Understanding your users: A practical guide to user requirements methods, tools, and techniques*. San Francisco, CA: Elsevier.
- Cox, A. M., & Verbaan, E. (2018). How academic librarians, IT staff, and research administrators perceive and relate to research. *Information and Learning Sciences*, 119(1/2), 39-53. <https://doi.org/10.1108/ILS-06-2017-0052>
- Connor, E. (2020). Librarians and data science: A practical example. *Information and Learning Sciences*, 121(1/2), 37-47. <https://doi.org/10.1108/ILS-04-2019-0029>
- Dede, C., Ho, A. D., & Mitros, P. (2016). Big data analysis in higher education: Promises and pitfalls. *EDUCAUSE Review*, 51(4), 22-34.
- Drachslar, H., & Greller, W. (2016). Privacy and analytics: It's a DELICATE issue a checklist for trusted learning analytics. *Proceedings of the Sixth International Conference on Learning Analytics & Knowledge - LAK '16*. <https://doi.org/10.1145/2883851.2883893>
- Elragal, A., & Klischewski, R. (2017). Theory-driven or process-driven prediction? Epistemological challenges of big data analytics. *J Big Data*, 4(1), 19.
- Garrison, D. R., Anderson, T., & Archer, W. (2000). Critical inquiry in a text-based environment: Computer conferencing in higher education. *The Internet and Higher Education*, 2(2-3), 87-105.
- Haddow, G., & Mamtara, J. (2021). Librarians and big data: Skills for the digital age. *Journal of Librarianship and Information Science*, 55(3), 140-151.
- Hayes, B. (2014). Doing Data Science, A Book Review. *Notices of the American Mathematical Society*, 61(09), 1068. doi: 10.1090/noti1167
- Haythornthwaite, C. (2002). Strong, weak, and latent ties and the impact of new media. *The Information Society*, 18(5), 385-401.
- Herrera, G. (2019). Academic Libraries and E-Learning: A Literature Review. *The Reference Librarian*, 60(4), 263-277. <https://doi.org/10.1080/02763877.2019.1649141>

- Jones, S. (2021). The role of data science in academic libraries: An analysis of challenges and opportunities. *College & Research Libraries*, 84(1), 15-30.
- Kelling, et al. (2009). Data-intensive science: A new paradigm for biodiversity studies. *Bioscience*, 59(7), 613-620.
- Kitchin, R. (2014). *The data revolution: Big data, open data, data infrastructures and their consequences*. Thousand Oaks: Sage.
- Lancaster, G. A. (2015). Pilot and feasibility studies come of age! *Pilot Feasibility Stud*, 1, 1.
- Leite, D. F. B., Padilha, M. A. S., & Cecatti, J. G. (2019). Approaching literature review for academic purposes: The Literature Review Checklist. *Clinics (Sao Paulo)*, 74, e1403. doi: 10.6061/clinics/2019/e1403
- Luo, J., & Clarke, C. (2022). Scaling data science in libraries: A case study. *Information Processing & Management*, 59(2), 102-114.
- Lynch, B. (2017). Teaching reference in the digital age: An analysis of syllabi from reference and information services coursework. *Journal of Education for Library and Information Science*, 58(2), 95-106. <https://doi.org/10.12783/issn.2328-2967/58/2/9>
- Martin, F., & Ndoye, A. (2016). Using learning analytics to assess student learning in online courses. *Journal of University Teaching & Learning Practice*, 13(3), 7.
- Mittelstadt, B., Allo, P., Taddeo, M., Wachter, S., & Floridi, L. (2019). The ethics of algorithms: Mapping the debate. *Big Data & Society*, 6(2), 2053951719871565.
- Mune, C. (2015). Online Learning and the Academic Librarian: Emerging Roles and Responsibilities. *Journal of Library & Information Services in Distance Learning*, 9(1-2), 45-53. <https://doi.org/10.1080/1533290X.2014.946354>
- Neff, et al. (2017). Critique and contribute: A practice-based framework for improving critical data studies and data science. *Big Data*, 5(2), 85-97.
- Picciano, A. G. (2012). The Evolution of Big Data and Learning Analytics in American Higher Education. *Journal of Asynchronous Learning Networks*, 16(3), 9-20.
- Ray, K., & Brown, D. (2019). Data mentors: Academic librarians increasing students' analytical, critical thinking, and communication skills. In K. V. Lillard & M. H. Macdonald (Eds.), *Transforming Libraries to Serve Graduate Students* (pp. 239-257). Libraries Unlimited.
- Siemens, G., & Baker, R. S. (2012). Learning analytics and educational data mining: Towards communication and collaboration. *Proceedings of the 2nd International Conference on Learning Analytics and Knowledge - LAK '12*. <https://doi.org/10.1145/2330601.2330661>
- Soria, K. M., & Fransen, J. (2021). The Impact of Academic Library Resources on Undergraduates' Degree Completion. *College & Research Libraries*, 82(1), 58-74. <https://doi.org/10.5860/crl.82.1.58>
- Stephens, M., Jones, K. M. L., & Grotti, M. (2018). The value of data literacy: A multi-institutional study. *The Journal of Academic Librarianship*, 44(2), 115-124.
- Taylor, N. G., & Thompson, C. (2018). Serving those who serve: Library services for military personnel and veterans. *Reference Services Review*, 46(2), 249-264. <https://doi.org/10.1108/RSR-12-2017-0047>
- The Star. (2023, May 16). *Open Science Platform to focus on strengthening open science ecosystem*. Retrieved from <https://www.thestar.com.my/news/nation/2023/05/16/open-science-platform-to-focus-on-strengthening-open-science-ecosystem>.
- Tijerina, B., & Erdmann, C. (2017). *Data Science in Libraries*. <https://d-scholarship.pitt.edu/33891/>
- Walter, S. (2016). Being Fluent in Information Technology (FIT): It's Time for a Third "Pillar" to Support General Education and Informatics Initiatives on Campus. *Journal of Academic Librarianship*, 42(1), 85-88. <https://doi.org/10.1016/j.acalib.2015.11.005>
- Xing, W., & Du, D. (2018). Data Science in Education. *Educational Technology & Society*, 21(4), 191-196.
- Yin, R. K. (2012). *Case study methods*. In H. Cooper, P. M. Camic, D. L. Long, A. T. Panter, D. Rindskopf, & K. J. Sher (Eds.), *APA handbook of research methods in psychology*, Vol. 2. Research designs: Quantitative, qualitative, neuropsychological, and biological (pp. 141-155). American Psychological Association. <https://doi.org/10.1037/13620-009>
- Zhou, M., & Brown, I. (2018). Machine learning for adaptive learning: A practical application. *International Journal of Information and Learning Technology*, 35(5), 377-391. <https://doi.org/10.1108/IJILT-06-2018-0063>
- Zimmer, M. (2022). Privacy in the age of big data: A time for big decisions. *Library & Information Science Research*, 44(2), 118-134.

Meeting the Demands of Industry: A Study on Identifying and Teaching Emerging Technologies in Engineering Education

Bronwyn Swartz and Sweta Patnaik

Faculty of Engineering and the Built Environment, Cape Peninsula University of Technology, Bellville Campus, Cape Town, South Africa

swartzb@cput.ac.za

patnaiks@cput.ac.za

Abstract: As technology advances at an unprecedented pace, it is crucial for engineering faculties at contemporary universities and higher education institutions to continuously update their curricula. This is to ensure that graduates are equipped with the skills and knowledge required to design, develop, and implement emerging technologies in various industries (Wahyuningsih et al., 2020). However, there is a lack of consensus on which emerging technologies should be included in the engineering curriculum and how they should be taught. This study aims to identify the emerging technologies that should be included in the engineering curriculum and the best practices for teaching these technologies to engineering students. By addressing this gap in knowledge, this study contributes to the development of a comprehensive and up-to-date engineering curriculum that prepares graduates for the challenges and opportunities of the 21st century. The objective of this research was to identify the most relevant emerging technologies, assess the current teaching practices and identify areas for improvement, and identify the key skills and knowledge that engineering students need to develop to prepare them for the challenges and opportunities of the 21st century. There were two phases to this study. An online survey was done in phase one to gather quantitative data from engineering educators on attitudes and perceptions on the emerging technologies that are most relevant to the engineering field, the current practices for teaching these technologies, and the key skills and knowledge that engineering students need to develop. In the second phase, a focus group interview was conducted to gather more in-depth qualitative data on how emerging technologies can be integrated into the curriculum. This research study found a comprehensive understanding of the emerging technologies that should be included in the engineering curriculum and the best practices for teaching these technologies to engineering students.

Keywords: Emerging Technologies, Engineering Education, Curriculum, Industry 4.0

1. Introduction & Background to the Research

The global community has entered the Fourth Industrial Revolution, marked by the integration of artificial intelligence (AI), big data, robotics, the Internet of Things (IoT), and other cutting-edge technologies. This transformation is poised to reshape the way people live and work, offering the potential for these technologies to become more intelligent and provide significant societal advantages. Disruptive technologies are already prevalent in our lives, such as smart sensors enhancing photography, self-driving vehicles, automated parking systems, smartphone digital assistants like Siri or Alexa, and personalized online experiences offered by search engines and tech giants like Amazon and Facebook. The profound impact of these technologies on every facet of life is likely to profoundly affect the labour force, leading to the evolution of nearly all industries and the automation of numerous processes. This shift will potentially render many current jobs obsolete while ushering in new or modified professions that demand expertise in AI and other emerging technologies (such as robotics, Augmented and Virtual Reality), proficiency in handling vast amounts of data, and cross-functional skills encompassing creativity, social and emotional intelligence, communication, collaboration, and critical thinking (Wahyuningsih et al., 2020). As technology advances at an unprecedented pace, it is crucial for engineering faculties at contemporary universities and higher education institutions to continuously update their curricula to ensure that graduates are equipped with the skills and knowledge required to design, develop, and implement emerging technologies in various industries. However, there is a lack of consensus on which emerging technologies should be included in the engineering curriculum and how they should be taught. This case study aims to identify the emerging technologies that can be included in the engineering curriculum and the best practices for teaching these technologies to engineering students. By addressing this gap in knowledge, this study will contribute to the development of a comprehensive and up-to-date engineering curriculum that prepares South African graduates for the challenges and opportunities of the 21st century.

The qualitative research case study was conducted at a University of Technology (UoT) in South Africa. The design was guided by the framework provided by the university's Vision 2030. The UoT's Vision 2030 encompasses two dimensions, namely Oneness and Smartness. The Smartness dimension specifically emphasizes technological advancements and innovations in alignment with present and future industrial revolutions. It underscores the university's commitment to leveraging technology comprehensively and

positively to advance various societal aspects such as improved socio-economic conditions, healthcare, education, safety, food security, and overall living conditions across local, national, and global scales, wherever feasible. The Faculty of Engineering at the (UoT) where this study took place encompasses a diverse array of academic disciplines, comprising eight distinct Engineering Departments. These departments include Chemical Engineering, Civil Engineering and Geomatics, Construction Management and Quantity Surveying, Clothing and Textile Technology, Industrial and Systems Engineering, Electrical, Electronic and Computer Engineering, and Mechanical and Mechatronic Engineering and Maritime Studies. Within the faculty's Program Qualification Mix (PQM) of the undergraduate diplomas and bachelor's degrees offered by these departments, an integral component of the curriculum entails the completion of a mandatory six-month workplace learning internship. To ensure the seamless execution of these internships and facilitate their coordination, the faculty has designated a workplace-based learning (WIL) coordinator within each department.

The objective of this research is to identify the most relevant emerging technologies, assess the current teaching practices and identify areas for improvement, and identify the key skills and knowledge that engineering students need to develop in order to prepare them for the challenges and opportunities of the 21st century. Thus, three investigative research questions developed for this study. These are:

1. What are the emerging technologies that are most relevant to the engineering field, and how are they being used in various industries?
2. What are the current practices for teaching emerging technologies in engineering programs, and what are the strengths and weaknesses of these practices?
3. What are the key skills and knowledge that engineering students need to develop in order to design, develop, and implement emerging technologies, and how can these be integrated into the engineering curriculum?

The WIL coordinators were thus identified as the vehicle of analysis in this study as the WIL coordinators provided the qualitative data to meet the objectives of the study.

2. Literature Review

While Industry 4.0 focuses on harnessing cyber-physical systems through increased integration of information and communication technologies into production, process automation, and the implementation of distributed and intelligent edge computing, Industry 5.0 (also known as Society 5.0) seeks to address societal challenges by merging physical and virtual spaces (Kobeleev & Borovik, 2017), a goal facilitated by the advancements of Industry 4.0. The products emerging from the fourth industrial revolution represent a fusion of software systems, communication technology, sensors/actuators, and embedded technologies, all working seamlessly together (Klotzer et. al., 2017). These intricate systems are increasingly operating in complex and loosely supervised environments, interacting with the Internet and its services, functioning with a high level of autonomy, involving human input, and often having safety-critical implications. To achieve the desired levels of safety, security, and privacy (Stankovic et. al., 2017), such systems need to address challenges like systems-of-systems complexities and desired failure modes. As the systems progress at an unprecedented pace in the era of the fourth industrial revolution, society and its generational characteristics are also evolving. Generational cohorts are groups of individuals born within a specific time frame who share similar cultural experiences. In the Western World, the recognized generations listed on Wikipedia (Generation, 2021) include the Lost Generation, the Greatest Generation, the Silent Generation, Baby Boomers, Generation X, Millennials (also known as Generation Y), and Generation Z. Generation Z is sometimes referred to as Generation C due to its notable attributes.

Some argue that Generation C does not pertain to a specific age group but rather a mindset. One can be 15 or 75 years old and still be considered a member of Generation C. What unites them is their status as digital natives, highly proficient in technology, and constantly connected. Furthermore, they are known for being Communicating, Content-centric, Computerized, Community-oriented, and Clicking. This generation is seen as a significant influence on all aspects of society, with most marketing decisions focusing on their preferences. It is not an exaggeration to say that many innovations are driven by them. Another noteworthy characteristic of Generation Z is their environmental and social consciousness, which will have an impact on the design of future cyber-physical systems. Nahavandi (2019) describes the current approach of Industry 4.0, stating that "unfortunately, Industry 4.0 does not place a strong emphasis on environmental protection or utilize technologies to enhance the Earth's environmental sustainability, despite numerous AI algorithms being employed to explore sustainability perspectives (Chen et. al., 2008) in the past decade." Industry 5.0 is expected

to bridge this gap and develop future systems and services that prioritize social and environmental aspects while leveraging data and technological advancements.

In their study, Broo et al. (2020) engaged in a trend-spotting exercise to uncover influential factors and emerging trends that could significantly shape the future of engineering education and research. They identified a total of 44 distinct trends, out of which 12 were chosen as the most influential factors. These factors are quite interesting and are listed in Table I.

Table 1: Influencing factors and their descriptions.

Influencing Factor	Description	Reference
Automation	Automating tasks, processes, and machines is one of the goals of any industry for a long time now. Essentially, automation focuses on the technologies and techniques to enable an apparatus, a process, or a system operate automatically. While some see automation as a threat to the labor market, many researchers argue that the automation and labor market has a more complex relationship and instead automation may increase productivity and economic growth.	(Robotics business review 2019; Schwab & Davis, 2018; Copigneaux et. al., 2016; CyPhERS, 2014)
Connectivity	The products of the Industry 4.0 and the machines, which will deliver the benefits to Society 5.0, cyber-physical systems are connected. The networking abilities combined with the cloud technologies, 5 G cellular networks, wireless energy harvesting, big data, smart network slicing, and similar technologies promise to provide integration where these systems communicate with each other seamlessly.	(Xu et. al, 2018; Lasi et. al., 2014; Schwab & Davis, 2018; Rais, 2018; Gurdur et. al., 2018; Xu, 2011; Gurdur et. al., 2016; Gurdur & Asplund, 2017)
Data	Today, the amount of data that has been collected, stored, analyzed and the insights delivered from data is already changing the world in many ways including some unexpected ones. This data-driven world is always on, always tracking, always monitoring, always listening, and always learning. Many organizations are interested in leverage data to improve customer experiences, deliver insights, open new markets, increase productivity and create new sources for competitive advantage.	(Schwab & Davis, 2018; National Intelligence Council (2012); Columbus, 2018; Gurdur et. al., 2019; Reinsel et. al., 2018; Cheng et. al., 2017; Gurdur et. al., 2018; Wellington et. al., 2020)
Data ethics	The increased usage of data throughout different industries bringing ethical complexities where data ownership, privacy, equity, responsibility, explainability, and transparency are becoming important topics of the Industry 5.0.	(Schwab & Davis, 2018; Lomas, 2018; Thompson et. al., 2018; Philbeck et. al., 2018; Deloitte Insights, 2019)
Electrification	It has been mentioned by many that electricity has the potential to deliver equivalent energy service with less energy input because it avoids conversion losses associated with burning fossil fuels. This electrification possibilities are seen as an opportunity to change the many sectors. For instance, electric vehicles are becoming mass-market products and reaching record sales. Similarly, new approaches to battery technologies, powertrain architectures, native electric vehicle platforms, and similar enablers of the electrification are gaining importance.	(Schwab & Davis, 2018; UN 2018; Burston, 2016; European Commission, 2009; The Society of Motor Manufacturers and Traders, 2016; McKinsey & Company, 2018)
Higher Education (HE) Environment	Different dynamics of the higher education environment impact education and research. These include rise of global university rankings, declarations by nations to have world-class universities, the development of regional units of control and reform, the development of cross-border quality assessment practices, and the internationalization of universities.	(Higgins, 2013; Rainie & Anderson, 2017; Musselin, 2018; Rust & Kim, 2013; Ferrari, 2020; Leoste et. al., 2021)
(Artificial) Intelligence	Intelligence enables the automated decision-making through interconnected networks of systems of systems and the intelligent systems are the results of a wide range of technologies including artificial intelligence, data analytics, cloud computing, cyber security, high performance CPUs and so on.	(Xu et. al, 2018; Robotics Business Review, 2019; Schwab & Davis, 2018; Copigneaux et. al., 2016; CyPhERS, 2014; Calderone, 2018; Boyd & Holton; 2018; Kim & Kim, 2020)

Influencing Factor	Description	Reference
Labor market	Several researchers pointed out the shift in the labor market which effects especially the basic skilled workers. The changes in the labor market due to technological advancements may cause unexpected effects in education, economy, and society.	(Schwab & Davis, 2018; Rainie & Anderson, 2017; Harris et. al., 2018)
Sustainable development goals (SDG)	SDG was adopted by all United Nations Member States in 2015 with an agenda [75] that provided a shared blueprint for peace and prosperity for people and the planet, now and into the future. These goals underline that ending poverty and other deprivations must go hand-in-hand with strategies that improve health and education, reduce inequality, and drive economic growth which is at the very core of Industry 5.0.	(Rainie & Anderson, 2017; Harris et. al., 2018; UN, 2015)
Technological development	As we have already discussed continuous or disruptive technological developments such as the Internet, mobile phones, personal computers, social media, and similar technologies, illustrate new devices, technologies, methods, and methodologies may cause series of changes and in return how they influence the learning and teaching environments.	(Schwab & Davis, 2018; UN, 2018; Burston, 2016; European Commission, 2009; Grunwald, 2018; J. Margolies, <i>et al</i> , 2018; Advanced Functional Materials Congress, 2019; Roland & Trend, 2015; Swerea, 2016; Ghobakhloo & Ching, 2019; Chen & Huang, 2020)
Trust in technology	While technology's role and effects on society are increasing, keeping the level of trust in these new technologies is becoming important. Increased usage of automation, data, and artificial intelligence, and changing power structures may have an opposite consequence to the trust in technology.	(UN, 2018; Harris et. al., 2018; UN, 2015; Edelman, 2019)
Lifelong learning	Lifelong learning is defined as an ongoing, voluntary, and self-motivated pursuit to acquire new knowledge. Motivating and providing opportunities for lifelong learning increases social inclusion, active citizenship, and personal development and helps the workforce to stay competitive and employable.	(Higgins, 2013; Rainie & Anderson, 2017; Torngren et. al., 2015; Torngren et. al., 2017; Komiyana & Yamada, 2018; Tai et. al., 2020)

Underscored by the foregoing discussion Ali and Khan (2023) and Amoruso (2023) access to resources such as LinkedIn Learning and the utilization of simulations holds significant value and can function as micro-credentials. Through the strategic utilization of these technological tools, students gain the ability to tap into supplementary educational materials, sustain their skill enhancement, and effectively connect theoretical knowledge with real-world application. Notably, simulations stand out as an exceptional tool, elevating students' confidence levels and furnishing them with a hands-on comprehension of emerging technologies.

3. Methodology

This qualitative study commenced March 2023 with the application for ethical clearance and a literature survey. It was concluded from June to July 2023 when data was collected and the manuscript written. The data collection process entailed online interviews conducted via MS Teams with a total of five WIL coordinators. Before the commencement of data collection, informed consent was obtained from all participating individuals, ensuring their voluntary involvement in the study. Ethical clearance was obtained prior to data collection. The sample comprised a total of five WIL coordinators (Participant 1, 2, 3, 4 and 5). Their perspectives and experiences provided valuable insights into the coordination and facilitation of workplace learning internships within the Faculty of Engineering. Each online interview session was recorded and lasted between 45 minutes to 70 minutes. This allowed for in-depth exploration of the research topic.

Following the completion of the interviews, the audio recordings were transcribed verbatim to transform them into a written format suitable for analysis. To maintain participant confidentiality and anonymity, appropriate measures were taken during the transcription process to remove any identifiable information. The anonymization process ensured the protection of participants' privacy and confidentiality throughout the analysis and reporting stages of the study. The data transcripts were then thematically coded according to the three categories derived from this study's investigative questions. which were (1) relevant emerging

technologies (2) current practices for teaching emerging technologies and (3) key skills and knowledge that need to be integrated into the engineering curriculum. The key research finding related to each of the three above-mentioned categories are discussed in the section that follows.

4. Research Findings

4.1 Emerging Technologies in the Engineering Field

In the interviews with the WIL coordinators, several key perceptions emerged regarding the integration of emerging technologies into the engineering curriculum. In separate interviews Participant 2 and Participant 5 noted that while MS Excel may not be classified as an emerging technology, it remains highly desired by industry. Participant 2 gave an example of a student who eventually developed a project management application which started as an MS Excel spreadsheet that was highly commended by the organisation where she was placed. He added *"Industry keeps every year saying like you need to teach them these kids Advanced MS Excel or even just like basic MS Excel"*. Notably, Participant 5 also offered an example of a student in a different engineering discipline who used MS Excel in a manner that added significant value to the organisation where the student was placed. Participant 5 described this as *"Not a not an emerging technology, but the student managed to take the knowledge that he that he did have, turn it into turn it into something [important]."* This highlights the importance of industry demands for specific technical skills such as using MS Excel or being able to do basic computer programming to develop a simple application, even if they are not at the forefront of technological innovation.

Participant 3 shed light on the university's financial constraints, which pose challenges in acquiring the latest technologies. By the time funds become available, the technologies may already be outdated. This presents a limitation from the university perspective to keeping pace with the rapidly evolving landscape of emerging technologies. Also related to the cost of technology, Participant 1 emphasized the variability of technologies used in different companies. It was recognized that students may be trained on specific technologies, only to discover that the companies they join utilize different technologies, in some cases more expensive technology that is not available at the University. Participant 1 delayed an incident where an organisation adamant about only employing a student who had experience in specific software that was not available at the university. *"We don't offer an introduction to it in any way, it's a it's a really expensive package which is used in industry. After long deliberation, I had to convinced him that if a student has what we've given them which is the introduction to AutoCAD, they can adjust and adapt their knowledge to the new package because there are similarities. Yeah we sometimes have to give up because companies are just – they don't have the time to spend to train the student to use the new technology"*. This underscores the need for engineering education to focus on developing adaptable students who can apply their learnings from one technology to another.

A consensus emerged among the participants, emphasizing the significance of continuous practice and application of technologies. It was acknowledged that simply training students on specific technologies without providing regular opportunities for practical implementation may lead to knowledge decay over time. Therefore, the development of resilient and adaptable students who are open to trying new technologies and can apply their learnings across different areas was seen as essential. These insights collectively emphasize the importance of striking a balance between incorporating emerging technologies into the curriculum and nurturing broader skills and competencies. By addressing financial constraints, promoting adaptability, and ensuring regular practical engagement, engineering education can better equip students to navigate the ever-changing technological landscape and meet the demands of industry effectively.

4.2 Teaching Emerging Technologies

In relation to research objective 2, which focuses on current teaching practices for emerging technologies, the interviews with Participant 1 and Participant 4, who are from the construction management and civil engineering field, revealed interesting perspectives. They highlighted the challenges faced by students when they have to go on-site, particularly in rural areas of South Africa, where there is no signal or access to technology. Participant 1 stated *"We still have places in South Africa which are not connected, ... students are not always able to access what we expect them to access... cellphone signal or IT connectivity ...we have to be very aware of that with the nature of our industry."* Similarly Participant 4 said *"[When] they need to go out [of town] to build a road - I had a student last year who had to drive 20 minutes from sight just to pick up cellphone reception to make contact"*.

This limited connectivity inhibits the use of technological tools and hinders students' ability to practice and apply emerging technologies in real-world scenarios.

Participant 4 specifically emphasized that the construction industry undergoes slow technological changes and expressed skepticism regarding the replacement of manual methods with technology. The participant raised concerns about the reliability of certain technological tools and the potential consequences if they were to malfunction.

These insights reveal the complexities and varied perspectives regarding the integration of technology into teaching practices. While some participants acknowledge the potential benefits of using technological tools, others express reservations about their suitability in certain contexts and industries. The concerns raised highlight the need for a balanced approach that considers the limitations and practicalities of technology while leveraging its potential benefits in engineering education.

4.3 Competencies and Knowledge Areas to be Incorporated in the Engineering Curriculum

In relation to the key skills and knowledge required for engineering students to design, develop, and implement emerging technologies, Participant 5 and Participant 2 emphasized the importance of mentorship and supervision. Participant 5 mentioned relying on former students to support current ones, while Participant 2 provided an example of a supportive former student who understands the challenges and experiences of being an intern. He offered the opinion that having a mentor who can empathize with the student's experience is highly advantageous. The participant further noted the value of being mentored by an accredited professional from the Engineering Council of South Africa (ECSA), as it aligns with the requirements set forth by the country's professional body *"we need to have a supervisors who has gone through the program, also it's an ECSA requirement"*. These insights highlight the valuable role that mentorship plays in guiding and developing students' skills in the engineering field.

Additionally, all participants expressed concerns about the short duration of the workplace learning internship, which limits the amount of learning that students can acquire. To address this challenge, the utilization of technology platforms like LinkedIn Learning and other similar tools was seen as beneficial. These technologies can supplement students' learning experiences and provide additional resources for skill development in emerging technologies.

Simulation was another key aspect highlighted by Participants 2, 3, 4, and 5. They emphasized the value of simulation in training engineers and how it contributes to building confidence. Participant 5 specifically mentioned the noticeable improvement in students' confidence after using simulators before engaging in practical in-service training as illustrated by this quote *"But when they come back, it's almost like they are now willing, you know, to play, to learn to end. Then also the subsequent engagement in class, and it's almost like a transformation for our students"*.

Regarding the integration of emerging technologies into the curriculum, Participant 3 provided valuable insights. They emphasized the importance of collaboration between industry and the university to identify the relevant emerging technologies that engineering students should possess. Furthermore, Participant 3 highlighted the need to create development opportunities that facilitate hands-on experience with emerging technologies. Additionally, the perception that emerging technologies could be seen as a threat by students, potentially leading to job displacement, was also mentioned. These findings underline the significance of mentorship, the benefits of utilizing technology for learning and skill development, and the role of simulation in building confidence. They also highlight the importance of collaboration between industry and academia in shaping the engineering curriculum to align with emerging technologies while addressing potential concerns related to job displacement.

5. Discussion

The findings from the participants' responses shed light on several important aspects related to the integration of emerging technologies in engineering education.

Firstly, aligned with the views of Alawamleh and Mahadin (2022), the significance of mentorship and supervision emerged as a key factor in supporting engineering students. Participant 5 highlighted the value of relying on former students as mentors, who offer understanding and support based on their own experiences. Similarly, Participant 2 emphasized the role of a supportive supervisor who can relate to the challenges faced by interns.

Mentorship bridges the gap between theoretical learning and practical application, aiding the development of students' skills and knowledge in emerging technologies.

Recognizing the limitations of short workplace learning internships, all participants agreed on the potential of technology in enhancing students' learning experiences. The availability of platforms like LinkedIn Learning and the use of simulations were highlighted as valuable tools. This is consistent with Ali and Khan (2023) and Amoruso (2023). By leveraging these technologies, students can access additional resources, continue their skill development, and bridge the gap between theory and practice. Simulations, in particular, were praised for their ability to boost students' confidence and provide a practical understanding of emerging technologies.

Moreover, the integration of emerging technologies into the engineering curriculum requires collaboration between academia and industry. Participant 3 emphasized the importance of industry-university partnerships in identifying relevant emerging technologies and creating development opportunities. This collaborative effort ensures that the curriculum aligns with industry needs, preparing students effectively for the demands of the field. Additionally, concerns about job displacement were raised, underlining the need for responsible integration of emerging technologies and addressing students' anxieties.

In summary, in support of work by Broo et al. (2020), our findings highlight the interconnectedness of mentorship, technology integration, and collaboration in engineering education. Effective mentorship provides guidance and support, while technology tools supplement traditional learning and offer continuous skill development opportunities. By fostering collaboration between academia and industry, educational institutions can ensure the curriculum aligns with industry demands and address students' concerns about job displacement. By considering these aspects holistically, engineering programs can better equip students with the skills and knowledge necessary to thrive in the ever-evolving landscape of emerging technologies.

6. Limitations

One limitation of this study is its narrow scope, focusing solely on the Faculty of Engineering at a single university in South Africa. While the insights and deductions drawn from the data analysis provide valuable insights for engineering educators, it is important to recognize that the findings may not be directly transferable to other contexts and universities. Each institution has its own unique characteristics, including resources, industry partnerships, and curriculum structures, which may impact the integration of emerging technologies in engineering education. Therefore, further research conducted in diverse settings is necessary to capture a broader understanding of the challenges and opportunities associated with incorporating emerging technologies into engineering curricula.

7. Conclusion

In conclusion, this case study delved into the critical task of integrating emerging technologies into the engineering curriculum to ensure that graduates are well-prepared for the demands of the 21st century. The findings highlighted the need for ongoing curriculum updates and the significance of incorporating industry perspectives in this process. The participants' insights emphasized the importance of mentorship, technological tools, and simulations in enhancing students' learning experiences and bridging the gap between theory and practice. Furthermore, the study underscored the value of collaboration between academia and industry in identifying relevant emerging technologies and creating development opportunities. By considering these findings, engineering faculties can shape a comprehensive and forward-thinking curriculum that equips students with the necessary skills, adaptability, and confidence to design, develop, and implement emerging technologies in diverse industries. This research contributes to the broader objective of preparing South African graduates to navigate the ever-evolving technological landscape and capitalize on the opportunities it presents.

References

- Alawamleh, M. and Mahadin, B.K., 2022. Will university internship secure you a job?: interplaying factors from an emerging market perspective. *Education+ Training*, 64(4), pp.491-515.
- Ali, S.A. and Khan, R., 2023. *Harnessing the Digital Nature of Micro-Credentials in Higher Education*.
- Amoruso, P., 2023. *Micro-Credentialing with Fuzzy Content Matching: An Educational Data-Mining Approach* (Doctoral dissertation, University of Central Florida Orlando, Florida).
- A.B. Swerea *The Future of Materials* (2016)
- A. Grunwald *Technology Assessment in Practice and Theory* (2018) Abingdon, Oxon; New York, NY: Routledge, 2019.: Routledge

- Advanced Functional Materials Congress Bridging Functional Materials (2019)
Available <https://www.advancedmaterialseries.com/afmc19/pages/about-afmc-2019>
- Ahlam Rais Next Stop: Industry 4.0 – Three Trends For the Digital Transformation (2018) [Online]. Available: <https://www.process-worldwide.com/next-stop-industry-40-three-trends-for-the-digital-transformation-a-712526/>
- B. Copigneaux, S. Engell, R. Paulen, M. Reniers, C. Sonntag, H. Thompson. (2016). Proposal of a European Research and Innovation Agenda On Cyber-physical Systems of Systems 2016-2025
- C. Musselin New forms of competition in higher education Socio-Econ. Rev., 16 (3) (2018), pp. 657-683, 10.1093/SER/MWY033
- Chen, C. C., & Huang, P. H. (2020). The effects of STEAM-based mobile learning on learning achievement and cognitive load. *Interactive Learning Environments*, 31, 100–116. <https://doi.org/10.1080/10494820.2020.1761838>
- CyPhERS CPS20: CPS 20 Years from Now (2014)
- CyPhERS Structuring of CPS Domain: characteristics, trends, challenges and opportunities associated with CPS - Deliverable D2.2," *CyPhERS - Cyber-Physical Eur Roadmap Strateg* (611430) (2014), p. 41
- C. Klotzer, J. Weibenborn, A. Pflaum The Evolution of Cyber-Physical Systems as a Driving Force behind Digital Transformation Proc. - 2017 IEEE 19th Conf. Bus. Informatics, CBI 2017, 2 (2017), pp. 5-14, 10.1109/CBI.2017.8
- D. Gürdür, *et al.* Knowledge Representation of Cyber-physical Systems for Monitoring Purpose Procedia CIRP, 72 (2018), 10.1016/j.procir.2018.03.018
- D. Gürdür Broo, U. Boman, M. Törngren. Cyber-physical Systems Research and Education in 2030: scenarios and Strategies. *J. Ind. Inf. Integr.* (2020)
- D. Gürdür, J. El-Khoury, T. Seceleanu, L. Lednicki. Making interoperability visible: data visualization of cyber-physical systems development tool chains *J. Ind. Inf. Integr.*, 4 (2016), pp. 26-34, 10.1016/j.jii.2016.09.002
- D. Gürdür, F. Asplund. A systematic review to merge discourses: interoperability, integration, and cyber-physical systems. *J. Ind. Inf. Integr.*, 9 (2017), pp. 14-23, 10.1016/j.jii.2017.12.001 December 2017
- D. Gürdür, J. El-khoury, M. Törngren. Digitalizing Swedish industry: what is next? *Comput. Ind.*, 105 (2019), pp. 153-163, 10.1016/j.compind.2018.12.011
- D. Reinsel, J. Gantz, J. Rydning. Data age 2025: the digitization of the world from edge to core *Int. Data Corp.* (2018), p. 28 Deloitte Insights. Government Trends 2020 (2019)
- Edelman 19th Annual Edelman Trust Barometer: Trust in Technology (2019)
- European Commission. EU Energy Trends to 2030 (2009) The Society of Motor Manufacturers and Traders. The Future of UK Automotive Manufacturing in 2025 and Beyond (2016)
- "Fridays for Future," 2018. [Online]. Available: <https://fridaysforfuture.org>.
- Ferrari, P. (2020). Trends in learning. STEM, STEAM, STREAM... A battle of acronyms? Available online: <https://www.capstan.be/trends-in-learning-stem-steam-stream-a-battle-of-acronyms/>
- Global Trends 2030: Alternative worlds: a Publication of the National Intelligence Council. National Intelligence Council (2012)
- H. Lasi, P. Fettke, H.G. Kemper, T. Feld, M. Hoffmann Industry 4.0 *Bus. Inf. Syst. Eng.*, 6 (4) (2014), pp. 239-242, 10.1007/s12599-014-0334-4
- H. Thompson, *et al.* Platforms4CPS Key Outcomes and Recommendations (2018)
- J. Margolies, *et al.* Tech Trends 2018: the symphonic enterprise Deloitte Insights (2018), p. 162
- J.M. Higgins The Fourth Singularity and the Future of Jobs *World Futur. Rev.*, 5 (1) (Mar. 2013), pp. 11-23, 10.1177/1946756712473437
- J. Burston. 5 Predictions For Energy in 2030 | World Economic Forum (2016) [Online]. Available <https://www.weforum.org/agenda/2016/11/5-predictions-for-energy-in-2030>
- J. Stankovic, J. A. J.W. Sturges, Eisenberg A 21st Century Cyber-Physical Systems Education Computer (Long. Beach. Calif), 50 (12) (2017), pp. 82-85
- K. Harris, A. Kimson, A. Schwedel Labor 2030: the Collision of Demographics, Automation, and Inequality - Bain & Company (2018) [Online]. Available <https://www.bain.com/insights/labor-2030-the-collision-of-demographics-automation-and-inequality/>
- K. Schwab, N. Davis (2018) Shaping the Future of the Fourth Industrial Revolution: A guide to Building a Better World. Penguin Books Limited (2018)
- Kim, J.-O., & Kim, J. (2020). Development and application of art based STEAM education program using educational robot. In *Robotic systems* (pp. 1675–1687). IGI Global. <https://doi.org/10.4018/978-1-7998-1754-3.ch080>
- L.Da Xu, E.L. Xu, L. Li. Industry 4.0: state of the art and future trends *Int. J. Prod. Res.*, 56 (8) (2018), pp. 2941-2962, 10.1080/00207543.2018.1444806
- L.Da Xu Enterprise systems: state-of-the-art and future trends *IEEE Trans. Ind. Inform.*, 7 (4) (2011), pp. 630-640, 10.1109/TII.2011.2167156
- Lee Rainie, Janna Anderson The Future of Jobs and Jobs Training (2017)

- Len Calderone AI Could Beat Humans at Everything by 2030 | RoboticsTomorrow (2018) [Online]. Available <https://www.roboticstomorrow.com/article/2018/09/ai-could-beat-humans-at-everything-by-2030/12536>
- Leoste, J., Jögi, L., Öun, T., Pastor, L., San Martín López, J., & Grauberg, I. (2021). Perceptions about the future of integrating emerging technologies into higher education—The case of robotics with artificial intelligence. *Computers*, **10**(9), 110. <https://doi.org/10.3390/computers10090110>
- Louis Columbus. 10 Charts That Will Change Your Perspective of Big Data's Growth (2018). Available: <https://www.forbes.com/sites/louiscolumbus/2018/05/23/10-charts-that-will-change-your-perspective-of-big-datas-growth/#5dfd9b272926>.
- M. Ghobakhloo, N.T. Ching Adoption of digital technologies of smart manufacturing in SMEs J. Ind. Inf. Integr., 16 (2019), Article 100107, 10.1016/j.jii.2019.100107
- McKinsey & Company. Insights On Best Practices For Paving the Road For Mass-Market Electric Vehicles (2018)
- N. Lomas. Gartner Picks Digital Ethics and Privacy As a Strategic Trend For 2019 | TechCrunch (2018) [Online]. Available https://techcrunch.com/2018/10/16/gartner-picks-digital-ethics-and-privacy-as-a-strategic-trend-for-2019/?guccounter=1&guce_referrer_us=aHR0cHM6Ly93d3cuZ29vZ2xlLnNvbS8&guce_referrer_cs=CQaA9EsJmZJPdKkXZA6yg
- Pew Research Center The Generation Gap in American Politics: Wide and Growing Divides in Views of Racial Discrimination (2018)
- P.O.S. Kobelev, S.Y. Borovik On the Way From Industry 4.0 To Industry 5.0 Int. Sci. J. "Industry 4.0, 2 (6) (2017), pp. 307-311
- R. Boyd, R.J. Holton Technology, innovation, employment, and power: does robotics and artificial intelligence really mean social transformation? J. Sociol., 54 (3) (2018), pp. 331-345, 10.1177/1440783317726591
- Robotics Business Review. 10 Trends in Robotics, AI, and Autonomous Systems to Watch in 2019 (2019) Available <https://www.roboticsbusinessreview.com/news/automation-business-2019-10-trends/>
- S. Nahavandi Industry 5.0-a human-centric solution Sustain, 11 (16) (2019), 10.3390/su11164371
- T. Roland, B. Trend RBI Trend Compendium 2030 (2015)
- T. Philbeck, N. Davis, A.M.E. Larsen. Values, Ethics, and Innovation: Rethinking Technological Development in the Fourth Industrial Revolution (2018)
- United Nations. World Economic and Social Survey 2018: Frontier technologies For Sustainable Development (2018) vol. E/2018/5027 July 2017–26 July 2018
- Tai, J., Ajjawi, R., Bearman, M., & Wiseman, P. (2020). Conceptualizations and measures of student engagement: A worked example of systematic review. In O. Zawacki-Richter, M. Kerres, S. Bedenlier, M. Bond, & K. Buntins (Eds.), *Systematic reviews in educational research: Methodology* (pp. 91–110). Perspectives and Application.
- U.S. National Intelligence Council
- United Nations Introduction: the scope of the inequality discussion in the 2030 Agenda for Sustainable Development Dev. Issues (4) (2015), pp. 1-10
- V.D. Rust, S. Kim. The Global Competition in Higher Education World Stud. Educ., 13 (1) (2013), pp. 5-20, 10.7459/wse/13.1.02
- Wikipedia, "Generation," 2021. [Online]. Available: <https://en.wikipedia.org/wiki/Generation>
- Wahyuningsih, S., Nurjanah, N. E., Rasmani, U. E. E., Hafidah, R., Pudyaningtyas, A. R., & Syamsuddin, M. (2020). STEAM learning in early childhood education: A literature review. *International Journal of Pedagogy and Teacher Education*, **4**(1), 33–44.
- Wellington, A., Easton, G., Davis, J. P., & Yeh, A. (2020). Beat and rhythm: Teaching science via integrated STEAM and digital technologies. *Teaching Science*, **66**(2), 20–25.
- Y. Cheng, K. Chen, H. Sun, Y. Zhang, F. Tao. Data and Knowledge Mining with Big Data towards Smart Production. J. Ind. Inf. Integr., 9 (2017), pp. 1-13, 10.1016/j.jii.2017.08.001 August 2017

What Have People Discussed about ChatGPT in Malaysian Education? A Qualitative Content Analysis of News Articles

Chun Meng Tang¹ and Lee Yen Chaw²

¹James Cook University Singapore, Singapore

²UCSI University, Malaysia

chunmeng.tang@jcu.edu.au

chawly@ucsiuniversity.edu.my

Abstract: ChatGPT became a top trending news topic in late 2022. People were astounded by the artificial intelligence (AI) chatbot's ability to write emails, essays and computer codes; edit and correct grammar; provide suggestions; and so on in a human-like conversational manner. Many months after its official launch, people are still debating whether and how the chatbot might transform the way people do things in various sectors. One such sector is education. Academics and educational institutions have been seeking to figure out how to effectively adapt teaching and learning in response to ChatGPT. This study examined what has been discussed in the news about ChatGPT in Malaysian education during the first few months following its launch. This study first searched for articles in three major Malaysian English newspapers using the search terms "ChatGPT" and "education". Then, qualitative content analysis was employed to classify discussions about ChatGPT in Malaysian education published in 16 articles into categories and subcategories. The findings show that the discussions in the news could be coded into five level-one categories and 14 level-two subcategories. The findings of this study could help academics and educational institutions gain a better understanding of people's attitudes, concerns, and sentiments towards ChatGPT in Malaysian education to adapt learning design and delivery as well as point to future research directions.

Keywords: ChatGPT, Chatbot, Education, News Articles, Qualitative Content Analysis, Teaching and Learning

1. Introduction

Since its launch in late 2022, ChatGPT by OpenAI has sparked considerable interest in the chatbot's capabilities and the challenges it may pose to the education sector (Crawford, Cowling and Allen, 2023; Kohnke, Moorhouse and Zou, 2023). Some studies have attempted to examine the opportunities, benefits, threats, challenges, and implications that ChatGPT or artificial intelligence (AI) chatbots bring to teaching and learning. Some examples of these studies include Adiguzel, Kaya and Cansu (2023), Dwivedi et al. (2023), Kasneci et al. (2023), and Rahman and Watanobe (2023).

ChatGPT is trained on large language models and can respond to questions in a conversational style through a simple user interface. Users have come up with creative ways to ask the chatbot to write things like lyrics, letters, and computer codes, which raises serious concerns about the authenticity and ethics of the work it produces. These concerns are especially relevant to learning assessment in education because students may enlist the help of chatbots to complete their assessments, making it difficult for assessors to determine whether the work is written by students or chatbots (Benuyenah, 2023; Geerling et al., 2023).

Because the use of ChatGPT is still in its early stages, before academics and educational institutions could better understand its applications and implications for teaching and learning, some educational institutions, such as a US school district in New York (Fahr, 2023), some Hong Kong universities (Mok, 2023), and a French university (The Star, 2023a), have banned the use of the chatbot in assessment due to concerns about plagiarism. Others, such as several Japanese institutions (The Star, 2023b), have restricted its use, while others, such as some Australian universities (Starcevic, 2023), have redesigned their assessment practices.

Skavronskaya, Hadinejad and Cotterell (2023) recommend that more studies be undertaken to better understand the implications of chatbots on education so that academics may stay relevant and adapt their learning design and delivery. To contribute to this understanding, this study attempts to answer the question "what have people said" about ChatGPT in Malaysian education in the news in the first few months following its launch. This investigation aims to achieve a more in-depth understanding of the discussion in order to provide deeper insight into people's views, attitudes, and concerns about ChatGPT in education in Malaysia.

The remainder of this paper provides a background to the research, explains the research design and method, presents the data analysis and results, and concludes with a discussion of the study findings.

2. Research background

2.1 ChatGPT

ChatGPT is a generative AI chatbot developed by OpenAI, a company that specialises in AI solutions. It is built on the large language model GPT-3.5. Unlike a traditional search engine, which returns pages of web links, a chatbot returns a specific, summarised text response to the user's questions. It can understand questions and learn from its own responses (OpenAI, 2022).

Launched on 30 November 2022, ChatGPT is free to use and can respond to questions in a dialogue format, mirroring the way two people converse with each other. In addition to text, users can also utilise speech recognition and text-to-speech functions to converse with the chatbot. The chatbot can communicate in many languages, although the quality and accuracy of responses may vary (OpenAI, 2022).

Although ChatGPT users may find the chatbot useful in many ways, such as planning a trip, writing an essay, or coding a software application, the GPT-3.5 model has several known limitations. Because it was trained on a huge dataset up to 2021, it is unable to answer questions with information after that date (OpenAI, 2022). Furthermore, OpenAI (2022) cautions that ChatGPT responses are not always accurate and may be biased in some cases.

OpenAI launched ChatGPT Plus on 1 February 2023, charging users a monthly subscription price of USD 20 for faster response and improved access (OpenAI, 2023). ChatGPT Plus customers were given access to a newer model, the GPT-4, on 14 March 2023 (OpenAI, 2023). The GPT-4 model performs better in advanced reasoning, can handle more complex questions, and can search the web for current information to provide more up-to-date responses (OpenAI, 2023).

ChatGPT and ChatGPT Plus compete with other chatbots, such as Google Bard and Microsoft Bing. These rival chatbots, which are free to use, also claim to be able to search the web for current information and are capable of citing sources of information (Google, n.d.; Microsoft, n.d.).

2.2 Implications of AI Chatbots for Education

AI chatbots are a potentially disruptive technology that can lead to a paradigm shift in transforming conventional teaching and learning (Adiguzel, Kaya and Cansu, 2023; Ivanov and Soliman, 2023; Tlili et al., 2023). With more chatbots becoming available, it is not surprising that they will eventually become an educational tool similar to calculators or computers (Geerling et al., 2023), presenting both opportunities and challenges, particularly in teaching, learning, and academic research (Dwivedi et al., 2023).

Kasneci et al. (2023) explain that chatbots can help students learn in various ways, such as developing reading, writing, and research skills, as well as critical thinking and problem-solving skills. Dwivedi et al. (2023) deem that, in addition to obtaining feedback on their work, students can use chatbots to gain foundational information that can be used to develop higher-order thinking skills. Rahman and Watanobe (2023) suggest that chatbots can function as tutors who are constantly available to answer questions and provide feedback to students at any time and location. Chatbots can also assist academics in their teaching, for example, in designing learning activities and exercises, developing lesson plans, and generating questions and quizzes (Kasneci et al., 2023; Rahman and Watanobe, 2023; Su and Yang, 2023).

However, despite the benefits, chatbots also bring challenges. Kasneci et al. (2023) identify twelve challenges in the use of chatbots in education: (1) copyright issues; (2) bias and fairness; (3) over-reliance by learners; (4) over-reliance by educators; (5) lack of understanding and expertise; (6) difficulty distinguishing model-generated or student-generated answers; (7) training and maintenance costs; (8) data privacy and security; (9) sustainable usage; (10) cost to verify information and maintain integrity; (11) difficulty distinguishing real knowledge from unverified model output; and (12) limited adaptability.

The use of chatbots in assessment frequently comes under the spotlight as it raises concerns about plagiarism and cheating (Skavronskaya, Hadinejad and Cotterell, 2023). Student misuse of chatbots might result in plagiarism, and it is difficult for assessors to discern work generated by chatbots (Dwivedi et al., 2023). In addition, over-reliance on chatbots may also reduce students' desire to learn to write and impede their cognitive development (Dwivedi et al., 2023). Kasneci et al. (2023) also warn that relying too much on chatbots can lead to students not putting in their own effort to problem-solve, which can hinder the development of creativity,

critical thinking, and problem-solving skills in students. Thus, academics should use chatbots to augment rather than replace learning delivery.

Academics and students should develop digital competency in using chatbots before using them for teaching and learning. Academics need to understand the benefits and downsides of chatbots, as well as how to provide students with the knowledge and skills required to use chatbots as a learning tool ethically and responsibly (Kohnke, Moorhouse and Zou, 2023; Tili et al., 2023). Guidelines and policies for the use of chatbots in education are also required to reduce academic dishonesty (Benuyenah, 2023; Dwivedi et al., 2023; Tili et al., 2023).

Academics should design assessments that encourage students to use chatbots as a learning tool instead of relying on them to generate final answers. Academics should also create learning environments that provide learning experiences that chatbots cannot replace (Geerling et al., 2023). Furthermore, in response to technological advances in chatbots, academics will have to adapt their teaching and assessment strategies (Benuyenah, 2023), review curriculum, change teaching methods, and revise assessment criteria (Kohnke, Moorhouse and Zou, 2023; Su and Yang, 2023; Tili et al., 2023).

3. Research Design and Method

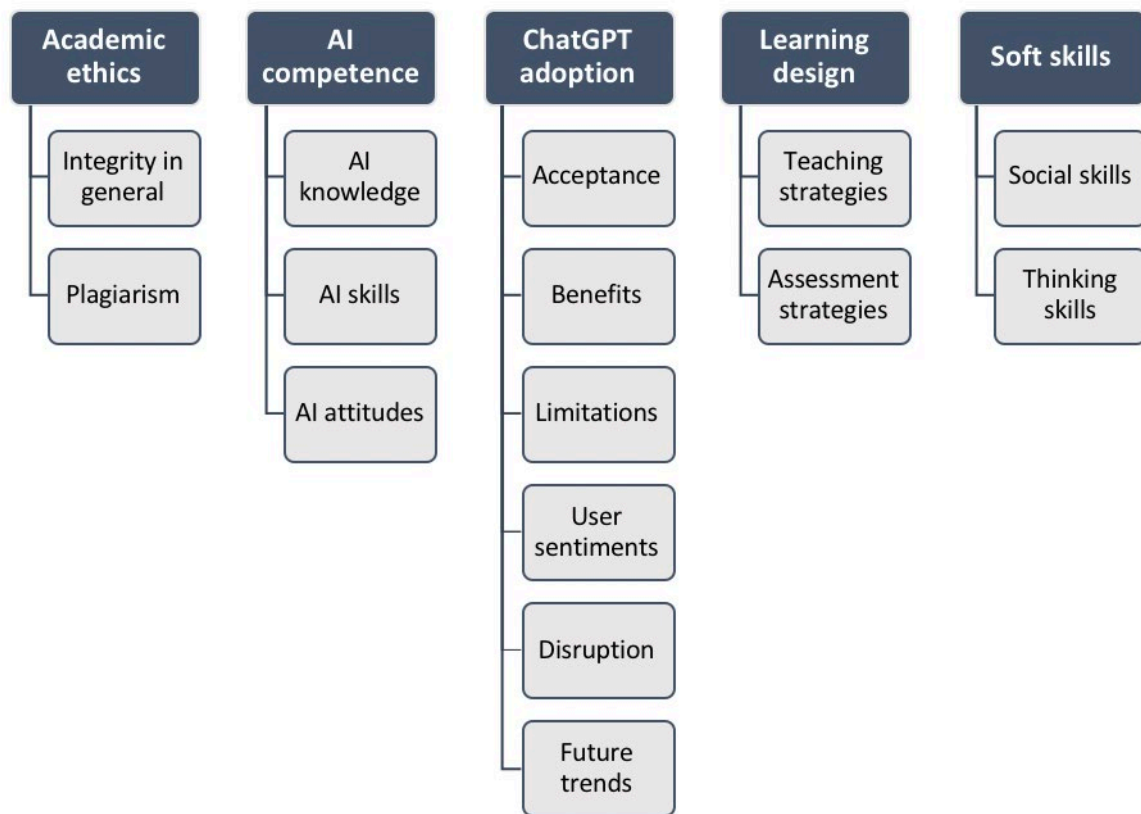
As the official launch of ChatGPT was on 30 November 2022, this study searched the top three English newspapers in Malaysia for articles that contained both search terms "education" and "ChatGPT" that were published between that date and 30 April 2023 (i.e., the cutoff date before a qualitative content analysis could begin at the beginning of May 2023). A search on Google found a total of 411 articles. A cloud-based web scraping software was then used to retrieve the contents of the articles from the newspaper websites. These articles were then filtered to remove any articles that were not specific to ChatGPT in education in the first round and those that were not specific to the Malaysian context in the second round. Table 1 provides a summary of the search and filter results. A total of 16 articles were retained for the subsequent qualitative content analysis.

Table 1: Summary of the article search and filter results

	New Straits Times	The Sun	The Star	Total
Initial articles	58	26	327	411
After 1st filter round (not specific to ChatGPT in education)	10	4	37	51
After 2nd filter round (not specific to the Malaysian context)	4	3	9	16

This study conducted a qualitative content analysis to examine the article texts to identify the topics of discussion by categories and subcategories (Mayring, 2014; Schreier, 2012). This study employed the eight-step process proposed by Schreier (2012) to conduct the analysis: (1) decide on the research question; (2) select the material; (3) build a coding frame; (4) segment coding units; (5) conduct trial coding; (6) evaluate the coding frame; (7) conduct the main analysis; and (8) present findings.

Following an inductive approach and based on the 16 articles, the study created a two-level coding frame that included five level-one categories and 14 level-two subcategories. The level-one categories represent the primary dimensions, and the level-two subcategories represent the subdimensions. The coding frame was built to meet four methodological requirements: unidimensionality, mutual exclusiveness, exhaustiveness, and saturation (Schreier, 2012). Figure 1 depicts the coding frame for this study.

Figure 1: Coding frame

The individual articles were the units of analysis in this study, and the article texts that were relevant to ChatGPT in Malaysian education were segmented into coding units. The coding units could be a partial sentence, a complete sentence, or multiple sentences. There were a total of 209 coding units. The same coder then pilot-tested the coding frame in two rounds, with a two-week gap in between, as suggested by Schreier (2012). There were no modifications to the categories or subcategories between the two rounds. With a percentage agreement of 82.4% (i.e., the number of coding units on which the coder agreed divided by the total number of coded units), intra-coder stability was satisfactory. Each coding unit was then coded into one or more subcategories in the main analysis. A coding unit, however, could not be assigned to more than one subcategory within the same category. To maintain coding consistency, the coding was done by a single coder with a two-week gap in between. In total, 209 coding units were coded 244 times in the main analysis, with one coding unit being coded an average of 1.2 times.

4. Data Analysis and Results

Table 2 shows the frequency and percentage of the coding units that have been coded into subcategories. The top five subcategories in order of frequency are: benefits (19.3%), plagiarism (13.9%), acceptance (8.6%), thinking skills (7.4%), and user sentiments (6.6%). The bottom five subcategories are: assessment strategies (4.9%), AI skills (3.3%), future trends (2.9%), AI attitudes (2%), and social skills (2%).

Table 2: Frequency and percentage of coding units coded into a subcategory

Subcategory	Frequency	Percentage (%)
Benefits	47	19.3%
Plagiarism	34	13.9%
Acceptance	21	8.6%
Thinking skills	18	7.4%
User sentiments	16	6.6%

Subcategory	Frequency	Percentage (%)
Disruption	15	6.1%
AI knowledge	15	6.1%
Limitations	14	5.7%
Integrity in general	14	5.7%
Teaching strategies	13	5.3%
Assessment strategies	12	4.9%
AI skills	8	3.3%
Future trends	7	2.9%
AI attitudes	5	2.0%
Social skills	5	2.0%
<i>Total</i>	<i>244</i>	<i>100.0%</i>

Table 3 shows the frequency and percentage of the coding units that have been coded into a subcategory within and across categories. Within the ChatGPT adoption category, the discussion about benefits led other topics by a large percentage (39.2%). AI knowledge (53.6%), plagiarism (70.8%), and thinking skills (78.3%) were the leading topics in the AI competence, academic ethics, and soft skills categories, respectively. There appeared to be a rather equal discussion of teaching strategies (52%) and assessment strategies (48%) in the learning design category. Across categories, the ChatGPT adoption category garnered the most discussion (49.2%), followed by academic ethics (19.7%), AI competence (11.5%), learning design (10.2%), and soft skills (9.4%).

Table 3: Frequency and percentage within and across categories

Category	Subcategory	Frequency	Within category percentage (%)	Across category percentage (%)
Academic ethics	Plagiarism	34	70.8%	
	Integrity in general	14	29.2%	
	<i>Subtotal</i>	<i>48</i>	<i>100.0%</i>	<i>19.7%</i>
AI competence	AI knowledge	15	53.6%	
	AI skills	8	28.6%	
	AI attitudes	5	17.9%	
	<i>Subtotal</i>	<i>28</i>	<i>100.0%</i>	<i>11.5%</i>
ChatGPT adoption	Benefits	47	39.2%	
	Acceptance	21	17.5%	
	User sentiments	16	13.3%	
	Disruption	15	12.5%	
	Limitations	14	11.7%	
	Future trends	7	5.8%	
	<i>Subtotal</i>	<i>120</i>	<i>100.0%</i>	<i>49.2%</i>
Learning design	Teaching strategies	13	52.0%	
	Assessment strategies	12	48.0%	
	<i>Subtotal</i>	<i>25</i>	<i>100.0%</i>	<i>10.2%</i>
Soft skills	Thinking skills	18	78.3%	
	Social skills	5	21.7%	
	<i>Subtotal</i>	<i>23</i>	<i>100.0%</i>	<i>9.4%</i>

5. Discussion and Conclusion

The category with the most subcategories is ChatGPT adoption. ChatGPT adoption was the most often discussed topic, accounting for over half of the total discussion. The launch of ChatGPT has sparked a great deal of interest in the chatbot. As a result, it is not surprising that there was a lot of discussion concerning its adoption for education in terms of benefits, acceptance, user sentiments, disruption, limitations, and future trends. The benefits of ChatGPT were the most frequently discussed topic in this category. People appeared eager to explore how they could benefit from using the chatbot, e.g., receiving feedback on their work or finding solutions to their problems (Ibrahim and Lee, 2023; Mohamed and Razawi, 2023). Although people recognised the limitations of ChatGPT, such as information accuracy or feedback quality (Goh, 2023; Mohamed and Razawi, 2023), and how it may change learning delivery (Ponnudurai, 2023; Wing, 2023) or replace humans in future jobs (Rahman, 2023b; Yeoh, 2023), it appears that people were generally supportive of embracing and adopting the chatbot (Lim, 2023; Wing, 2023) and anticipated that it will become more powerful at a faster rate in the future (Ponnudurai, 2023; Rahman, 2023a).

Academic ethics was the second most often discussed topic, accounting for over one-fifth of the total discussion. Plagiarism issues were the most frequently discussed topic in this category. People were concerned about how students may use ChatGPT to complete their assignments while maintaining academic integrity in general (Muthiah and Carvalho, 2023; Yeoh, 2023) and avoiding plagiarism because it can be difficult to distinguish whether an assignment is the student's own work or produced by the chatbot (Muthiah, 2023; Yeoh, 2023). People also discussed the use of anti-plagiarism software to detect plagiarism. These findings are similar to the concerns that have also been reported in past studies (e.g., Dwivedi et al., 2023; Kasneci et al., 2023; Skavronskaya, Hadinejad and Cotterell, 2023).

AI competence was the third most often discussed topic, accounting for slightly more than one-tenth of the total discussion. The discussion centred around a need to help students use ChatGPT ethically and responsibly by establishing some guidelines, principles, or skills (Muthiah and Carvalho, 2023; Yeoh, 2023). This discussion was highly similar to the concept of digital competence as defined by the European Commission in terms of knowledge, skills, and attitudes (European Commission, 2019). The need for AI knowledge was the most frequently discussed topic in this category. These findings support the suggestions made by Dwivedi et al. (2023), Kohnke, Moorhouse and Zou (2023), and Tlili et al. (2023) to develop competence in using chatbots ethically and responsibly.

Learning design was the fourth most often discussed topic, accounting for around one-tenth of the total discussion. The discussion was fairly even between teaching and assessment strategies. People discussed the need to adapt teaching strategies, such as teaching methods, pedagogies, the role of academics, and so on (Kuan, 2023; Rahman, 2023b), as well as assessment strategies, such as using authentic assessment or revising assessment criteria, to keep up with the developments in ChatGPT and how the chatbot may be better integrated into learning delivery (Kuan, 2023; Ponnudurai, 2023). These findings are consistent with the conclusions made in past studies that academics and educational institutions should adapt teaching and assessment strategies to coexist with chatbots (e.g., Benuyenah, 2023; Kohnke, Moorhouse and Zou, 2023; Su and Yang, 2023; Tlili et al., 2023).

Soft skills were the fifth most often discussed topic, accounting for just under one-tenth of the total discussion. The discussion of soft skills can be divided into two categories: social skills and thinking skills. Thinking skills were the most frequently discussed topic in this category. People discussed the idea that using ChatGPT does not help students develop personality traits such as empathy, attitudes, emotions, or interpersonal skills (Ngo, 2023; Raman, 2023). However, the discussion appeared to differ on whether the chatbot supports or hinders students from developing critical thinking, problem-solving, or creativity skills (Muthiah and Carvalho, 2023; Zaideen, 2023). This finding concurs with those of Dwivedi et al. (2023) and Kasneci et al. (2023) that over-reliance on ChatGPT may impede students from learning these crucial soft skills.

Overall, based on the top five most often discussed topics, people appeared keen to discuss how they could benefit from using ChatGPT, although it was a relatively new technology to them. Others, on the other hand, were concerned about the effects of the chatbot, particularly plagiarism issues. It is worth noting that people were open to using ChatGPT as a tool. They were aware, however, that while the chatbot is beneficial for specific tasks, it is limited in terms of enhancing cognitive skills such as creative thinking, problem-solving, and so on. People also had mixed feelings about the chatbot. While some people expressed positive sentiments (e.g., fun, impressive, exciting), others indicated negative sentiments (e.g., nervous, scary, anxiety).

In conclusion, this study has answered the question "what have people said" about ChatGPT in Malaysian education in the news following the first few months of its launch by identifying the categories and subcategories (along with frequency and percentage) of the most discussed topics in news articles. The findings help academics and educational institutions obtain a better understanding of the issues and challenges arising from the use of chatbots in education.

The findings have three practical implications for academics and educational institutions as chatbot functions and features continue to evolve. First, adapt learning design and delivery to improve student soft skill learning while leveraging chatbots as an educational tool; second, update assessment strategies and policies to address academic ethics issues; and third, incorporate training into the curriculum to develop AI competence in students in preparation for the anticipated wider use of AI in the future. Furthermore, the findings can also serve as a springboard for future research. Future AI research may conceptualise variables based on the categories and subcategories identified in this study to develop a research model.

References

- Adiguzel, T., Kaya, M.H. and Cansu, F.K. (2023) "Revolutionizing Education with AI: Exploring the Transformative Potential of ChatGPT", *Contemporary Educational Technology*, Vol. 15 No. 3, pp ep429.
- Benuyenah, V. (2023) "Commentary: ChatGPT Use in Higher Education Assessment: Prospects and Epistemic Threats", *Journal of Research in Innovative Teaching & Learning*, Vol. 16 No. 1, pp 134-135.
- Crawford, J., Cowling, M. and Allen, K.A. (2023) "Leadership is Needed for Ethical ChatGPT: Character, Assessment, and Learning Using Artificial Intelligence (AI)", *Journal of University Teaching & Learning Practice*, Vol. 20 No. 3.
- Dwivedi, Y.K., Kshetri, N., Hughes, L., Slade, E.L., Jeyaraj, A., Kar, A.K., Baabdullah, A.M., Koohang, A., Raghavan, V., Ahuja, M., Albanna, H., Albashrawi, M.A., Al-Busaidi, A.S., Balakrishnan, J., Barlette, Y., Basu, S., Bose, I., Brooks, L., Buhalis, D., ... Cunningham, S.W. (2023) "So What if ChatGPT Wrote it?" Multidisciplinary Perspectives on Opportunities, Challenges and Implications of Generative Conversational AI for Research, Practice and Policy", *International Journal of Information Management*, Vol. 71, pp. 102642.
- European Commission (2019) *Key Competences for Lifelong Learning*, Publications Office of the European Union, Luxembourg.
- Fahr, M. (2023) "Opinion: ChatGPT will Change the Future of Education" [online] Available at: <https://www.thestar.com.my/tech/tech-news/2023/01/30/opinion-chatgpt-will-change-the-future-of-education> [Accessed 20 May 2023]
- Geerling, W., Mateer, G.D., Wooten, J. and Damodaran, N. (2023) "ChatGPT has Aced the Test of Understanding in College Economics: Now What?" *The American Economist*, pp 1-13.
- Goh, H.H. (2023) "ChatGPT will Revolutionise the way Researchers Work", [online] Available at: <https://www.nst.com.my/opinion/columnists/2023/03/890978/chatgpt-will-revolutionise-way-researchers-work> [Accessed 06 May 2023]
- Google (n.d.) "Bard FAQ", <https://bard.google.com/faq> [Accessed 28 May 2023]
- Ibrahim, J. and Lee, B. (2023) "AI Tools Help Make Studying a Breeze, Say Students", [online] Available at: <https://www.thestar.com.my/news/nation/2023/04/12/ai-tools-help-make-studying-a-breeze-say-students> [Accessed 06 May 2023]
- Ivanov, S. and Soliman, M. (2023) "Game of Algorithms: ChatGPT Implications for the Future of Tourism Education and Research", *Journal of Tourism Futures*, Vol. 9 No. 2, pp 214-221.
- Kasneci, E., Sessler, K., Küchemann, S., Bannert, M., Dementieva, D., Fischer, F., Gasser, U., Groh, G., Günemann, S., Hüllermeier, E., Krusche, S., Kutyniok, G., Michaeli, T., Nerdel, C., Pfeffer, J., Poquet, O., Sailer, M., Schmidt, A., Seidel, T., ... Kasneci, G. (2023) "ChatGPT for Good? On Opportunities and Challenges of Large Language Models for Education", *Learning and Individual Differences*, Vol. 103, pp 102274.
- Kohnke, L., Moorhouse, B.L. and Zou, D. (2023) "ChatGPT for Language Teaching and Learning", *RELC Journal*, pp 1-14.
- Kuan, H.C. (2023) "Aye to AI", [online] Available at: <https://www.thestar.com.my/news/education/2023/03/05/aye-to-ai> [Accessed 06 May 2023]
- Lim, C.L. (2023) "Treat AI as Ally, not Enemy", [online] Available at: <https://www.thesundaily.my/opinion/treat-ai-as-ally-not-enemy-GK10830446> [Accessed 06 May 2023]
- Mayring, P. (2014) *Qualitative Content Analysis: Theoretical Foundation, Basic Procedures and Software Solution*, Klagenfurt.
- Microsoft (n.d.) "Frequently Asked Questions", <https://bard.google.com/faq> [Accessed 28 May 2023]
- Mohamed, N. and Razawi, N.A. (2023) "ChatGPT — Use it but Don't Rely on it", [online] Available at: <https://www.nst.com.my/opinion/letters/2023/02/880707/chatgpt-%E2%80%94-use-it-dont-rely-it> [Accessed 06 May 2023]
- Mok, D. (2023) "Hong Kong's Baptist University Bans Students from Using ChatGPT for Class Work" [online] Available at: <https://www.thestar.com.my/tech/tech-news/2023/02/24/hong-kongs-baptist-university-bans-students-from-using-chatgpt-for-class-work> [Accessed 06 May 2023]

- Muthiah, W. (2023) "Keeping an 'AI' on Red Flags", [online] Available at: <https://www.thestar.com.my/news/nation/2023/04/12/keeping-an-039ai039-on-red-flags> [Accessed 06 May 2023]
- Muthiah, W. and Carvalho, M (2023) "ChatGPT can be used Positively", [online] Available at: <https://www.thestar.com.my/news/nation/2023/04/12/chatgpt-can-be-used-positively> [Accessed 06 May 2023]
- Ngo, C.K.D (2023) "'AI Alone can't Save the World'", [online] Available at: <https://www.thestar.com.my/news/education/2023/04/02/ai-alone-cant-save-the-world> [Accessed 06 May 2023]
- OpenAI (2022) "Introducing ChatGPT", [online] Available at: <https://openai.com/blog/chatgpt> [Accessed 28 May 2023]
- OpenAI (2023a) "GPT-4", [online] Available at: <https://openai.com/research/gpt-4> [Accessed 28 May 2023]
- OpenAI (2023b) "Introducing ChatGPT Plus", [online] Available at: <https://openai.com/blog/chatgpt-plus> [Accessed 28 May 2023]
- OpenAI (2023c) "Release Notes (March 14)", [online] Available at: <https://help.openai.com/en/articles/6825453-chatgpt-release-notes> [Accessed 28 May 2023]
- OpenAI (n.d.) "GPT-4 is OpenAI's Most Advanced System, Producing Safer and More Useful Responses", [online] Available at: <https://openai.com/gpt-4> [Accessed 28 May 2023]
- Ponnudurai, P. (2023) "Leverage on ChatGPT Technology", [online] Available at: <https://www.thesundaily.my/opinion/leverage-on-chatgpt-technology-1A10671548> [Accessed 06 May 2023]
- Rahman, D. (2023a) "ChatGPT: Exciting AI Possibilities for Education in 2023", [online] Available at: <https://www.thestar.com.my/opinion/columnists/whats-your-status/2023/01/02/chatgpt-exciting-ai-possibilities-for-education-in-2023> [Accessed 06 May 2023]
- Rahman, M.M. and Watanobe, Y. (2023) "ChatGPT for Education and Research: Opportunities, Threats, and Strategies", *Applied Sciences*, Vol. 13 No. 9, pp 5783.
- Rahman, M.T. (2023b) "Let's Harness ChatGPT for Education", [online] Available at: <https://www.nst.com.my/opinion/columnists/2023/02/881847/lets-harness-chatgpt-education> [Accessed 06 May 2023]
- Raman, M. (2023) "Why GPT will Never Replace 'PHG'", [online] Available at: <https://www.thestar.com.my/news/education/2023/04/30/why-gpt-will-never-replace-phg> [Accessed 06 May 2023]
- Schreier, M. (2012) *Qualitative Content Analysis in Practice*, SAGE, Thousand Oaks.
- Skavronskaya, L., Hadinejad, A. and Cotterell, D. (2023) "Reversing the Threat of Artificial Intelligence to Opportunity: A Discussion of ChatGPT in Tourism Education", *Journal of Teaching in Travel & Tourism*, Vol. 23 No. 2, pp 253-258.
- Starcevic, S. (2023) "As Australian Colleges Crack Down on ChatGPT, Students with Disabilities Defend AI", [online] Available at: <https://www.thestar.com.my/tech/tech-news/2023/01/25/as-australian-colleges-crack-down-on-chatgpt-students-with-disabilities-defend-ai> [Accessed 20 May 2023]
- Su, J. and Yang, W. (2023) "Unlocking the Power of ChatGPT: A Framework for Applying Generative AI in Education", *ECNU Review of Education*, pp 1-12.
- The Star (2023a) "Top French University Bans Use of ChatGPT to Prevent Plagiarism", [online] Available at: <https://www.thestar.com.my/tech/tech-news/2023/01/28/top-french-university-bans-use-of-chatgpt-to-prevent-plagiarism> [Accessed 20 May 2023]
- The Star (2023b) "Universities in Japan Restrict Students' Use of ChatGPT" [online] Available at: <https://www.thestar.com.my/aseanplus/aseanplus-news/2023/04/09/universities-in-japan-restrict-students-use-of-chatgpt> [Accessed 20 May 2023]
- Tlili, A., Shehata, B., Adarkwah, M.A., Bozkurt, A., Hickey, D.T., Huang, R. and Agyemang, B. (2023) "What if the Devil is My Guardian Angel: ChatGPT as a Case Study of Using Chatbots in Education", *Smart Learning Environments*, Vol. 10 No. 15, pp 1-24.
- Wing, L. (2023) "Time to Embrace AI", [online] Available at: <https://www.thestar.com.my/news/education/2023/02/05/time-to-embrace-ai> [Accessed 06 May 2023]
- Yeoh, A. (2023) "Grade Expectations: Is ChatGPT Friend or Foe to Local Universities?", [online] Available at: <https://www.thestar.com.my/tech/tech-news/2023/02/20/grade-expectations-is-chatgpt-friend-or-foe-to-local-universities> [Accessed 06 May 2023]
- Zaideen, I.M.M. (2023) "Opportunities or Obstacles for Higher Education", [online] Available at: <https://www.thesundaily.my/opinion/opportunities-or-obstacles-for-higher-education-E110906460> [Accessed 06 May 2023]

Asynchronous e-Learning: A Collaborative, Process-Based Solution for Design and Development Challenges

Dilini Lakma Thoradeniya, Malik Ranasinghe, Vishaka Nanayakkara, Buddhika Karunaratne, Eshana Ranasinghe, Gaindu Saranga Jayathilaka and Niranjana Gunawardena

University of Moratuwa, Sri Lanka

dilthora@gmail.com

malik@uom.lk

vishaka@cse.mrt.ac.lk

buddhika@cse.mrt.ac.lk

enranasinghe1@gmail.com

gaindusaranga@gmail.com

ndg@uom.lk

Abstract: This paper presents a case study of an asynchronous online learning program, 'Project Management Skills', benchmarked to the Exam Content Outline (ECO) that was released in October 2022 for the Certified Associate in Project Management (CAPM) qualification of the Project Management Institute (PMI), USA. It investigates how the design and development processes have incorporated contemporary research findings and practices in online course design and development. Key challenges of the program include supporting resource persons with traditional, face-to-face teaching experiences to effectively deliver content in online asynchronous mode, as well as producing content in the English language in a manner that can be easily digested by students who are not native English speakers. The study presents an analysis of data gathered from key informant interviews with Content Developers, as well as project documentation such as meeting minutes and reviewer comments. The findings indicate that the multiple review model employed in the design and development process complements best practices in asynchronous online education and enables a high level of collaboration which reduces the burden on the Content Developer to take on multiple roles. Additionally, it facilitates the input and support of a diverse group of team members with specialist knowledge.

Key Words: Online Course Development, Course Design, Asynchronous Learning, Instructional Design, Collaborative

1. Introduction

Extant literature on the design and development of online courses is numerous, of which a smaller component is on courses delivered in asynchronous mode. Findings of such studies usually focus on success factors, strategies and best practices, or on theories, frameworks and models (Volery and Lord, 2000; Niess and Gillow-Wiles, 2013; Picciano, 2021; Varkey et al., 2023). However, there are fewer studies on how such knowledge is practically incorporated within the design and development process of online asynchronous courses.

This paper aims to contribute towards narrowing this knowledge gap by investigating the design and development process of the asynchronous online "Project Management Skills" programme to be delivered on open.uom.lk, the open learning platform of the University of Moratuwa (UoM), Sri Lanka. In particular, the objectives of the study are (1) to understand how the steps in this process have incorporated contemporary research findings and practices in online course design and development, and (2) to identify challenges which emerged in course development and their potential solutions. The objectives are expected to help establish lessons learned that can be used to refine the process further. This is important as at least eight (8) other courses of the programme are still in development, and all courses are expected to undergo annual improvements for up to three (3) years. Additionally, the case study is expected to provide insights into overcoming specific contextual challenges, namely, supporting resource persons with traditional face-to-face teaching experiences to effectively deliver content in online asynchronous mode, as well as producing content in the English language in a manner that can be easily digested by students who are not native English speakers.

The scope of the study is limited to reviewing the design and development process, primarily from the perspectives of those who were involved in the process, i.e., the content development team including content developers, reviewers, and coordinators. Student perspectives of the course are not included, as at the time of initially writing this article, the courses were yet to be launched.

2. Literature Review

2.1 Success Factors and Best Practices

While there are many studies on critical success factors and best practices for online education, the research question requires a focus on asynchronous online education, instructor perspectives, as well as course design, development, and delivery.

Instructors of online courses must possess certain characteristics. First is pedagogical competence and its application to online education. This includes knowledge of instructional design, assessment strategies and the ability to create meaningful learning experiences (Rapanta et al., 2020). Instructors should possess effective written and verbal communication skills to effectively convey ideas to students (Foster, Colburn and Briggs, 2018). Digital literacy and online competence is another factor, as its absence can be an obstacle to effectively implementing quality online education (Al-Azawei, Parslow and Lundqvist, 2016).

In terms of course design and delivery, the course structure is notable (Peters, 1998; Kim and Kim, 2021). Another recurring factor is student interaction and its relation to learner engagement and motivation (Baxter and Hainey, 2023). Student interaction is of three types: (1) instructor-student interaction, which is limited in asynchronous learning, (2) student-student interaction, the importance of which is debated in asynchronous online education, and (3) student-content interactions which may be the most critical and easiest to implement in asynchronous learning (Moore, 1989; Kuo et al., 2013).

Varkey et al. (2023) has reviewed the best practices in asynchronous learning in the perspective of instructional and learning sciences. Sequence learning is one; it allows for spaced learning periods and retention intervals. This may be facilitated in an asynchronous environment via discussion forums, spaced question sets and formative assessments. Another key concept for asynchronous instruction is the use of Mayer's twelve principles in the creation of multimedia content (Mayer and Moreno, 1998). Additionally, clear and concise feedback to students is important to enable learning and change student behaviours.

2.2 Rubrics, Guidelines and Evaluation Instruments

Quality is a major concern in the design and development of online courses, and has given rise to various rubrics, guidelines and evaluation instruments.

Ko and Rossen (2010) reviewed several such systems, such as those developed by the Illinois Quality Online Course Initiative (IQOCI), North American Council for Online Learning (NACOL), California State University, Chico (CSUC), and Quality Matters™. Instructional Design and Student Evaluation and Assessment were the common elements across all four systems. Instructional Design in this case can include the course overview and introduction, clear course and learning objectives, content structure and sequence, active learning strategies and multiple learning paths. Other elements that were represented in at least three of the four systems are learner support & resources, and course evaluation and course management.

Several of these elements are repeated in a review of evaluation instruments by Baldwin, Ching and Hsu (2018) presenting 63 elements in four categories: (1) Course Design including goals, objectives, content presentation, learner engagement and technology, (2) Interaction and Collaboration, (3) Assessments, and (4) Learner support.

3. Methodology

The aim of the study requires a research design that enables an in-depth, descriptive investigation of the design and development process of the "Project Management Skills" programme. Hence, an exploratory case study was conducted (Yin, 2014; Tan, 2022). Case studies are well suited for instances where processes, problems and/or programs need to be studied to improve understanding which can in turn improve practice (Ponelis, 2015).

It purposively samples two of the twelve courses in the programme, as at the time of writing this paper, these modules had progressed the furthest in the design and development process, and therefore can provide more holistic insights.

The primary method for data collection was the review of documents such as meeting minutes, the project progress tracker, and content development drafts that include internal, external and language reviewer feedback. These are supplemented by key informant interviews conducted with four of the five Content Developers involved in the sampled two courses. These structured interviews were supplemented with a

questionnaire to categorize some of the responses. The structured interviews and supplementary questionnaire addressed four key areas of interest: (1) the Professional and Teaching Background of the Content Developer, as well as the Content Developer's perspectives of (2) the development of content, (3) feedback from reviewers, and (4) other support provided to the Content Developer.

4. Case Study

4.1 Programme Overview

The intention behind the "Project Management Skills" programme is threefold, and is reflected in the three options that will be provided to students for undertaking the modules.

1. **Audit Course:** The objective is to provide a student with the required knowledge and skills of a subject. It includes a range of formative assessments to ensure the student has gained the knowledge and the skills. No summative assessments or examinations are included. On completion of the course an e-certificate of participation is issued. As a policy all Audit Courses on open.uom.lk platform is offered free-of-charge (FOC). This paper focuses on the design and development of these Audit Courses.
2. **Credit Courses:** The objective is to assess a student's knowledge and skills at the end of a course and certify their competency at a given level. After a student has gained the required knowledge and skills as described in the Audit Course, the students must successfully complete the summative assessments and examination to earn the credit. On successful completion of the course a certificate with the credit value and the earned grade is issued. A nominal fee is charged for the summative assessments.
3. **Master's Programme:** This is a stackable programme leading to a Conversion Master's degree qualification at Level 6 of the Sri Lanka Qualifications Framework (SLQF) (Ministry of Higher Education, 2012). It is equivalent to the 4-year of the undergraduate honours degree. The objective is to provide students who have completed 3-years of undergraduate education in any field of study, such as the humanities, commerce, technology, or natural sciences an opportunity to top-up to an equivalent honours degree in Project Management.

Why will this course be offered online in asynchronous mode? First, it encourages self-directed learning which provides more flexibility to the student in terms of their commitment of time, and is predominantly dependent upon the student's self-motivation (Davis, Gough and Taylor, 2019; Alzahrani et al., 2023). Perhaps the most important reason was to increase accessibility to the course regardless of the student's geographical location, providing a more "inclusive and equitable learning experience" (Bower et al., 2015, p.2). As a result of the COVID-19 pandemic, the use of smart devices for learning (e.g., phones, tablets and laptops) became more prevalent among students in Sri Lanka. Despite this, the stability of internet connections in remote areas is a concern, and this can cause interruptions leading to a poor learning experience. This problem is resolved by offering the course in asynchronous mode. Additionally, the asynchronous mode can circumvent the problem of time zones and can encourage the enrolment of foreign students, which was seen as a potential revenue stream amidst Sri Lanka's currency crisis.

Four courses of the programme were launched on the 23rd of June 2023. At the 8-week mark, the programme recorded more than 2300 student registrations and around 150 course completions.

4.2 Course Design

The Course Design process consists of four stages leading to the Content Development Process (Figure 1).

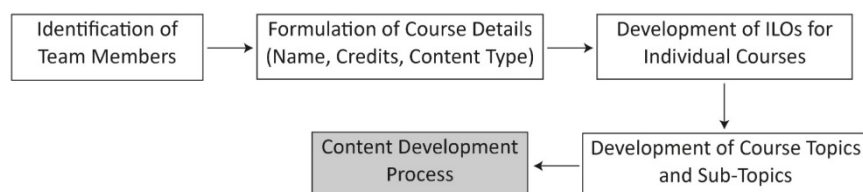


Figure 1: Course Design Process

The process began with the identification of team members. These include the Content Developers and Course Coordinators. Content Developers take on the role traditionally held by instructors in that they are responsible for developing and delivering the content of the module. They consist of a mix of industry professionals and academics. If more than one Content Developer is assigned to a module, a Content Lead is appointed to handle coordination between the Content Developers. Course Coordinators are academic staff from the University. Their primary responsibilities include formulating the scope and sequence of the module (i.e., course structure) in addition to some activities that may be usually undertaken by an Instructional Designer (Kenny et al., 2005). They are responsible for ensuring that the quality of the module meets the university's standards.

The next step was the formulation of course details. After discussions, the twelve modules of the programme were developed by grouping appropriate Project Management Knowledge Areas and the additional inclusion of project management subjects specific to law and the IT industry. Each module should contain fourteen Topics, with each Topic having at least three Sub-Topics. Each Sub-Topic should contain a Lecture Video, the Script of the video, Lecture Notes, and Quiz Questions for Formative Assessments. Content Developers were requested to create at least 60-minutes of video per topic (i.e., 14 hours of lecture video per course), in order to meet the requirements for awarding the necessary credits for the Master's programme.

In the third stage, the Intended Learning Outcomes (ILOs) for the courses were developed collaboratively by the Course Coordinator and Content Lead, supported by senior academics in the team. Considering that the target is to produce students eligible to sit for the CAPM exam, the program's ILOs were mapped to the October 2022 Exam Content Outline (ECO) for the CAPM. Keeping in line with instructional design requirements, Bloom's Taxonomy was used to formulate ILOs appropriate for the Master's programme.

Thereafter, the course topics and sub-topics were developed based on the content of the Project Management Body of Knowledge (PMBOK) 6th and 7th Editions where possible. Additionally, the topics were benchmarked to the content of various project management courses worldwide, particularly those available in online asynchronous mode.

Information on the ILOs and course syllabus (i.e., topics) is made available to potential students prior to their enrolment in the course. The content types (i.e., lecture videos, scripts, notes and formative assessments) and a more detailed topic breakdown (i.e., sub-topics) are presented in a dedicated Course Overview section once the student is enrolled in the course.

4.3 Content Development Process

The Content Development process followed the Course Design Process (Figure 2).

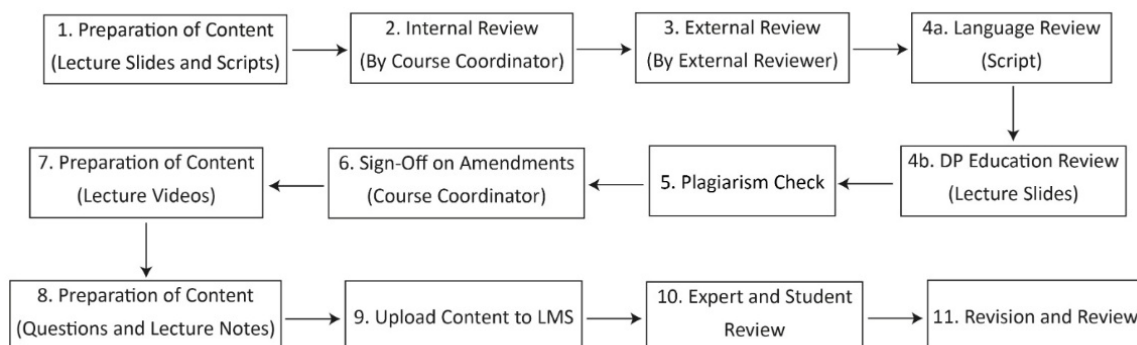


Figure 2: The Content Development Process

In addition to investigating the content development process in relation to contemporary practices, this section also presents the Content Developers' perspectives on the process, particularly on developing the various content types: lecture slides, scripts, videos, notes, and formative assessment questions. The Content Developer's perspectives help identify the challenges of the content development process. This is followed by complementary insights from the multiple "review" stages of the content development process.

4.3.1 Preparation of Lecture Slides and Scripts

The Content Developers were provided with a PowerPoint presentation template to ensure uniformity of content. The template includes colour coding instructions for text, to differentiate between important points, terminology and peripheral information in line with Mayer's Signalling Principle.

The script was prepared for two reasons. Asynchronous delivery required pre-recording of videos totalling 1-hour per topic. There is no flexibility to "spill-over" to next week's lecture when the content is too large, or to finish a lecture early if the content is too small. Another reason to include a script was to alleviate difficulties with language: while the medium of instruction is English, Content Developers and Students are not native English speakers. A script would allow the Content Developer to lecture with an uninterrupted flow and the correct use of the language, while students can follow the narration in the video or re-check any instances where terminology or enunciation is unclear.

The lecture script was the most challenging type of content to create, with one Content Developer finding it 'Very Challenging', and the remaining three found it 'Challenging'. The development of Lecture slides was found to be the third most challenging content type with three content developers finding it 'Challenging', while one was 'Neutral'.

A recurring theme on the development of the script was tied to experience in and a preference for traditional, face-to-face (F2F) or synchronous teaching. Adapting to asynchronous online course delivery was challenging for most Content Developers, but some stated that once adopted, the mechanism became easier. *"It was challenging to portray the necessary information while maintaining the appropriate speaking style"* and *"Speaking by looking at a script was very challenging because the usual practice is for [the narration] to naturally come out during the physical lectures"*, are statements made by content developers indicating a concern about sounding as if they are "reading" rather than "speaking" during the lecture.

The time requirement of 60-minutes of lecture video was challenging for contrasting reasons. One Content Developer found that *"it was very difficult to identify what should and should not be included within the time period"*. In contrast, at least two other Content Developers had trouble extending the videos to the required time due to their speed of speech or as stated: *"Sometimes there is no information to add."* The latter reason can be overcome by improvements to instructional design and strategy by the Course Coordinators, e.g., revision of the syllabus to include more topics and/or by including examples or case studies during the planned improvement cycles for the programme. Such strategies have the added advantage of increasing student interest in the content.

Other challenges encountered when writing the scripts include inexperience with asynchronous course development, the lack of project management knowledge of the target audience (thus requiring more detailed explanations), concerns about copyright, the use of *"correct information from reliable sources"* and difficulties in finding reference textbooks.

Per topic, lecture slides and scripts each took 6-12 hours for half the content developers while the other half took more than 24 hours to complete development. Interviews revealed that those who took less time were either more experienced in teaching or had not met the required total video length. Some felt that the financial payment for content development was not sufficient for the time put in and was de-motivating, indicating that content development activities took longer than initially anticipated.

4.3.2 Preparation of Lecture Videos

The lecture videos employ a didactic video style, specifically the "Talking Head", combining both the Voice and Image Principles of Mayer (Choe et al., 2019). In terms of pedagogy, the Content Developers were guided to create short videos no longer than 20 minutes in line with the Segmenting Principle allowing for the content to be digested easily.

Content Developers found Lecture Videos to be the second most challenging content type to prepare, both due to technological issues and being inexperienced with asynchronous education. They noted that not having interactions with students *"was very difficult to adapt to"*. One Content Developer found it 'Very Challenging' and took more than 4 hours per topic to complete recording. He opted to record the video by himself and experienced technical issues such as disruptions from surrounding noises and comparatively lower playback volume. He also experienced issues with video editing.

4.3.3 Preparation of Lecture Notes

The course includes Lecture Notes in line with the learning culture of Sri Lanka. It also serves to increase student-content interaction and provides an avenue to direct students to additional material on the internet.

Lecture Notes were the second easiest content type to produce. Three Content Developers felt 'Neutral' towards the process and took 2-4 hours of preparation per topic, while one felt the process was 'Easy' and completed preparation in 1-2 hours. The Content Developers noted that the reason for the relative ease of preparation is that the information required was already compiled when preparing the lecture slides and scripts.

4.3.4 Preparation of Quiz Questions

The Audit Courses require only formative assessments, which test the student's understanding of the work. Using H5P features on Moodle, some of these questions are made available at various points in the Interactive Lecture Video, in order to maintain student interest and increase student-content interaction. The remaining questions are made available as a quiz at the end of each topic, and the students must complete these to access subsequent topics. The Content Developers noted the formulation of questions as the easiest content to produce because of the variety of question formats available through Moodle, e.g., multiple-choice-questions, drag-and-drop etc. Summative assessments are still in development for the Credit Courses and Master's programme.

4.3.5 Reviews

The content development process includes multiple stages of review (Figure 2) both as a mechanism for providing support to the Content Developers, and to maintain quality. The feedback was categorized and rated in terms of their usefulness in the perspective of Content Developers.

Feedback on improvements to the content was the most highly rated with three Content Developers finding it 'Very Useful', remarking that the input from Course Coordinators with an academic background and those with experience in developing online content was very helpful. In contrast, one rated the feedback as 'Somewhat Useful', stating that the review process was detrimental at times due to the inclusion of new team members who proceeded to alter module outlines and/or were unfamiliar with the PMI process, as well as because the feedback provided at different stages would at times contradict one another.

Tips on Presenting was rated highly, with 2 Content Developers finding it 'Useful' and 2 more finding it 'Very Useful'. After watching sample videos prepared by the Content Developers, feedback on lighting, facial expressions, gestures, voice modulation and speed were provided.

The Language check was similarly rated, with one Content Developer commenting, "*Language is important [because the] content developer does not have 100% English fluency.*" Another noted that if unfamiliar with technical terms, the Language Reviewer could alter terminology and phrases that could change the meaning of the content. This is not a major issue, as all feedback is incorporated to the content at the Content Developer's discretion. Additionally, language reviews were conducted with the target non-native English speaker audience in mind and included suggestions for simplifying sentence structure and terms.

The perception of feedback on teaching strategies is mixed with two finding it 'Very Useful' and others finding it 'Somewhat Useful'. Pedagogical advice from academics were appreciated by some, while others felt that they did not receive enough feedback on the topic, perhaps indicating that more uniformity in providing feedback is necessary.

The final review stage, that is, the "Expert and Student Review" was conducted using a feedback form. Most responses were rated on a scale (either labelled or numbered). In general, the feedback was positive, and the consensus was that all the content of the courses are at least at an acceptable level. The reviewers suggested improvement to the content, which can be incorporated in future iterations of the development process. Closed Captions were recommended as an alternative or supplement to the script to facilitate better understanding of the English language for non-native speaker students. Suggestions regarding the user interface of the course (e.g., ability to scroll through the script while watching the video) were noted and will require modifications to the LMS itself. The reviewers noted that the ability to move freely within the content without restrictions could be improved. Currently, students cannot skip ahead when watching videos, and cannot access subsequent topics without completing a set number of tasks (i.e., watching the video and answering the formative assessment

questions). However, the removal of such restrictions may cause concerns as to whether students would genuinely review the course material before acquiring a certificate of completion.

5. Collaboration and Support

The Course Design and Development processes require collaboration of many parties as seen in Figure 3.

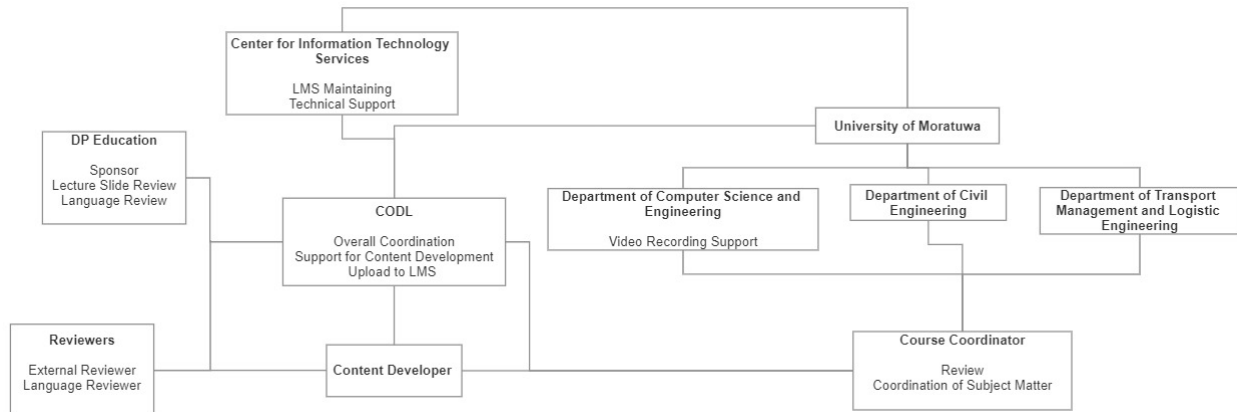


Figure 3: Network of Collaborative Parties

The Content Developer may be viewed as the central figure supported by Course Coordinators, External and Language Reviewers, as well as the Centre for Open and Distance Learning (CODL). Traditionally, an instructor would perform four roles: Pedagogical, Social, Managerial and Technical (Berge, 1995; Morris, Xu and Finnegan, 2005). In this case study, the content developers are either supported in these roles or are completely removed from some roles as others fully take on some of these responsibilities. For example, CODL as the overall coordinating body, takes on the Social and Managerial roles as well as the uploading and management of content on the Learning Management System (LMS). Other elements of the Technical role are undertaken by the University's Centre for Information Technology Services. It leaves the Content Developer primarily with the Pedagogical role, supported by the Course Coordinator. This is an important feature, as it reduced the burden on the Content Developers who work full-time on other jobs, and/or may not have the competencies required for all four roles.

It is also relevant that the primary selection criteria for Content Developers is their familiarity with the subject matter. Possessing a PMI certification was not essential, but an added advantage. Technological competency was not a criterion, as support was to be provided through the CODL. Consequently, CODL had to provide more technical guidance and support to Content Developers of the Project Management Skills programme, especially in comparison to the Content Developers involved in previous IT related programmes such as the Trainee Full Stack Developer Course. The selected Content Developers consisted of mostly industry professionals and a few academics, and had additional workloads and time constraints.

Collaboration was facilitated mainly through Meetings on the Zoom platform, while collaboration on content was facilitated by the use of shared folders and documents on Google Drive. It is interesting to note that the team had convened in person only on one occasion (to attend a workshop), but have otherwise worked remotely. Communication lines are open via phone, email and group chats on WhatsApp.

In terms of usefulness, Meetings received mostly positive feedback from Content Developers. Positive comments noted that the meetings allowed for input and discussions on how to improve content and was a useful medium to receive comments from persons experienced in the use of asynchronous online education. A recurring suggestion for improvement was adjustments to the frequency and length of meetings, moments of repetition and lack of structure leading to feelings of unproductivity. As an industry professional, a Content Developer noted "*financial loss*", or the opportunity cost of time spent at meetings. A strategy used by CODL to counter the number of weekly meetings was to form clusters (i.e., combining the teams from multiple courses).

Material support provided to the content developers included a detailed 'Guideline for Content Creation' which outlined requirements for and provided support on pedagogical (e.g., consistency of content) and technological issues, and additional support material relating to Project Management content (e.g., reference texts).

The Technical Assistance provided was appreciated by the Content Developers, who cited their lack of technical knowledge. Additional help in video editing was requested by one Content Developer. Technical assistance was initially provided with instructional videos on specific activities (e.g., the creation of lecture videos using three different types of software), and then individual requirements on request. While most Content Developers chose to record the videos using their own devices and in their own spaces, the university also provided recording equipment and access to the recording studio on request. Additionally, a workshop on video preparation was conducted on a face-to-face basis early in the content development process.

A perceived downside of collaboration was the inconsistency in subject matter and presentation due to the involvement of multiple Content Developers for the same course. A suggested solution was greater involvement in subject matter coordination by the Course Coordinator.

6. Conclusion

The case study explores the content design and development process of two course of the open.uom.lk's online asynchronous "Project Management Skills" programme and notes that in general, the process complements contemporary theories and practices, especially in the pedagogical and technical arenas. For example, Mayer's Principles were incorporated in multiple aspects of creating content for the courses to deliver an effective asynchronous learning experience to the students.

A key finding of the study is the role of collaboration that emerges from the process. Collaboration through the multiple review content development process (Figure 2) was found to resolve many issues, including the case-specific contextual challenges stemming from the Content Developer's inexperience with teaching in online asynchronous mode, and addressing the issues of English language competencies of both Content Developers and potential students. Additionally, the delegation of the traditional instructor's roles in pedagogical, social, managerial and technical arenas to other team members helped reduce the Content Developers' workload and played a significant role in maintaining the quality of the content. Significantly, the programme was able to engage many industry professionals as lecturers, as they were supported in the pedagogical, technical and managerial roles by members of the collaborative team. However, the study notes that collaboration requires both good communication and coordination strategies. Particularly, tools such as meetings must be streamlined to maintain productivity and team motivation.

The findings of the study will be very useful for other courses currently in development under the "Project Management Skills" programme, as well as for the development of other asynchronous learning courses within similar contexts. The study is limited by the small number of key informants. The inclusion of more courses in the analysis may provide insights of statistical significance. This could be the basis for further work once more courses are complete. A larger sample size for questionnaires could allow analysis for statistical correlations, for example, between the Content Developer's competencies in asynchronous online education and their experience developing content for this programme.

References

- Al-Azawei, A., Parslow, P., Lundqvist, K., 2016. Barriers and Opportunities of E-Learning Implementation in Iraq: A Case of Public Universities. *Int. Rev. Res. Open Distrib. Learn.* 17. <https://doi.org/10.19173/irrodl.v17i5.2501>
- Alzahrani, H.A., Shati, A.A., Bawahab, M.A., Alamri, A.A., Hassan, B., Patel, A.A., Ahmad, M.T., El Maksoud, W.A., Alsaleem, M.A., 2023. Students' perception of asynchronous versus synchronous distance learning during COVID-19 pandemic in a medical college, southwestern region of Saudi Arabia. *BMC Med. Educ.* 23, 53. <https://doi.org/10.1186/s12909-023-04034-5>
- Baldwin, S., Ching, Y.-H., Hsu, Y.-C., 2018. Online Course Design in Higher Education: A Review of National and Statewide Evaluation Instruments. *TechTrends*. <http://dx.doi.org/10.1007/s11528-017-0215-z>
- Baxter, G., Hainey, T., 2023. Remote learning in the context of COVID-19: reviewing the effectiveness of synchronous online delivery. *J. Res. Innov. Teach. Learn.* 16, 67–81. <https://doi.org/10.1108/JRIT-12-2021-0086>
- Berge, Z.L., 1995. Facilitating Computer Conferencing: Recommendations from the Field. *Educ. Technol.* 35, 22–30.
- Bower, M., Dalgarno, B., Kennedy, G.E., Lee, M.J.W., Kenney, J., 2015. Design and implementation factors in blended synchronous learning environments: Outcomes from a cross-case analysis. *Comput. Educ.* 86, 1–17. <https://doi.org/10.1016/j.compedu.2015.03.006>
- Choe, R.C., Scuric, Z., Eshkol, E., Cruser, S., Arndt, A., Cox, R., Toma, S.P., Shapiro, C., Levis-Fitzgerald, M., Barnes, G., Crosbie, R.H., 2019. Student Satisfaction and Learning Outcomes in Asynchronous Online Lecture Videos. *CBE Life Sci. Educ.* 18, ar55. <https://doi.org/10.1187/cbe.18-08-0171>
- Davis, N.L., Gough, M., Taylor, L.L., 2019. Online teaching: advantages, obstacles and tools for getting it right. *J. Teach. Travel Tour.* 19, 256–263. <https://doi.org/10.1080/15313220.2019.1612313>

- Foster, L., Colburn, A.N., Briggs, C., 2018. Language & Online Learning: Inform, Inspire and Engage Virtual Learning Communities. *J. Couns. Prep. Superv.* 11.
- Kenny, R., Zhang, Z., Schwier, R., Campbell, K., 2005. A Review of What Instructional Designers Do: Questions Answered and Questions Not Asked. *Can. J. Learn. Technol.* <https://doi.org/10.21432/T2JW2P>
- Kim, S., Kim, D.-J., 2021. Structural Relationship of Key Factors for Student Satisfaction and Achievement in Asynchronous Online Learning. *Sustainability* 13, 6734. <https://doi.org/10.3390/su13126734>
- Ko, S. & Rossen, S.K., 2010. *Teaching Online: A Practical Guide*, 3rd ed. Routledge, New York. <https://doi.org/10.4324/9780203855201>
- Kuo, Y.-C., Walker, A.E., Belland, B.R., Schroder, K.E.E., 2013. A predictive study of student satisfaction in online education programs. *Int. Rev. Res. Open Distrib. Learn.* 14, 16–39. <https://doi.org/10.19173/irrodl.v14i1.1338>
- Mayer, R.E., Moreno, R., 1998. A cognitive theory of multimedia learning: Implications for design principles. *J. Educ. Psychol.* 91, 358–368.
- Ministry of Higher Education, 2012. Sri Lanka Qualifications Framework. MOHE, Colombo. URL <https://www.eugc.ac.lk/qac/slqf.html> (accessed 5.25.23).
- Moore, M.G., 1989. Editorial: Three types of interaction. *Am. J. Distance Educ.* 3, 1–7. <https://doi.org/10.1080/08923648909526659>
- Morris, L.V., Xu, H., Finnegan, C.L., 2005. ROLES OF FACULTY IN TEACHING ASYNCHRONOUS UNDERGRADUATE COURSES. *Online Learn.* 9. <https://doi.org/10.24059/olj.v9i1.1803>
- Niess, M., Gillow-Wiles, H., 2013. Developing Asynchronous Online Courses: Key Instructional Strategies in a Social Metacognitive Constructivist Learning Trajectory. *J. Distance Educ.* 27.
- Peters, O., 1998. *Learning and Teaching in Distance Education: Analyses and Interpretations from an International Perspective*. Routledge, London. <https://doi.org/10.4324/9780203046029>
- Picciano, A.G., 2021. Theories and Frameworks for Online Education: Seeking an Integrated Model, in: *A Guide to Administering Distance Learning*. Brill, pp. 79–103. https://doi.org/10.1163/9789004471382_005
- Ponelis, S.R., 2015. Using interpretive qualitative case studies for exploratory research in doctoral studies: A case of information systems research in small and medium enterprises. *Int. J. Doc. St.* 10, p.535.
- Rapanta, C., Botturi, L., Goodyear, P., Guàrdia, L., Koole, M., 2020. Online University Teaching During and After the Covid-19 Crisis: Refocusing Teacher Presence and Learning Activity. *Postdigital Sci. Educ.* 2, 923–945. <https://doi.org/10.1007/s42438-020-00155-y>
- Tan, W.C.K., 2022. *Research methods: A practical guide for students and researchers*. World Scientific.
- Varkey, T.C., Varkey, J.A., Ding, J.B., Varkey, P.K., Zeitler, C., Nguyen, A.M., Merhavy, Z.I., Thomas, C.R., 2023. Asynchronous learning: a general review of best practices for the 21st century. *J. Res. Innov. Teach. Learn.* 16, 4–16. <https://doi.org/10.1108/JRIT-06-2022-0036>
- Volery, T., Lord, D., 2000. Critical success factors in online education. *Int. J. Educ. Manag.* 14, 216–223. <https://doi.org/10.1108/09513540010344731>
- Yin, R.K., 2014. *Case study research: Design and methods (applied social research methods)*. Sage publications Thousand Oaks, CA.

Investigating Effective Ways to Use Artificial Intelligence in Teacher Education

Nyarai Tunjera and Agnes Chigona

Cape Peninsula University of Technology. South Africa

tunjera@cput.ac.za

chigonaa@cput.ac.za

Abstract: The current advancements in natural language processing (NLP) have paved the way for the development of highly effective AI-powered language models. These models can produce human-like writing, making them valuable in various domains, including education. Given the importance of preparing pre-service teachers who can effectively facilitate student learning in the ever-evolving digital landscape, it becomes crucial to explore innovative approaches. This study focuses on investigating the potential integration of ChatGPT, an NLP model, in teacher training programs. The qualitative research involved 2nd and 3rd-year pre-service teachers enrolled in ICTs in the Education curriculum. Data collection was done through a questionnaire and class discussions to gain insights into the pre-service teachers' experiences with using ChatGPT. The findings shed light on the potential strategies for leveraging ChatGPT to enhance lesson planning and classroom activities, as it generates text that closely resembles human communication and exhibits independent learning capabilities. Implementing ChatGPT in teacher training programs holds promise for empowering pre-service instructors in creating engaging educational materials.

Key Words: Artificial Intelligent, ChatGPT, Teacher preparation education, Personalised Learning, Marginalised Communities, AI applications, mobile learning, teacher beliefs

1. Introduction

South Africa's education system has a history of unequal distribution of educational resources, with particular communities being disadvantaged owing to their colour, ethnicity, and socioeconomic condition. Inequality and marginalization have long-term consequences, resulting in limited access to quality education and prospects for social mobility. The education system in the country is still battling with these issues, which have contributed to poor academic achievements and high dropout rates, particularly in marginalised communities. However, researchers believe that incorporating emerging technologies such as AI into teacher preparation education has the potential to improve equal access to quality education (Crompton & Burke, 2022; Jaiswal & Arun, 2021), regardless of background, socioeconomic status, race, gender, or any other characteristics within South African marginalised communities (Chen et al., 2020).

While the use of AI in education has enormous potential, it is not without problems. One of the major issues is bridging the digital divide in South Africa's marginalised areas. There are fears that the use of AI-based education methods may exacerbate the divide between those who have access to technology and those who do not. Furthermore, teachers and students may lack the necessary expertise and resources to effectively employ AI-based technology, which may impede their adoption. Additionally, cultural context, local requirements, and ethical considerations must be considered. As a result, engagement with community people, local educator participation, and addressing potential biases or discrimination in AI systems are crucial to ensuring that AI technologies serve and empower students in marginalised communities while fostering fairness and inclusivity in education.

To emancipate the above dilemma the study's main research problem is the effective implementation of AI in teacher preparation institutions in South African marginalised communities. The study seeks to answer the following research question:

What strategies be employed to effectively implement AI in teacher preparation education in South African marginalised communities?

2. Literature Review

The use of NLP and AI in pre-service teacher education, particularly in marginalized environments, has received relatively little investigation. We may now explore the significance of looking at potential NLP and AI applications for assisting pre-service teachers in marginalized contexts after acknowledging this gap in the research. By filling this study gap, we can learn important lessons about how these technologies might be used to improve support for educators and training in inadequately funded educational contexts.

2.1 Artificial Intelligence (AI)

AI is a branch of computer science concerned with developing intelligent computers capable of perceiving and comprehending their surroundings, learning from experiences, reasoning, making decisions, and interacting with humans in a manner resembling human intelligence (Hwang & Chang, 2021). It includes machine learning, natural language processing, computer vision, and robotics, to develop systems capable of doing difficult tasks that traditionally require human cognitive abilities (Hwang & Chang, 2021). While tremendous progress has been made, the pursuit of artificial general intelligence, in which robots may demonstrate human-level ability across multiple domains, remains an ongoing effort in the field of AI.

The application of AI in education is outlined in this paper as a technique to improve and revolutionise the teaching and learning process (Jean-Claude, 2022). To evaluate data, personalise learning experiences, provide meaningful feedback, and support educational decision-making, AI tools, and algorithms are used. AI, according to Crompton and Burke (2022), AI helps overcome difficulties faced by learners and educators. It generates personalised and flexible learning environments, resulting in improved learning results. Furthermore, by offering online platforms and digital materials, AI bridges the educational gap in rural or disadvantaged places, increasing access to excellent education in areas with few teachers and resources.

2.2 AI in Education

The use of AI in education is gaining popularity worldwide due to its potential to improve the equality and quality of education provided to learners. AI is used to create personalised learning experiences for learners, assess student performance, and support teachers in identifying areas where learners need additional support.

3. Improve Learning Outcome

Improving learning outcomes refers to increasing the overall efficacy and quality of the learning process as well as student outcomes. It entails putting techniques, approaches, and resources in place to improve students' comprehension, retention, and application of knowledge and skills. In this study, AI is employed as a tool to aid in the acquisition and retention of knowledge and skills in marginalised populations.

Chen et al. (2023) revealed the affordances of AI on student increased engagement and learning outcomes specifically for those experiencing resource constraints. Using AI, the system was able to analyse student performance data, determine individual strengths and weaknesses, and make personalised suggestions and interventions. Students were able to acquire specific advice in their weakest academic areas with the help of this adaptive technique, overcoming hurdles to learning and increasing it. This implies the use of an AI system provided students with a personalised learning environment, which most likely contributed to improved learning outcomes.

While the higher engagement suggests that students were more actively interested and motivated in the learning process, the improved learning outcomes imply that students attained greater academic performance. These observations are consistent with the potential advantages of AI in education, which allows for personalised learning experiences and offers each student with specialised support. It shows how AI effectively meet the various demands of students, including those who might need extra help, ultimately resulting in improved learning outcomes.

Intelligent tutoring systems (ITS) is an AI application in education that provides self-paced learning giving instant feedback to students. King et al. (2021) utilised an ITS to help students learn mathematics and reported that the AI technique improved students' learning outcomes as well as their attitudes toward mathematics. Students who used the ITS performed better on tests than those who did not, demonstrating that AI is a useful tool for enhancing students' learning. Therefore, implies an AI-based ITS has a positive impact on student's performance in learning abstract concepts.

Chatbots and virtual assistants are also being investigated as ways to instantly provide students with real-time responses to their questions. Hwang, and Chang (2021) created a chatbot to assist students in a computer science course. The researchers observed chatbot assisted students understand course material as it tailored feedback and support to individual needs. The researchers concluded that chatbots are beneficial in providing students with personalised guidance and resources, hence improving their learning outcomes and sense of satisfaction with the educational process.

4. Personalised Learning

Personalised learning is an educational approach that designs learning experiences to individual student's unique needs, interests, skills, and preferences. AI technologies and personalised learning experiences be extended to students in marginalised communities, ensuring that they receive an education that meets their unique needs and maximises their potential. Hence, AI's personalised approach has the potential to address educational disparities, improve outcomes, and empower students in marginalised communities to achieve academic success. Zhai, Chu, Chai, et al. (2021) examined the potential of AI in education in a review article, emphasising its capacity to offer individualised and adaptable learning experiences as well as its potential to assist teachers in their duties. The authors also discussed the hurdles of integrating AI, such as data privacy concerns and the necessity for teacher training and support. Similarly to this, Kasneci et al. (2023) investigated the difficulties of integrating AI in education in Nigeria and emphasised the demand for laws and procedures that promote the moral and responsible use of AI as well as for teacher assistance and training.

5. Personalisation of Content

Personalisation of content AI uses students' profiles, and performance data to develop or suggest educational materials that are tailored to students' specific needs. These platforms use algorithms to analyse data from patterns on what content students search for, and cultural references (UNESCO, 2019). This helps students to connect with knowledge that is relevant to their backgrounds and experiences, making learning more relevant and meaningful. AI-personalised educational content delivers instruction that is personalised to each student's learning needs using its AI algorithm. The intelligent tutoring system (ITS) entails tailoring the material, difficulty level, or delivery manner to their abilities and learning preferences (King *et al.*, 2021; Laine *et al.*, 2022; Hu, Fu and Yeh, 2023). As a result, students are allowed to progress through the material at their own pace.

Ouyang et al. (2023) discovered that student engagement and satisfaction with the instructional materials dramatically rose when recommendations from AI platforms considered the students' preferences, interests, and cultural backgrounds. AI improves students' learning experiences, increase engagement, and fosters a sense of inclusivity by modifying the educational content to the unique requirements and histories of each student context. Students get more emotionally invested in the lessons, which improves their motivation, understanding, and memory of the information. This specialised strategy results in better learning outcomes raised student satisfaction, and promoted a more welcoming learning atmosphere (Hu, Fu and Yeh, 2023). Though AI has enormous promise for creating and proposing personalised educational content, ethical issues need to be considered. Appropriate use of AI and caution must be taken to prevent reinforcing preconceptions, protect student privacy, and maintain transparency in the underlying algorithmic processes.

These AI-assisted personalised learning resources have the potential to address educational disparities, improve outcomes, and empower students in marginalised communities to achieve academic success. By acknowledging and accommodating the specific needs of each student, personalised learning provides a more equitable and inclusive education system that benefits all learners. In light of inclusivity, ITS offer innovative approaches to evaluating students using their current progress. By exploring the capabilities of AI in assessment, we can uncover the potential benefits and alleviate the concerns associated with traditional standardized assessments.

6. Enhanced Assessment

Machine learning techniques and natural language processing are used by AI-based assessment systems to gauge student achievement. In their research, Huang et al. (2023) demonstrate how this has the potential to revolutionise educational evaluation practices by providing more precise and impartial measurements of student performance. Prejudice, consistency problems, and grading errors are less likely to occur when machine learning, and natural language processing techniques are used. It is also crucial to remember that automated grading ensures that every student receives a consistent and fair rating in addition to saving teachers' time. This increases the validity of tests and gives a more precise indication of students' development.

AI systems give students fast, thorough feedback on their academic achievement, highlighting both their strong points and their needs for development (Kuleto et al., 2021). Use of this knowledge, pupils are better able to recognise their errors and correct them. Researchers found that tracking progress, alters students study habits, and eventually enhancing performance, thereby help students stay in school longer (Jaiswal and Arun, 2021; Li and Xing, 2021; Chen *et al.*, 2023). Students adapt their learning tactics in real-time, correct misconceptions, and enhance their performance by using AI to deliver immediate feedback (Chen *et al.*, 2023). Personalized learning

experiences powered by AI encourage students' ongoing progress as it provides immediate feedback loop, leading to more efficient and tailored learning opportunities.

7. Analysis Insights

In instances where manual grading is unfeasible owing to time constraints or a large number of students, AI-powered assessment systems may easily manage enormous amounts of evaluations, making them very scalable and perfect (Jaiswal & Arun, 2021). AI technologies free up teachers to concentrate on other elements of instruction and provide students with more individualized attention by managing enormous numbers of input. Additionally, AI develops clever insights from evaluation data to assist educators in comprehending student performance, learning trends, and places for improvement. Teachers use this data to tailor their instruction to the unique needs of each student, resulting in a more successful and personalized learning process. 4 Additionally, AI-based evaluation systems offer data-driven reports and visualizations that give teachers comprehensive analyses of their students' performance and informing sound educational decisions. The ability of AI to identify data patterns that human evaluators may not see right away allows educators to identify areas where their teaching practices or curriculum may need modification.

While AI-based evaluation techniques offer many benefits, it is essential to balance automation with human engagement. Educators are still crucial when it comes to creating tests, establishing criteria, and analysing outcomes. Collaborating between AI systems and human expertise results in the creation of evaluation methods that are both reliable and efficient. Educational institutions increase the efficacy, objectivity, and reliability of evaluations by utilizing AI to improve assessment methodologies. This will ultimately give students a more accurate assessment of their progress and encourage continual learning.

8. Remedial Support

Remedial support is crucial in education as it provides students with the necessary tools to understand and master complex concepts. Every student has individual strengths and limitations, learning styles, and motivations, which means that one-size-fits-all solutions may not be effective for all students. Therefore, tailored remedial teaching is critical to ensuring that every student realises their full potential. Researchers posit that AI helps design personalise and modify learning experiences to suit individual students' needs, by analysing their performance, identifying areas of weakness, offering tailored solutions, and helping them catch up if they fall behind (Kuleto *et al.*, 2021).

Merging AI and remedial support offers a powerful force that transforms education and helps students reach their full potential. With the advancement of technology and the increasing demand for personalised education, AI-assisted remedial support marginalised communities where learning resources are scarce. Proponents of the use of AI in education argue for its potential to significantly assist disenfranchised South African populations (Mbunge *et al.*, 2021; İçen, 2022). According to Jaiswal and Arun (2021) AI-assisted remedial support help to improve access to education for marginalised communities by providing educational resources and support to learners who may not have access to traditional educational resources.

AI-powered remedial support applications and platforms are used to provide educational materials to learners in remote areas or those who are unable to attend traditional schools. This help to increase access to education and reduce educational inequalities. The South African education adapting of AI-assisted intervention helps to address the challenges of low literacy rates in the majority of under-resourced schools and provides a more equitable and effective educational experience for all learners.

8.1 Challenges of using AI in education

While there are numerous potential benefits to using AI in education in South African marginalised communities, there are also several challenges that must be addressed. These challenges include issues related to access to technology, data privacy concerns, and the potential for exacerbating existing educational inequalities.

9. Access to AI infrastructure

The implementation of AI in education presents considerable challenges, especially in marginalised communities. Access to reliable internet connectivity, digital devices, and infrastructure is crucial for the successful functioning of AI technologies (Jaiswal and Arun, 2021). Unfortunately, many students from marginalised communities lack access to such resources, which widens the digital divide and fuels educational

inequalities (Huang *et al.*, 2023; Hwang & Chien, 2022). Consequently, personalised learning experiences, targeted interventions, and the benefits of AI-enabled education may not be accessible to these students. The inadequate infrastructure and resources in marginalised communities further limit the potential benefits of AI.

The use of AI in education may exacerbate existing educational inequalities. In some cases, the implementation of AI-powered educational systems may require significant investment in technology and infrastructure, which may be out of reach for some schools in marginalised communities (Laine *et al.*, 2022). This leads further to a digital divide, where some students have access to cutting-edge educational technology while others do not. It is important to ensure that the implementation of AI in education does not further entrench educational inequalities but rather serves as a tool to reduce them.

Advancing equal access to AI infrastructure, efforts such as supplying devices, internet access, and preservice teacher training are required to ensure that all students be exposed to AI-based educational solutions (UNESCO, 2019). This requires collaborative efforts between governments, non-profit organizations, and private companies undertaking to ensure that all students have equal access to AI-based education solutions, thereby creating an education system that is equitable and beneficial to all students (UNESCO, 2019).

10. Lack of skilled trained Educators

The successful implementation of technology-enhanced learning is hindered by a shortage of technologically skilled teachers. Jaiswal and Arun (2021) posit that to effectively integrate AI technologies into their teaching practices, educators need to have the necessary skills and expertise in integrating emerging technologies. Many teachers lack the technical proficiency and training required to leverage AI tools effectively in the classroom (Zhang and Aslan, 2021). This skills gap limits the potential benefits of AI in enhancing learning outcomes and personalising education experiences for students.

Addressing this challenge requires investing in teacher training programs that focus on building both technological and pedagogical skills among preservice teachers (Scaradozzi *et al.*, 2019). Encouraging collaboration between educators and educational technology experts also helps to ensure the effective and equitable integration of AI in education (Kasneci *et al.*, 2023). Providing teachers with access to necessary hardware and software resources is another critical step towards the successful use of AI in schools.

Importantly, there is a need to encourage collaboration between educators and technology experts also help to address this challenge and ensure effective and equitable integration of AI in education. Furthermore, there is a need to train technology educators who would help realise effective technology-enhanced education. Transforming teacher preparation education in line with the current technology-driven economies is essential for creating a successful AI-based education system, typically in South African marginalised communities.

10.1 Ethical issues

The integration of AI into education raises ethical and privacy concerns that require careful consideration. One major concern is the collection and use of student data. The use of AI in education requires the collection of large amounts of data, including personal information, which may be sensitive and confidential. This raises concerns about how this data will be used, who will have access to it, and how it will be protected from misuse (Gao *et al.*, 2022). Another concern is algorithmic transparency, especially in decision-making processes. Decisions by AI algorithms, such as personalised recommendations or assessments, should be transparent and explainable to ensure accountability and avoid unjust outcomes (Mbunge *et al.*, 2021). This is particularly important since AI algorithms may reflect biases and perpetuate existing inequalities if not monitored.

Additionally, there are ethical concerns related to student privacy and data security. The collection and analysis of student data raise privacy concerns, particularly when it comes to sensitive student information. It is essential to develop robust ethical frameworks and guidelines for AI in education to safeguard student rights and ensure equitable treatment (Chen *et al.*, 2023). All stakeholders involved in the collection, storage, and analysis of student data must be aware of their responsibilities in protecting student privacy and ensuring data security.

11. Methodology

11.1 Research design

In the study, a qualitative methodology was utilised, which involved utilizing in-depth techniques such as questionnaires and class discussions to gather information from preservice teachers who belong to marginalised communities in South Africa.

11.1.1 Data Collection Methods

To gain a deeper understanding of preservice teachers' experiences with AI in the lesson planning activity, a survey and class discussions were conducted (Maxwell, 2013). The survey link was disseminated to 2nd and 3rd-year intermediate phase preservice teachers enrolled in an ICT in Education course with evaluative and reflective questions after their AI-generated lesson plan. The survey and class discussions were created to gather participants' perceptions, experiences, and attitudes regarding the use of AI in education. During these discussions, participants provided detailed narratives, insights, and thoughts about their encounters with AI technologies, including perceived advantages or disadvantages, and any modifications they noticed in their teaching or learning methods.

The results of the Likert scale survey were complemented by the rich qualitative data that was revealed during open-ended conversations in class. Combining these methods of data collecting made it possible to fully comprehend how preservice instructors have used AI in teaching and learning. Discussion analysis gave a more comprehensive grasp of preservice teachers' perspectives while also giving a wider view of AI in education as a whole. The participants were chosen through a purposeful sampling process from a South African teacher preparation program that educates educators from underserved communities. Based on their participation in the course preparation exercise and their prior AI experiences, participants were chosen.

11.1.2 Data Analysis Techniques

11.1.3 The study used a combination of questionnaires and class discussions to get insight into how pre-service teachers perceive and interact with AI in teacher preparation programs. The acquired data were analyzed using a qualitative content analysis method, which entailed detecting reoccurring themes and patterns in the data (Maxwell, 2013).

Using a systematic coding approach and carefully analysing the data, the researchers hoped to uncover noteworthy findings and contribute knowledge that could shape future policies and processes. The qualitative content analysis technique allowed for a more in-depth assessment of educators' experiences with AI, as well as the identification of significant themes pertinent to the study's aims (Babbie, 2013).

12. Results and Discussion

The sample population for this study consisted of 2nd and 3rd-year intermediate phase pre-service teachers from marginalised communities in South Africa who are enrolled in teacher preparation education. The focus was on educators from communities that historically faced economic and social disadvantages, such as low-income neighbourhoods and rural areas. The sample size was determined by volunteering participants. Triangulation was used to validate the findings of the study by using multiple sources of data to corroborate the results. The survey data was triangulated with classroom discussion data to provide an effusive and more complete understanding of the experiences of preservice teachers. While research specifically focused on the implementation of AI in teacher preparation education in South African marginalised communities is limited, some studies have shed light on the potential benefits and challenges associated with such implementation (Crompton and Burke, 2022).

13. The Affordances of AI in Education

The participating preservice teachers made some inferences on the advantages and disadvantages of AI in education. They realised that educators should embrace and incorporate AI to enhance their teaching and learning. The preservice teachers emphasised the necessity of emphasising personal skills such as critical thinking, creativity, collaboration, and ability to communicate (4Cs) in teacher preparation education as the study revealed that content is accessible using AI. The majority of preservice teachers stressed the significance of accepting change and adjusting to it to make learning relevant to modern-day digital trends.

13.1 Use of a smarter search engine

During class discussions, preservice teachers reveal the potential of AI as a smart search engine that provides more accurate and relevant search results. Thereby improving the efficiency and effectiveness of information discovery for students and educators.

Google gave us a lot of links, but AI retrieves relevant information about the search

This study's finding demonstrates how AI revolutionise education by acting as a smart search engine and giving students access to effective and individualised information retrieval tools.

1. Generate teaching and learning content, lesson plans, assessments

This study's lesson design exercise helped students understand the potential and limitations of AI in teaching and learning. The participants remarked that the ChatGPT lesson plan was a general lesson plan that requires the teacher to contextualise to their specific class settings. However, the content and assessment generated by AI were very relevant and made it easy for Educators to have a starting from and add their style.

*It was an exciting activity of having ChatGPT generate a lesson plan, ... ChatGPT was a general plan and I had to add more specific notes and improvements... at least I had somewhere to start from. ... the objectives for my lesson plan were similar to the ones we have in our CAPS subject guide... I agree with *** the context matters most in our teaching plans...*

The majority of preservice teachers echoed the aforementioned viewpoints, indicating that educators not simply replicate existing practices but must adapt and grow to meet the needs of their students. However, they emphasised the importance of not spending excessive time on content research but rather exploring innovative approaches to create a stimulating and captivating learning environment that accommodates diverse learning styles.

ChatGPT was able to apply known context-specific knowledge, according to one participating preservice teacher, when we used location and grade in constructing lesson plans.

I listed the grade level and location on my lesson plan. ChatGPT was able to provide content examples that were relevant to our situation... I simply need to take my class out particularly to emphasise and relate to the material...

This observation is consistent with earlier research that shows AI develop innovative and engaging content that meets the different demands of learners (Crompton and Burke, 2022).

2. AI and the use of portable technologies

AI and the utilization of portable technologies have emerged as transformative tools in the field of teaching. Crompton and Burke (2022) educators create dynamic and impactful learning environments that cater to the diverse needs of students.

Using my smartphone in this project made me remain active as I use the ChatGPT app and MS Word helped me engage in our project team...

The assertion draws attention to the advantages of using smartphones and particular applications to actively engage in project teamwork. The person was able to stay involved and make a valuable contribution to the project by using the ChatGPT app and MS Word on their smartphone. This highlights how portable technology may facilitate cooperation and production regardless of location because of its simplicity and adaptability. Utilizing mobile apps and productivity tools improve collaboration, document sharing, and project management as a whole, encouraging effective teamwork and involvement.

3. Equal access to infrastructure

In this study, preservice participants emphasised the potential of AI to provide teaching and learning tools to underserved regions. Ninety per cent of the participants emphasised the value of equal access to educational resources, something that AI might help with. However, ten per cent of respondents were sceptical of a viable and comprehensive equity plan in light of the infrastructure inequality in the majority of marginalised communities, particularly the primarily black African population.

Deng et al. (2023), posit that a good infrastructure fosters ongoing professional development, assisting preservice teachers in expanding their expertise, implementing cutting-edge pedagogies, and successfully

integrating AI tools into their lesson plans. This suggests investing in the right technology infrastructure as well as enhancing physical infrastructure and internet connectivity. South Africa can offer equitable infrastructure to establish an egalitarian educational system. Cooperation between governmental organizations, academic institutions, and commercial enterprises is required to close the infrastructure gap.

The application of AI should not make previously existing inequalities worse among marginalised communities, which already experience gaps in educational possibilities. The requirements and circumstances of these communities must be taken into consideration to make sure that AI technologies are available, reasonably priced, and culturally sensitive. The participating preservice Educators highlighted the importance of a 'needs assessment' in line with educational technology,

I am tired of being exposed to technologies that do not work in our communities, however, the approach used in this course helped me to see the opportunities AI have for my academic and future teaching work, however, the one size fits all approach used is wrong, and my thinking...

A participating preservice teacher echoed the aforementioned viewpoint, demonstrating the necessity of a "Needs Assessment" strategy to successfully adopt AI in informal communities. What technologies work best for them and the most effective ways to implement these technologies? Everyone has a cell phone, as demonstrated by the preservice teachers' use of them during study activities.

... we used a mobile phone, I do not have a personal laptop, in this exercise, my mobile phone became my tool to access the AI resources.

This approach recognises and builds upon the strengths and resources already present within the community, empowering learners and promoting educational success. AI resources reduce the dependency on costly resources and expand the availability of quality educational resources.

4. Utilization of available mobile technology

An effective way to address educational issues and improve access to high-quality education in underrepresented groups is to make use of already-existing technologies. Leveraging the resources and technologies already present in these communities might result in significant and long-lasting benefits instead of just concentrating on introducing new technologies.

The majority of preservice teachers who took part in the project, if not all of them, had access to or owned a smartphone. This is in line with Chen et al. (2023) who observed that mobile phone usage is rising among underprivileged groups in places with poor infrastructure. Mobile devices are useful tools for distributing educational content, gaining access to learning resources and enhancing parent-child and teacher-student communication. Mobile technology be used to close the digital divide and guarantee equal access to education.

13.2 Challenges and Concerns about Using AI in Teaching

The potential for improving teaching and learning processes through AI integration in education is enormous. But it is crucial to handle the problems and worries that come with it. One of the primary concerns with AI integration in education is the collection and analysis of large volumes of student data (Kasneci *et al.*, 2023). Educational institutions are obliged to implement stringent data protection measures to safeguard student information and comply with relevant data protection regulations. It is essential to address concerns regarding data privacy, algorithmic transparency, and the potential for unintended consequences to ensure the ethical implementation of AI technologies.

While AI can assist with administrative tasks, personalization, and data analysis, it cannot replace the essential human elements of teaching, such as building relationships, providing emotional support, and promoting critical thinking skills (Kasneci *et al.*, 2023). This calls for educators, policymakers, and all stakeholders to collaborate to create strategies and guidelines that support responsible and efficient integration of AI in education by concentrating on data privacy and security, equitable access, bias and fairness, teacher roles and professional development, ethical considerations, and technological limitations. By doing this, educators maximize the advantages of AI while maintaining fairness, equality, and moral application to enhance student learning results.

14. Conclusion

This study investigated the effective use of AI in teacher preparation education for marginalised communities in the South African context. The findings show the potential benefits of AI in addressing current educational

challenges faced by students from marginalised communities in South Africa. The findings revealed that preservice teachers were able to access educational resources regardless of their physical location. However, challenges such as accessibility to AI infrastructure and connectivity were highlighted as drawbacks to the inclusivity that AI bring. The findings further hinted at the need to develop supportive policies and procedures to facilitate the effective implementation of AI in teacher preparation courses. However, further research is required to explore the efficacy of AI-based teaching approaches, assess the impact of AI on teacher preparation programs, and examine the long-term viability of AI interventions in these communities. Successful integration of AI in teacher education significantly enhances educational standards, making it an area worth exploring for policymakers, educators, and researchers alike.

Acknowledgement

This study was facilitated by funding from the National Research Foundation of South Africa.

References

- Babbie, E. (2013) *Qualitative Research, The Practice of Social Research*. Edited by E. Babbie.
- Chen, Y. *et al.* (2023) 'Artificial Intelligence (AI) Student Assistants in the Classroom: Designing Chatbots to Support Student Success', *Information Systems Frontiers*, 25(1), pp. 161–182. Available at: <https://doi.org/10.1007/s10796-022-10291-4>.
- Crompton, H. and Burke, D. (2022) 'Artificial intelligence in K-12 education', *SN Social Sciences*, 2(7). Available at: <https://doi.org/10.1007/s43545-022-00425-5>.
- Deng, W.H., Eslami, M. and Holstein, K. (2023) 'Towards "Anytime, Anywhere" Community Learning and Engagement around the Design of Public Sector AI', pp. 1–4. Available at: <http://arxiv.org/abs/2304.00167>.
- Gao, C.A. *et al.* (2022) 'Comparing scientific abstracts generated by ChatGPT to original abstracts using an artificial intelligence output detector, plagiarism detector, and blinded human reviewers', *bioRxiv*, p. 2022.12.23.521610. Available at: <https://www.biorxiv.org/content/10.1101/2022.12.23.521610v1%0Ahttps://www.biorxiv.org/content/10.1101/2022.12.23.521610v1.abstract>.
- Hu, Y.H., Fu, J.S. and Yeh, H.C. (2023) 'Developing an early-warning system through robotic process automation: Are intelligent tutoring robots as effective as human teachers?', *Interactive Learning Environments*, pp. 1–14. Available at: <https://doi.org/10.1080/10494820.2022.2160467>.
- Huang, X. *et al.* (2023) 'Trends, Research Issues and Applications of Artificial Intelligence in Language Education', *Educational Technology and Society*, 26(1), pp. 112–131. Available at: [https://doi.org/10.30191/ETS.202301_26\(1\).0009](https://doi.org/10.30191/ETS.202301_26(1).0009).
- Hwang, G. and Chang, C. (2021) 'A review of opportunities and challenges of chatbots in education', *Interactive Learning Environments*, 0(0), pp. 1–14. Available at: <https://doi.org/10.1080/10494820.2021.1952615>.
- Hwang, G.J. and Chien, S.Y. (2022) 'Definition, roles, and potential research issues of the metaverse in education: An artificial intelligence perspective', *Computers and Education: Artificial Intelligence*, 3(April), p. 100082. Available at: <https://doi.org/10.1016/j.caeai.2022.100082>.
- İçen, M. (2022) 'The future of education utilizing artificial intelligence in Turkey', *Humanities and Social Sciences Communications*, 9(1), pp. 1–10. Available at: <https://doi.org/10.1057/s41599-022-01284-4>.
- Jaiswal, A. and Arun, C.J. (2021) 'Potential of Artificial Intelligence for transformation of the education system in India', *International Journal of Education and Development using Information and Communication Technology (IJEDICT)*, 17(1), pp. 142–158.
- Kasneci, E. *et al.* (2023) 'ChatGPT for good? On opportunities and challenges of large language models for education', *Learning and Individual Differences*, 103(February), p. 102274. Available at: <https://doi.org/10.1016/j.lindif.2023.102274>.
- King, C.L. *et al.* (2021) 'Intelligent Tutoring System: Learning Math for 6th-Grade Primary School Students', *Education Research International*, 2021. Available at: <https://doi.org/10.1155/2021/5590470>.
- Kuleto, V. *et al.* (2021) 'Exploring opportunities and challenges of artificial intelligence and machine learning in higher education institutions', *Sustainability (Switzerland)*, 13(18), pp. 1–16. Available at: <https://doi.org/10.3390/su131810424>.
- Laine, J. *et al.* (2022) 'Systematic Review of Intelligent Tutoring Systems for Hard Skills Training in Virtual Reality Environments To cite this article : Systematic Review of Intelligent Tutoring Systems for Hard Skills Training in Virtual Reality Environments', *International Journal of Technology in Education and Science (IJTES)*, 6(2), pp. 178–203.
- Li, C. and Xing, W. (2021) 'Natural Language Generation Using Deep Learning to Support MOOC Learners', *International Journal of Artificial Intelligence in Education*, 31(2), pp. 186–214. Available at: <https://doi.org/10.1007/s40593-020-00235-x>.
- Maxwell, J.A. (2013) *Qualitative Research Design An Interactive Approach An Interactive Approach* - Joseph A. Edited by V. Knight *et al.* Washington DC: Sage.

- Mbunge, E. *et al.* (2021) 'Ethics for integrating emerging technologies to contain COVID-19 in Zimbabwe', *Human Behavior and Emerging Technologies*, 3(5), pp. 876–890. Available at: <https://doi.org/10.1002/hbe2.277>.
- Ouyang, F. *et al.* (2023) 'Integration of artificial intelligence performance prediction and learning analytics to improve student learning in online engineering course', *International Journal of Educational Technology in Higher Education* [Preprint]. Available at: <https://doi.org/10.1186/s41239-022-00372-4>.
- Scaradozzi, D. *et al.* (2019) 'Implementation and Assessment Methodologies of Teachers' Training Courses for STEM Activities', *Technology, Knowledge and Learning*, 24(2), pp. 247–268. Available at: <https://doi.org/10.1007/s10758-018-9356-1>.
- UNESCO (2019) *Artificial intelligence in education: challenges and opportunities for sustainable development*, Unesco. Available at: <https://en.unesco.org/themes/education-policy->.
- Zhang, K. and Aslan, A.B. (2021) 'AI technologies for education: Recent research & future directions', *Computers and Education: Artificial Intelligence*, 2, p. 100025. Available at: <https://doi.org/10.1016/j.caeai.2021.100025>.

Exploring the Validity of Continuous Assessment in a First-Year Programming Course at a Comprehensive Open Distance e-Learning University

Dalize van Heerden and Mmafani Serote

University of South Africa, Pretoria, South Africa

vheerme1@unisa.ac.za

Abstract: Continuous assessments are commonly used to determine students' level of understanding to implement measures to address any shortcomings. Assessment practices of programming courses at distance universities have always had numerous drawbacks due to large student bodies and time constraints. The large student body, in most instances, creates questions related to the validity and authenticity of the assessments. Time constraints in grading large numbers of assessments create questions related to the validity and authenticity of the feedback on assessments. The assumption is that the more assessments required for programming courses in a distance learning environment, the more chances there are for cheating and the less time there is to provide feedback for learning. This paper will investigate and report on assessment practices that were adopted in a first-year programming course to ensure valid authentic continuous assessment. Experiences shared in this paper offer programming instructors and the e-learning community, in general, an opportunity to make decisions on the extent to which they can use the continuous assessment strategies employed in their own settings.

Keywords: Continuous Assessment, Validity, Authenticity, Programming, E-Learning

1. Introduction

Valid and authentic continuous assessment is necessary to track student progress, give prompt feedback, promote deep learning, and encourage active learning. Also, it is crucial to guarantee that students can successfully learn and apply the abilities and expertise required to succeed in the programming sector. Valid, authentic continuous assessment promotes critical thinking, guards against plagiarism, and helps students prepare for the workforce. This paper will explore the validity and authenticity of continuous assessment in a programming course at a Comprehensive Open Distance e-Learning (CODEL) university.

The paper is based on a first-year programming course at a CODEL university. The course allows students to demonstrate an understanding of the concepts of interface design in view of its importance to the success of a computer-based product as well as a clear understanding of problem statements as stated by computer users in various industries. The course teaches the students to identify and apply user interface design principles which allows them to design a user interface, considering the visual, cognitive, and physical considerations of humans and environmental and social issues.

The course is presented fully online through the university LMS (Learning Management System). Lessons were created for each chapter of the prescribed textbook; each lesson starts with a video providing the outcomes of the chapter followed by a presentation related to theoretical work. Once a certain amount of work has been covered, the student must complete a quick check consisting of 5 "match the terms" questions to see if they have grasped certain concepts. Students cannot move on to the next section of the lesson unless they have successfully completed the quick check. The next section normally contains a video based on the practical example of coding in the prescribed book. The students are shown what to do, how to do it, and where to do it while explanations are given verbally and in a speech bubble as to why they are doing it. Students are encouraged to complete the practical example of the code on their own once they have watched the video. The theory video, quick check, and practical video are repeated until the end of the chapter is reached. Students can download all the provided videos for offline viewing. Each presentation is also made available below the video as a PDF which can be downloaded. The complete code for each chapter's practical example as well as other self-assessment exercise solutions are made available for download as a ZIP file below the video of the final practical video. Links to Open Education Resources (OERs) regarding specific topics are also made available in the "Additional Reading section" of each Lesson. Considering the rapid changes in the World Wide Web (WWW) environment these links provide the most up-to-date information regarding a specific topic.

The primary objective of the assessment is to select a strategy that best reflects the course's outcomes. Additionally, the selection of assessment methods must be compatible with the institution's systems and requirements (Goosen and Van Heerden, 2016). The specific outcomes, assessment criteria of this course, the assessment method, and the assessment tool as available in the institution are listed in Table 1.

Table 1: Course Assessment

Specific outcomes	Assessment criteria	Assessment Method	Assessment Tool
Demonstrate an understanding of the concepts of Interface Design in view of its importance to the success of a computer-based product	• An understanding of what a user interface is and how it should be developed • The descriptions of the concepts of a graphical user interface were correct and according to the theory • The descriptions of the intelligent user interface were correct and according to the theory	• Theoretical – Bloom's understanding and memorizing	• Moodle Quiz
Demonstrate a clear understanding of problem statements as stated by computer users in various industries.	• Language proficiency is clearly demonstrated	• Theoretical – Bloom's evaluation and analysing	• Moodle forum blog
Identify and apply User Interface design phases	• The different phases of the user interface design process were demonstrated	• Theoretical – Bloom's understanding and memorizing	• Moodle Quiz
Design a user interface, considering visual, cognitive, and physical considerations of humans should be considered when designing a user interface	• An understanding of the visual, cognitive, and physical considerations is demonstrated through documentation	• Practical – Bloom's applying and creating	• CodeGrade
Design a user interface taking environmental and social issues into account when designing a user interface	• An understanding of the environmental and social issues is demonstrated through documentation	• Practical – Bloom's applying and creating	• CodeGrade
Design and evaluate graphical user interfaces	• The structure of a graphical user interface is demonstrated using window, dialog boxes and menus • The user interaction with a graphical user interface is demonstrated using industry standards, corporate standards, and the development of a solution specific and to the satisfaction of the client • The presentation of a graphical user interface will be demonstrated by how the data is shown on screens and windows.	• Practical – Bloom's applying and creating	• CodeGrade

1.1 Background

The drop-out and failure rates of programming courses have been contentious issues for many years. Mathematical proficiency, programming language, learning styles, teaching methods, assessment methods, and intrinsic and extrinsic motivation have all been examined by researchers as contributing factors to drop-out and failure rates. Nearly two decades ago Bergin and Reilly (2005) noted that it was well-known “in the Computer Science Education ... community that students have difficulty with programming courses and this can result in high drop-out and failure rates”. A decade later Vihavainen, Airaksinen, and Watson (2014) stated that despite decades of research, “no factor to date has been shown to influence programming performance across a range of different teaching contexts”. Goosen and Van Heerden (2018) investigated the uptake of different assessment approaches in programming courses and concluded “Even if the best-planned, supported and implemented assessment strategies were in place, but they were not supported by the institutional systems and students, they will not be effective in addressing high drop-out and failure rates.”

Prior to 2020 the course was presented in two semesters (February – June and July – November), students were required to submit four formative assessments, three quiz and a project-based assessment, and to write a venue based summative assessment. In 2020, when the Covid pandemic started, the course was still presented in two semesters with the same formative assessments, the summative assessment was, however, conducted as an online written examination. The course underwent some extensive changes during 2021, it became a year course (March – November), continuous assessment was introduced, and students were required to submit six formative assessments, three quiz and three blog assessments and one summative project-based assessment. Auto-graded coding assessments was incorporated in the course in 2022 and students were required to submit nine formative assessments, three quiz, three blog and three auto-graded coding assessments as well as one manually graded summative project-based assessment.

The 2022 quiz assessments had 30 questions consisting of a combination multiple-choice, true or false and fill in the missing word covering 3 chapters of the prescribed book, thus 10 questions per chapter. The blog assessments required student to write a 300-word reflection on each chapter they studied, each assessment covered 3 chapters. The students also had to comment on a minimum of three of their fellow students' blogs. The Automatic Grading System (AGS) coding assessments were based on In the Lab projects in the prescribed textbook that provide step-by-step coding instructions, increases in difficulty, and requires students to create webpages based on what they learned in each chapter. For the summative assessment students had to contact a car repair service company in their area and obtain their permission to use their information to develop a website for them.

1.2 Aim of the Study

The study reported on in this paper is aimed at investigating perceptions of continuous assessment by seeking to answer the following research question:

- Can a CODEL institution foster an enabling environment for valid and authentic continuous assessment in a programming course?

2. Literature Review

The Moodle LMS platform allows for online activities like quizzes, which assists in tracking student performance and learning. There is a wide range of quizzes that can be created with various item types and settings. López-Tocón (2021) states that "The use of Moodle quizzes, as online activities, favours the implementation of a different educational methodology..." and warns that "...not all quizzes can be used as assessment tools given that the item type and the quiz settings play an important role." Students find the Moodle quiz tool easy to use and that it helps them study theoretical aspects (Romero, García and Ceamanos, 2021).

Students learn authentic and meaningful ways of thinking and practicing through blogging, by participating in an assessment technique that required them to actively consider the course material (Christie and Morris, 2021). This is supported by Van Heerden and Van Der Merwe (2014) who stated "...the implementation of knowledge blogging in an ODL environment is particularly well suited to introductory programming courses when such blogging demands reflective activities and continued engagement with the course work."

Thompson *et al.* (2021) found that "When utilised correctly, an AGS can be of huge benefit to the development of a student's knowledge, providing additional scaffolding. Through effective feedback, effective use of test cases and all the other considerations, a student will have access to what is essentially a "digital tutor"." Barlow *et al.* (2021) states that "Faculty were able to assess learning objectives at a granular level with the scaffolded programming assignments provided, and the auto-grader provides frequent and timely formative feedback. Students and teachers alike report a positive user experience, as do cost savings and ease of use". The user experience or user interface that the students have created using web frameworks or languages like HTML, CSS, and JavaScript is frequently the most important aspect of the grade. From the CodeGrade AGS "We cannot normally rely on unit testing or (command line) input and output tests for this reason. Instead, we will need to investigate and test ways to automatically interact with their website's UI." (Hillenius, 2021).

Since students actively participate, learn by doing, put their learning into practice, and address real or simulated issues, project-based learning is perfectly suited to evaluation for learning in programming courses (Munje, 2022). It is possible for students to demonstrate in concrete ways that they have understood the theory and can use it in the actual world through project-based assessment, which goes beyond merely evaluating their knowledge (Cifrian *et al.*, 2020). The implementation of project-based learning and evaluation has been shown through study to increase the performance of students taking programming courses (Cifrian *et al.*, 2020).

There are three major consideration when assessing students, validity, authenticity and dishonesty (Gikandi, Morrow and Davis, 2011). They categorized validity of assessment in an online environment as (1) authenticity of assessment activities, (2) effective formative feedback, (3) multidimensional perspectives, and (4) learner support. The authenticity of online assessment is categorized as (1) opportunities for documenting and monitoring evidence of learning, (2) multiple sources of evidence of learning and (3) explicit clarity of learning goals and shared meaning of rubrics. Gikandi, Morrow, and Davis (2011) also indicated that dishonesty "...is closely related to the issues of validity and authenticity. This implies that within the context of online formative assessment, aspects of dishonesty can be addressed by enhancing validity and authenticity."

Defining continuous assessment is somewhat problematic as there is a large variety of implementation instances. The major differences in defining continuous assessment were “key purposes, methods employed, sources of the tools or items, frequency, and context” (Muskin, Joshua A and Ibe, 2017). For the purposes of this paper the definition provided by United Nations Educational, Scientific and Cultural Organization (UNESCO) will be used. Their In-Progress Reflection No. 13 on Current and Critical Issues in Curriculum, Learning and Assessment defines continuous assessment as follows: “identify the level of learning of individual students (and sometimes of a class or some other grouping) on different aspects of the curriculum. These occur either for summative or formative purposes, and often both.” (Muskin, Joshua A and Ibe, 2017).

3. Theoretical framework

Constructivism is an educational theory that may be traced back to the work of Jean Piaget (Bakar, Mukhtar and Khalid, 2019). Constructivism is embedded in Vygotsky’s theory (Kozulin *et al.*, 2003). The constructivist theory holds that learners are active participants in their learning journey and that knowledge is built via experiences. In this study, students gain knowledge by actively participating in continuous assessment tasks.

One of the concepts of continuous assessment is to improve or reinforce teaching and learning which may be accomplished by having students participate in relevant activities within the teaching and learning process. According to constructivists effective teaching and learning is associated with authentic assessment, learner-centred learning, and the facilitator being a guide in a collaborative learning process (Ahmad, Sultana and Jamil, 2020). Throughout this process, facilitators must provide students with immediate feedback so that students may examine the existing gap between current knowledge and intended learning goals (Riese and Bälter, 2022). Through the feedback process, continuous assessment functions as a guide to self-evaluation for both the facilitator and students.

4. Methodology

4.1 Research Design

A mixed method approach is adopted (Mertens, 2019). This study conducted a survey that enabled the collection of both qualitative and quantitative data. These methods were selected with the purpose to answer the identified research question.

4.2 The Population

The class consisted of 538 students who were invited to participate in the course review hosted as an anonymous questionnaire in Google Drive. There were 184 respondents who participated.

4.3 The Participants

The survey respondents were drawn from students of a first-year programming course at a CODEL university in South Africa. The participants were 184 first-year programming students in the academic year 2022, in the computer science department.

4.4 Data Collection Process

The study utilised qualitative and quantitative approaches. A survey was used to collect both qualitative and quantitative data that was based on open-ended (qualitative) and closed-ended (quantitative) questions (Mertens, 2019).

4.5 Instrument Design

The survey was designed according to the objective of the study and prepared after critically studying the literature review. The respondents were asked questions related to their perceptions regarding continuous assessment in a programming course. The survey form utilised open-ended questions (qualitative data) and closed-ended Likert scale questions (quantitative data). The scoring for the Likert scale was e.g., Fully disagree, Disagree, Neutral, Agree, and Fully agree.

5. Results

The average submission rate of the quiz assessment was 98% of the participants in the study. Most of the students disagreed with the statement that the quiz tool made it difficult to complete the assessment, 34% fully disagreed and 40% disagreed. The statement "It is easy to pass quiz assessments" elicited a 28% fully agree, 23% agree and 30% neutral response.

On average 85% of the students who participated in the study submitted their blog assessments. Participants disagreed with the statement "I cannot see how blogging about programming will assist my communication skills in the work environment.", 25% fully disagreed, 29% disagreed and 23% was neutral. The participants agreed that the blog assessment assesses their insight into the work they studied, 20% fully agreed, 33% agreed and 24% was neutral.

The AGS coding assessments have the lowest submission rate at only 73% of participants having submitted the assessments. The assessment tool did not contribute toward the low submission rate as 23% of the participants totally disagreed with the statement that "CodeGrade made it difficult to submit the assessment", 31% disagreed and 24% was neutral. The participants felt that CodeGrade assisted them in finding errors in the code with 18% fully agreeing, 27% agreeing and 24% being neutral.

The project-based assessment was submitted by 91% of the participants. The CodeGrade AGS was used for the submission of the assessments, however, the assessment was graded manually. The above answers as pertaining to CodeGrade are also relevant for this assessment.

The participants preferred continuous assessment over writing examinations as 45% fully agreed with the statement "I prefer continuous assessment to writing an examination for the course", 17% agreed and 17% were neutral. The participant responses to the statement "I prefer viewer assignments and writing an examination" supports the first statements outcome as 35% fully disagreed with the statement, 24% disagreed and 24% were neutral. The participants agreed with the statement "The instructions on how to complete the assessments was clear", with 32% fully agreeing, 37% agreeing and 17% was neutral. The statement "I feel the assessments for the course was setup in such a way that I can perform well if I apply myself" was responded to positively with 37% respondents fully agreeing, 32% agreeing and 16% being neutral.

6. Discussion

6.1 Validity and Authenticity of Quiz Assessment

Addressing the validity, authenticity and dishonesty in the quiz assessments, question pools was created for each chapter consisting of between 90 – 120 questions, ten questions per chapter were selected randomly for each student and multiple-choice answers were also randomized. Students received immediate feedback on their quiz assessments that provides explanation as to why a questions answer is considered wrong. Students were given three opportunities to complete the assessment and a new set of questions were generated for each opportunity. Through the randomization of both questions and answers the aspect of dishonesty is addressed.

6.2 Validity and Authenticity of Blog Assessment

Students were required to write a blog reflecting on what they have learned for the assessment based on the material they studied in specific chapters. Each reflection must be at least 600 words long, with 200 words for each chapter. For every three chapters that students have studied, they were required to submit one blog. In addition, students were required to leave comments on at least three other students' blogs. This gives them a chance to interact with other students and get a different perspective on the material. These assessments have a high validity and authenticity, which is crucial in the CODEL environment because no two students can have identical reflections on what they have learned.

6.3 Validity and Authenticity of Automated Grading System Assessment

CodeGrade was implemented as the AGS to grade the coding assessments. Students were given a specific set of instructions to follow to build a website, they were provided with image, sound, video, links, and detailed descriptions of how to write the code. After every third chapter in the prescribed book the students must submit the completed code for the three chapters. In CodeGrade web user interfaces were auto graded with Selenium and Jest. The specific requirements were used as a rubric against which the code is tested, and feedback provided. Feedback entails showing students the required code versus what they submitted, which allows them to make corrections to their code. Students were allowed three submissions and the grade of the final

submission is captured. As all students were required to submit the exact same code the assessment have a low validity and authenticity with a high possibility of dishonesty.

6.4 Validity and Authenticity of Project Based Assessment

The summative assessment of the course was project-based, students were required to contact a car repair shop in their area and develop a website for them based on given criteria. Students had to obtain images, sound, videos, and all other relevant information about the shop to incorporate into the website. The students were given three opportunities to submit their assessment via the CodeGrade AGS and the last submission was graded manually using a rubric that was also provided to the students. Although students may design the website for the same shop, their code and website should never look identical, if this is the case there is a high probability of dishonesty extending high validity and authenticity to this assessment.

6.5 Validity and Authenticity of Continuous Assessment

The continuous assessment strategy followed in the course was to implement different assessment methods to assess different aspects of the curriculum. Students were given explicit instructions on what will be assessed through each assessment method and how each assessment method works. The feedback received on certain assessments allowed students to return to the work they have studied and make corrections where necessary and then resubmit their work.

7. Conclusion

Ensuring valid and authentic continuous assessment of programming courses at a CODEL institution requires careful planning, attention to detail, and the use of appropriate assessment methods and tools (Van Zyl and Le Roux, 2019). The first step is to clearly define the learning outcomes for the programming courses and the assessment criteria that will be used to evaluate students' performance (Wallace, Gloria and Munetsi, 2022). This should be done at the beginning of the course and communicated clearly to the students.

It is important to use a variety of assessment methods to evaluate students' learning, such as quizzes, coding assignments, blogs, and online tests. This can help ensure that different aspects of the learning outcomes are being assessed and can also reduce the risk of cheating (Pereira, Flores and Niklasson, 2016). Providing clear instructions for all assessments and giving students detailed feedback on their performance are also essential. This will help them understand what they need to do to improve and will also help maintain the validity and authenticity of the assessment.

Regular monitoring of student progress can help identify issues early on and allow for intervention if necessary (Apaloo, Kombat and Mohammed, 2022). This can be done using learning analytics and online discussion forums. Academic integrity is crucial to ensure the validity and authenticity of assessments. This can be achieved by using appropriate assessment methods and tools, clearly communicating academic expectations to students, and taking appropriate actions if academic misconduct is detected.

Overall, ensuring valid and authentic continuous assessment of programming courses at a CODEL institution requires a proactive approach and the use of a range of strategies and tools to promote student learning and maintain academic integrity. CODEL institutions can foster an enabling environment for valid and authentic continuous assessment in a programming course.

References

- Ahmad, S., Sultana, N. and Jamil, S. (2020) 'Behaviorism vs Constructivism: A Paradigm Shift from Traditional to Alternative Assessment Techniques Sadia Jamil', *Journal of Applied Linguistics and Language Research*, 7(2), pp. 19–33.
- Apaloo, M., Kombat, D. and Mohammed, Y. (2022) 'Continuous Assessment As a Good Predictor of Actual Performance', *Education, Sustainability & Society*, 5(1), pp. 21–23. doi: 10.26480/ess.01.2022.21.23.
- Bakar, M. A., Mukhtar, M. and Khalid, F. (2019) 'The development of a visual output approach for programming via the application of cognitive load theory and constructivism', *International Journal of Advanced Computer Science and Applications*, 10(11), pp. 305–312. doi: 10.14569/IJACSA.2019.0101142.
- Barlow, M. et al. (2021) 'MOCSIDE: An Open-Source and Scalable Online IDE and Auto-Grader for Introductory Programming Courses', *J. Comput. Sci. Coll.*, 37(5), pp. 11–20.
- Bergin, S. and Reilly, R. (2005) 'The influence of motivation and comfort-level on learning to program.', in *17th Annual Workshop of the Psychology of Programming Interest Group*. Sussex University: Psychology of Programming Interest Group, pp. 293–304.

- Christie, H. and Morris, N. (2021) 'Using assessed blogs to enhance student engagement', *Teaching in Higher Education*. Taylor & Francis, 26(4), pp. 573–585. doi: 10.1080/13562517.2019.1662390.
- Cifrian, E. *et al.* (2020) 'Integration of different assessment approaches: application to a project-based learning engineering course', *Education for Chemical Engineers*, 31, pp. 62–75. doi: 10.1016/j.ece.2020.04.006.
- Gikandi, J. W., Morrow, D. and Davis, N. E. (2011) 'Online formative assessment in higher education: A review of the literature', *Computers & Education*. Elsevier Ltd, 57(4), pp. 2333–2351. doi: 10.1016/j.compedu.2011.06.004.
- Goosen, L. and Van Heerden, D. (2016) 'E-learning environment tools to address online and open distance education context challenges', *Proceedings of the International Conference on e-Learning, ICEL*, 2016-Janua, pp. 275–284.
- Goosen, L. and Van Heerden, D. (2018) 'Assessment of Students in Higher Education— Information and Communication Technology Tools and Tips', *Progressio*, 40(1 & 2), pp. 1–23. doi: 10.25159/0256-8853/4704.
- Hillenius, D. (2021) *Autograding Web UI*. Available at: <https://www.codegrade.com/blog/autograding-web-user-interfaces-with-selenium-and-jest-in-codegrade>.
- Kozulin, A. *et al.* (2003) *Vygotsky's Educational Theory in Cultural Context*. Cambridge University Press.
- López-Tocón, I. (2021) 'Moodle quizzes as a continuous assessment in higher education: An exploratory approach in physical chemistry', *Education Sciences*, 11(9). doi: 10.3390/educsci11090500.
- Mertens, D. M. (2019) *Research and Evaluation in Education and Psychology: Integrating Diversity ... - Donna M. Mertens - Google Books*. 5th edn. SAGE Publications. Available at: https://books.google.co.za/books?hl=en&lr=&id=6RR7DwAAQBAJ&oi=fnd&pg=PT17&dq=mixed+method+research+approach+computer+science+education&ots=dfI9FvB2fO&sig=e6ARz4sUZpGs2bmHJs6zyjLA2XU&redir_esc=y#v=onepage&q=mixed+method+research+approach+computer+science (Accessed: 14 March 2023).
- Munje, R. K. (2022) 'Project-Based Learning: Teaching Methodology to Impart Knowledge and Skills', *Journal of Engineering Education Transformations*, 35(Special Issue 1), pp. 326–333. doi: 10.16920/jeet/2022/v35is1/22047.
- Muskin, Joshua A and Ibe (2017) *Continuous assessment for improved teaching and learning: a critical review to inform policy and practice; Current and critical issues in curriculum, learning and assessment; Vol.:13; 2017*. 13. Available at: <https://unesdoc.unesco.org/ark:/48223/pf0000255511>.
- Pereira, D., Flores, M. A. and Niklasson, L. (2016) 'Assessment revisited: a review of research in Assessment and Evaluation in Higher Education', *Assessment and Evaluation in Higher Education*. Routledge, 41(7), pp. 1008–1032. doi: 10.1080/02602938.2015.1055233.
- Riese, E. and Bälter, O. (2022) 'A Qualitative Study of Experienced Course Coordinators' Perspectives on Assessment in Introductory Programming Courses for Non-CS Majors', *ACM Transactions on Computing Education*, 22(4), pp. 1–29. doi: 10.1145/3517134.
- Romero, E., García, L. and Ceamanos, J. (2021) 'Moodle and Socrative quizzes as formative aids on theory teaching in a chemical engineering subject', *Education for Chemical Engineers*, 36, pp. 54–64. doi: 10.1016/j.ece.2021.03.001.
- Thompson, A. *et al.* (2021) 'Considerations when using an Automatic Grading System within Computer Science Modules', *International Conference on Higher Education Advances*, pp. 589–597. doi: 10.4995/HEAd21.2021.13045.
- Van Heerden, D. and Van Der Merwe, M. (2014) 'Employing objective measures in search of a relationship between knowledge Blogs and introductory programming performance outcome', *Proceedings of the International Conference on e-Learning, ICEL*, pp. 185–189.
- Van Zyl, C. J. and Le Roux, W. J. (2019) 'Article title: Implementing Continuous Assessment in an Academic Programme for More Effective Learning Implementing Continuous Assessment in an Academic Programme for More Effective Learning', *UnisaRxiv*, (May), pp. 0–2. doi: 10.25159/UnisaRxiv/000006.v1.
- Vihavainen, A., Airaksinen, J. and Watson, C. (2014) 'A systematic review of approaches for teaching introductory programming and their influence on success', in *Proceedings of the tenth annual conference on International computing education research - ICER '14*, pp. 19–26. doi: 10.1145/2632320.2632349.
- Wallace, M. T., Gloria, M. L. and Munetsi, H. W. (2022) 'Continuous Assessment Learning Activity : an Overdue Progressive Assessment Approach Compromisingly Implemented', *International Journal of All Research Writings*, 4(July), pp. 57–68.

School Reading Lists and Understanding Written Information for Life and Work

Dana Vicherková, Veronika Murinová and Nela Nováková

University of Ostrava, Czech Republic

dana.vicherkova@osu.cz

l22434@student.osu.cz

p22048@student.osu.cz

Abstract: School reading lists are an essential factor influencing understanding the content and form of various types of texts: artistic, non-artistic, and electronic texts of an everyday nature among Czech technical secondary school pupils. The research aims to determine by analysing eight key school documents whether recommended school lists of texts for study at secondary technical schools are published electronically on schools' websites in the Moravian-Bohemian and Olomouc Regions of the Czech Republic. A partial goal is to determine whether school reading lists contain different types of texts and whether pupils at technical secondary schools understand information with a professional, artistic, media, etc., focus. A quantitatively oriented questionnaire survey through the lens of 523 pupils from 5 Czech secondary technical schools investigated what factors influence the reader's understanding of printed and electronic texts. The research results showed that Czech secondary school pupils like working with informal texts on social networks, frequently require help understanding texts of an administrative nature, and rarely work with texts from everyday life at school. The average to below-average level of reading and digital literacy among Czech 15-year-old pupils was also highlighted by the PISA 2018 international research.

Keywords: analysis of reading lists, types of texts, factors of comprehension of non-artistic texts, literacy competence for life, pupils of secondary technical schools

1. Introduction

Developing reading and digital literacy is paramount for Czech pupils and adults in the 21st century, as it plays a crucial role in everyday life and employment. This objective is reflected in the lifelong education concept of 2030+. The Czech Republic is currently undergoing a period of transition regarding the oral examination in the mother tongue, shifting from a national uniform Maturita examination framework to a school-based profile examination framework. As part of this shift, secondary schools must prepare a list of artistic reading materials for pupils, constructed per recommended guidelines from the Ministry of Education and Culture (CERMAT, 2020). The school Maturita reading list serves as a binding e-learning tool for Czech pupils, aiding in creating individual pupil lists of Maturita reading and education with reading (e)books. This e-learning strategy has proven effective even in the era of online education during the Covid-19 pandemic. As defined by Clark and Mayer (2016, p. 30 – 31), E-learning refers to instruction delivered on a digital device intended to support learning. E-learning courses incorporate content and instructional methods that facilitate the acquisition of knowledge. The courses are offered via digital devices. Notably, non-artistic texts are no longer mandatory in the Czech language Maturita examination. Recent assessments of pupils' reading skills in primary and secondary schools, conducted in conjunction with international researches PISA 2018 (2019) and PIRLS (2021), highlight the need to enhance literacy education among modern readers. The results underscore the importance of promoting reading and digital literacy among Czech pupils and adults, as it is an essential aspect of functional literacy in the 21st century.

2. Reading skills of Czech pupils

Reading comprehension is a crucial skill for effective studying and securing employment in the labour market. The Czech School Inspectorate (ČŠI) places significant importance on reading skills, regularly administering national-level tests to primary school pupils to evaluate their abilities in addition to active participation in international research surveys, such as PIRLS (2021) and PISA 2018 (2019), focused on ten-year-old and fifteen-year-old pupils, respectively. The ČŠI National Report (NZ ČŠI, 2023, p. 5) emphasises that reading skills are a crucial prerequisite for the effective acquisition and mastery of many other skills, including mathematical or scientific skills. By regularly participating in international studies of reading literacy, such as PIRLS and PISA, the Czech Republic can track trends in pupil skills, focusing on reading comprehension and mapping the reading comprehension level when working with diverse information sources, such as electronic forms of testing. However, the latest results from the PIRLS survey show that there has been a slight increase in the proportion of pupils (4%) whose skills did not even reach the lowest level of reading skills (NZ ČŠI, PIRLS, 2023, p. 7).

Furthermore, while Czech pupils tend to be more successful in searching for and deriving information from the text, they fall behind in more complex reading skills, such as interpreting and assessing information. In teaching reading at Czech primary schools, teachers predominantly require pupils to read aloud and practice vocabulary (80%). Individualised instruction reading or pupils' independent work on their preferred task is used significantly less than the EU average (NZ ČŠI, 2023, p. 8, p. 55). Additionally, Czech pupils' learning and reading activities realised through digital devices are lower than the EU average. Approximately three-quarters of pupils have teachers in whose classes they never encounter digital devices during individualised activities (NZ ČŠI, 2023, p. 61). A secondary analysis of the PISA 2018 survey highlights the importance of motivation for successfully developing reading skills. According to the research, motivation is a necessary and determining condition for the successful development of reading literacy (NZ ČŠI, 2023, p. 59). Tomas et al. (2021, p. 109) identify the reading environment, family support for reading, and reading-motivated teaching as factors influencing text comprehension. Wharton Mc Donald (2011, p. 265) emphasises the role of the teacher in teaching as a critical factor affecting the pupil's reading comprehension skills.

3. Working with texts and pupils' positive attitude to reading (PIRLS research, 2021)

According to the NZ ČŠI communique (2023, p.13), the structure of textual tasks in the PIRLS tests (2021) contained a diverse range of text types, including conventional written texts, electronic texts, Internet texts, and information on simulated websites with multimedia elements. During the PIRLS (2021) testing process, pupils were exposed to various types of texts, such as literary texts (e.g., narrative), scientific, historical, and biographical informational texts, biographical data, descriptions of work processes, advertising information, and reports. The primary focus of PIRLS (2021) was to emphasise four critical text comprehension processes: searching for information, drawing conclusions, interpreting and evaluating text, and two primary reading purposes, namely, reading for gaining experience (literary orientation) and reading for obtaining and using information (informational texts). Furthermore, the long-term mapping of pupils' reading preferences through the international PISA and PIRLS surveys revealed a connection between pubescents' attitudes towards reading and their reading skills.

3.1 Types of texts in educational practice

The Czech secondary school education system has long been criticised for its heavy focus on professional expository non-artistic printed texts, primarily through teaching texts or textbooks in teaching the mother tongue. In contrast, journalistic-style texts from magazines and daily newspapers receive comparatively less attention. Barták (1993, p. 1116) states that printed text is "the result of the printing workflow, by which the colour is transferred from the printing form by pressure to the paper." However, the Covid-19 pandemic has brought about a new trend and the need for changes in the digitisation of teaching and learning, both from a European and global perspective. The pandemic has highlighted the importance of utilising new technological approaches, tools, and applications to provide effective learning support within school practice. The demand for innovative teaching methods to handle various types and forms of text, such as electronic and hybrid, has been increasing dynamically. As Čermák (2017, p. 398) notes, any continuous text, whether written or spoken, that can be read by a computer and processed can be defined as electronic text. The extent and manner of processing such texts depend on the goal, technical conditions, and needs. Nowadays, many schools work with both printed and electronic forms of text. Due to the increased societal need to communicate with authorities electronically, the need to understand non-artistic administrative texts has also surged. Polívková (2009, p. 87) argues that the informational procedure is frequently applied in administrative texts. Čechová (2017) highlights the prevalence of wordiness in normative, documentary, and notification texts. Administrative communication encompasses formal messages of administrative, organisational, and official nature, such as postal and bank texting. On the other hand, artistic texts bring the uniqueness of the author's expression and fulfil various functions, such as aesthetic and cognitive. In literary education, artistic texts are categorised into four main genres: lyrical, epic, lyrical-epic, and dramatic. As Nünning et al. (2006, p. 163) define, a literary genre is a specific type of text determined based on various criteria, such as a novel, satire, epic, tragedy, historical drama, etc. In modern, effective teaching, it is vital to incorporate a wide range of texts, including artistic, non-artistic, and everyday life texts that provide both practical information and emotionally charged informal messages. These texts may include emoticons, content abbreviations, colloquial phrases (without respect to language norms), e-mail, informal communication on social networks, SMS messages, and more. By engaging with diverse texts, pupils can better understand language and its many forms.

4. The current approach towards creating Maturita reading lists in Czech secondary schools

From 2011 to 2020, the Maturita examination in the field of Czech language and literature was administered as part of the common section of the Maturita examination in three distinct formats: a written essay, an oral examination, and a didactic test. This approach was based on the then-current Maturita Catalogues, designed and implemented by the Ministry of Education, Youth and Sports of the Czech Republic. However, significant curricular adjustments have been made to the Maturita examination model in the Czech language from 2020 to 2023. As of 2022/2023, the common section of the Maturita examination in the Czech language consists solely of a didactic test (containing closed questions and open tasks from the following areas: spelling, morphology, sentence structure and word formation, knowledge of literature (overview, text analysis, understanding of different types of texts), while the profile section includes a written essay and an oral examination, the content and organisation of which are determined by the school head teacher without reference to the previously mandatory curricular documents – Catalogues. It is noteworthy that individual secondary schools are encouraged by the Ministry of Education, Culture, and Sports to establish a list of Maturita readings for the oral component of the examination in the Czech language.

Before the academic year of 2019-2020, secondary schools completed by the Maturita examination adhered to the Catalogues of examination requirements of the common part of the Maturita examination (Cermat, 2019/2020). These Catalogues established strict guidelines for compiling school and pupil reading lists, encompassing specific literary genres and types of works and selected Czech and world literary works. Furthermore, the Catalogues outlined precise numerical requirements for the literary works designated for secondary school reading. The Maturita reading list is a basic aspect of the Czech language curriculum. It outlines the necessary scope and content of knowledge required to realise the oral Maturita examination. As part of the e-learning process, each pupil collaborates with their mother tongue teacher to create a personalised reading list integral to the partial oral Maturita examination.

Basic rules for compiling a school Maturita reading list (valid until 2019/2020, according to the Catalogue):

- "1. The minimum total number of literary works offered is 60; the upper limit is not set.
2. A comprehensive work, not a part of it, is considered a literary work.
3. The edition is specified for a literary work from world literature.
4. The pupil submits to the head teacher a list of 20 literary works compiled based on the criteria for selecting Maturita assignments for the oral examination" (Catalogue, 2019/2020).

Basic rules for compiling a pupil's Maturita reading list (valid until 2019/2020, according to the Catalogue):

- "1. Prose, poetry, and drama must be represented by at least two literary works.
2. The list can contain a maximum of two works by one author" (Catalogue, 2019/2020).

From 2020/2021, every Czech secondary school completed by the Maturita examination sets its binding curriculum document for the current school year as a mandatory part of the oral Maturita examination: "School Maturita reading list" as well as rules for compiling the so-called "Pupils' Maturita reading list", which is created by each pupil based on publications read throughout secondary school studies in the field of artistic literature. Currently, school lists of secondary school reading of non-artistic texts in the Czech Republic are not part of binding curriculum documents valid for the common or profile part of the Czech language and literature Maturita examination. The research delves into the current curricular predicament within the Czech concept of the Maturita examination in the mother tongue and its evolution towards a nationwide unified national testing of pupils through partial examinations in the mother tongue. Specifically, the study explores utilising the school Maturita reading list in the form of e-learning (2011) and its impact on the gradual changes in the concept of the Maturita examination (2020 - 2023). Every Czech secondary school completed by Maturita examination designs a draft of the school Maturita reading list to assess the pupil's knowledge of the books from the pupil's reading list in the partial oral examination. This tool has proven helpful in testing the pupils' understanding of literary works and their ability to apply critical thinking skills.

5. Research Methodology 1

In the initial stage of our research, our focus was on the issue of the school reading list as a crucial element affecting the comprehension of artistic texts in both printed and electronic formats. The quantitative research conducted by Vicherková, Paličková, and Davidová (2020) served as the foundation for the development of our research plan and tool for executing a content analysis of the Maturita lists of literary works at selected technical secondary schools within the Czech Republic. Our research objective was to scrutinise the content of the school Maturita lists of literary works of secondary technical schools completed by the Maturita examination in the Moravian-Silesian and Olomouc regions. We aimed to determine the types of texts in the selected school Maturita reading lists. A total of 20 secondary schools were approached to participate in our study; eight agreed to participate and provided the researchers with school Maturita reading lists. The documents' content analysis research sample thus included eight school reading lists from eight secondary technical schools in the Moravian-Silesian and Olomouc Regions. The first phase of the research was conducted between December 2022 and March 2023.

The research goal was to analyse the content of the school Maturita reading lists of secondary technical schools completed by the Maturita examination and to find out what types of texts are part of the selected school Maturita reading lists. The key recommendations for schools, teachers and pupils published in the ČŠI National Report include supporting efforts "to develop advanced reading abilities and skills in all pupils by including suitable reading situations in teaching within all subjects and to use the available methodical care in the area of pupils' reading literacy" (NZ ČŠI, PIRLS 2021, IEA, 2023, p. 64).

5.1 Content analysis of school Maturita reading lists (artistic literature)

5.1.1 Objectives of Content Analysis and Research Questions

Main objective:

The research objective is to analyse the content of school Maturita reading lists of secondary technical schools completed by the Maturita examination.

Sub-objectives and research questions

1. To find out how many works of contemporary Czech literature of the 21st century (published since 2000) are represented in selected school Maturita reading lists.
Does the reading list contain at least 5 Czech literary works?
2. To find out how many works of contemporary world literature of the 21st century (published since 2000) are represented in selected school Maturita reading lists.
Does the reading list contain at least 4 works of world literature?
3. To find out how many world and Czech literature works up to the end of the 18th century are represented in selected school Maturita reading lists.
Does the reading list contain at least 2 works of literature?
4. To determine how many world and Czech literature works up to the end of the 19th century are represented in selected school Maturita reading lists.
Does the reading list contain at least 3 works of literature?
5. To determine whether there is a difference in the number of books in selected school Maturita reading lists.
Do the selected Maturita lists contain a higher/lower number of works than the minimum specified in the Catalogue, 2019/2020 (i.e., 60 works)?
6. To determine how many printed publications are represented in selected school Maturita reading lists.
Are printed publications represented in selected school Maturita reading lists?
7. To determine how many electronic publications are represented in selected school Maturita reading lists.
Are electronic publications represented in selected school Maturita reading lists?
Does the number of printed publications exceed electronic in selected school Maturita reading lists?

Research sample:

The research sample consisted of eight documents (i.e., eight school Maturita reading lists from eight participating Czech secondary technical schools). The reading lists were analysed using the document analysis method).

5.1.2 Items (P1-P7):

P1 - works of world and Czech literature up to the end of the 18th century

1 – contains 2 – doesn't contain

P2 - works of world and Czech literature up to the end of the 19th century

1 – contains 2 – doesn't contain

P3 - works of world literature of the 20th and 21st centuries

1 – contains 2 – doesn't contain

P4 - works of Czech literature of the 20th and 21st centuries

1 – contains 2 – doesn't contain

P5 - minimum number of works (60 works)

1 – contains 2 – doesn't contain

P6 - printed publications

1 – contains 2 – doesn't contain

P7 - electronic publications

1 – contains 2 – doesn't contain

5.2 Research results summary (the occurrence of individual items P1 – P7):

A table contains data acquired by the content analysis of documents of school Maturita reading lists of selected schools in MSK and OL regions (S1 – S8).

Table 1: Content analysis data of school Maturita reading lists

List →	S1		S2		S3		S4		S5		S6		S7		S8	
Item ↓	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
P1		X	X		X		X		X		X			X	X	
P2	X		X		X		X		X		X		X		X	
P3	X		X		X		X		X		X		X		X	
P4	X		X		X		X		X		X		X		X	
P5	X		X		X		X		X		X		X		X	
P6	X		X		X		X		X		X		X		X	
P7		X		X		X		X		X		X		X		X

List of secondary technical schools that participated in the research (the number of literary works included in the school Maturita reading list is in parenthesis):

S1 – Secondary school 1, (61)

S2 – Secondary school 2, (73)

S3 – Secondary school 3, (65)

S4 – Secondary school 4, (80)

S5 – Secondary school 6, (100)

S6 – Secondary school 7, (70)

S7 – Secondary school 8, (61)

S8 – Secondary school 9, (80)

The present study conducted a content analysis of the school Maturita reading lists of eight Czech secondary technical schools completed by the Maturita examination.

The analysis presented in Table 1 offers a comparative overview of the total occurrence of individual items in a selected sample of eight schools. As per the curriculum recommendations, item P2 contains the correct minimum number of world and Czech literature works until the end of the 19th century. This requirement entails including three literary works in all eight school Maturita reading lists based on the participating schools' research. Furthermore, the content analysis of school reading lists reveals that item P3 comprises works of world literature of the 20th and 21st centuries, with a minimum of four literary works. Similarly, item P4 includes works of Czech literature of the 20th and 21st centuries, with a minimum of five literary works. Additionally, item P6 highlights that the school Maturita reading lists of the entire research sample (100%) only contain works in the printed text.

One interesting discovery is that item P1 encompassing the world and Czech literature works until the end of the 18th century in the specified minimum number of 2 literary works, is fulfilled by only 6 school Maturita reading lists. Two school Maturita reading lists contain only works of world literature up to the end of the 18th century and no works of Czech literature from the same period. Another research finding pertains to item P5, which determines the minimum number of literary works included in a school's list to 60 literary works. However, the variable exhibits significant variation in the number of literary works featured in the reading lists of eight participating schools, ranging from 61 to 100 books. Furthermore, item P7 indicates that none of the literary works in the school Maturita reading lists is available in electronic form. No link to an electronic publication on the school's website was found within the analysed school Maturita reading lists.

6. Research Methodology 2

A quantitative questionnaire research focusing on five secondary technical schools was conducted in two regions of the Czech Republic: the Moravian-Silesian Region and the Olomouc Region. The research was carried out from December 2022 to March 2023 and obtained data from 523 respondents (pupils). It is worth noting that most of the respondents were male, with 459 pupils accounting for 87.76% of the total number of pupils in the 1st - 4th year of technically oriented secondary school studies. To gather our data, we utilised a semi-structured questionnaire that contained 25 semi-open items carefully sorted into four distinct categories (A - E):

- A. "Types of texts in terms of their popularity among technical secondary school pupils" (5 items)
- B. "Types of texts in terms of the frequency of reading texts from the point of view of secondary school pupils" (5 items)
- C. "Effects of reading a non-artistic text on a secondary school pupil" (3 items)
- D. "School Maturita reading list" (5 items)
- E. "Factors supporting the reading of non-artistic texts" (7 items)

6.1 Research objectives

The research objective was to determine factors influencing pupils' reading of non-artistic and artistic texts at secondary technical schools. The sub-objectives of the research were to find out what kinds of non-artistic and artistic texts are popular with secondary school pupils and what kinds of texts technical secondary schools classify as recommended reading,

The research problem was decomposed into the following research questions:

1. Is there a relationship between peer recommendation of non-artistic reading and perceptions of non-artistic as reading for knowledge? H1 (9x11)
2. Is there a relationship between reading non-artistic texts for knowledge and the frequency of reading non-artistic texts? H2 (18 x 23)
3. Is there a relationship between reading electronic text for knowledge and reading electronic text for entertainment? H4 (12x13)

6.2 Results

The research objectives and questions conveyed three research hypotheses, presented simultaneously with the results of their statistical verification in the next chapter.

6.3 Descriptive research data

The descriptive data analysis helps to comprehensively understand the reading preferences on artistic and non-artistic texts among individuals within the research group. The results showed that out of all the respondents surveyed, only 33 (6.31%) preferred administrative texts, while 99 (18.93%) indicated a predilection for advertising texts. Moreover, a significant majority of the respondents, 393 (75.14%), identified knowledge as the primary motivator for reading non-artistic texts. Notably, around half of the secondary school pupils, i.e., 265 (50.67%), select non-artistic texts based on recommendations from their peers, such as friends and classmates. Interestingly, the findings revealed that most respondents, i.e., 450 (86.04%), preferred informal and visually appealing texts. Furthermore, almost half of the respondents, 254 (48.57%), found reading non-artistic texts enjoyable, while a third of the respondents, 174 (33.27%), believed that reading non-artistic texts was beneficial for learning. The results also indicated that most respondents, i.e., 457 (87.38%), reported reading texts online during leisure time. The qualitative responses to the semi-structured questionnaire provided an insightful understanding of Czech secondary school pupils' reading habits and preferences. The findings revealed that these pupils preferred working with informational texts on social media platforms and frequently struggled to comprehend administrative texts. Additionally, they rarely engaged with texts related to everyday life during class. Interestingly, the pupils preferred technical texts over artistic ones as a gift.

6.4 Relational research results

Using Pearson's Chi-square for the contingency table, three hypotheses were tested. The source data and corresponding statistical results are shown in the following tables.

The pupils answered questions 9 (whether reading non-artistic texts affects their knowledge) and 11 (which texts they read more frequently daily) of the questionnaire.

Table 2. Detected and expected frequencies to H1

Pearson's chi-square = 0.010977 degree of freedom = 1 significance $p = 0.9165574$			
Q 9	Q 11 – non-artistic text	Q 11 - artistic text	Line totals
Yes, it affects my cognition	343 (342.65)	50 (50.35)	393
No, it doesn't affect my cognition	113 (113.35)	17 (16.65)	130
Column totals	456	67	523

Hypothesis 1, stating that pupils who think that reading non-artistic texts affects their cognition read non-artistic texts more frequently daily than pupils who do not think that reading non-artistic texts affects their cognition, **was not confirmed** (Tab. 2). There is no statistically significant relationship between reading non-artistic texts for knowledge and daily reading of non-artistic texts.

The pupils answered questions 18 (whether they have a list of reading recommended by the school) and 23 (concerning texts they own) of the questionnaire.

Table 3. Detected and expected frequencies to H2

Pearson's chi-square = 8.828069 degree of freedom = 1 significance $p = 0.0029663$			
Q 18	Q 23 - artistic text	Q 23 - non-artistic text	Line totals
Yes	274 (265.22)	211 (219.78)	485
No	12 (20.78)	26 (17.22)	38
Column totals	286	237	523

Hypothesis 2, stating that pupils who have a school-recommended art reading list own more artistic texts than pupils who do not have a school-recommended art reading list, **was confirmed** (Tab. 3). There is a statistically significant relationship between the school reading list and the type of text in the home library.

The pupils answered questions 12 (what kind of text do they read more frequently for knowledge) and 13 (what kind of text do they read for entertainment) of the questionnaire.

Table 4. Detected and expected frequencies to H3

Pearson's chi-square = 72.701127 degree of freedom = 1 significance $p= 0.1508E-18$			
Q 12	Q 13 - printed text	Q 13 - electronic text	Line totals
Printed text	61 (26.84)	55 (89.16)	116
Electronic text	60 (94.16)	347 (312.84)	407
Column totals	121	402	523

Hypothesis 3, stating that pupils who read an electronic text more frequently for knowledge also read an electronic text more frequently for entertainment than pupils who do not read an electronic text more frequently for knowledge, **was confirmed** (Tab. 4). There is a statistically significant relationship between reading electronic texts for knowledge and entertainment.

The study's findings indicated that several factors influence the comprehension of non-artistic texts. Among these factors, the availability of daily opportunities to engage with non-artistic texts was identified as a crucial aspect, as reported by 87.19% of the participants (456). Additionally, the research highlighted the impact of technological advancements, such as robotisation, digitalisation, and automation, on reading for knowledge and interaction with virtual, electronic, digital, and hybrid texts. Most respondents (77.82%; 407) reported that these processes had influenced their reading habits. Furthermore, the study revealed that electronic texts are increasingly preferred for leisure-time reading, with 76.86% of the participants (402) indicating their preference for this format. Notably, technical school pupils perceived reading non-artistic texts as a vital factor in enhancing their general knowledge, with 75.14% of the respondents (393) acknowledging its importance.

Other findings include the factors influencing pupils' comprehension of artistic and non-artistic texts. Among these factors, the possession of a personal library was found to be a significant determinant. Specifically, a higher number of artistic kinds of literature in pupils' libraries, totalling 286 or 54.68%, was found to correlate positively with their internal motivation to read artistic texts recommended by the school. Additionally, the awareness of the existence of a functional school list for artistic literature was found to be a decisive factor in shaping the reading culture of secondary school pupils, their orientation in verbal art, and their acquaintance with the traditional literary references of our ancestors to the values of everyday life as was evident in the responses of 485, or 92.73% of the participants. As for non-artistic literature, it was found that administrative texts do not constitute the most frequently read material among the school's recommended list. The absence of a higher number of administrative texts in school literature lists and the associated lower reading activity in contact with official texts of an everyday nature can be understood as a factor influencing the reading experience and reading misunderstanding of the texts needed for everyday civic literacy. This factor may lead to insufficient reading and digital competence when filling out e-mail and e-banking forms needed for everyday life. Furthermore, the study revealed that graphic imagination and the experience of working with graphic displays in everyday and professional texts significantly influence pupils' understanding of information in the graphic image of the text. As indicated by 431 or 82.41% of the respondents, this aspect of reading is an area that has the potential to enrich the reading experience and enhance the comprehension of the information presented in the graphic form.

7. Discussion and conclusion

The investigation into creating school Maturita reading lists at Czech secondary schools has yielded significant findings. The content analysis on the "School Maturita Reading List" document from 8 secondary technical schools in the Czech Republic determined that literary works are only listed in printed texts, with no links to electronic literary publications available on school websites. Moreover, an analysis of school documents revealed that schools recommend a minimum of 61 and a maximum of 100 literary works for school Maturita reading, with contemporary Czech and world literature being frequently recommended. Interestingly, the minimum number of publications recommended by the schools in particular time-limited literary periods in Czech and world literature was observed in all analysed lists. However, it was noted that a minimum number of literary works of world literature by the end of the 18th century were represented in 75% of school reading lists, and no literary work from Czech literature until the end of the 18th century was present in all analysed lists. One concerning research finding was the absence of lists of non-artistic literature for secondary school studies

finished by Maturita examination on school websites. The study also quantitatively presented the reading habits and preferences of technically oriented Czech secondary school pupils towards different types of texts, their understanding of information towards different purposes of reading, and the frequency of reading different types of texts. Additionally, the research defined selected factors influencing the comprehension of content and form of various non-artistic texts (professional and leisure) and reading artistic texts. The dominance of reading leisure activity of pupils (aged 15-19 years) in reading texts in the Internet environment was also highlighted. These findings provide insight into the reading habits and preferences of the younger generation concerning different types of texts.

The quantitative research results did not confirm (H1) a statistically significant relationship between reading non-artistic texts for knowledge and daily reading of non-artistic texts.

Research has confirmed:

- (H2) that pupils with a school-recommended art reading list own more artistic texts than pupils who do not have a school-recommended art reading list.
- (H3) that a statistically significant relationship exists between reading electronic texts for knowledge and entertainment.

An interesting research finding is that as a gift, pupils would prefer a printed, technically oriented text over an artistic one. Research by Ludewig et al. (2022) pointed to a decline in average reading comprehension, corresponding to one-third of a year of the learning process. The problem of language and cognitive skills of pupils was dealt with in the research of Kim (2020). Research by Duke and Cartwright (2021) highlighted the importance of active self-regulatory processes in reading success. Králíková (2020, p. 5) and Hník (2016, p. 234 – 241) dealt with the problem of critical discussions on the current Czech Maturita school reading canon. The research of Utami and Nur (2021) dealt with analysing pupils' reading interests during learning (e-learning) throughout the Covid-19 pandemic.

Acknowledgement

The paper was created with the financial support of the SGS project at the Faculty of Education of the University of Ostrava. The authors thank for the support provided to SGS12/PDF/2023 Factors influencing the understanding of (e)non-artistic texts among pupils at secondary vocational schools with a technical orientation in the Moravian-Silesian and Olomouc regions.

References

- Barták, J. (1993). *Encyklopedický slovník*. Odeon, Encyklopedický dům. [Barták, J. (1993). Encyclopedic dictionary. Odeon, Encyclopedia House.]
- Clark, R. C. and Mayer, R. E. (2016). *E-Learning and the Science of Instruction: Proven Guidelines for Consumers and Designers of Multimedia Learning* (Fourth Edition). Center for Creative Leadership.
- Čechová, M. (2017). Administrativní styl. In: P. Karlík, M. Nekula, J. Pleskalová (eds.). *CzechEncy - Nový encyklopedický slovník češtiny*. Retrieved from: https://www.czechency.org/slovník/ADMINISTRATIVNÍ_STYL [cit. 2023-06-07].
- [Čermák, F. (2017). Electronic text. In: P. Karlík, M. Nekula, J. Pleskalová (eds.). *CzechEncy - New encyclopedic dictionary of the Czech language*. Retrieved from: https://www.czechency.org/slovník/ADMINISTRATIVNÍ_STYL [cit. 2023-06-07].]
- Čermák, F. (2017). Elektronický text. In: P. Karlík, M. Nekula, J. Pleskalová (eds.). *CzechEncy - Nový encyklopedický slovník češtiny*. Retrieved from: https://www.czechency.org/slovník/ELEKTRONICKÝ_TEXT [cit. 2023-06-07].
- [Čermák, F. (2017). Electronic text. In: P. Karlík, M. Nekula, J. Pleskalová (eds.). *CzechEncy - New encyclopedic dictionary of the Czech language*. Retrieved from: https://www.czechency.org/slovník/ELEKTRONICKÝ_TEXT [cit. 2023-06-07].]
- Duke, N.K. and Cartwright, K.B. (2021). The Science of Reading Progresses: Communicating Advances Beyond the Simple View of Reading. *Reading Research Quarterly*, 56(S1), S25-S44. Retrieved from <https://doi.org/10.1002/rrq.411>
- Hník, O. (2016). Školní literární kánon. *Český jazyk a literatura*, 66(5), 234–241. ISSN 0009-0786. [Hník, O. (2016). School literary canon. *Czech language and literature*. 66(5), 234–241. ISSN 0009-0786.]
- Katalog požadavků Zkoušky společné části maturitní zkoušky 2019/2020. Praha: Centrum pro zjišťování výsledků vzdělávání. Retrieved from <https://maturita-ceremat.cz/menu/katalogy-pozadavku> [Catalogue of requirements Examinations of the common part of the Maturita examination 2019/2020. Prague: Center for the Assessment of Education Results. Retrieved from <https://maturita-ceremat.cz/menu/katalogy-pozadavku>]
- Kim, Y. S. G. (2020). Hierarchical and dynamic relations of language and cognitive skills to reading comprehension: Testing the direct and indirect effects model of reading (DIER). *Journal of Educational Psychology*. 112, 667–684. Retrieved from <https://doi.org/10.1037/edu0000407>

- Králíková, A. (2020). Pitva literatury: Co prozrazují diskuse o maturitním kánonu. A2, XVI(15), 5. ISSN 1803-6635. [Králíková, A. (2020). An autopsy of the literature: What the discussions about the graduation canon reveal. A2, XVI(15), 5. ISSN 1803-6635]
- Ludewig, U., Kleinkorres, R., Schaufelberger, R., Schillter, T., Lorenz, R., Koenig, Ch., Frey, A. and Mc Elvany, N. (2022). COVID-19 Pandemic and Pupil Reading Achievement: Findings From a School Panel Study. *Frontiers in Psychology* [18 May 2022] Sec. *Educational Psychology*, vol. 13. Retrieved from <https://doi.org/10.3389/fpsyg.2022.876485>
- NZ ČŠI (2023). Mezinárodní šetření PIRLS 2021. Retrieved from <https://csicr.cz> [ČŠI National Report (2023). International survey PIRLS 2021. Retrieved from <https://csicr.cz>]
- Nünning, A., Trávníček, J. a Holý, J. (2006). Lexikon teorie literatury a kultury: koncepce, osobnosti, základní pojmy. Host. [Nünning, A., Trávníček, J. and Holý, J. (2006). Lexicon of the theory of literature and culture: concepts, personalities, basic terms. Guest.]
- PISA 2018 Results. (2019). What Pupils Know and can do (Volume I). Retrieved from <https://read.oecd-ilibrary.org/...-en>
- Polívková, A. (2009). Jak být IN v písemném projevu. Praha: Euromedia Group, k.s., 160. ISBN 978-80-242-2419-0. [Polívková, A. (2009). How to be IN in written speech. Prague: Euromedia Group, k.s., 160. ISBN 978-80-242-2419-0.]
- Tomas, M. J. L., Villaros, E. T. and Galman, S. M. A. (2021). The Perceived Challenges in Reading of Learner: Basis for School Reading Programs. *Open Journal of Social Sciences*, 9(5).
- Utami, S. and Nur, J. (2021). An Analysis of Pupils' Reading Interest during Learning from Home Amidst the Covid-19 Pandemic. *IJEE Journal*, 8(1), 140-155. Retrieved from <https://doi.org/10.15408/ijee.v8i1.17157>
- Vicherková, D., Paličková, A. a Davidová, P. (2020). E-learning of Pupils for Elaboration of Reading Lists for Secondary School Examination. In: *19th European Conference on e-Learning ECEL 2020: 19th European Conference on e-Learning ECEL 2020 2020-10-28 Berlín*. UK: Published by Academic Conferences International Limited Reading, 517-525. ISBN 978-1-912764-78-5.
- Wharton McDonald, R. (2011). Expert classroom instruction for pupils with reading disabilities: Explicit, intense targeted...and flexible. In R. L. Allington & A. McGill-Franzen (Eds.), *Handbook of reading disability research*, 265-272. New York, NY: Routledge.

HyFlex Learning as Support for Lifelong Learning

Tone Vold and Linda Kjøning

Inland Norway University of Applied Sciences, Rena, Norway

Tone.vold@inn.no

Linda.kionig@inn.no

Abstract: Since the COVID-19 pandemic, the courses in a study programme in Knowledge Management have been offered as a hybrid version, serving students at both a campus and online. The official policy from the universities is that the students are wanted back at the campuses. However, students in a work-life lifelong learning situation do not always have the opportunity of travelling to a campus. Hence, the possibility of taking part digitally in a class with a mix of online and physically present students has been the right solution for many working students. This paper presents results from a survey among students enrolled in four different courses in the study programme of Knowledge Management at the Inland Norway University of Applied Sciences, Norway, where the physical classroom is based in Kongsvinger, and the students are either present at the campus or online simultaneously. The preliminary results show that the students in this lifelong learning situation are depending on this hybridity in order maintain their learning opportunities, as this enables them to stay in an often-demanding work situation, as well as being able to stay as learners at a university. This implies that the hybridity, first boosted by the COVID-19 pandemic, now, independently of the pandemic, is a demand within the segment of lifelong learners, as this will support access to higher education independent of place of residence, family situation or work situation. The students in this segment claim to attend physically if and when they have the opportunity to travel due to the above-mentioned situations. Hence, online only is not always the best option.

Keywords: Lifelong Learning, Blended Learning, Adult Learning, Hyflex Learning, Flipped Classroom

1. Introduction

Online learning has been around for quite a while. From remote schooling (hand-) written assignments to be sent via mail to the teachers, to today's email or learning management system (LMS), there are a plethora of systems organizing online learning. During the COVID-19 pandemic, both students and lecturers had to rely on online systems for lecturing and all correspondence and communication. In many cases, this led to students feeling isolated and developing psychological problems (Knight *et al.*, 2021; Salimi *et al.*, 2023). Although not all investigations showed a declining mental health issue among the students (Hamza *et al.*, 2021), there has been a definite turn to students asking for the online option if they are prevented from leaving, or otherwise wanting to stay at home or at work. However, post-pandemic, many universities have returned to face-to-face lecturing (Zhao & Xue, 2023), with some now having a blended learning approach (Mozelius, 2020; Remenyi, 2020; Singh, Steele, & Singh, 2021; Cobo-Rendón *et al.*, 2022).

Nevertheless, according to Cobo-Rendón *et al.* (2022), due to the quick turn to online lecturing for the lecturers, many have not been able to adapt to the various options and possibilities that lie in the online medium. Moreover, the equipment chosen may not have been optimal to fully utilize the online potential. Hence, the "return" to an ordinary classroom situation may be preferred.

1.1 Adult Learning

Adults may be in different situations when they need to upgrade their knowledge. They may be living far away from the higher education institution; they may have family situations that make travelling difficult and they may even have jobs where it is difficult to prioritize taking time away from in order to go to school.

According to Knowles (2015), adults learn differently from children. According to Brookfield (1995), adults are concerned about self-directed learning, critical reflection, experiential learning and learning to learn. Self-directed learning is about adults taking control of their own learning. Transformational learning (Mezirow, 2010) involves critical reflection, and is about reframing previous schemes as they make sense of the newly acquired knowledge. Experiential learning (Kolb, 2014) is about learning from experiences. Kolb, being heavily influenced by Dewey (1938, 1966), described how one can utilize an experience for reflection, abstract conceptualization, which can be "fed" into a new active experiencing, see Figure 1:

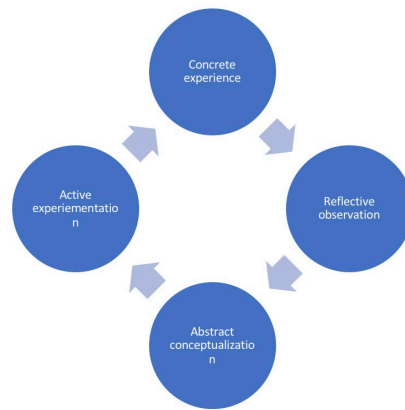


Figure 1: Kolb's experiential learning cycle (Kolb, 2014)

For adults to learn how to learn, it means that “that adults possess a self-conscious awareness of how it is they come to know what they know; an awareness of the reasoning, assumptions, evidence and justifications that underlie our beliefs that something is true” (Brookfield, 1995, p. 5).

Adults need to know why they should learn something, and are more prone to follow an intrinsic motivation, rather than an external one (Merriam & Baumgartner, 2020). This may imply that the adult students want to be involved in the development of the learning, as they are then able to control the learning outcome. However, according to Courtenay, Arnold and Kim (1994), participation in the development has no effect on the adult's gain in learning.

Learning is also about changes in the brain. When the brain and its environment interact, it may result in changes (Merriam & Baumgartner, 2020). Bronfenbrenner (1996) also claimed that the general environment would also influence a person's development.

As pointed out earlier, *reflection* is also important for the learning process (Schön, 1984, 1987; Moon, 2013). Reflection can be facilitated before an action (Cowan, 2008), during an action (Schön, 1984; Moon, 2013) and after an action (Allen & Smith, 1994).

1.2 Different Learning Approaches

Several approaches to combining online and on-campus learning have been described. Blended learning is defined by Cronje (2020) as “the appropriate mix of theories, methods and technologies to optimise learning in a given context” (Cronje, 2020, p. 120). This means that we need to consider both the constructivist and behaviourist approaches to learning. There are some disagreements regarding the terms “blended learning” and “hybrid learning”. According to Fisher, Frey, Almarode and Henderson-Rosser (2021) Blended learning is about both distance learning and face-to face learning, but not simultaneously, and hybrid learning is when students “learn part time with at teacher in a physical school classroom and part-time online” (p. 9). According to others, blended learning is often about mixing face-to-face lecturing with online lecturing (Boelens, De Wever, & Voet, 2017; Boelens, Voet, & De Wever, 2018). It may also include other approaches such as the “flipped classroom” (Bishop & Verleger, 2013). Hybrid learning is about dividing time between an online and face-to-face presence during a course (Ranganathan, Negash, & Wilcox, 2007), which is similar to what Fisher et al. (2021) claimed. This has had a positive outcome on the learning outcome (Saichaie, 2020).

HyFlex and Synchromodal learning is about synchronous and face-to-face learning at the same time (Howell, 2022). In other words, HyFlex learning allows the students to choose between face-to-face or online instruction (Kohnke & Moorhouse, 2021). Creating a community out of the students who are face-to-face and online may be a challenge for the lecturers, but should be encouraged to encourage the students to develop teams and groupwork across the “borders” of the technology (Kohnke & Moorhouse, 2021).

Howell (2022) developed an overview of the different terms, which is reprinted below with kind permission from the author. It explains the different approaches, how they relate to each other and how they place themselves on a continuum providing high flexibility to low flexibility. Here, we see that the HyFlex/Synchromodal approach is of high flexibility and such, thereby allowing students to choose between an online presence or a face-to-face appearance.

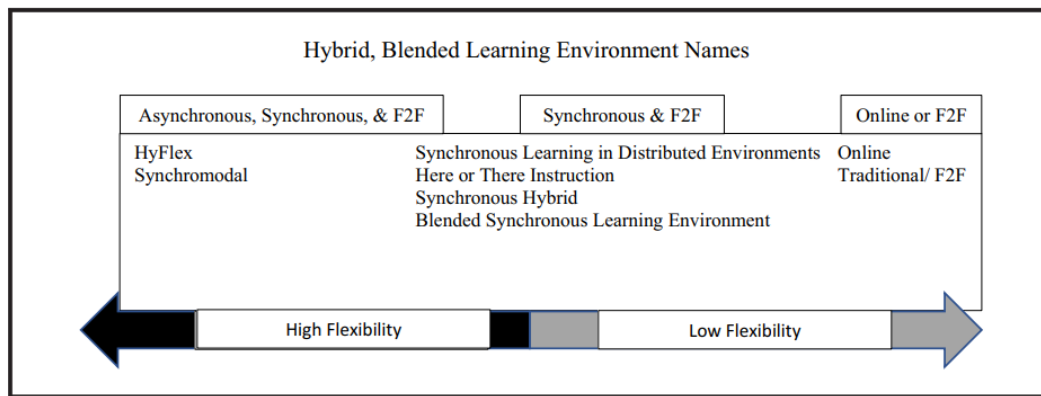


Figure 2: Distinction of terms (Howell, 2022) reprinted with permission.

1.3 The Courses in Learning Organizations and Knowledge Management

At the Inland Norway University of Applied Sciences, Norway, many studies have returned to a campus-based lecturing regime. One study that has chosen a blended approach is the study programme of Knowledge Management, which consists of four courses: two in the autumn semester and two in the spring semester. The students enrolled in this study programme are generally adult students in a work-life. The students are from all over Norway, with many having to travel for several hours to attend live campus lectures. The lecturers are given in seminars over two days, three times per semester. During the seminars, they attend two different courses in parallel, one day with each course throughout the semester.

We wanted to investigate how the students perceive an approach that allowed both analogue and digital students to attend the same lectures. The courses are conducted in a semi-flipped way, with streaming video of full lectures, a short version of the lectures at the beginning of the day of the seminar and then work on developing assignments before solving them.

1.4 Lifelong Learning

Organizations are exposed to changes due to the development of technology, changes in markets and access to knowledge and/or material, as well as changes in politics or other influences (Jacobsen & Thorsvik, 2019). Among other issues, these changes require updates, and that the workforce stays up to date with the developments. There may be several different changes during a person's work-life, with the ability to learn and develop accordingly very sought after, and one of the desired skills to develop, according to the OECD (Toner, 2011).

Governments have also recognized the need for workforces to develop to stay up to date, not only in the private-, but also in the public sector (Jarvis, 2007). Lifelong learning strategies are promoted, both within the organization and as initiatives in cooperation with higher education (Clarke, 2001). In addition to reflection and being reflective practitioners, situated learning (Lave & Wenger, 1991) is mentioned among the methods used for lifelong learning purposes.

1.5 Research Question

What we wanted to understand the connection between Hyflex or Synchromodal learning and adults lifelong learning. Hence, the research question:

How does HyFlex/Synchromodal learning support lifelong learning?

In the following, we present our data collection methods and findings before we conclude and look to future research on the topic.

2. Method of Inquiry

We have chosen to treat this as a case study (Remenyi, 2012; Yin, 2014). Although we have not aimed for generalizing findings, using the case study approach has allowed us to take an in-depth look at a specific subject, here regarding if or how HyFlex/Synchromodal learning can contribute to lifelong learning.

We have chosen to use a mixed methods approach (Creswell, 2007; Creswell & Creswell, 2017), and base our findings on a survey and interviews. We have done a qualitative interpretation of the data (Creswell, 2007; Kvale & Brinkmann, 2015; Johannessen, Christoffersen, & Tufte, 2020). The data has been categorized into main categories and sub-categories.

The survey had 37 answers, and we have interviewed (group interviews and individual interviews) 11 students (out of a possibility of 82).

3. Findings

Our findings show us that there are several students who choose the HyFlex/Synchromodal. The main reasons for not attending face-to-face lectures are primarily: 1) the travel costs, 2) the time away from family and/or from work, 3) young children or otherwise difficult family situations, and 4) not granted time off from an employer. Due to work or family situation, some of these students then choose an online version of the lecturing if time permits. Several students claim that this is the only way to attend lectures at all, and that due to the option of online lectures they are able to stay in the study programme.

There are also students who oppose travelling for reasons of sustainability. They claim to see the online option as environmentally friendly and less costly, both regarding nature and time.

Some of the students prefer the face-to-face lectures and claim that the socialization and possibilities for learning and reflecting together with other fellow students is preferred. Still, these students also claim that there is some security in knowing that there is an option to take part online if the situation should not allow them to attend in person.

Yet, some students are doing both, attending maybe one or two face-to-face lectures and attending the rest of the seminars online. Again, this group claims that without this option, it would be difficult to follow the study programme.

All of the respondents seem to prefer the blend of learning opportunities that are otherwise provided in the course, such as the “flipped classroom” approach, with the streaming video and developing and solving assignments in plenary, as well as working on utilizing the students’ own backgrounds, in order to develop their critical reflection, support their transformational learning and even their intrinsic motivation for self-directed learning.

This seems to invite for the development of a model, including both blended learning opportunities in a HyFlex/Synchromodal setting. We may propose a model that can be viewed as a three-dimensional model. It shows the different learning approaches in one dimension, and the HyFlexity/Synchromodality in the other dimension (Figure 3):

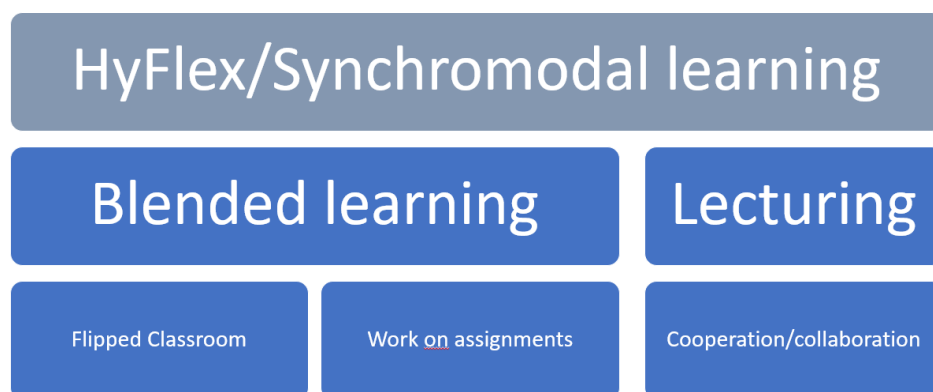


Figure 3: Overview of HyFlex/Synchromodal as an overarching learning method, with the different learning adaptions within this context

For example, within the cooperation/collaboration are Communities of Practice, teamwork and other collaborative learning approaches.

The difficulties reported with the HyFlex/Synchromodal learning are that the equipment is not fully supporting a full integration, to make it both a full face-to-face experience and a full online experience. The lecturers also

seem not to be trained to handle a dual face-to-face/online situation as lecturers. Attention will therefore have to be on either the students being physically present or online.

4. Conclusion

The HyFlex/Synchromodal learning approach seems to support adult students in diverse situations to take part in lifelong learning that they otherwise would not have been able to attend. It is thus possible to utilize most of the blended learning processes such as the “flipped classroom”, working on assignments, developing and utilizing reflection processes and experiential learning processes within the frames of the HyFlex/Synchromodal learning. Even for students who have planned to attend face-to-face in seminars, it is reassuring to have the opportunity to take part online if they are prohibited from travelling to the campus. For the ones in a family/work/financial situation that does not allow for travel expenses, nor time off from work or family, the online option is also appreciated. Hence, the HyFlex/Synchromodal learning supports lifelong learning, as it allows more adult students to take part in higher education due to the online possibilities that lie in HyFlex/Synchromodal learning.

The equipment and training for a smoother transition between the different modes are needed, meaning that the technology must be developed to support a more streamlined online/in person appearance, and the lecturers need to be trained to better handle and treat the audiences in the various media.

4.1 Further research

Further research is needed, and different technological appliances may be utilized. A broader investigation of the different types of technologies available should be carried out and based on this the lecturers should be trained to handle this technology.

References

- Allen, G. and Smith, R. (1994) ‘After action review in military training simulations’, in *Proceedings of Winter Simulation Conference*. IEEE, pp. 845–849.
- Bishop, J. L. and Verleger, M. A. (2013) ‘The flipped classroom: A survey of the research’, in *ASEE national conference proceedings, Atlanta, GA*, pp. 1–18.
- Boelens, R., Voet, M. and De Wever, B. (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 and education*, 120, pp. 197–212. doi: 10.1016/j.compedu.2018.02.009.
- Boelens, R., De Wever, B. and Voet, M. (2017) ‘Four key challenges to the design of blended learning: A systematic literature review’, *Educational research review*, 22, pp. 1–18. doi: 10.1016/j.edurev.2017.06.001.
- Bronfenbrenner, U. (1996) *The ecology of human development : experiments by nature and design*. Cambridge, Massachusetts: Harvard University Press.
- Brookfield, S. (1995) ‘Adult learning: An overview’, *International encyclopedia of education*, 10, pp. 375–380.
- Clarke, J. (2001) *Supporting Lifelong Learning : Volume I: Perspectives on Learning*. Edited by A. Hanson, R. Harrison, and F. Reeve. Hoboken: Taylor and Francis.
- Cobo-Rendón, R. et al. (2022) ‘Return to university classrooms with Blended Learning: a possible post-pandemic COVID-19 scenario’, in *Frontiers in Education*. Frontiers Media SA.
- Courtenay, B. C., Arnold, G. W. and Kim, K. (1994) ‘An examination of the empirical basis for involving adult learners in planning their learning experiences’, *International journal of lifelong education*, 13(4), pp. 291–300. doi: 10.1080/0260137940130404.
- Cowan, J. (2008) ‘Facilitating development through varieties of reflection’, *Higher Education Academy*, pp. 1–17.
- Creswell, J. W. (2007) *Qualitative inquiry & research design : choosing among five approaches*. 2nd ed. Thousand Oaks, Calif: Sage.
- Creswell, J. W. and Creswell, J. D. (2017) *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications.
- Cronje, J. (2020) ‘Towards a new definition of blended learning’, *Electronic journal of e-Learning*, 18(2), pp. pp114-121.
- Dewey, J. (1938) *Experience & education*. New York: Kappa Delta Pi/Touchstone.
- Dewey, J. (1966) ‘Democracy and education (1916)’, *Jo Ann Boydston (ed.). The Middle Works of John Dewey*, 9, pp. 1899–1924.
- Fisher, D. et al. (2021) ‘The quick guide to simultaneous, hybrid, & blended learning’, *Quick guide to simultaneous, hybrid, and blended learning*. 1st ed. Thousand Oaks, California: Corwin.
- Hamza, C. A. et al. (2021) ‘When social isolation is nothing new: A longitudinal study on psychological distress during COVID-19 among university students with and without preexisting mental health concerns.’, *Canadian Psychology/Psychologie canadienne*, 62(1), p. 20.

- Howell, E. (2022) 'HyFlex model of higher education: understanding the promise of flexibility', *On the Horizon: The International Journal of Learning Futures*, 30(4), pp. 173–181.
- Jacobsen, D. I. and Thorsvik, J. (2019) *How organizations are working (in Norwegian: Hvordan organisasjoner fungerer)*. 5. utgave. Edited by J. Thorsvik. Bergen: Fagbokforlaget.
- Jarvis, P. (2007) *Globalization, Lifelong Learning and the Learning Society: Sociological Perspectives*. Florence: Florence: Routledge (Lifelong Learning and the Learning Society). doi: 10.4324/9780203964408.
- Johannessen, A., Christoffersen, L. and Tufte, P. A. (2020) *Research methods for the area of business and administration (Translated from Norwegian: Forskningsmetode for økonomisk-administrative fag)*. 4. utgave. Edited by L. Christoffersen and P. A. Tufte. Oslo: Abstrakt forlag.
- Knight, H. et al. (2021) 'Impacts of the COVID-19 pandemic and Self-Isolation on students and staff in higher education: A qualitative study', *International journal of environmental research and public health*, 18(20), p. 10675.
- Knowles, M. S., Holton III, E. F. and Swanson, R. A. (2015) *The Adult Learner: The definitive classic in adult education and human resource development*. London: London: Routledge. doi: 10.4324/9781315816951.
- Kohnke, L. and Moorhouse, B. L. (2021) 'Adopting HyFlex in higher education in response to COVID-19: students' perspectives', *Open Learning: The Journal of Open, Distance and e-Learning*, 36(3), pp. 231–244.
- Kolb, D. A. (2014) *Experiential learning: Experience as the source of learning and development*. FT press.
- Kvale, S. and Brinkmann, S. (2015) *InterViews : learning the craft of qualitative research interviewing*. 3rd ed. Edited by S. Kvale. Thousand Oaks, Calif: Sage.
- Lave, J. and Wenger, E. (1991) *Situated learning: Legitimate peripheral participation*. Cambridge university press.
- Merriam, S. B. and Baumgartner, L. M. (2020) 'Learning in adulthood : a comprehensive guide'. Edited by L. Baumgartner and J.-B. Inc. Hoboken, New Jersey: Jossey-Bass (Jossey-Bass higher and adult education series).
- Mezirow, J. (2010) 'Transformative learning in practice : insights from community, workplace, and higher education'. Edited by E. W. (Edward W. Taylor. San Francisco: Jossey-Bass.
- Moon, J. A. (2013) 'Reflection in learning and professional development: Theory and practice'.
- Mozelius, P. (2020) 'Post Corona Adated Blended learning in Higher Education', in Remenyi, D., Grant, K. A., and Singh, S. (eds) *University of the Future-Responding to COVID-19*. Reading, UK: ACPIL, pp. 93–97.
- Ranganathan, S., Negash, S. and Wilcox, M. V (2007) 'Hybrid learning: Balancing face-to-face and online class sessions'.
- Remenyi, D. (2012) 'Case study research: The quick guide series', in. Academic Conferences Limited.
- Remenyi, D. (2020) 'Post-Covid-19 Universities: Reformed or Reinvented', in Remenyi, D., Grant, K. A., and Singh, S. (eds) *University of the Future-Responding to COVID-19*. Reading, UK: ACPIL, pp. 1–7.
- Saichaie, K. (2020) 'Blended, flipped, and hybrid learning: Definitions, developments, and directions', *New Directions for Teaching and Learning*, 2020(164), pp. 95–104.
- Salimi, N. et al. (2023) 'College students mental health challenges: Concerns and considerations in the COVID-19 pandemic', *Journal of College Student Psychotherapy*, 37(1), pp. 39–51.
- Schön, D. A. (1984) *The reflective practitioner: How professionals think in action*. Basic books.
- Schön, D. A. (1987) *Educating the reflective practitioner: Toward a new design for teaching and learning in the professions*. Jossey-Bass.
- Singh, J., Steele, K. and Singh, L. (2021) 'Combining the best of online and face-to-face learning: Hybrid and blended learning approach for COVID-19, post vaccine, & post-pandemic world', *Journal of Educational Technology Systems*, 50(2), pp. 140–171.
- Toner, P. (2011) 'Workforce skills and innovation: An overview of major themes in the literature'.
- Yin, R. K. (2014) *Case study research: design and methods*. 5. edition. Los Angeles: Los Angeles: SAGE.
- Zhao, X. and Xue, W. (2023) 'From online to offline education in the post-pandemic era: Challenges encountered by international students at British universities', *Frontiers in Psychology*, 13, p. 1093475.

Using Video-Feedback to Support Learning Outcome and Work-life Relevance

Tone Vold, Ole Jørgen Ranglund and Linda Kiønig

Inland Norway University of Applied Sciences, Rena, Norway

tone.vold@inn.no

Ole.ranglund@inn.no

Linda.kionig@inn.no

Abstract: With students having the opportunity of choosing to take part in courses online rather than attend physically, they may lose the personal contact with the lecturers. One way of inducing a personal touch is by providing personalized video-feedback on the students' assignments to maintain or establish a connection with the students. Video-feedback is tested out in blended learning, and thus far, the results have been positive. The students claim that this is a more personal and direct way of obtaining feedback on their work. The students in this research project are students in the study programme of Knowledge Management at the Business School at the Inland Norway University of Applied Sciences. The courses consist of three full-day seminars per semester, in addition to streaming video of the curriculum. There is also a mandatory assignment that the students need to pass in order to proceed and take their exam. The courses, both in the autumn semester and the spring semester, have been delivered as a hybrid version, meaning that the students have been able to follow the courses, either online or present in a (physical) classroom. The video-feedback on their assignments has been developed from only being feedback on their assignment and issues for improvement, to where in this semester, the focus has been on tying the feedback to the learning objectives of the course. In this paper, the focus has been on the students who have only been able to follow the courses on an online basis. Via in-depth interviews, such as via Zoom with online students, the impact of the video-feedback has been compared for these particular students to the generic students who have also attended in person. Our investigations have revealed that the impact on the online students were positive, as they do find this type of feedback more personal compared to the students who had also been present in the classroom.

Keywords: Online Learning, Blended Learning, Video-Feedback, Learning Objectives, Motivation

1. Introduction

During the COVID-19 pandemic, all the lecturing had to be online at the Inland Norway University of Applied Sciences, Norway. After the pandemic, many study programmes returned to classes with physical attendance. In the study programme of Knowledge Management, in which the students are mainly adult students having to balance working full-time and studying part-time. For these students, the question of online lectures arose long before COVID-19 hit. At the end of the pandemic, there seemed to be an expectation of a continued online lecturing situation. The students are generally in a work-life situation, and there are various reasons as to why they ask for online attendance. At the Inland Norway University of Applied Sciences in Norway, many of the courses that were deployed online during the COVID-19 pandemic are now only offered as courses at a campus where the students are to meet in person. According to Vold, Lervik and Holen (2022), most adult students prefer online courses. Bashir et al. (2021) claim that many universities are working on more flexible learning solutions. Hence, in the years after the pandemic, the Knowledge Management study programme has been offered as a hybrid virtual classroom,; both with the opportunity for students to physically attend classes/lectures in person on campus, but also to follow lectures online if for various reasons they have no opportunity to attend in person (Raes, 2022). Overton (2022) refers to hybrid learning as "the standard term which encompasses the similar definitions above of teaching students both face-to-face and online synchronously" (Overton, 2022, p. 332). The study programme at the Inland Norway University of Applied Sciences has two of the courses offered in streaming video of recorded lectures as a part of the "Flipped Classroom" approach (Bishop & Verleger, 2013; Vold, 2014). However, this is not the same as being an active participant in the lectures. In higher education, there are students of all ages, whether full-time or full-time with a part-time job, or full-time workers studying part-time, or in other combinations. In this paper, the majority are "employed adult learners (EAL)" (Nguyen, 2022, p. 302).

In online education, it is important to facilitate the learning in such a way that the needs of the adult students are catered to. Cercone (2008) suggests that one needs to consider the learning styles of the learners, facilitating for an active involvement in the learning process, supporting the learners and aiding in the process of constructivist learning, thereby facilitating for linking new knowledge to their work experiences, and providing opportunities for testing their new knowledge, as well as supporting collaboration and social interaction, thus facilitating for reflection and a learning environment in which they may feel comfortable. In addition, Frey and

Alman (2003) suggest to be clear on expectations, and support the learning with different forms of feedback to the students. According to Wolsey (2008), feedback supports learning, as it establishes a relationship between the learner and the lecturer, and that the quality of this feedback will influence the learners' improvement of their work. This is supported by Hattie and Timperley (2007), when they claim that feedback is strongly supporting academic achievements with the learners.

In order to support the learning for all the students, including online and physically attending seminars, we decided to do a project in which video-feedback would be used as feedback on their mandatory assignments. Hence, all the students received a video file with comments on their assignments.

According to Mathisen (2012), video-feedback is perceived to be "more precise and nuanced than written feedback, and as such gives students a greater amount of inspiration and motivation when completing future academic work" (Mathisen, 2012, p. 111). Mathisen has used screen capture technology in his studies, which means that the student's text is shown, and that there is a "talking head" in the video (Mathisen, 2012). We have a different approach, as it is only a recording where the lecturer is visible, and is talking about the pros and cons with their own assignments. However, there is some learning to take from Mathisen's works. For instance, the results showed that the students felt a proximity to the teacher (Mathisen, 2012), which again is part of establishing a relationship with the learner (Wolsey, 2008).

Lamey (2015) states that video-feedback is aimed at the student, while written feedback is more about the assignment, as it comes across more as coaching and motivating for improvement, rather than focussing on mistakes. This is supported by Evans (2013), stressing the social dimension, even if the feedback is concerning the content of the course. Preferably, video-feedback should embrace communication produced by body language, gestures and voice (Priest, 1998). Ordinary (written) feedback does not contain the non-verbal communication that can be offered through video-feedback (Borup et al., 2014).

However, would the online students be perceived differently than the ones who attended in person? The ones who came to campus got to experience other students, the lecturer in a physical "habitat", and in a "normal" setting. Hence, the online students only "see" the lecturers and the ones who choose to show themselves in the video conferencing tool. Does this affect the way they perceive the video-feedback? And could we support their learning outcome by pointing towards how the content of their assignments could apply to a work-life?

1.1 Context of the study

The students attend a 30 European Credit Transfer and Accumulation System (ECTS) study programme in Knowledge Management at the Inland Norway University of Applied Sciences in Norway. The study programme runs over two semesters, with two courses of 7.5 ECTS per semester. The courses are held as two-day seminars, with one course the first day and the second course the next day, three times per semester. Approximately 80 to 100 students attend the study programme each year, with all the courses having a minimum of one mandatory assignment. Generally speaking, the students receive a written comment/feedback that should aid them in their process of preparing for their exams.

Since the COVID-19 pandemic, these courses have also been online, whereas after the pandemic, the courses were kept as a hybrid version with an option of participating online or physically at the campus in Kongsvinger. Some of the students choose to come at least once a semester to attend seminars at the campus, but for various reasons there are also a few who cannot come to campus. It may be family issues, work issues, funding issues, environmental issues, or a combination of some of these. Even if some of the students are relatively satisfied with the online lectures, from the lecturers' perspective, they are missing out on the social aspect of education. Consequently, we sought to personalize the feedback by providing a video recorded in the video tool in the LMS Canvas.

1.2 Aim of the study

The aim of the study was to focus on the online students' perspectives regarding how they perceive video-feedback. Would we succeed offering the students a more personal follow up, and thus support their learning outcome from the courses? Therefore, the research questions are:

How does personal feedback by video support the student's learning outcome?

How does it contribute to learning motivation, and does it support work-relevance?

In the following, the research methodology will be elaborated, and our findings presented, before the conclusion and suggestions for further research are elaborated.

2. Methodological approach

We treated this as a case study (Yin, 2014), in which we used a survey as our instrument to collect data. The study took place in the end of December 2022 and January 2023 by distributing a survey in the Learning Management System (LMS) called Canvas. The survey was designed by the researchers, and used “Nettskjema” as a platform, as this was a web-based survey tool developed at the University of Oslo (see: <https://nettskjema.no/?lang=en>). We gathered feedback using our survey with open- and closed-ended questions (Johannessen, Tufte, & Christoffersen, 2010; Johannessen, Christoffersen, & Tufte, 2020). Of the approximately 85 students, 37 answered the survey; out of these 37, 19 were online students, with 18 attending seminars in person. It is not possible to trace the names of the respondents.

The survey form has a mix of questions, in which the students are to assess their input according to a Likert scale from 1 to 5, in which 1 is “strongly agree” and 5 is “strongly disagree”, as well as open-ended answers, in which the students were encouraged to provide feedback. The researchers have jointly discussed and interpreted the data (Creswell, 2009), using categories and sub-categories. The replies from the students were somewhat inconclusive, as 11 of 19 students claimed they disagreed or strongly disagreed, with the feedback being perceived as personal. Yet, in the open-ended answers, most of them have comments that seemed to appreciate the personal feedback. The primary emphasis is thus on the open-ended answers.

3. Findings

Our findings can be divided into three major categories: perception of the feedback being personal, motivational and clear on expectations.

3.1 Perception of being personal

Statements like: “Plainly, that it was delivered orally so that one could hear the tone of voice, and which words were stressed. Written feedback is not always so deliberate, and it may be misinterpreted by eager students and taken as more negative than it was intended” (respondent 9 online), and “Personal feedback with concrete feedback with examples from work-life” (respondent 12 online) support the impression of it being perceived as personal.

The feedback from respondent 12 (see above) also suggests that we have met Cercone’s (2008) suggestion of connecting the learning to their work-life. Respondent 9’s feedback (see above) also suggests that that we have achieved a form of proximity to the lecturer (Wolsey, 2008; Mathisen, 2012).

Compared to the ordinary students (attending in person), 12 of 19 online students have left a reply, in which only one has nothing to add, whereas six of the remaining 18 students have left a reply. The replies from the “ordinary” students do not refer so much to the perception of it being personal, with the exception of respondent 12 (in person): “It felt very personal, and I perceived that the lecturer had thoroughly read the assignments, it felt very good! Very positive! I perceived it as better than ordinary written feedback. If I had to choose between video or written, I would choose video.”

3.2 Perception of being motivational

Statements like, “By receiving feedback via video, the body language and the tone of voice will reduce the misinterpretation of the feedback. This in turn allows for more words and explanations, which points out which areas needs more attention” (respondent 8 online), showing that they still perceive it as personal and is perceived as more focussing on the student, and therefore has more potential of being motivational regarding improvements (Lamey, 2015).

3.3 Perceptions of clarity about expectations and work-relevance

Statements like: “Good to know concretely what one has understood and done right; at the same time, it is very useful to get concrete feedback on what is missing and what could have been improved. Useful for preparing for exams and also in the work-life” (respondent 17) also support what Frey and Alman (2003) suggest about being clear about expectations, in this case regarding improvements for the exams.

In order to not only receive their perceptions, we asked the students to give examples of what they had picked up from the feedback, including in open-ended feedback.

Examples of feedback are: “I have to discuss more” (respondent 10 online), “More about how to transfer knowledge from projects to the organization, and how the company has allocated time for reflection” (respondent 17 online), as well as “Clarity on how to develop a reference list” (respondent 19 online).

Only six of the 19 online students, and 11 out of 18 students who met in person, did not reply to what they have perceived as important improvement points. The ones who answered have similar answers to the online students. We found it interesting, to a much higher degree, that the online students chose to answer this question, and that this should be elaborated further.

There may be several explanations as to their obvious contradiction in their answers, such as interpreting the 5 in the Likert scale to be “strongly agree” rather than “strongly disagree”, or that they interpret “personal” differences in the two different answers.

4. Conclusion

We set out to investigate whether video-feedback would be perceived as personal, and if this would support the students’ learning outcomes by contributing to motivation. In the feedback, it would also be pointed out how the lecturers perceived the assignments’ connections to a work-life situation.

The findings show that students seem to prefer video-feedback to ordinary written feedback. It is perceived as more personal and seems to enhance the proximity to the online students, as they refer to how they perceive the tone of voice and our facial expressions. Many of the students claim to be motivated to work on the feedback towards their exams. It also seems to support the work-life relevance, as we have been able to communicate the transferability to their work-life through our feedback.

Our findings are supported by the theory we have used to enlighten our study. Mathisen’s studies claim that it is important to show the students where in the texts they need to improve, but our respondents claim to understand what needs to be improved without being presented the outlines in the text. Hence, it is possible to provide feedback either as we did, in the LMS (Canvas), record in Camtasia, from Zoom, Teams or other suitable media. Our recommendations are to address the students by name, be concrete about improvements and about where they have provided a sufficient or even excellent reply, and how well they have connected their assignment to a work-life situation.

The research did unveil a new issue worth pursuing compared to the “in-person” students, as more of the online students provided feedback, both on how they have perceived the feedback and about what they learned from this. As a result, when developing the survey, it is important to be very clear about what the different numbers in the Likert scale represent, and be consistent throughout the survey form.

4.1 Further research

The blended learning will continue over the next two semesters with new students. Thus, we will pursue further investigations with the new students. We are also planning on contacting the students who finished this spring semester, in order to conduct in-depth interviews, to see whether there are any differences in how online students and students retrospectively attend in-person perceive video-feedback on assignments.

Our finding about the richer response from the online students is also worth further exploring. Is it due to the perceived proximity through video-feedback, and/or that this is the way they are able to communicate this (unlike the students attending in-person who have the physical proximity in the classroom, and therefore have less interest in- or desire to communicate this)?

References

- Bashir, A., Bashir, S., Rana, K., Lambert, P., & Vernallis, V. (2021). ‘Post-COVID-19 adaptations; the shifts towards online learning, hybrid course delivery and the implications for biosciences courses in the higher education setting’, in *Frontiers in Education*. Frontiers, p. 310.
- Bishop, J. L., & Verleger, M. A. (2013). ‘The flipped classroom: A survey of the research’, in *ASEE National Conference Proceedings, Atlanta, GA*, pp. 1–18.
- Borup, J., West, R., Thomas, R. A., & Graham, C. R. (2014). ‘Examining the impact of video-feedback on instructor social presence in blended courses’, *International Review of Research in Open and Distributed Learning*, 15(3), pp. 232–256.

- Cercone, K. (2008). 'Characteristics of adult learners with implications for online learning design', *AACE Review (formerly AACE Journal)*, 16(2), pp. 137–159.
- Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches*. 3. ed. Los Angeles, Calif. [u.a.]: Los Angeles, Calif. [u.a.]: Sage.
- Evans, C. (2013). 'Making Sense of Assessment Feedback in Higher Education', *Review of Educational Research*, 83(1), pp. 70–120. doi: 10.3102/0034654312474350.
- Frey, B. A., & Alman, S. W. (2003). 'Applying adult learning theory to the online classroom', *New Horizons in Adult Education and Human Resource Development*, 17(1), pp. 4–12.
- Hattie, J., & Timperley, H. (2007). 'The Power of Feedback', *Review of Educational Research*, 77(1), pp. 81–112. doi: 10.3102/003465430298487.
- Johannessen, A., Christoffersen, L., & Tufte, P. A. (2020). *Research methods for the area of business and administration (Translated from Norwegian: Forskningsmetode for økonomisk-administrative fag)*. 4. utgave. Edited by L. Christoffersen and P. A. Tufte. Oslo: Abstrakt forlag.
- Johannessen, A., Tufte, P. A., & Christoffersen, L. (2010). *Introduction to Social Science Methods (Translated from Norwegian: Introduksjon til samfunnsvitenskapelig metode)*. Abstrakt Oslo.
- Lamey, A. (2015). 'Video-Feedback in Philosophy', *Metaphilosophy*, 46(4–5), pp. 691–702. doi: 10.1111/meta.12155.
- Mathisen, P. (2012). 'Video-Feedback in Higher Education – A Contribution to Improving the Quality of Written Feedback', *Nordic Journal of Digital Literacy*, 7(2), pp. 97–113. doi: 10.18261/ISSN1891-943X-2012-02-02.
- Nguyen, N. B. C. (2022). 'Improving Online Learning Design for Employed Adult Learners', in *European Conference on e-Learning*, pp. 302–309.
- Overton, S. (2022). 'Engagement challenges in a hybrid classroom: Reflections of a higher education tutor', in *European Conference on e-Learning*, pp. 331–337.
- Priest, S. (1998). 'Merleau-Ponty'. London: Routledge (Arguments of the philosophers).
- Raes, A. (2022). 'Exploring student and teacher experiences in hybrid learning environments: Does presence matter? Postdigital Science and Education, 4 (1), 138–159'.
- Vold, T. (2014). 'How can the concept of "Flipped Classroom" support the development of reflective practitioners in higher education?', in *2014 Information Technology Based Higher Education and Training (ITHET)*. IEEE, pp. 1–3.
- Vold, T., Lervik, M., & Holen, S. (2022). 'Post-COVID-19 Pandemic Education: The Student Perspective', in *European Conference on e-Learning*, pp. 489–497.
- Wolsey, T. D. (2008). 'Efficacy of Instructor Feedback on Written Work in an Online Program', *International Journal on e-Learning*, 7(2), p. 311.
- Yin, R. K. (2014). *Case study research: Design and methods*. 5. edition. Los Angeles: Los Angeles: Sage.

Facilitating Lifelong Learning for Mature Part-time Students: Findings from South Africa and Norway

Tone Vold¹, Linda Kiønig¹, Ann Lourens² and Curwyn Mapaling³

¹Inland Norway University of Applied Sciences, Rena, Norway

²Nelson Mandela University, Gqeberha, South Africa

³University of Johannesburg, South Africa

tone.vold@inn.no

Linda.kionig@inn.no

Ann.Lourens@mandela.ac.za

curwynm@uj.ac.za

Abstract: When the COVID-19 pandemic spread, governments worldwide ordered most of the population to stay at home. From one day to the other all lecturing in higher education institutions (HEIs) had to be online. For many this resulted in solitude and isolation, something that in turn had an effect on students' well-being and academic achievements. The situation was somewhat different for mature part-time students (MPTS). They had struggled with being able to attend classes (at a campus), sometimes feeling alienated and left "on their own". During the pandemic, they were able to attend more lectures as they were offered online.

After the pandemic, most courses were offered as a hybrid version; they could return to campus or follow the courses online. Some students returned to campus, but not as many as one hoped. Hence, the student well-being and the academic achievements did not improve as much as hoped and expected.

There have been several discourses regarding "forcing" students back to campus in order to improve the students' situation and to regain the personal contact with the students. However, for one growing group of students, the MPTS', the hybridity is what has brought them closer to the campus. For these students, the academic achievements have not deteriorated nor their well-being. In fact, investigations show that the hybrid education enables a life-long education situation.

In this paper we present investigations from two universities from two very different parts of the world; The Inland Norway University of Applied Sciences, Norway and Nelson Mandela University, South Africa. Our joint research has focussed on looking at how hybridity can be adapted in order to better facilitate for the MPTS to maintain in a life-long learning situation supporting academic success and ensuring retention, as this group is now no longer in a home office, but back in a work-life.

Keywords: Hybrid Education, Facilitating Life-Long Learning, Work-Life Balance, Work-Education Balance

1. Introduction

Lifelong learning, primarily propelled by rapidly evolving technology and shifting job markets, has emerged as an essential component in maintaining a resilient workforce (Field, 2000; OECD., 2016). The present literature review aims to navigate through this complex landscape, exploring how technology, particularly Learning Management Systems (LMS), are shaping lifelong learning experiences, the effect of the COVID-19 pandemic on these experiences, the challenges and opportunities of self-regulated online courses, and the role of motivation in successful learning outcomes.

Role of Technology in Lifelong Learning

The advent of technology in education has brought forth a new dawn for lifelong learners. Learning Management Systems (LMS) have provided a platform to distribute a plethora of learning materials—articles, videos, quizzes, podcasts, external links—making education more accessible to those juggling work and family commitments (Bradley, 2021). The "flipped classroom" model has demonstrated an enhancement in course outcomes, enabling students to participate in active learning at their convenience, as opposed to being confined to specific times (Bishop and Verleger, 2013; Venemyr et al., 2017; Vold, 2014).

Impact of COVID-19 on Lifelong Learning

The COVID-19 pandemic introduced unprecedented challenges into academia, compelling educators and students alike to adapt swiftly to digital platforms for instruction and examination. While this sudden shift was built upon a foundation of at least three decades of online and blended learning practices, it also spotlighted the inherent problems with such modalities. Concepts like Massive Open Online Courses (MOOCs) gained traction during this period (Carbonnier, 2014; Margaryan, Bianco, and Littlejohn, 2015; Littlejohn et al., 2016),

yet the crisis exacerbated the balancing act many students struggled with, blurring boundaries between work, home, and study (Bergum, Peters, and Vold, 2023).

Challenges and Opportunities of Self-Regulated Online Courses

Despite the opportunities online education affords, the self-regulation required for MOOCs poses a significant hurdle for many students, especially those with demanding work-life balance and family obligations (Deci, Olafsen, and Ryan, 2017; Ryan and Deci, 2017; Littlejohn et al., 2016). The need to prioritize work over studies becomes particularly acute during stressful periods (Boltz et al., 2021). Still, the flexibility offered by online education has been shown to be valuable, particularly when coupled with face-to-face interactions that enhance the learning experience (Tseng and Walsh Jr, 2016).

Teacher's Motivation and Abilities for Online/Hybrid Education

The successful delivery of online education is also contingent on educators' motivation and competence with digital platforms. During the pandemic, many teachers reported feeling demotivated by the impersonal nature of digital interactions (Han and Yin, 2016; Vold and Ranglund, 2019; Vold, Lervik, and Holen, 2021). Consequently, the role of educators' motivation in online education delivery warrants further investigation.

The rapid transition to digital learning platforms, catalysed by the COVID-19 pandemic, has underscored the importance of lifelong learning in today's ever-evolving technological landscape. While online education has made learning more accessible for many, it comes with its own unique set of challenges that require further exploration to ensure the best learning outcomes for all students.

1.1 Our joint study

At last year's European Conference on e-Learning (ECEL), we noticed that our presentations had similar approaches and similar results. This inspired us to dig deeper into the data and look at the data again to compare similarities and differences. Being from two very different parts of the world with potentially different issues regarding education, triggered our interest to compare our data.

Hence, in this paper we compare two studies; one from Nelson Mandela University, South Africa (here after called NMU) (Lourens et al., 2022) and one from The Inland Norway University of Applied Sciences, Norway (hereafter called INN) (Lervik, Vold, and Holen, 2022). Both studies enlist adult students in a work-life; mature part-time students.

At both NMU and INN we use an LMS where all the course material is available. At the NMU Moodle is used, and at INN the LMS called Canvas is used.

Our main objectives for this paper have been to look at similarities and differences within the student groups. Both our investigations were about their preferences regarding attending education digitally and/or physically regarding work-life balance, how they handle work-education balance and other issues regarding attending education physically and/or digitally.

2. Methodology

In the study from NMU, a questionnaire was used to collect the data, and in the study from INN a mixed methods approach was used (Creswell and Creswell, 2017). The data from South Africa was interpreted qualitatively as well as the quantitative data from Norway. The interviews (from Norway) were conducted using a semi-structured interview guide (Dalen, 2011; Jacobsen, 2015). Originally the study from Norway was treated as a case study (Yin, 2014) and the data are from two cohorts; one from 2021 and one from 2022.

2.1 Data collection instrument

The principal data collection instrument for our study was an online questionnaire administered to the NMU cohort. This tool was designed to garner insight into students' experiences with and perceptions of online learning, particularly in the context of the changes spurred by the COVID-19 pandemic. The questionnaire primarily employed 5-point Likert scale questions, enabling us to capture the nuanced variations in students' responses.

A selection of the key questions in the questionnaire are as follows:

- “In general, I find online learning different to face-to-face learning in a way that suits me and my learning style.” This question aimed to probe the degree to which online learning matches individual students' preferred learning styles.
- “I enjoy the type of learning used during the COVID-19 pandemic.” This question provided insights into students' levels of satisfaction with the shift to online learning during the pandemic.
- “In general, the current type of learning and teaching allows me to work at a pace that is suitable for me.” This question helped us gauge whether students felt the online learning pace met their individual learning needs.
- “I know and remember more about each module topic after completing each study unit online.” By posing this question, we aimed to understand whether online learning enhanced students' knowledge retention.
- “I learn more about the topics when I complete an online session than what I would learn in a face-to-face class.” This question allowed us to measure students' perceptions of the effectiveness of online learning compared to traditional face-to-face classes.
- “Do you experience any differences in the contact with the lecturer in digital lecturing compared with the face-to-face lectures?” This question was to reveal how the students experienced the online medium compared to the face-to-face lecturing.

The responses to these questions provided valuable insights into the students' online learning experiences, informing our understanding of the benefits and challenges inherent in this mode of education.

3. Results and discussion

Here we will present the different results from our investigations. We will present them based on our joint agreed focus areas; preferences on online and/or physical attendance regarding work-life balance, work-education balance and issues hybridity regarding education.

3.1 Preferences regarding work-life balance

The responses from NMU show that the students prefer the flexibility of a hybrid alternative. This allows them to focus better on their own time, rather than having to always meet physically at a class. Only one student (of 11) reply negatively regarding work-life balance.

At the INN, the additional answers show that the travelling time, small (and sometimes sick) children, old (and sometimes sick) parents or other relatives that needs attention, is a part of the bigger picture regarding work-life balance. By reducing travelling time and time away from family (such as travelling time and the time at school), they obtain a better work-life balance as well. Also, some of the students at INN does not get the time off for formal education, hence, they have to draw on their days off designated to holidays to attend. Some of the students at INN also report on being able to stay at work whilst taking part in online seminars.

Both the NMU and INN students responds positively regarding the material provided in the LMS. At both NMU and INN the students claim that the LMS is easy to use and that the provided course material is helping them in their studies not only by its nature, but because it is available online at all times.

This is in line with the findings in the theory. The availability of material allows for a more flexible approach as they can access it several times and at the times that they have available (Bishop and Verleger, 2013).

3.2 Work-education balance

Both regarding the suitability of pace, effectiveness and perception of knowledge transfer, most of the students reply positively from both universities. However, in the data from INN we register that some of the students are working at the same time as studying (or vice versa). At INN, lectures are recorded as streaming video, in addition to a hybrid version where students may attend physically or online. This they report as being distraction and that they are not concentrating well on either. Also, due to them being at their work, they are unable to take part in groupwork or group discussions. In the NMU, this is not listed as an issue in the paper. However, this does not mean that this does not happen. Indeed, if someone needs to leave education as they are too busy with work, indicate that the students may have a heavy workload.

The findings may indicate a number of issues regarding work-education balance. It may be that the students are not given the time off to take part in the physical or online lectures. It may also be that the students do not themselves prioritize to focus only on the online lecturing.

Either way, the students that are at work when studying may miss out on taking a more active part in the lectures, and they definitely miss out on the social learning aspects.

These are interesting findings as we have not come across a lot of studies that refer to a simultaneous focus on work and study. Hence, this is a topic to study further.

3.3 Hybrid education

Both at NMU and at INN the students are clear about how the opportunities for hybrid education is crucial for many students as they would have been unable to attend all classes physically, mainly due to issues mentioned above.

3.3.1 Issues regarding physically and/or digital attendance

At the NMU, travelling during wintertime is listed as an issue. Providing online lecturing that they can take part in at home without travelling, would thus solve a problem.

At INN, the students attending online sometimes feel “left out” and not payed attention to. Even if the students have been encouraged to attend physically as it is hard to cater for both present and online students, they seem to compare the present to the times of COVID-19 pandemic where we were only working online and all the attention was on the students that were on “the other side” of the line.

However, many of the students prefer to have lectures online (16 out of 20 respondents). 10 out of 19 prefer to have the choice of taking part online or face-to-face.

Here it may also be about the teachers’ motivation and abilities of catering for both student groups (physically present and online) (Finsterwald *et al.*, 2013; Han and Yin, 2016; Vold, Lervik and Holen, 2021). If the teachers are not provided with adequate equipment nor with sufficient education on how to cater for hybrid education, it may seem as a daunting task for the teachers and as less useful to the students. Compared to the COVID-19 pandemic setting, the online students in a hybrid version of lecturing, will not have the same closeness and receive the immediate response from the teachers as the ones physically present at the lectures, as the technology will delay any responses to what is presented in the lectures.

4. Conclusion

What we have found in our joint study, is that students in a lifelong learning situation, seem to struggle with many of the same things. They prefer to have the flexibility of a hybrid version. This will allow them to attend physically if they have the time off, are able to travel due to distances, economy, family situations, etc., as this is rated highest regarding learning outcome. It will also allow them to participate online if any of the listed reasons should prevent them from travelling to attend the physical lecture. The students recognize the positive in the options but would yet like to have a fully online version in the “pandemic way” when they cannot attend physically. Sometimes this is due to teachers lack of motivation and/or capabilities regarding hybrid versions of education. There is also an issue with the work-life balance, as many students are attending education to either keep a job, or to be able to change jobs. The workload on many of the students are reported as high. This may lead to issues such as a work-education imbalance, sometimes resulting in having to work simultaneous to attending lectures. This is perceived as stressful and deprives the students of the few options of social learning opportunities that the online versions are offering. Although far apart, the students at both NMU and INN seems to be facing and struggling with many of the same problems.

The conclusions drawn from this study are nonetheless constrained by certain limitations, notably the constraints set by the original ethical clearance on the extent of statistical analyses that could be performed. While the analyses we conducted provided valuable insights, a more sophisticated and advanced statistical approach could potentially offer a more in-depth understanding of the dynamics at play. Due to ethical considerations, such advanced analyses were not feasible in the context of this study. However, recognising this limitation, we plan to apply for an amendment to our ethical approval to facilitate more advanced statistical investigations in future research.

Despite this, the similarities in the struggles faced by lifelong learners at both NMU and INN underscore the universality of the issues and challenges identified. Moving forward, this recognition can inform interventions and strategies that cater to the unique needs and preferences of this student demographic, regardless of their geographical location. Flexibility in learning modalities—whether hybrid or fully online—will be crucial, as will be the consideration of factors like work-life balance and the pressures of simultaneously juggling work, education, and family commitments. This understanding will continue to guide our ongoing research and efforts to support lifelong learners in achieving their educational goals.

4.1 Future research

There seems to be lacking investigations into the issue of simultaneously having to work whilst taking part in lectures, which leads to a more passive role in the online part of the class. What does this do to the learning outcome? Are there other options that technology would provide for? What would it take to make the students focus on education for the duration of the online lecturing?

Also, this study has mainly focussed on the students replies. It would be interesting to see if there are similar perceptions amongst the lecturers. How are they coping with the hybridity? How are they upgraded and supported in order to handle hybrid lecturing? Are there other ways to utilize the technologies in better ways to support not only the learners/students, but also the teaching faculty staff? These are questions that require further investigations.

References

- Bergum, S., Peters, P. and Vold, T. (2023) *Virtual Management and the New Normal: New Perspectives on HRM and Leadership since the COVID-19 Pandemic*. Springer Nature.
- Bishop, J. L. and Verleger, M. A. (2013) 'The flipped classroom: A survey of the research', in *ASEE national conference proceedings, Atlanta, GA*, pp. 1–18.
- Boltz, L. O. et al. (2021) 'Transitioning to remote learning: Lessons from supporting K-12 teachers through a MOOC', *British Journal of Educational Technology*, 52(4), pp. 1377–1393.
- Bradley, V. M. (2021) 'Learning Management System (LMS) use with online instruction.', *International Journal of Technology in Education*, 4(1), pp. 68–92.
- Carbonnier, G. (2014) 'Education, learning, training : critical issues for development'. Edited by Gilles Carbonnier et al. Leiden, Netherlands: Brill (International development policy).
- Creswell, J. W. and Creswell, J. D. (2017) *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications.
- Dalen, M. (2011) 'Intervju som forskningsmetode [Interview as a research method]', *Oslo: Universitetsforlaget*.
- Deci, E. L., Olafsen, A. H. and Ryan, R. M. (2017) 'Self-Determination Theory in Work Organizations: The State of a Science', *Annual review of organizational psychology and organizational behavior*, 4(1), pp. 19–43. doi: 10.1146/annurev-orgpsych-032516-113108.
- Field, J. (2000) 'Governing the Ungovernable: Why Lifelong Learning Policies Promise so Much Yet Deliver so Little', *Educational management & administration*, 28(3), pp. 249–261. doi: 10.1177/0263211X000283002.
- Finsterwald, M. et al. (2013) 'Fostering lifelong learning – Evaluation of a teacher education program for professional teachers', *Teaching and teacher education*, 29(1), pp. 144–155. doi: 10.1016/j.tate.2012.08.009.
- Han, J. and Yin, H. (2016) 'Teacher motivation: Definition, research development and implications for teachers', *Cogent Education*, 3(1), p. 1217819.
- Jacobsen, D. I. (2015) *How to conduct research: introduction to social science research methods (Translated from Norwegian: Hvordan gjennomføre undersøkelser? : innføring i samfunnsvitenskapelig metode"*. 3. utg. Oslo: Cappelen Damm akademisk.
- Kionig, L. et al. (2021) 'Use of IT in Higher Education and Training - Social learning through outdoor quiz game app', in *ITHET*. Piscataway: Piscataway: IEEE, pp. 1–4. doi: 10.1109/ITHET50392.2021.9759410.
- Lervik, M., Vold, T., and Holen, S. (2022) 'Post-COVID-19 Pandemic Education: The Student Perspective', *21st European Conference on e-Learning (ECEL)*, pp. 489–497.
- Littlejohn, A. et al. (2016) 'Learning in MOOCs: Motivations and self-regulated learning in MOOCs', *The Internet and higher education*, 29, pp. 40–48. doi: 10.1016/j.iheduc.2015.12.003.
- Lourens, A., Connelly, R., Plaatjes, R., and Mapaling, C. (2022) 'The Impact of Emergency Online Learning and Teaching on Mature Part-Time Students', *21st European Conference on e-Learning (ECEL)*, pp. 230–239.
- Margaryan, A., Bianco, M. and Littlejohn, A. (2015) 'Instructional quality of Massive Open Online Courses (MOOCs)', *Computers & Education*, 80, pp. 77–83. doi: 10.1016/j.compedu.2014.08.005.
- OECD. (2016) *Innovating education and educating for innovation: The power of digital technologies and skills*. OECD.
- Ryan, R. M. and Deci, E. L. (2017) *Self-determination theory : basic psychological needs in motivation, development, and wellness*. New York: Guilford Press.

- Schön, D. A. (1987) *Educating the reflective practitioner: Toward a new design for teaching and learning in the professions*. Jossey-Bass.
- Tseng, H. and Walsh Jr, E. J. (2016) 'Blended versus traditional course delivery: comparing students' motivation, learning outcomes, and preferences', *Quarterly review of distance education*, 17(1), p. 43.
- Venemyr, G. O. et al. (2017) 'Flipped gaming for enhanced learning outcome crisis preparedness courses', in *2017 16th International Conference on Information Technology Based Higher Education and Training (ITHET)*. IEEE, pp. 1–4.
- Vold, A. T., Lervik, M. J. and Holen, S. (2021) 'Teacher motivation during the corona crisis, facing "black screens" and missing "watercoolers"', in. Academic Conferences and Publishing International, pp. 512–520.
- Vold, T. (2014) 'How can the concept of "Flipped Classroom" support the development of reflective practitioners in higher education?', in *2014 Information Technology Based Higher Education and Training (ITHET)*. IEEE, pp. 1–3.
- Vold, T. and Ranglund, O. J. S. (2019) 'How can Flipped Classroom Activities Support Teacher Motivation?'
- Yin, R. K. (2014) *Case study research: design and methods*. 5. edition. Los Angeles: Los Angeles: SAGE.

A Review of Tools for the Design and Development of Online Interactive Gamified Content: A Simulation Study

Ludmiła Walaszczyk

Sieć Badawcza ŁUKASIEWICZ, Instytut Technologii Eksploatacji, Poland

Ludmila.walaszczyk@itee.lukasiewicz.gov.pl

Abstract: Nowadays on-line education has become extremely popular, mainly due to COVID-19 and social distancing. While more and more companies already offer on-line courses, a vast group of institutions stay away from such methods, mostly due to the belief that on-line learning may not be as effective as classroom training, the infrastructure required to deliver on-line courses is costly, the transformation of course content into digital interactive content is time consuming, and so forth. But the reality is that more and more learners find a lot of advantages in on-line learning. They wish to attend courses anytime, anywhere. There are thousands of pieces of open-source software and tools to choose from in order to create interactive content without the need of costly software, and infrastructure or coding. Even so, converting course materials to on-line digital interactive courses can be time consuming since a trainer needs to research for the appropriate tool in a vast market of free or low-cost open-source software, evaluate them, master their usage and then transform the content into digital interactive content. Time and human resources can be considerably minimised if organisations have access to a complete framework for the development of interactive, gamified courses by using open-source or low-cost software. The objective of this paper is to present and compare a set of selected digital tools which can be successfully used for the development of on-line interactive content in different types of institutions e.g., educational organisations, but also in companies during the process of organising training or courses for employees. Such a review is useful especially for the staff who teach the students using digital tools in order to improve the interest of the students and the effectiveness of their work i.e.: teachers, adult educators, VET educators, trainers, mentors or coaches. The paper offers them the opportunity to select the most appropriate tools for the teaching process. On the other hand, the target audience can also be the students who decide for self-learning. In this case, they can choose the tools which seem to be the most interesting and effective in their learning process. The identified tools were assessed by the VET trainers/educators in five European countries: Poland, Italy, Greece, Cyprus, and the United Kingdom (n=172). The research results indicate the most appropriate, friendly and free of charge open-source software used for the development of the interactive content. The originality of this paper comes from the fact that so far there has been no complex comparative analysis of the tools which can be supportive in the process of the development of the on-line training content with the use of interactive elements.

Keywords: E-Learning, Interactive Content, Gamification, Online Software, Online Platforms

1. Introduction

Nowadays more and more companies offer courses online, but still a vast group of organisations and trainers stay away from such methods, mostly due to the belief that online learning may not be as effective as classroom training (Hylland, 2022). We can try to guess what the reasons of such way of thinking may be.

1.1 Negative aspects and feelings of implementing digital tools

Over the decades, there has been more and more interest in equipping of educational institutions with digital tools (Flangan & Jakobsen, 2003; Cheng, 2019; Borawska-Kalbarczyk et al., 2019). It was a kind of the pressure to use digital tools (Säljö, 2010). On the other hand, the teachers were not informed which kinds of tools they should use, how to use them, how to improve the effectiveness of work and how to encourage the students to get more familiar with these tools (Afshari, 2009; Ghavifekr et al., 2016; Anggeraini, 2020). Another aspect concerns the students. They heard about the possibility of using digital tools, but they were not taught how to do it, which tools are the most appropriate for them, they did not have any instructive lessons (Sevara et al., 2022). According to Kolikan (2010), already in 2010 the students had high access to the Internet, but very low use of this technology (e.g., Veen, 1993; Cuban, 2001). The research mentioned by Kolikan concerned 40 countries: *“major investment outlays over the past 20 years have brought modern Information and Communications Technologies (ICT) into nearly all schools in the most advanced OECD countries, but the extent to which computers are in day-to-day use in these schools remains disappointing”* (OECD Report, 2004). After more than 10 years the situation has improved, but full success has not been achieved in this field (Bleakley, 2022). The students and the teachers have been using digital tools during lessons, but the digital offer is so wide, that they are often frustrated which tools to use and how to use them. For example, Bleakley indicates that the experiences with VRs are still frustrating. Similarly, Kee (2021) underlines the students’ fear and anxiety towards the use of digital tools. Some teachers may hold negative perceptions about online learning, citing concerns about the lack of face-to-face interaction and the perceived difficulty in delivering practical skills training through

online platforms (Ni, 2013; Syauqi *et al.*, 2020; Seyffer *et al.*, 2022; Bliuc *et al.*, 2012; Cechella, 2021; Desnenko *et al.*, 2021; Palomino, 2019). It is sometimes underlined that the infrastructure required to deliver online courses is costly. However, while there may be initial investments required for hardware, software, and network infrastructure, the literature suggests that the long-term benefits of online learning, such as scalability, reach, and cost savings in terms of physical facilities and travel expenses, can outweigh the initial costs (Kulkarni, 2013). Moreover, there are a lack of skills in the organisation to switch to online course delivery as well as numerous technical obstacles such as compatibility issues, programming complexities, and the need for specialized skills to create interactive elements. These challenges can increase development time and costs, especially for individuals or organisations with limited technical expertise (Irfan *et al.*, 2020).

It cannot be, however, assumed that the use of digital tools is related only to negative feelings.

1.2 Positive aspects and feelings of using digital tools

The literature offers numerous examples that online learning can be as effective as, and sometimes more effective than, traditional classroom instruction (e.g.: Barneva, 2017; Papadakis, S., & Kalogiannakis, 2019). Factors such as instructional design, learner engagement (Huang and Soman, 2013), and facilitation methods play crucial roles in determining the effectiveness of online learning (Papadakis *et al.*, 2023).

What is also very important nowadays is that the gamification aspects are included in the learning/teaching process (Zourmpakis *et al.*, 2023). Through the use of the digital tools, the students can learn easily through using games. The literature shows that the effectiveness of using games is assessed at a high level (da Rocha Seixas, 2016; Papadakis, S., & Kalogiannakis, 2019). This is especially important for the students with different learning problems such as the difficulties to analyse long materials or who are simply bored with the manuals (Bond, 2015; Behnamghadr *et al.*, 2021; Marinelli *et al.*, 2023).

The main objective of this paper is to present and compare the features of selected digital tools (22) which can be used in the learning/teaching process in different organisations. The author posed the following research questions:

- Which digital tools can be used in the improvement of the learning/teaching process of the students?
- What are the differences between the presented digital tools?
- Which of the tools can be especially implemented in the learning/teaching process enriched with the elements of the gamification?

In the literature we can find many papers devoted to digital tools and digital education. Mucundanyi and Woodley (2021) describe several digital tools which may be used in educational process, such as Digital Tools, Google Classroom, Google Docs, Google Scholar, Screencast-O-Matic, QuickTime Player, YouTube. However, the article is typically technical. The authors only include short descriptions of each of the tool in order to give an overview to the reader how the tool can be applied. The tools were not tested by groups of the students or teachers. In their paper, Baldwin *et al.* (2018) present six digital instruments which are applied in a national system. Similarly like in the first paper, they were not assessed by any of the target groups, at least this information is not included in the paper. Brown and Green (2016) indicate four randomly selected online tools which can be used in education. In many other scientific papers, we can find information about digital tools (e.g.: Tomiyama *et al.*, 2009; Jin & Bridges, 2014; Ragnedda & Mutsavairo, 2018; Jin & Bagaka, 2005), but there is a lack of the condensed information on different low cost or free tools which can be used in the educational process. What is a significant contribution of this paper is the fact that the author has performed testing of these tools with a sample of 172 VET trainers/educators. The results of the testing cause that the information about the potential use of the digital tool is more credible, because the target group was asked to implement the tool in selected tasks and activities.

2. Methodology

The following methodology was used in order to identify and select the most appropriate and useful software in the learning/teaching process and especially for the creation of a gamified interactive content for different types of end-users.

Step 1. The first step was to search for and test free-ware, open-source software and low-cost software for the development of gamified interactive content. During this activity more than 50 open-source software, free-ware

and low-cost software such as interactive videos, assessments, quizzes with hotspots, word banks, matching, put in the right order, memory games, drop down lists, fill in the banks, video recording and making, cartoons creation were identified. Each organisation from Poland, Italy, Greece, Cyprus, and the United Kingdom which took part in the research had to identify at least 10 pieces of software that can be used for the creation of gamified interactive content.

Step 2. The testing was circulated for peer reviewing followed by a 15-hour webinar (5 sessions – 3 hours each session) where each organisation presented their findings and provided a short training on the usage of the tools. Upon the completion of the webinar, the software (in the number of 22 pieces) which was the most useful, complete, easy to use and compatible with various LMS and CMS platforms was identified. This is the step which is described in details in this paper.

Step 3. Based on the final selection, the organisations were responsible to develop a guide for a set of software. The guide includes the list of the software containing the name of the software, an overview of its capabilities (in a table format) as well as an in-depth description what the tool is capable of creating/delivering, the pros and cons (if any), guidelines of installation and usage (online or offline where possible), a comprehensive training guide, links for downloading and compatibility with LMS and CMS platforms.

3. Research Results and Discussion

The pieces of software for the creation of gamified interactive content in the learning/teaching process which were presented and tested during the webinars are included in Table 1. As for each identified piece of software, the following elements were highlighted during the webinars: a short description of the software and its main capabilities; its features; the guidelines for installation and usage; the how-to / tutorial; the indication of the official website the generated content and compatibility with the LMS and CMS platforms.

Table 1 indicates only the names of the pieces of software (detailed descriptions can be found in the Toolkit for the Creation of Interactive Contents, 2023).

Table 1: The selected pieces of software

Name of the piece of software			
H5P	Adobe Captivate	OpenShot	Mentimeter
iSpring	Articulate Presenter	Reaper	Sticky Notes
Audacity	Elucidat	Shotcut	Student Quiz
Adapt Learning	Audiotool	Quizlet	Swipe
Debate	Real Time Quiz	Good Habits	Quizventure
Mindmap	Lectora		

Source: own study based on the work of different organisations in the i-CONTENT project.

Testing of the software

In the testing phase, there were 172 people engaged from Poland, Italy, Cyprus, Greece and the United Kingdom (table 2).

Table 2: Participant demography

Country	Poland	Greece	Italy	Cyprus	The UK
Number of respondents	72	25	25	25	25
Type of respondents					
VET trainers	23	20	18	21	21
Students	47	0	0	0	0
Other interested in the topic	2	5	7	4	4

Source: own study.

As it can be seen in Table 2, the participants for testing the software consisted mainly of VET trainers. In Poland there was an additional group of the participants who tested the software – the students of informatics and polygraphy for whom the development of the interactive content is important (n=47).

The participants evaluated the usefulness of the presented software taking into account their everyday activities based on the detailed information on each piece of software: the main capabilities of the software; features; the guidelines for installation and usage; the how-to / tutorial; the official website; the generated content and

compatibility with the LMS and CMS platforms (table 3). All these elements are described in details in the Guide "Toolkit for the Creation of Interactive Content".¹

Table 3: Evaluation of the usefulness of the software

Sections included in the questionnaire	Frequency (number of times as '5- excellent' and '4- good') in %	
How would you rate the overall usefulness of the presented software?	87	13
How valuable is the software in helping you gain new knowledge and competences?	79	21
Will you utilise the knowledge and skills gained whilst undertaking the software?	81	19
The presented software is appropriate to my professional needs (selected up to three software).	91	9
The software enables me to engage employees in the interactive design process of the creation of the training.	74	26
The identified software facilitates the development and learning process.	80	20
Mean:	82	18
Do you think the competences related to the use of the presented software are useful in innovative and interactive organisations?	69	31
Do you think the identified software can easily be used by the training organisations to train managers and employees?	78	22
Mean:	73,5	26,5
Sufficiency of the software and efficiency of the process		
The quantity of information provided.	90	10
The quality of the content explained.	92	8
The language used in the description of the software.	89	11
Navigation and usability of the software.	87	13
Quality of the multimedia resources.	86	14
Form and organisation of the software on the original website.	87	13
Mean:	88,5	11,5
Grand mean:	81	19

Source: own study.

The software was evaluated positively, and was rated as excellent or good by VET providers, and in the case of Poland – by students. The participants admitted that the usefulness of the presented pieces of software is good or excellent (82% mean). The respondents admitted that the software can be easily used in the courses dedicated to the development of the gamified interactive content as well as while teaching students in different areas. Notably, 81% stated that they would use their competences and knowledge on this issue in their professional work. In particular, they paid attention to the software related to the creation of games, because the topic is especially fashionable at this moment in the training area. Surely, among the 22 pieces of software, the participants chose several of them stating that they are more interesting than the others. They appreciated especially the software related to the gamification which could be used in the interactive training (Caponetto et al., 2019; Nah et al., 2014; Kiryakova et al., 2014).

The participants generally agreed that nowadays the inclusion of the interactivity in the educational courses is crucial, because for the possible users the interesting course is very important. Although the sample for the testing was 172 people, the results cannot be generalised for the whole population. In this study the author invited the VET teachers and trainers for the testing, so the people for whom the digital tools are extremely important to engage the students more in the learning/teaching process. The average age of the teachers was 36 years old, so it can be assumed that these were people with sufficient knowledge of how to work with digital tools. We must pay attention to the fact that perhaps with another target group the results could be different, especially because of the age, geographical location or the types of the lectures led by the teachers. On the other hand, the author presents only the results of the testing phase, so the teachers were not able to use these tools in a real environment. Perhaps, after using the selected tool in a real environment, the results would be different.

The participants of the testing phase agreed with Bleakley (2022) that they had opportunities to use digital skills, but they were overwhelmed with a huge offer of different digital tools. Following with Kee (2021) they stated that not only students, but also teachers were always afraid of using digital tool, because they did not know how to do it, which tools were relevant for specific lessons, etc.

¹ https://icontent.projectsgallery.eu/wp-content/uploads/2022/03/ICONTENT-IO2_Software_Toolkit_V2.pdf

Apart from the overall evaluation of the usefulness of the software, the core element was to evaluate the engaging software including the gamification elements. Out of the 172 participants, 107 participants found the selected software to be highly engaging, 93 respondents found the selected software to be used in the development of the interactive course especially for young students, and 110 respondents stated that the learning-teaching process should include the software which can be easily used for the improvement of the education, both by teachers and learners. They confirmed that the effectiveness of using games is often assessed at a high level (da Rocha Seixas, 2016; Papadakis, S., & Kalogiannakis, 2019). What is similar to what was observed by Bond (2015) and Behnamghadr et al. (2021) is that the teachers sometimes use games during lessons with the students who have difficulties in learning, they have Asperger or autism syndrome. Such group of students like being engaged in games, but what is important they prefer using them for fun, obviously not for competing with the others.

The participants were also asked to rank the software including the gamification elements which was then synthesised to identify the most favourable software types. The combined frequency is summarised in table 4.

Table 4: Combined frequency of times software is collectively ranked in top 3

Selected software	Frequency (number of times)	Relative Frequency [%]
Adapt learning	47	9
Adobe Captivate	61	12
Articulate 360	85	16
Lectora Inspire	77	15
Blockgame	50	10
Bookwidgets	44	8
Camtasia	72	14
Elucidat	80	16

Source: own study.

For 94% of the respondents the elements of the gamification were very important. Some of them have had experience with the creation of games before, but for many of them it would be the challenge of getting started with eLearning, and creating good-looking courses quickly. Thanks to the presented software, it is possible to design beautiful eLearning content in minutes with the all-new ready-to-go slides. 87% of the respondents paid attention to the following aspects of the software: games (bingo, crosswords, hangman, etc.); pictures & videos (before/after, frame sequence, YouTube, Vimeo, etc.); math (active plots, arithmetic, charts, and spreadsheets); third parties (Google map, PDF, web embed, Wikipedia); miscellaneous (clear storage, planner, form/survey). What is important for the respondents is that with the use of the software, they can evaluate, grade, and provide feedback to their students: many exercises are automatically graded, freeing up time for you to give quality feedback to your students with a click. If they want to follow a student's activity live, they can monitor their students' progress in real-time while they're working, for example, on BookWidgets assignments, at home or in your classroom. Immediately they can discover students that need extra challenges, help struggling students, play live games, and take real-time surveys.

There are several software options available for developing interactive training courses, each with its own strengths and features. The choice of software depends on various factors, such as one's specific requirements, budget, technical expertise, and desired functionalities. The participants paid attention especially to the five pieces of software:

- *Articulate 360* (85 number of times) which is a comprehensive e-learning authoring suite that includes tools like Storyline, Rise, and Review. They underlined that storyline enables the creation of highly interactive and customizable courses with features such as branching scenarios, assessments, and multimedia integration. They appreciated that Articulate 360 offers a user-friendly interface, extensive templates, and a strong community support network.
- *Adobe Captivate* (61 number of times) was assessed as a powerful authoring tool for creating interactive e-learning content. The participants underlined that it provides a wide range of features such as responsive design, branching scenarios, simulations, and assessments. What is important, is that it also provides options for creating virtual reality (VR) and augmented reality (AR) content.
- *Lectora Inspire* (77 number of times) was perceived as an e-learning authoring tool known for its flexibility and extensive interactivity options. For the participants it was important that it offers a range of features, including customizable templates, multimedia integration, branching scenarios,

assessments, and gamification elements. What is more, they underlined the fact that Lectora supports SCORM and xAPI standards for seamless integration with learning management systems (LMS).

- *Camtasia* (72 number of times) was perceived as a tool which can be utilised to create interactive training videos. The participants indicated many advantages of Camtasia such as the capture and editing of screen recordings, webcam footage, and audio, along with adding annotations, quizzes, and interactivity. What is more, Camtasia is particularly useful for software demonstrations and tutorial-style training content.
- *Elucidat* (80 number of times) was seen as a cloud-based authoring tool that focuses on creating responsive and mobile-friendly interactive courses. The participants liked its user-friendly interface, a wide range of templates, and collaborative features for team-based development.

As a summary, the participants stated that gamification elements play a crucial role in educational courses due to their ability to enhance engagement, motivation, and learning outcomes. Here are some reasons why gamification elements are important in educational courses:

- *Increased Engagement*: Gamification elements, such as badges, and rewards, make the learning experience more engaging and enjoyable for students. By incorporating game-like features, educational courses capture students' attention and encourage active participation, which can lead to increased focus and retention of knowledge.
- *Motivation and Goal Orientation*: Gamification taps into students' intrinsic motivation by setting clear goals and providing immediate feedback and rewards. By offering challenges, levels, and achievements, gamification elements create a sense of progress and accomplishment, driving students to strive for improvement and complete tasks.
- *Active Learning and Problem-solving*: Gamification in educational courses promotes active learning by providing interactive challenges and problem-solving opportunities. Students actively participate, make decisions, and apply knowledge in a practical context, fostering critical thinking skills and enhancing their ability to transfer knowledge to real-world scenarios.
- *Personalized Learning Paths*: Gamification allows for personalized learning paths and adaptive content delivery. By tracking students' progress, performance, and preferences, educational platforms can tailor the learning experience to individual needs, providing targeted feedback and content that matches students' skill levels and interests.
- *Collaboration and Social Interaction*: Gamification elements often include social features, such as multiplayer challenges, or discussion forums. These elements foster collaboration, healthy competition, and peer interaction, creating a supportive learning community where students can learn from and with their peers, share knowledge, and engage in collaborative problem-solving.

4. Conclusions

In order to encourage both students and teachers to engage more in different courses, one of the ways is to propose to develop them in an interactive way. Nowadays, the students want to learn, but they do not just want to read simple texts. They want to learn with the use of their creativity and through fun and using different tools, such as games.

This article discusses the potential of the application of interactive software that aims to support digital competences in the organisation through the ability to develop an interesting interactive course. In our investigations we identified and tested a set of 22 digital tools with the group of 172 educators which can be useful in the learning/teaching process. In the article the author has made a condense review of selected tools in one place. And apart from the presentation of the tools, they also have been tested to guarantee more credibility in the selection and use of an individual tool in individual educational process.

This article has discussed and presented a pragmatic approach in designing and developing the educational resources for supporting the development of the competences. The participants underlined the following aspects:

- *Engaging and Interactive Learning*: Interactive software enables the creation of engaging and interactive learning experiences. By incorporating multimedia elements, interactive quizzes, simulations, and gamification elements, such software can capture learners' attention, increase their motivation, and enhance the overall learning experience.

- *Personalized Learning Paths*: Through assessments, learner analytics, and intelligent algorithms, the software can identify knowledge gaps and provide targeted content and exercises to address specific areas of improvement. This personalized approach allows learners to progress at their own pace and focus on the areas that require attention, enhancing their digital competences effectively.
- *Real-World Application*: Through interactive simulations, case studies, and problem-solving activities, learners can gain hands-on experience and develop skills that are directly applicable to their roles within the organization.
- *Assessments and Progress Tracking*: Interactive software can include built-in assessments and progress tracking features, enabling learners and organizations to monitor their progress and proficiency in digital competences. Regular assessments can provide feedback on learners' strengths and areas.

Having performed the research, some recommendations for practitioners can be indicated: the digital tools can provide training and support through organising workshops, webinars or tutorials; the use of the tools offers flexibility allowing practitioners to adapt the tools to meet their specific needs and align with their pedagogical approaches; and finally, the recognition of digital tools can inspire practitioners to explore them and experiment with new teaching methods.

The research has addressed the challenges associated with the development of the interactive training courses for different needs. The research significantly contributes to expanding the development practice in this area, specifically the design approach for the corresponding educational resources. The potential impact of the educational program designed and developed could be extended to consider more international dimensions as the outcomes can be further adapted by enterprises globally. Future work will also include correlating the engagement with the assessment of knowledge and competencies.

References

- Afshari, M., Bakar, K. A., Luan, W. S., Samah, B. A., and Fooi, F. S. (2009). Factors affecting teachers' use of information and communication technology. *International Journal of Instruction*, Vol 2, No 1, pp. 77-104.
- Anggeraini, Y. (2020). Language teaching in the digital age: Teachers' views and its challenges. *Research and Innovation in Language Learning*, Vol 3, No 3, pp. 163-172.
- Baldwin, S., Ching, Y. H., and Hsu, Y. C. (2018). Online Course Design in Higher Education: A Review of National and Statewide Evaluation Instruments. *TechTrends*, Vo. 62, pp. 46–57.
- Barneva, R.P., Kanev, K., Kapralos, B., Jenkin, M., and Brimkov, B. (2017). Integrating technology-enhanced collaborative surfaces and gamification for the next generation classroom. *Journal of Educational Technology Systems*, Vol 45, No. 3, pp. 309-325.
- Behnamghader, M., Khaleghi, A., Izadpanah, P., and Rahmani, F. (2021). *Using gamification based on mobile platform in therapeutic interventions for children with dyslexia*. In Internet of Things, Infrastructures and Mobile Applications: Proceedings of the 13th IMCL Conference 13 (pp. 814-824). Springer International Publishing.
- Bleakley, A., Rough, D., Edwards, J., Doyle, P., Dumbleton, O., Clark, L., Rintel, S., Wade, V., and Cowan, B. R. (2022). Bridging social distance during social distancing: exploring social talk and remote collegiality in video conferencing. *Human-Computer Interaction*, Vol 37, No 5, pp. 404-432.
- Bliuc, A. M., Casey, G., Bachfischer, A., Goodyear, P., and Ellis, R. A. (2012). Blended learning in vocational education: teachers' conceptions of blended learning and their approaches to teaching and design. *The Australian Educational Researcher*, Vol 39, pp. 237-257.
- Bond, L. (2015). *Mathimagicians Quest: Applying Game Design Concepts to Education to Increase School Engagement for Students with Emotional and Behavioural Disabilities* (Doctoral dissertation).
- Borawska-Kalbarczyk, K., Tołwińska, B., and Korzeniecka-Bondar, A. (2019). From smart teaching to smart learning in the fast-changing digital world. In L. Daniela (Ed.), *Didactics of smart pedagogy. Smart pedagogy for technology enhanced learning* (pp. 23-39). Cham: Springer.
- Brown, A., and Green, T. (2016). Virtual Reality: Low-Cost Tools and Resources for the Classroom, *TechTrends*, Vol 60, pp. 517–519.
- Caponetto, I., Earp, J., and Ott, M. (2014). *Gamification and education: A literature review*. European Conference on Games Based Learning, Academic Conferences International Limited, Vol. 1, p. 50.
- Cechella, F., Abbad, G., and Wagner, R. (2021). Leveraging learning with gamification: An experimental case study with bank managers. *Computers in Human Behaviour Reports*, Vol 3, p. 100044.
- Cheng, G. (2019). Exploring factors influencing the acceptance of visual programming environment among boys and girls in primary schools. *Computers in Human Behaviour*, Vol 92, pp.361–372.
- Cuban, L. (2001). *Oversold and underused: Computers in the classroom*. Harvard University Press, Cambridge.
- Desnenko, S., Pakhomova, T., Starostina, S., and Tokareva, J. (2021). *Gamification in the formation of digital skills of future teachers*. E3S Web of Conferences, EDP Sciences, Vol. 273, p. 12118.

- Flanagan, L., and Jacobsen, M. (2003). Technology leadership for the twenty-first century principal. *Journal of Educational Administration*, Vol 41, No 2, pp. 124–142.
- Ghavifekr, S., Kunjappan, T., Ramasamy, L., and Anthony, A. (2016). Teaching and Learning with ICT Tools: Issues and Challenges from Teachers' Perceptions. *Malaysian Online Journal of Educational Technology*, Vol 4, No 2, pp. 38-57.
- Huang, W. H. Y., and Soman, D. (2013). Gamification of education. Report Series: *Behavioural Economics in Action*, Vol. 29, No. 4, pp. 1-29.
- Hylland, O. M. (2022). Digital cultural policy. The story of a slow and reluctant revolution. *International Journal of Cultural Policy*, Vol 28, No 7, pp. 813-828.
- Irfan, M., Kusumaningrum, B., Yulia, Y., and Widodo, S. A. (2020). Challenges during the pandemic: use of e-learning in mathematics learning in higher education. *Infinity Journal*, Vol 9, No. 2, pp. 147-158.
- Jin, J., and Bridges, S. M. (2014). Educational Technologies in Problem-based Learning in Health Sciences Education: A Systematic Review. *Journal of Medical Internet Research*, Vol 16, No 12, e251.
- Jin, S., and Bagaka, J. (2005). The role of teacher practices and classroom characteristics on the “digital divide” in students’ usage of technology tools: A Multilevel Analysis. *Contemporary Issues in Technology and Teacher Education*, Vol 5, No 3, pp. 318-329.
- Kee, C. E. (2021). The impact of COVID-19: Graduate students’ emotional and psychological experiences, *Journal of Human Behaviour in the Social Environment*, Vol 31, No 1-4, pp. 476-488.
- Kiryakova, G., Angelova, N., and Yordanova, L. (2014). *Gamification in education*. Proceedings of 9th international Balkan Education and Science Conference, Vol 1, pp. 679-684.
- Kolikant, Y. B. D. (2010). Digital natives, better learners? Students’ beliefs about how the Internet influenced their ability to learn. *Computers in Human Behaviour*, Vol 26, No 6, pp. 1384-1391.
- Kulkarni, K. G. (2013). *Digitalization in higher education: costs and benefits*. International Conference on Digitalization and Beyond, pp. 1-6.
- Marinelli, C. V., Nardacchione, G., Trotta, E., Di Fuccio, R., Palladino, P., Traetta, L., and Limone, P. (2023). The Effectiveness of Serious Games for Enhancing Literacy Skills in Children with Learning Disabilities or Difficulties: A Systematic Review. *Applied Sciences*, Vol 13, No 7, p. 4512.
- Mucundanyi, G., and Woodley, X. (2021). Exploring Free Digital Tools in Education. *International Journal of Education and Development using Information and Communication Technology*, Vol 17, No 2, pp. 96-103.
- Nah, F. F. H., Zeng, Q., Telaprolu, V. R., Ayyappa, A. P., and Eschenbrenner, B. (2014). *Gamification of education: a review of literature*. HCI in Business: First International Conference, HCIB 2014, Proceedings 1, pp. 401-409, Springer International Publishing.
- Ni, A. Y. (2013). Comparing the effectiveness of classroom and online learning: Teaching research methods. *Journal of Public Affairs Education*, Vol 19, No. 2, pp. 199-215.
- Palomino, P. T., Toda, A. M., Oliveira, W., Cristea, A. I., and Isotani, S. (2019). *Narrative for gamification in education: why should you care?*. IEEE 19th International Conference on Advanced Learning Technologies (ICALT), Vol 2161, pp. 97-99.
- Papadakis, S., and Kalogiannakis, M. (2019). Evaluating the effectiveness of a game-based learning approach in modifying students' behavioural outcomes and competence, in an introductory programming course. A case study in Greece. *International Journal of Teaching and Case Studies*, Vol 10, No 3, pp. 235-250.
- Papadakis, S., Zourmpakis, A. I., and Kalogiannakis, M. (2023). *Analyzing the Impact of a Gamification Approach on Primary Students' Motivation and Learning in Science Education*. In Learning in the Age of Digital and Green Transition: Proceedings of the 25th International Conference on Interactive Collaborative Learning (ICL2022), Vol 1 (pp. 701-711). Cham: Springer International Publishing.
- Ragnedda M., and Mutsavairo, B. (2018). *Digital inclusion: An international comparative analysis*. Rowman & Littlefield.
- Säljö, R. (2010). Digital tools and challenges to institutional traditions of learning: technologies, social memory and the performative nature of learning. *Journal of Computer Assisted Learning*, Vol 26, No 1, pp. 53-64.
- Sevara, S., Shakhriyor, K., and Kosimov, A. (2022). Implementation of Digital Tools in the EFL Classroom. International Conference on New Scientific Methodologies (pp. 34-37). Retrieved from https://www.researchgate.net/publication/366190924_IMPLEMENTATION_OF_DIGITAL_TOOLS_IN_THE_EFL_CLASS_ROOM on 26, June 2023.
- Seyffer, S., Hochmuth, M., and Frey, A. (2022). Challenges of the coronavirus pandemic as an opportunity for sustainable digital learning in vocational education and training (VET). *Sustainability*, Vol 14, No. (13), p. 7692.
- Syauqi, K., Munadi, S., and Triyono, M. B. (2020). Students' Perceptions toward Vocational Education on Online Learning during the COVID-19 Pandemic. *International Journal of Evaluation and Research in Education*, Vol 9, No. 4, pp. 881-886.
- Tomiyama, T., Gu, P., Jin, Y., Lutters, D., Kind, C., and Kimura, F. (2009). Design Methodologies: Industrial and Educational Applications. *CIRP annals*, Vol 58, No 2, pp. 543-565.
- Toolkit for the Creation of Interactive Contents. (2023). Retrieved from <https://icontent.projectsgallery.eu/results/> on 5, July 2023.
- Veen, W. (1993). How teachers use computers in instructional practice—four case studies in a Dutch secondary school. *Computers & Education*, Vol 21, No 1-2, pp. 1-8.
- Zourmpakis, A. I., Kalogiannakis, M., and Papadakis, S. (2023). *A Review of the Literature for Designing and Developing a Framework for Adaptive Gamification in Physics Education*. The International Handbook of Physics Education Research: Teaching Physics.

PhD Research Papers

Student Notetaking Media in Higher Education

Colin Loughlin

Lund University, Sweden

colin.loughlin@brunel.ac.uk

Abstract: This paper explores the evolution of research methodology in the study of student notetaking in higher education (HE) and its impact on pedagogic approaches. While acknowledging the importance of notetaking for student learning, the paper argues that the overreliance of randomized control trials (RCTs) has led to some potentially misleading conclusions about lectures in HE and the notes students make during them. The paper traces the historical development of research methodologies in student notetaking, highlighting the shift from early observational studies to experimental research focused on identifying effective notetaking styles. However, the paper contends that these experimental studies often failed to capture the complex real-world factors that influence student note taking behaviour and learning outcomes. Contradictory findings between experimental and observational research are presented, challenging the assumptions drawn from RCTs. Observational studies suggest that the quality and quantity of notes taken during lectures may have limited impact on long-term conceptual understanding and learning outcomes, while the revision and review process may play a more significant role. The paper also examines the issues of internal and external validity in experimental research on student notetaking. It argues that the experimental methodologies used in these studies often controlled for important contextual factors, resulting in misleading outcomes that do not translate well into real-world settings. Drawing on the concepts of holist underdetermination and auxiliary hypotheses, the paper emphasizes the need for mixed methodologies and a holistic approach to investigate and establish causation in the study of student notetaking. In conclusion, the paper suggests that a shift in focus from student notetaking to the lecture itself may be necessary. It highlights the importance of considering the broader context, individual differences, and the review and revision process in understanding the impact of notetaking on student learning outcomes. The paper calls for a re-evaluation of experimental methodologies and a more comprehensive approach to studying student notetaking in higher education

Keywords: notetaking, higher education, research methods

1. Introduction

Although it was the start of the twentieth century before any formal research was published on the subject, the importance of notetaking by students was acknowledged as far back as the Roman era, Quintilian asserting that it was, 'the only way to ensure real, deep-rooted progress' (Quintilian, 2001, p. 79). As Higher Education (HE) expanded and class sizes grew, academics started to take an interest in what notes students were taking during lectures, and how those notes impacted student outcomes. The research generated over the last century has informed both academic practice and the study skills advice provided to students. This paper argues that the more recent overreliance on randomised control trials (RCTs) has led to some (potentially damaging) misconceptions about lectures in HE, and the notes that students make in them.

The short history of research into notetaking by students in HE is a fascinating reflection of other areas of research which appear to go through similar stages of development. Echoing those of natural science, even biology, where early research was observational, there was then (and is still) a great deal of experimental research, but now there is an acknowledgement that individual biological components can behave in unexpected ways when combined into complex systems. This has led to the development of entirely new fields of study such as Systems Biology, in which sophisticated computational approaches can now successfully model multiple interdependencies and is used to predict the efficacy of cancer treatments for instance. The research methodology on student notetaking has yet to reach the point of such sophisticated modelling.

This paper briefly explores the evolution of research methodology into student notetaking in HE and its impact on pedagogic approaches. It questions the external validity of RCTs in relation to student notetaking practices using Duhem's concept of 'underdetermination' in conjunction with an analysis of some specific examples compared to observational data.

2. Methodology

This paper employs a literature review and critical reflection to explore the evolution of research methodologies in the study of student notetaking in higher education. It critically analyses existing research literature, including both experimental and observational studies, to assess the strengths and limitations of different methodologies. The paper synthesises findings from multiple sources and presents a nuanced understanding of the complexities involved in studying student notetaking. By examining historical trends and contrasting experimental results

with observational data, the paper highlights the contextual factors and auxiliary hypotheses that are often overlooked in experimental research. The methodology employed in this paper involves a comprehensive review and synthesis of existing literature to provide a broader perspective on the research on student notetaking in higher education.

3. Evolving Research Methodology

Initially the research into student notetaking was observational, interested in what the students were doing of their own volition and what correlation that had with test scores. For example, Crawford (1925) identified a strong positive correlation between the quantity of notes taken and students' test results. He noted the difficulty of ascribing causality due to the myriad of possible influences on the note taking and the learning, including the fact that some lecturers forbade the taking of notes so that, students would get 'their ideas rather than their words' (ibid). For much of the next three decades research focused on the *product* of notetaking, trying to identify whether any particular styles of notetaking were more effective than others in aiding recall.

There is considerable debate as to what constitutes learning and how that should be assessed, and in notetaking studies especially, the area of recall verses conceptual understanding. However, for the purposes of this discussion, programme test, or exam scores are used as the measure of success.

As with other fields of study, 'causation is the "holy grail" of educational research' (Cohen et al., 2011, p. 54), and by the 1960s and 1970s researchers were taking more of an interest in the *process* of notetaking, and whether the act of writing things down had any intrinsic value. Di Vesta and Gray (1972) introduced the idea of notes as *external storage* which could be used for later retrieval. The theory of notes as external storage spawned nearly thirty years of experimental research which tried to isolate, identify, and control the ways in which this might happen.

To be able to claim causality the researchers had to control for as many extraneous influences as possible. Therefore, the majority of this experimental research required that the students take part in lectures on subjects with which they were not familiar, so as not to taint the data with any previous knowledge that individual students may have had. They were often instructed to use a particular style of notes such as transcription or summary. And, in order to keep the subjects of the study engaged and the data manageable there was often only one lecture, typically no more than ten to fifteen minutes in length. RCT groups are also common in these experiments to further isolate the effects being studied.

The results of the experimental notetaking studies seemed to be conclusive, with both valid and reliable outcomes in most cases. For instance, that summarised or paraphrased notes were better than transcription, and that, skeletal lecture slides were better than complete lecture slides. Skeletal (or incomplete) lecture slides/notes are where the lecturer includes headings and leaves space for the student to add their own notes during the lecture.

Kenneth Kiewra suggested the idea of teaching notetaking for students, as 'left to their own devices [students] are terribly incomplete note takers, recording only about 30% of lecture ideas for future reference' (1985, p. 173). Over the years what was 'known' about notetaking became embedded into academic skills workshops for students and professional development programs for academics. To this day, a significant number of academics provide skeletal lecture slides on the basis that it encourages a more complete and therefore a more effective set of notes.

4. Discussion

The only problem is that what was *established* in these experiments did not always translate into the real world. Observational research, which examined what was happening in authentic classroom settings, came to some very different conclusions. In relation to skeletal lecture notes for example (and in far less prominent/cited research), James Hartley found that following 'a clear initial advantage for the incomplete hand-out group [after nine weeks the] difference was no longer statistically significant' (1976, p. 62). Even more disturbingly, Kiewra (who published extensively on student notetaking in the 1980s and 1990s) found that students who did not attend the lecture *at all*, but were given complete lecture notes, did better in test scores than students *who attended the lecture* but were given skeletal lecture notes. As mentioned, experimental research established that summarised (paraphrased) notes were more effective than transcribed notes (those written out as fully as possible). However, observational research which also included the revision/review process found that the opposite was true (Kobayashi, 2009). This area of research has since be further complicated by the discovery

that short-term memory capacity means that some students benefit more from transcribing, and others, more from paraphrased notes.

My own projects (Loughlin, 2015, 2017) looked at digitally mediated student notetaking. Although I took a phenomenological approach to my data collection, I realised during the analysis that it was becoming hypothetico-deductive because of the influence of research discovered during the literature review. I was expecting students using laptops to perform badly, having read articles which suggested that students who took lecture notes on a laptop were disadvantaged because of the amount of notes they could take compared to traditional note-takers (Van Schaack, 2009) and also because of their potential as a distraction (Kraushaar and Novak, 2010). Mueller and Oppenheimer's (2014) experimental research found that students with laptops took more notes than those with a pen and paper but performed worse in tests, they suggested that this was because students were typing mindlessly, transcribing the content and thus, losing the encoding benefits of taking notes, throwing doubt again, on whether transcription or paraphrasing was more effective as a notetaking strategy.

My 2015 study of a large cohort of 200 students found no statistically significant difference between different notetaking media, in fact, those using laptops scored marginally higher on all tests than traditional note-takers. However, my main findings were that; firstly, the students took very few notes! This appears to be partly the result of lecture slides being made available before lectures and partly due to the revision/review strategy of individual students. Secondly, notetaking in lectures had assumed a disproportionate significance and was in fact, considerably less important to student strategies and learning outcomes than the revision/review process. However, the quantity and quality of notes taken during lectures and their relationship to academic success is highly contextually dependent, and the same students who took few notes in this series of lectures indicated that they behaved differently, contingent on the subject being taught and the approach of the lecturer.

Axial Coding - Mapping initial codes to ecosystem of academic practice

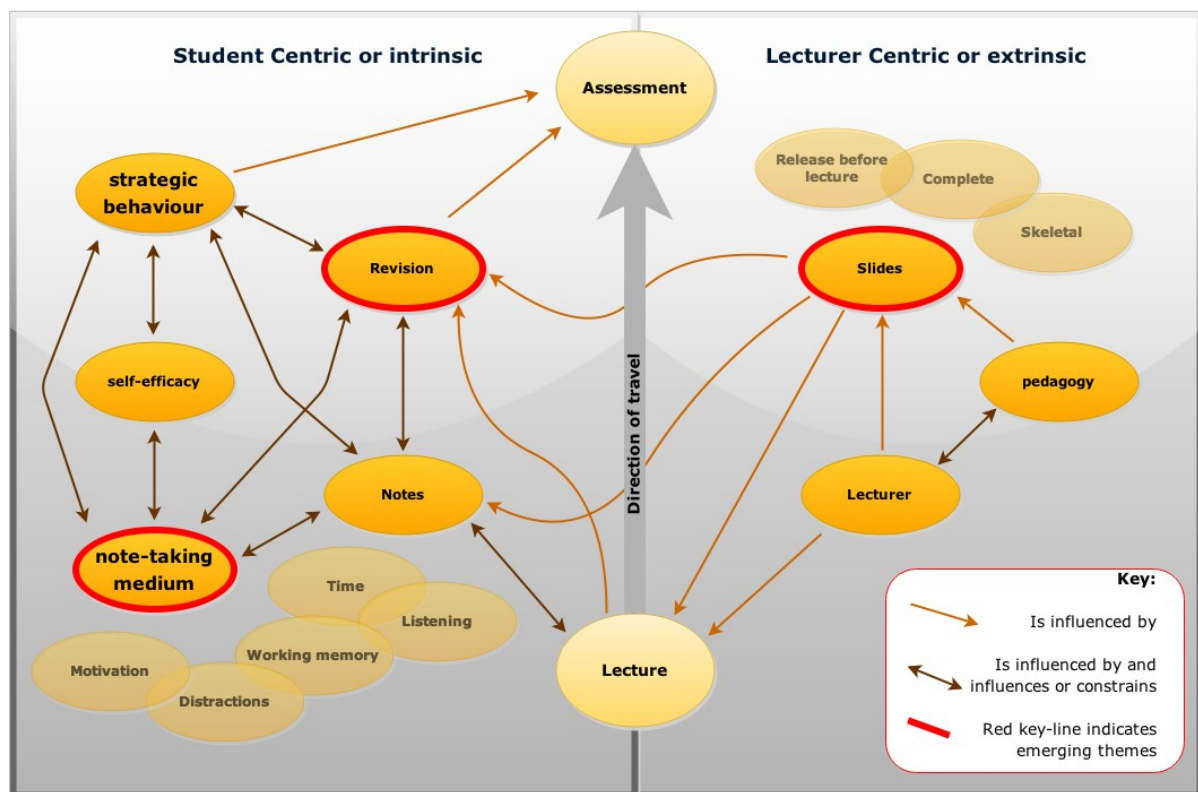


Figure 1: Axial Coding (Loughlin, 2015)

As can be seen in the diagram of the initial axial coding of the interviews for the study (Figure 1), even at a superficial level, there is a comparatively complex systemic relationship which influences the quantity and quality of notes taken during lectures. The attempts of experimental researchers to isolate notetaking behaviours led to outcomes which were misleading, and many of those behaviours and outcomes changed when real world influences were reintroduced. These contradictory findings highlight some of the problems associated with research into student notetaking. Students in a real-world setting are in lectures lasting two hours, or more,

and which generally form part of a lecture, seminar, self-study cycle; therefore, the students notetaking strategy could be very different. Ascribing causality of learning outcomes related to notes taken in a lecture is almost impossible, as the ideas would have been discussed in the seminar and revised before the test. Is learning said to have taken place when you can test for it after one week? nine weeks? or one year? While forcing students to take notes during lectures has been shown to improve short-term recall, it is much less conclusive when it comes to long-term conceptual understanding. The students disciplined enough to take comprehensive lecture notes are also likely to engage with the seminar and self-study/revision with equal vigour.

The data from a recent publication (Loughlin and Lindberg-Sand, 2022) - a mixed methods study of a lecture series in the health sciences with a cohort of 180 - again found that there was no statistically significant relationship between notetaking medium and exam results. While notetaking was not the primary focus of the study, we found that there was a weak correlation between notetaking quantity (self-reported) and the exam score ($r(96) = .078$, p value $<.01$) (see figure 2 – the width of the bars indicates the proportion of the sample in each box). Notetaking medium (iPad, Laptop or Pen) and the style of notes (from summarised to verbatim) had no statistically significant relationship with the exam scores.

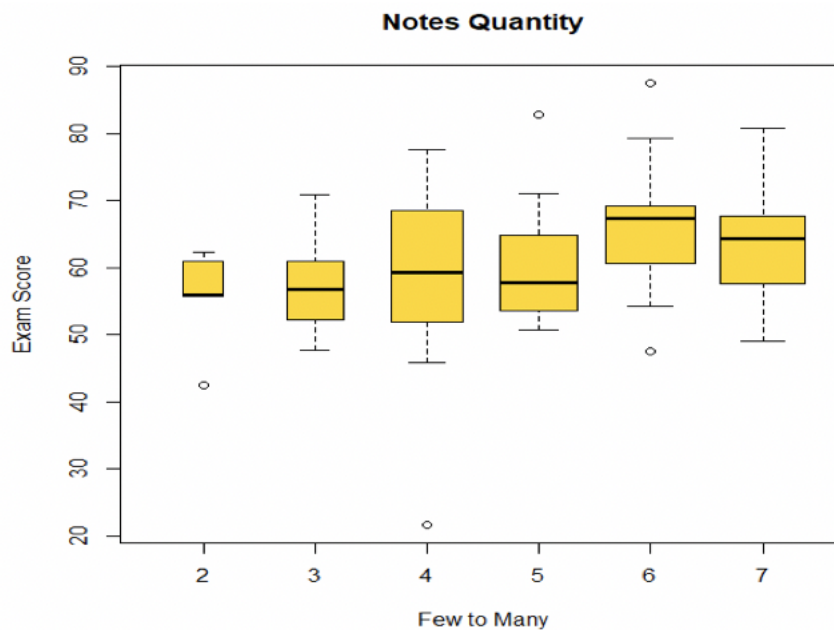


Figure 2

Thus (and contrary to several RCT trials), in three separate observational studies of a large-class lecture series (across two disciplines), laptop users outperformed pen users in the final exam, though not to a statistically significant degree.

4.1 Internal/External Validity

Munro (in Cartwright and Montuschi, 2014, p. 60) states that a 'study is said to have external validity when the "same intervention" has the "same result" as the RCT [randomised control trial] when used with a new population'. However, this measure of internal/external validity would fail to deal with some of the issues identified with the experimental research into notetaking by students, as the RCTs themselves would likely produce similar results in a similar RCT.

The experimental research into notetaking among students measured what it set out to measure, with methodology which would be replicable in different contexts. The problem with the research is that it controlled *out* some of the elements which are integral to notetaking in real world situations, such as, previous knowledge, motivation, personal strategies and preferences. While Cartwright and Hardie say that '[c]auses work in teams' (in Cartwright and Montuschi, 2014, p. 60) and describe a phenomenon of internally valid interventions failing in different contexts because one of the essential elements present in the experiment was missing in a different situation; they are describing the reverse of the experiments with student notetaking, where elements present in the real world were missing from the experiment. If one takes a broad definition of external validity as the ability to generalise the results into an everyday setting, then clearly some of these experimental studies would

fail. However, some experimental notetaking research has been taken at face value, and used to inform academic practice without reference to real world outcomes.

4.2 Auxiliary Hypotheses

Pierre Duhem introduced the idea of holist underdetermination in his 1914 book, *The Aim and Structure of Physical Theory*. The Stanford Encyclopaedia of Philosophy website describes holist underdetermination as the 'claim that theories or hypotheses can only be subjected to empirical testing in groups or collections, never in isolation' (Stanford, 2017). This appears to be a more promising description of the problems encountered with experimental notetaking research. They go on to say: 'The idea here is that a single scientific hypothesis does not by itself carry any implications about what we should expect to observe in nature; rather, we can derive empirical consequences from a hypothesis only when it is conjoined with many other beliefs and hypotheses' (ibid). Duhem, a physicist, was talking primarily about scientific underdetermination, but this was broadened to encompass 'all knowledge' by Willard Quine and appears to be particularly applicable to the social sciences.

Quine felt that, in addition to the underdetermination that Duhem outlined, that there is a psychological element, in which the researchers themselves, in the face of disconfirming evidence, choose which hypotheses to reject based on the simplicity or elegance of the solution, or even their own beliefs (Stanford, 2017). This can be seen in the work of Fried (2008) and Mueller and Oppenheimer (Mueller and Oppenheimer, 2014) who openly acknowledge a preference for handwritten notes, and use their results to draw conclusions about handwritten notes superiority over laptops, when a number of alternative explanations is equally likely.

Karl Popper (2008, p. 62) seems to imply that all auxiliary hypotheses are explicit and should add to the experimental fidelity, whereas, I would argue that, in the case of experimental notetaking research, the key auxiliary hypotheses remained implicit and unstated. There are many possible explanations for the discrepancy between the experimental research and its translation into real world situations. However, a good candidate is the auxiliary hypothesis that the quality of students' notetaking in lectures is causally responsible for the quality of their learning. It is not born out in observational research, and among many possibilities, it is just as likely that diligent students who are academically successful would produce good quality notes as a by-product of their diligence, rather than the good quality notes being a cause of their success. As John Stuart Mill points out, 'an hypothesis [...] is not to be received as probably true because it accounts for all the known phenomena' (ibid).

5. Conclusion

In attempting to demonstrate causality, researchers have been tempted into reductive experimental methodologies which have in some cases produced misleading results. In a social science context, attempting to describe complex systemic relationships can be further complicated by irrational and apparently random behaviour of individual subjects; for example, there is the game theory example where subjects choose options based on normative conditioning rather than logic (Cartwright and Montuschi, 2014). Cohen *et al* argue for 'establishing causation other than through reduction and recombination of atomistic, individual items and elements' (Cohen et al., 2011, p. 71) and contend that 'mixed methodologies and mixed methods [are more appropriate for] investigating and establishing causation' (ibid, p. 72).

Studies of students in higher education show that notetaking is influenced by such factors as, cognitive capacity; attitudes; motivation; the students' relationship with and regard for the lecturer; and the review process adopted by individual students. By reducing the notetaking event to a ten-minute, one-off session, experimental researchers can control for many factors but also eliminate the essence of what motivates students to take notes in the first place. With students 'only vaguely aware of accountability demands' (Van Meter et al., 1994, p. 332), and unable to relate the material in the lecture to previous knowledge, the experience becomes too abstract. Only by looking at the notetaking experience holistically in a real world setting and taking account of review and revision strategies can you begin to assess its impact.

In a meta-study, Kobayashi found that the 'overall effect of notetaking compared with no notetaking was positive but modest' (2009, p. 253); this, combined with Kiewra's finding that students who did not attend lectures but were given complete lecture notes could outperform those who attended, has shifted my focus from student notetaking to the Lecture itself. My own study found that the style, quantity and medium of notes taken during lectures, or even taking no notes at all, had no significant impact on learning outcomes, and that the review and revision process was considerably more important to students.

The use of experimental methodologies in relation to student notetaking in higher Education has highlighted a number of issues. Firstly, an internal/external validity problem, where some reductive RCT approaches have produced misleading outcomes. This has been compounded by some subsequent research relying on assumptions garnered from the flawed research as auxiliary hypotheses of their own. And secondly, the issue of implicit auxiliary hypotheses themselves. The RCT trials into student notetaking were trying to establish that particular techniques produced better notes, on the assumption that better quality lecture notes resulted in improved learning outcomes. The bigger question, of whether better notes were causally responsible for better learning outcomes has been subsequently answered with observational qualitative methodologies and renders many of the RCT studies moot.

Learning is a nebulous concept and measuring it not simply a matter of watching a litmus paper change colour. Personal psychology plays a significant role in learning outcomes and does not always lend itself to deductive experimental research techniques. While the balance of the evidence suggests that taking notes is beneficial to the learning process (probably on the basis that it helps with encoding), there is little to indicate that this should take place in the lecture hall, rather than as private study, or part of the revision and review process.

References

- Cartwright, N. and Montuschi, E. (eds.) (2014) *Philosophy of social science: a new introduction*, First edition., Oxford, United Kingdom, Oxford University Press.
- Cohen, L., Manion, L. and Morrison, K. (2011) *Research methods in education*, 7th ed., London ; New York, Routledge.
- Di Vesta, F. J. and Gray, G. S. (1972) 'Listening and note taking.', *Journal of Educational Psychology*, vol. 63, no. 1, pp. 8–14 [Online]. DOI: 10.1037/h0032243.
- Fried, C. B. (2008) 'In-class laptop use and its effects on student learning', *Computers & Education*, vol. 50, no. 3, pp. 906–914 [Online]. DOI: 10.1016/j.compedu.2006.09.006.
- Hartley, J. (1976) 'Lecture Handouts and Student Note-taking', *Innovations in Education & Training International*, vol. 13, no. 2, pp. 58–64 [Online]. DOI: 10.1080/1355800760130208.
- Kiewra, K. A. (1985) 'Investigating Notetaking and Review: A Depth of Processing Alternative', *Educational Psychologist*, vol. 20, no. 1, pp. 23–32 [Online]. DOI: 10.1207/s15326985ep2001_4.
- Kobayashi, K. (2009) 'Comprehension of relations among controversial texts: effects of external strategy use', *Instructional Science*, vol. 37, no. 4, pp. 311–324 [Online]. DOI: 10.1007/s11251-007-9041-6.
- Kraushaar, J. and Novak, D. (2010) 'Examining the Affects of Student Multitasking with Laptops during the Lecture', *Journal of Information Systems Education*, vol. 21, no. 2, pp. 241–251.
- Loughlin, C. (2015) 'Digitally Mediated Note-taking Practices of Students in Higher Education', Masters thesis, Kingston Upon Thames, Kingston University.
- Loughlin, C. (2017) 'Digitally Mediated Notetaking Practices of Students in Higher Education', *SRHE Annual Research Conference, New Port, South Wales, UK*, Celtic Manor, New Port.
- Loughlin, C. and Lindberg-Sand, Å. (2022) 'The use of lectures: effective pedagogy or seeds scattered on the wind?', *Higher Education* [Online]. DOI: 10.1007/s10734-022-00833-9 (Accessed 13 March 2022).
- Mueller, P. A. and Oppenheimer, D. M. (2014) 'The Pen Is Mightier Than the Keyboard: Advantages of Longhand Over Laptop Note Taking', *Psychological Science*, vol. 25, no. 6, pp. 1159–1168 [Online]. DOI: 10.1177/0956797614524581.
- Popper, K. R. (2008) *The Logic of scientific discovery*, Routledge classics, Repr. 2008 (twice)., London, Routledge.
- Quintilian (2001) *The orator's education*, Loeb classical library, Cambridge, Mass, Harvard University Press.
- Stanford, K. (2017) 'Underdetermination of Scientific Theory', in Zalta, E. N. (ed), *The Stanford Encyclopedia of Philosophy*, Winter 2017., Metaphysics Research Lab, Stanford University [Online]. Available at <https://plato.stanford.edu/archives/win2017/entries/scientific-underdetermination/>.
- Van Meter, P., Yokoi, L. and Pressley, M. (1994) 'College students' theory of notetaking derived from their perceptions of note-taking.', *Journal of Educational Psychology*, vol. 86, no. 3, pp. 323–338 [Online]. DOI: 10.1037/0022-0663.86.3.323.
- Van Schaack, A. (2009) *LIVESCRIBE IN K-12 EDUCATION: RESEARCH SUPPORT*, Vanderbilt University [Online]. Available at http://www.livescribe.com/en-us/media/pdf/education/Livescribe_K-12_Research_Support.pdf.

Towards a Brain-Compatible Approach for Online Programming Education Through CHAT

¹Vuyolwethu Mdunyelwa, ¹Lynn Fitcher, ^{1,2}Johan van Niekerk

¹Nelson Mandela University, Gqeberha, South Africa

²Noroff University College, Kristiansand, Norway

vuyolwethu.mdunyelwa@mandela.ac.za

lynn.fitcher@mandela.ac.za

johan.vanniekerk@noroff.no

Abstract: During the outbreak of the COVID-19 pandemic, the majority of higher education institutions were faced with the challenge of adopting various online platforms as a means for teaching and learning. This added an additional level of complexity in teaching modules such as programming, which are difficult to teach even in traditional classroom environments. Teaching and learning programming is difficult since the teaching does not only focus on programming, but should also show the students how to solve complex programming problems. Also, many programming students struggle to understand programming since they would typically not put their programming knowledge into practice outside of the learning environment. Online learning adds additional challenges, since the teacher is not available to provide immediate feedback which is one of the critical aspects in programming education. This paper reports on a case which considers brain-compatible principles when creating online programming content for learning programming. Furthermore, it reflects on the use of the Cultural-Historical Activity Theory (CHAT) to delineate the various elements required for teaching and learning programming.

Keywords: Brain-Compatible Principles, Online Programming Education, Cultural-Historical Activity Theory.

1. Introduction

Higher education institutions offering software development and other computer related courses have experienced an increase in growth relating to student numbers in recent years (Abesadze and Nozadze, 2020). Many students registered for these courses are required to study some form of programming, either at introductory level or throughout their qualification (Fawcett and Juliana, 2015). This is certainly the case in software development qualifications since programming is the main skill which students need to be equipped with (Espinha Gasiba, Lechner and Pinto-Albuquerque, 2020). While this is the case, students studying programming often face difficulties in learning, which is evident in the high failure rate experienced in programming modules, especially at introductory and second year level (Waite and Sentance, 2021).

This high failure rate was experienced prior to the adoption of online education, where lecturers were able to teach in their traditional face-to-face lecturing environments. Numerous educational tools provide an effective educational experience in an online environment. However, if these tools are unfamiliar to lecturers and students, they cannot be used to provide effective programming education (Waite and Sentance, 2021). This paper reports on how online programming education was implemented at a South African university to address the challenges relating to online learning.

Section 2 presents the related literature relating to programming education, with a specific focus on the online environment. In addition, it presents brain compatible principles that should be considered in teaching and learning programming. A discussion of the Cultural Historical Activity Theory (CHAT) follows as it relates to planning for teaching and learning. Section 3 presents the research context and design, while Section 4 highlights the research approach undertaken. Section 5 reflects on the use of CHAT and brain-compatible principles to enhance online programming education and Section 6 concludes the paper.

2. Related Literature

Due to the recent advances in information technology, the emphasis on programming in numerous disciplines has increased (Lee and Cho, 2017). This is the case in many computing related disciplines where students are required to learn programming at introductory level or throughout their qualification (Garov and Tabakova-Komsalova, 2017).

Students who do not intend to pursue programming further can obtain the introductory programming knowledge and skills required for their specific qualification (Robins, Rountree and Rountree, 2003). One issue

which is a common contributor to the loss of interest among programming students is the high failure rate, which often results in students dropping out of their qualification (Antón-Rodríguez *et al.*, 2020).

2.1 Programming Education

Although the failure rate may not be high in more advanced programming courses, many students continue to encounter challenges that make learning programming at introductory level difficult, particularly in classes that emphasise algorithms (Kori *et al.*, 2016). Such challenges include:

- The inability to relate learnt programming knowledge to contexts outside the classroom (Lee and Cho, 2017).
- Large student numbers causing less individual feedback to students.
- The lack of an effective approach for providing programming education to students (Santos *et al.*, 2020).

These challenges are noted in programming education and are crucial in its success. Student learning is influenced by prior programming knowledge and continuous feedback on their work, which allows them to continuously improve their programming knowledge and skills (Bailey and Mentz, 2017).

If implemented correctly, various educational approaches can enhance programming education by offering a standardised method of teaching programming (Kadar *et al.*, 2021). These approaches should be adaptable to diverse settings in which programming education takes place, including large classes. Furthermore, they should incorporate the context of students' learning and work in various educational environments such as online, blended, or traditional classroom education (Özden and Tezer, 2018).

2.2 Online Programming Education

For many higher education institutions, programming education continued to be online during the Covid-19 pandemic, until a blended-learning approach was adopted (Santos *et al.*, 2020). A key challenge in the online environment is that instructors have little control over students' learning (Tufekci and Demirel, 2009).

The objective of online education is to provide a learning experience that is comparable to that of a traditional classroom environment, but in a virtual environment. This can be readily accomplished in subjects that are primarily theoretical in nature. However, programming, being very applied, makes this task more complex. Learning programming seeks to address both knowledge and behavioural aspects, requiring online educational platforms to replicate the effectiveness of traditional classroom environments with benefits of online learning which allows students to explore their own learning styles and revisit the learning material at their own time (Mdunyelwa, Fitcher and van Niekerk, 2019). Online programming education enables instructors to use learning management systems and other online educational tools to achieve the following:

- Upload lecture recordings for student content engagement.
- Conduct virtual online classes (Rawashdeh *et al.*, 2021);
- Engage in live coding sessions and grant students' access to the coding examples and video recordings.
- Allow students to utilise collaborative programming platforms such as GitHub.

Various technologies used to achieve the above can be effective in programming education if introduced in a manner suitable for student learning (Shen and Ho, 2020). Online learning approaches should seek to address the needs of the human brain by including content which is based on pedagogically sound educational approaches such as brain-based learning (van Niekerk and Webb, 2016).

2.3 Brain-Compatible Educational Principles

The concept of brain-based learning relates to educational approaches which are based on the underlying biology of learning instead of simply following traditional practices (Jensen, 2000; van Niekerk and Webb, 2016). This educational approach stems from a set of available brain-compatible principles as referred to by various researchers (Jensen, 2000). Although many of these principles are difficult to measure in a learning environment, they can positively impact student learning if considered as part of the learning process.

Comprehensive lists of brain-compatible principles are available in the literature and have been used in education, however, due to space limitations, these cannot be depicted in their entirety and can be found in literature

(Caine and Caine, 1990; Jensen, 2000; van Niekerk and Webb, 2016)}. In this study, only the brain-compatible principles which are deemed most relevant to programming education were considered when developing the educational material for the Development Software II module. These included the following:

- There is no long term retention without rehearsal (Jensen, 2000);
- Short, focused learning activities are best (Caine and Caine, 1990; Jensen, 2000);
- Learning with specific context is best (Caine and Caine, 1990);
- Learning should be given choices to accommodate different learning styles (Caine and Caine, 1990; Jensen, 2000);
- Immediate feedback amplifies learning (Jensen, 2000);
- Learning is collaborative and influenced by interactions with others (Jensen, 2000).

In addition, CHAT was used to delineate the online programming educational elements which were considered in the delivery of the educational content.

2.4 Cultural-Historical Activity Theory

The Cultural Historical Activity Theory (CHAT) is a tool typically used for the observation and analysis of people's actions within an organisation, for planning and determining its success (Koszalka, 2004; Czerniewicz, Trotter and Haupt, 2019). CHAT is useful for ensuring a system's thinking view when identifying online programming educational elements. Chang et al (2006) provides a clear view for understanding the concept of system's thinking, where they define a system as a technical set of interrelated parts, all of which work together towards a defined goal (Chang, 2006).

The parts of the system depend on each other in pursuing the target and uses feedback to determine successes of the system (Dick, Carey and Carey, 2006). Chang et al (2006) also provides an analogy of an automotive braking system, where the driver is a less reliable system. They argue that mechanical failure is rarely the cause of accidents that are brake-related, rather that human beings (driver) are largely the contributors of such failures (Chang, 2006). This is also true in situations where human physiological and psychological characteristics are key elements of a system; it becomes less predictable and more difficult to predict whether the targets will be reached, especially if a specific approach has not been identified.

Consider the case of the adoption of online education in South Africa. With the onset of Covid-19, this was often done without a proper analysis of the elements required for teaching and learning. CHAT provides a more concise theoretical framework to delineate such educational elements and tools.

CHAT was successfully used in a study at a South African university during the #FeesMustFall campaign where teaching and learning had to take place online (Czerniewicz, Trotter and Haupt, 2019). Similarly, CHAT was used in this study to delineate the key elements required for online programming education.

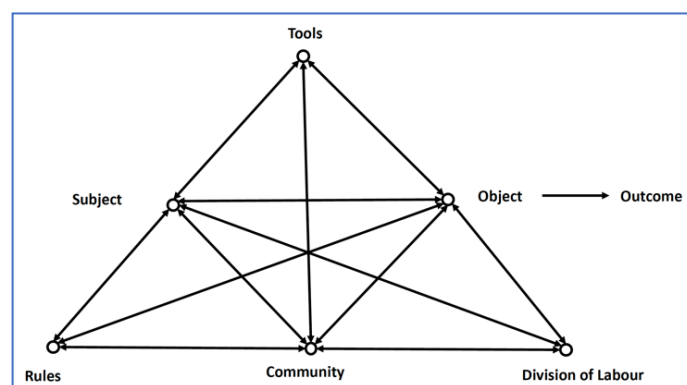


Figure 1: Cultural-Historical Activity Theory (Czerniewicz, Trotter and Haupt, 2019)

Figure 1 presents CHAT in its basic form, where the key elements are presented in each of the triangle ends. The elements include the *tools*, *subject*, *rules*, *community*, *division of labour*, *object* and *outcomes* as discussed below:

- **Tools-** refers to the resources used to achieve the specific outcomes in the planned activities(Czerniewicz, Trotter and Haupt, 2019).

- **Subject** – represents the various parties included in the activities and are required to perform the necessary objectives (Andriani, Priskananda and Budiraharjo, 2022).
- **Rules** - reflects the formal and informal demands which the organisation should perform under (Czerniewicz, Trotter and Haupt, 2019).
- **Community** - includes the stakeholders involved in the activity system (Czerniewicz, Trotter and Haupt, 2019) .
- **Division of Labour** - refers to the persons involved and the duties they are required to perform (Havnes, 2010) .
- **Object** - refers to the assigned task which people are required to work towards (Czerniewicz, Trotter and Haupt, 2019).
- **Outcome** - refers to the target which the activity system would seek to achieve (Havnes, 2010).

These elements interact dynamically and influence each other within a socio-cultural context. It provides a framework for analysing complex activity systems and understanding the socio-cultural dynamics that influence human behaviour and learning.

3. Research Context and Design

This paper is presented in the form of a case study since it involves an in-depth examination of a particular phenomenon or situation within its real-life context (Creswell, 2007). Case studies are particularly useful for exploring complex issues and understanding how different factors interact to shape a particular outcome (Creswell, 2007). According to Creswell, the researcher must clearly define the focus and scope of the research in the research objectives (Creswell, 2007).

This study was conducted at the Nelson Mandela University, School of Information Technology within the second year Development Software module which forms part of the Software Development Diploma. In this module, students are introduced to database programming, Object Oriented Programming, and Web Development. The students are required to write their programs using the .NET framework for Windows Forms and ASP.NET using C#, and databases using Microsoft SQL Server.

This paper presents the theoretical underpinnings and literature that informed the study in Section 2, followed by an exploration of the real-life context of the research in Sections 4, and 5.

The focus of the study is presented in the form of two specific objectives, namely:

- **Objective 1:** To reflect on an approach for delineating online programming educational elements;
- **Objective 2:** To reflect on the brain-compatible principles used to enhance online programming education;

The following section discusses how each of these objectives were achieved and their relevance in online programming education.

4. Research Approach

This study followed a phased approach, comprising of two phases, where each phase represents the objectives identified in Section 3. Objective 1, which seeks to identify an approach for delineating the educational elements required for teaching and learning programming was achieved by the use of the Cultural-Historical Activity Theory (Grimalt-Álvaro and Ametller, 2021). Objective 2, which seeks to identify the principles required for effective online education was achieved by considering the most relevant brain-compatible principles (Caine and Caine, 1990; van Niekerk and Webb, 2016).

Phase 1 incorporated the use of CHAT within the Development Software II module, while Phase 2 highlights the most relevant brain-compatible principles considered in the creation of online educational content for the Development Software II module.

The next section provides a list of brain-compatible principles which were deemed relevant for creating online programming educational material.

5. Using CHAT and Brain-Compatible Principles to Enhance Online Programming Education

CHAT was used to identify the various elements required for teaching and learning programming online within the Development Software II module. This was deemed relevant since programming education requires specific tools and rules for it to be implemented successfully. This is important, especially for online programming education to ensure that students know what is required to learn programming online. The basic elements of CHAT are provided in Section 2. Figure 2 provides an example of the process used for creating the educational material and how the students interacted with the module content. The university's Learning Management System (LMS), Moodle, was instrumental in the teaching and learning of this module. Moodle was adopted by the university before the onset of Covid-19 as its tool for managing student and lecturer interactions. The Development Software II Moodle site is broken down into topics which relate to various learning units within the module. An example of such a topic is Files and Streams which relates to programmatically interacting with file contents, files and folders. This learning unit was split into 3 videos which were uploaded on Moodle using HTML5 Package (H5P).

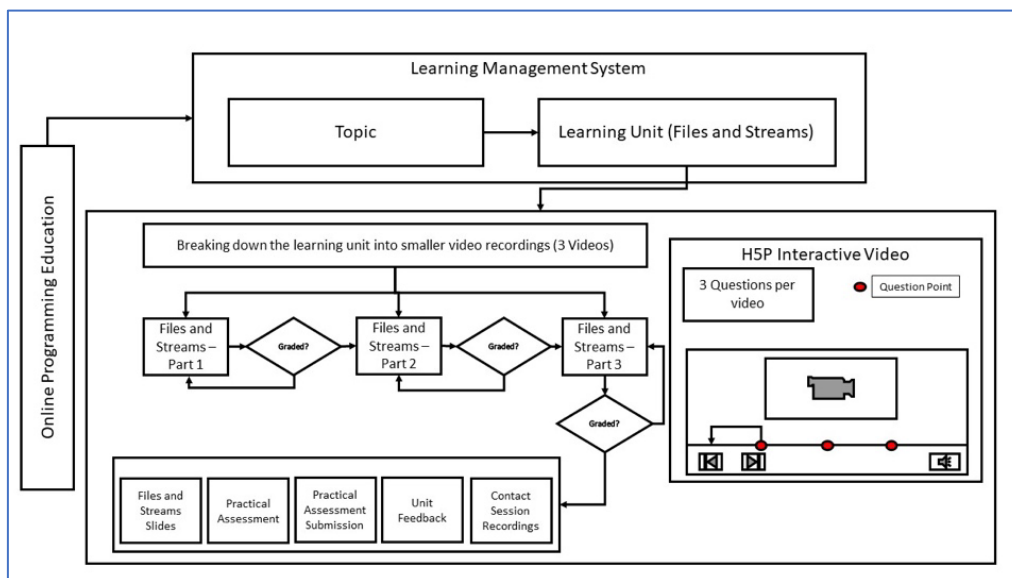


Figure 2: Online Programming Education Steps.

Figure 2 provides the process used for creating the educational material and how the students interact with the module. A learning Management System is instrumental in the teaching and learning of this subject. The learning management system used is Moodle, which has been adopted by the university as its tool for managing student and lecturer interactions. Moodle includes topics which relate to a learning unit in a module, such Files and Streams which relates to programmatically interacting with file contents, files and folders. The learning unit is split into 3 videos where which are uploaded on Moodle using HTML5 Package (H5P).

H5P is a content collaboration package which aims to ease interactive content (Mekterovic *et al.*, 2020). This includes a number of collaborative elements such as interactive videos, course presentations and branching scenarios (Mekterovic *et al.*, 2020). This study made use of interactive videos which allows adding questions to a video for students to answer while watching the video. Various techniques were included such as configuring the video to rewind to the relevant content if the student did not get a specific mark in the question.

Such techniques were included in this exercise to ensure that students understand the content. Since the video was split into 3 parts (Part 1, Part 2, and Part3), a student's access to the next video was restricted by only allowing access to the following video if they got 80% in the previous video. Once students completed Part 3 of the video, they were granted access to the practical assessment, slides, submission and a unit feedback activity for the learning unit. On completion of the learning unit, they were granted access to the next learning unit. Below is a discussion of how these elements relate to online programming education.

5.1 Phase 1: Identifying Online Programming Elements Through CHAT

Figure 2 below provides the elements which relate to the basic CHAT elements as discussed in Section 2.3.

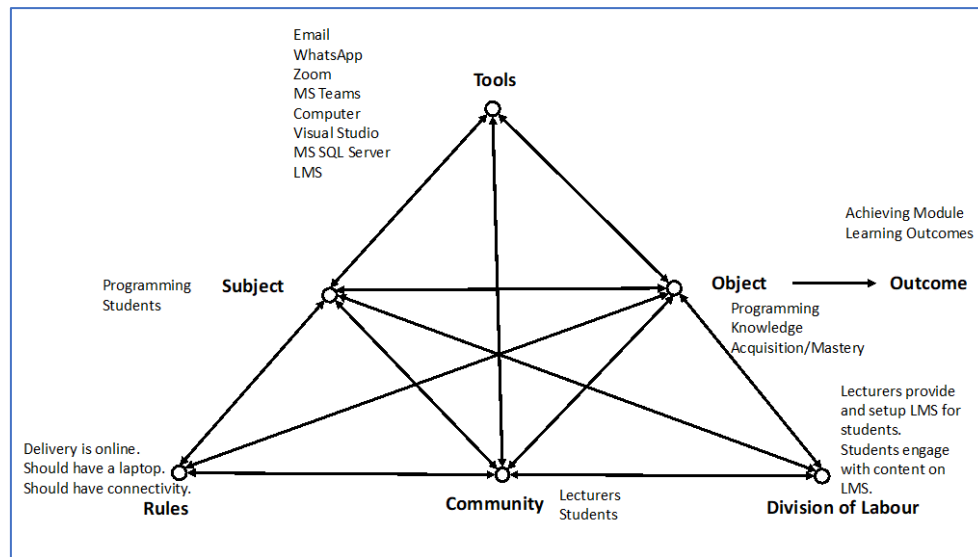


Figure 3: CHAT for Teaching Online Programming Education.

It is important to identify elements which are deemed necessary, relevant or accepted in online environments generally. In this context, CHAT was applied to online programming education to delineate the required elements and understand the complex interactions involved as discussed below:

- **Subject:** In online programming education, the subject refers to the learners who are engaged in learning programming concepts. It includes their prior knowledge, experiences, motivations. Understanding this is crucial for designing effective online programming education (Havnes, 2010).
- **Object:** The object in online programming education is the mastery of programming knowledge and skills. The object can include specific learning outcomes, such as understanding programming concepts, problem-solving abilities, or database programming which is the goal for the Development Software II module. Defining clear and meaningful learning objectives is essential to guide the development of programming content for online teaching and learning (Andriani, Priskananda and Budiraharjo, 2022).
- **Tools:** Online programming education relies on various tools and technological means. These include programming languages, integrated development environments (IDEs) such as Visual Studio or MS SQL Server, code editors, simulation environments, online learning platforms (LMS), discussion forums (WhatsApp, Email), and collaborative coding tools. The choice and use of appropriate tools significantly influence learners' engagement and learning outcomes (Havnes, 2010).
- **Rules:** In online programming education, rules involve instructional guidelines, pedagogical strategies, and assessment criteria. They can include coding standards and problem-solving methodologies. However, since this happened during the Covid-19 pandemic, the rules also include that the delivery of the module should be online without interaction or access to the university facilities. Therefore, student were required to have a reliable internet connection and a laptop. Establishing clear rules and guidelines helps learners understand expectations and promotes consistent and effective learning experiences.
- **Community:** The online programming education community consists of learners, instructors, teaching assistants, and fellow students. It also includes online forums, coding communities, and social media groups where learners can interact, collaborate, and seek help. There were used by both students and the instructor to seek and to provide feedback for students. Fostering a supportive and collaborative community can enhance engagement, knowledge sharing, and peer learning \cite{Gasiba2020}.
- **Division of Labour:** The division of labour in online programming education refers to the distribution of roles and responsibilities among learners and instructors. It involves structuring learning activities, providing instructional materials, facilitating discussions, and offering feedback.

This included gamifying the learning by requiring students to unlock various stages in the various topics to allow students to proceed in the learning units by engaging with the content and answering the various questions. Effective division of labour ensures a balanced workload and supports learners' progression and achievement (Czerniewicz, Trotter and Haupt, 2019).

- **Outcome:** The outcome in online programming education can encompass both tangible and intangible aspects. Tangible outcomes may include learners' developed coding projects, completed assignments. This also was measured through the students' end of year assignment which the students develop to demonstrate the various learning outcomes for the module. Intangible outcomes can include increased problem-solving skills, computational thinking abilities, or improved self-efficacy in programming. Continuously assessing and evaluating learning outcomes helps refine instructional strategies and improve the learning experience (Czerniewicz, Trotter and Haupt, 2019).

By applying CHAT to online programming education, educators can gain a comprehensive understanding of the interplay between these elements and design more effective and engaging learning experiences in preparation to create the online programming educational content as discussed in Section 5.2.

5.2 Phase 2: Brain-Compatible Principles Considered in Online Programming Education

Once the required elements for teaching programming online have been identified, the brain-compatible principles identified in Section 2.3 will be used to reflect on the use in creation online programming education for the Development Software module as discussed below:

- **There is no long term retention without rehearsal** - This was achieved using questions in the H5P interactive content video. While the students were watching the video, a question would appear and they would be required to answer the question. This allowed them to assess their understanding of the content covered in the video.
- **Short, focused learning activities are best** - The learning units for the modules were split into 3 videos which were between 7 and 10 minutes in length. This allowed for the students to be able to focus on specific tasks which would be integrated in the last part of the video. This was important since it allowed students to digest and understand the detail of the learning unit.
- **Learning with specific context is best** - This module is based on the .NET framework and C\# was used as the programming language which the students were required to learn and code in.
- **Learning should be given choices to accommodate different learning styles** - The main benefits of online education is that it allows for a variety of students to study at their own pace. The content for this module was made available to the students without limits on time. The students were allowed to work through the content and revise whenever they wanted to.
- **Immediate feedback amplifies learning** - Feedback is important in programming, especially since students' learning builds on concepts learned in prior topics. In this module, students were provided with feedback in their interactive content when watching the videos. This occurred when students selected incorrect answers when answering multiple choice questions. Students were also required to submit practicals for each learning unit,. The lecturer discussed the solution to the practicals in online classes and provided the students with a solution to apply to their work.
- **Learning is collaborative and influenced by interactions with others** - This principle relates to allowing students to work together in understanding the module. This was achieved in two ways. Firstly, through having contact sessions with the students where the lecturer allowed students to come up with a scenario which could be solved using a relevant programming topic using live coding. Students received access to the recording enabling them to go through the video and practice in their own time. Secondly, providing students with a practical assessment at the end of each learning unit, where the students were allowed to work in groups making use of version control tools and encouraging them to practice pair programming.

The identified brain-compatible learning principles were effective in online programming education. While implementing this approach was time consuming, it assisted students in successfully meeting the learning outcomes of the Development Software I module in the online environment.

6. Conclusion

This paper reported on a case study aimed at improving online educational content for programming education. The paper focused primarily on the creation of content used for student engagement. The study consisted of two phases. Firstly, CHAT was used as a lens to provide a system thinking overview to improve understanding of the interaction between various educational elements when designing online programming educational content. The use of CHAT allowed for a clear delineation of educational elements through which educators gained a comprehensive understanding of the interplay between these elements. This allowed the educators to address possible problems proactively. Subsequently, the study used brain compatible learning principles as a pedagogical basis for the created online educational material. The use of brain compatible principles was found to be effective for the creation of such content. The authors are not implying that CHAT and brain compatible principles specifically are needed for effective online programming educational design, but rather that using an existing theory, such as CHAT, allows educators to accurately define the scope, interactions, and requirements for learning activities. Once defined, in order to be effective, such activities should be implemented through the use of established educational principles, for example through the use of brain compatible principles.

References

- Abesadze, S. and Nozadze, D. (2020) 'Make 21st Century Education: The Importance of Teaching Programming in Schools', *International Journal of Learning*, 6(3), pp. 158–163. Available at: <https://doi.org/10.18178/IJLT.6.3.158-163>.
- Andriani, E., Priskananda, A.A. and Budiraharjo, M. (2022) 'A Cultural-Historical Activity Theory (CHAT) Analysis on Educational Psychology Class: The Challenges in Delivering a Fully Online Classroom Environment', *Journal of Foreign Language Teaching and Learning*, 7(1), p. PRESS. Available at: <https://doi.org/10.18196/ftl.v7i1.13196>.
- Appana, S. (2008) 'A review of benefits and limitations of online learning in the context of the student, the instructor, and the tenured faculty', *International Journal of E-Learning*, 7(1), pp. 5–22.
- Bailey, R. and Mentz, E. (2017) 'The value of pair programming in the IT classroom', *Independent Journal of Teaching and Learning*, 12(1), pp. 90–103.
- Caine, R.N.R. and Caine, G. (1990) 'Understanding a brain-based approach to learning and teaching', *Educational Leadership*, (October), pp. 66–70.
- Chang, S.L. (2006) 'The Systematic Design of Instruction', *Educational Technology Research and Development*, 54(4), pp. 417–420. Available at: <https://doi.org/10.1007/s11423-006-9606-0>.
- Creswell, J.W. (2007) *Qualitative enquiry & research design, choosing among five approaches*, Book. Available at: <https://doi.org/10.1016/j.aenj.2008.02.005>.
- Czerniewicz, L., Trotter, H. and Haupt, G. (2019) 'Online teaching in response to student protests and campus shutdowns: academics' perspectives', *International Journal of Educational Technology in Higher Education*, 16(1), pp. 1–22. Available at: <https://doi.org/10.1186/s41239-019-0170-1>.
- Dick, W., Carey, L. and Carey, J. (2006) *The Systematic Design of Instruction*, Pearson.
- Espinha Gasiba, T., Lechner, U. and Pinto-Albuquerque, M. (2020) 'Sifu - a cybersecurity awareness platform with challenge assessment and intelligent coach', *Cybersecurity*, 3(1). Available at: <https://doi.org/10.1186/s42400-020-00064-4>.
- Fawcett, G. and Juliana, M. (2015) *Teaching in the Digital Age, Designing Instruction for Technology-Enhanced Learning*. Available at: <http://opentextbc.ca/teachinginadigitalage/%5Cnhttp://services.igi-global.com/resolvedoi/resolve.aspx?doi=10.4018/978-1-930708-28-0.ch004>.
- Garov, K.A. and Tabakova-Komsalova, V.V. (2017) 'Learning content of educational tasks in computer programming training for 10-11 year old children', *TEM Journal*, 6(4), pp. 847–854. Available at: <https://doi.org/10.18421/TEM64-26>.
- Grimalt-Álvaro, C. and Ametller, J. (2021) 'A Cultural-Historical Activity Theory Approach for the Design of a Qualitative Methodology in Science Educational Research', *International Journal of Qualitative Methods*, 20, pp. 1–12. Available at: <https://doi.org/10.1177/16094069211060664>.
- Havnes, A. (2010) 'Cultural-historical activity theory', *International Encyclopedia of Education*, pp. 491–497. Available at: <https://doi.org/10.1016/B978-0-08-044894-7.00464-4>.
- Jensen, E. (2000) 'Brain-based learning: A reality check', *Educational Leadership*, 57(7), pp. 76–80. Available at: <https://doi.org/10.1080/00220973.2013.813367>.
- Kadar, R. et al. (2021) 'A Study of Difficulties in Teaching and Learning Programming: A Systematic Literature Review', *International Journal of Academic Research in Progressive Education and Development*, 10(3), pp. 591–605. Available at: <https://doi.org/10.6007/ijarped/v10-i3/11100>.
- Kori, K. et al. (2016) 'The Role of Programming Experience in ICT Students' Learning Motivation and Academic Achievement', *International Journal of Information and Education Technology*, 6(5), pp. 331–337. Available at: <https://doi.org/10.7763/ijiet.2016.v6.709>.
- Koszalka, T.A. (2004) 'A cultural historical activity theory [CHAT] analysis of technology integration: Case study of two teachers', *Association for Educational Communications and Technology*, pp. 1–11. Available at: <http://files.eric.ed.gov/fulltext/ED485000.pdf>.

- Lee, Y. and Cho, J. (2017) 'The Influence of Python Programming Education for Raising Computational Thinking', *International Journal of u- and e- Service, Science and Technology*, 10(8), pp. 59–72. Available at: <https://doi.org/10.14257/ijunesst.2017.10.8.06>.
- Mdunyelwa, V., Fitcher, L. and van Niekerk, J. (2019) 'An Educational Intervention for Teaching Secure Coding Practices', in *IFIP Advances in Information and Communication Technology*, pp. 3–15.
- Mekterovic, I. et al. (2020) 'Building a comprehensive automated programming assessment system', *IEEE Access*, 8, pp. 81154–81172. Available at: <https://doi.org/10.1109/ACCESS.2020.2990980>.
- Mukhtar, K. et al. (2020) 'Advantages, limitations and recommendations for online learning during covid-19 pandemic era', *Pakistan Journal of Medical Sciences*, 36(COVID19-S4), pp. S27–S31. Available at: <https://doi.org/10.12669/pjms.36.COVID19-S4.2785>.
- van Niekerk, J. and Webb, P. (2016) 'The effectiveness of brain-compatible blended learning material in the teaching of programming logic', *Computers and Education*, 103, pp. 16–27. Available at: <http://dx.doi.org/10.1016/j.compedu.2016.09.008>.
- Özden, C. and Tezer, M. (2018) 'The effect of coding teaching on students' self-efficacy perceptions of technology and design courses', *Sustainability (Switzerland)*, 10(10), pp. 1–29. Available at: <https://doi.org/10.3390/su10103822>.
- Rawashdeh, A.Z. Al et al. (2021) 'Advantages and disadvantages of using E-learning in university education: Analyzing students' perspectives', *Electronic Journal of e-Learning*, 19(2), pp. 107–117. Available at: <https://doi.org/10.34190/ejel.19.3.2168>.
- Robins, A., Rountree, J. and Rountree, N. (2003) 'Learning and teaching programming: A review and discussion', *International Journal of Phytoremediation*, 21(1), pp. 137–172. Available at: <https://doi.org/10.1076/csed.13.2.137.14200>.
- Santos, S.C. et al. (2020) 'Innovative approaches in teaching programming: A systematic literature review', *CSEDU 2020 - Proceedings of the 12th International Conference on Computer Supported Education*, 1(Csedu), pp. 205–214. Available at: <https://doi.org/10.5220/0009190502050214>.
- Shen, C. wen and Ho, J. tsung (2020) 'Technology-enhanced learning in higher education: A bibliometric analysis with latent semantic approach', *Computers in Human Behavior*, 104(November 2018), p. 106177. Available at: <https://doi.org/10.1016/j.chb.2019.106177>.
- Tufekci, S. and Demirel, M. (2009) 'The effect of brain based learning on achievement, retention, attitude and learning process', *Procedia - Social and Behavioral Sciences*, 1(1), pp. 1782–1791. Available at: <https://doi.org/10.1016/j.sbspro.2009.01.316>.
- Waite, J. and Sentance, S. (2021) 'Teaching programming in schools: A review of approaches and strategies Raspberry Pi Foundation', (November). Available at: www.raspberrypi.org.
- Wang, Y. (2019) 'Research on Programming Practice Based on CDIO Concept', 298(Essd), pp. 246–248. Available at: <https://doi.org/10.2991/essd-19.2019.54>.

Masters Research Papers

Technology-Based Strategies Predicated on Self-Regulated Learning in a Flipped Computer Programming Classroom

Simphiwe Dayimani and Keshnee Padayachee

University of South Africa, Pretoria, South Africa

56283415@mylife.unisa.ac.za

Padayk@unisa.ac.za

Abstract: The lack of self-regulation is believed to be at the centre of learning difficulties experienced by novice programming students. The Flipped Classroom Model (FCM) is a constructivist pedagogical strategy that could be used to engage students in a programming classroom. While the traditional approach to learning remains a passive environment, the FCM enhances active learning, problem solving while facilitating an unlimited access to the learning content. However, the success of the FCM depends extensively on a student's capability to self-regulate their learning process. As the FCM is a combination of face-to-face and online environments, Self-Regulated Learning (SRL) becomes more germane within the online dimension of the model. This study aims to identify the strategies for SRL that can improve the achievement of learners within a Flipped Programming classroom – specifically to reflect on the design features that should be considered for the adoption of technological tools to support SRL in a Flipped Programming classroom. This involved identifying relevant technological features to facilitate SRL strategies and the self-regulation phases leveraging a systematic review approach. The findings of this study could potentially maximise the student's self-regulation capacity to learn programming within an FCM.

Keywords: Self-Regulated Learning, Self-Regulated Learning Strategies, Flipped Classroom Model, Technology Tools, Programming, Flipped Programming Classroom.

1. Introduction

Learning to program is a complex endeavour for entry level students. These challenges arise from inadequate resources, inefficient teaching pedagogies and the lack of interest from students. Lack of self-regulation is believed to be at the centre of learning difficulties experienced by students in a programming classroom (Derus and Ali, 2012; Falkner, Vivian and Falkner, 2014). Self-regulated learning (SRL) is described as an individual's learning abilities to initiate plans, analyse the task at hand, set goals, assess their potential to accomplish these goals, develop learning strategies upon task implementation and reflect on performance (Zimmerman, 1990). Another possible strategy that could be used to engage students in a programming classroom is the Flipped Classroom Model (FCM) approach. The FCM is described as a form of blended learning that utilises technology to invert the traditional teaching and learning classroom roles and responsibilities (Strayer, 2012). The model may help students to engage with learning content and allow them more time for active and problem-based learning leveraging technology (Maher *et al*, 2015; Fetaji *et al*, 2016). As the FCM is a combination of face-to-face and online environments, SRL becomes more germane within the online dimension of the model (Çakıroğlu and Öztürk, 2017). In the FCM environment, students are expected to utilise their SRL skills to construct their knowledge through active participation in their learning process (Sletten, 2017). This study aims to discover the strategies for SRL that can improve the achievement of learners in a Flipped Programming classroom, specifically to reflect on the design features that should be considered for the adoption of technological tools to support SRL in a Flipped Programming classroom.

The SRL process is described as a significant activity required for students to be successful in learning how to program (Lai and Hwang, 2016). There is a positive correlation between students' application of SRL strategies and their performance (Alhazbi, 2014). The lack of self-regulation translates to deeper contextual problems such as poor coding skills and problem decomposition. Students are expected to regulate their cognition and metacognition strategies, motivation, behaviour and context through the utilisation of strategies that require proper planning, monitoring, control and reflection (Pintrich, 2000). Given the persistent challenges encountered by students to successfully regulate these areas, technology is proving to be a vital tool to assist, develop and improve students' self-regulation processes (Kumar *et al*, 2005). Clearly, the need for SRL tools is amplified within the FCM, negating the advantages of the modality for novice programmers.

Therefore, this study aims to review available SRL technological tools that may be harnessed within an FCM through a systematic analysis guided by the following research questions:

RQ1: What technology-based tools could be integrated into programming language courses to promote SRL?

RQ2: What design features should be considered for the adoption of a technological tool to support SRL in a Flipped Programming classroom?

The study reviews the specific areas of SLR strategies that can be supported through technology tools when learning programming. Furthermore, the study aims to provide potential design features that instructors need to consider when using technological tools within FCM to enhance SRL and coding capacity. The paper is structured as follows – Section 2 presents the background. Section 3 presents the theoretical framing regarding SRL. Section 4 describes the study methodology. Section 5 and Section 6 present the data analysis and discussion respectively. Limitations and delimitations are presented in Section 7. Finally, the paper concludes in Section 8.

2. Background

Bergin, Reilly and Traynor (2005) established the relationship between self-regulation and programming performance. They deduced that the effectiveness of self-regulation can function as a major determinant of student performance. Falkner, Vivian and Falkner (2014, p. 295) also examined the use of SRL strategies in software development courses and concluded that these strategies “guide the development of scaffolding activities to assist in learning the process of software development”. The identified strategies are then aligned with the desired performance level with constant monitoring and are altered to sustain goal attainment (Panadero and Alonso-Tapia, 2014).

Çakıroğlu and Öztürk (2017) noted that students may possess some preferences to apply strategies depending on the learning environment. This was demonstrated in a flipped classroom setting where strategies like environmental restructuring were mainly executed at home to maximise comfort when accessing the learning content. Assistance was sought in the classroom environment when students encountered difficulties. However, the application of the learning content learned at home was a challenge to students as the use of monitoring strategies was ineffective at home (Çakıroğlu and Öztürk, 2017). Manso-Vázquez and Llamas-Nistal (2015) suggest students may struggle with monitoring in the absence of a teacher. The study proposed monitoring tools to visualise and quantify learning activities to develop SRL.

While using the FCM approach provides more learning time for programming learners, the issue of self-regulation is amplified in this context, and this is the basis of this research undertaking.

3. Theoretical Framing

SRL has been a subject of research to understand how students develop from novice to improved levels of learning. Panadero (2017) reports on the most popular SRL models that have a different view of SRL. Pintrich (2000) focuses on the students’ specific self-regulation areas and phases (see Table 1). To achieve the desired learning goals, students should start planning, monitoring, controlling and reacting to the areas of regulation (Pintrich, 2000). Each phase has four areas of self-regulation – cognition, motivation, behaviour, and context. Although there is no clear visible structure on the order of execution of the SRL phases, Ye and Pennisi (2022) suggest that the model is naturally cyclical as it is an extension of the SRL model (Zimmerman, 2000).

Table 1: Self-regulation phases with areas of regulation (adapted from (Pintrich, 2000))

Phases	Areas of regulation			
	Cognition	Motivation/affect	Behaviour	Context
Forethought, planning and activation	Goal formation and plans to achieve goals with previously acquired knowledge.	Self-examination of capacity to complete a task and conduct complexity judgment including interest activation.	Time and effort planning and planning for self-observation of behaviour.	Perception of the task and context.
Monitoring	Metacognitive awareness and monitoring of cognition.	Awareness and exercising motivational control.	Self-observation of behaviour.	Monitoring changing task and context conditions
Control	Selection and adaptation of learning strategies for learning and thinking.	Selection and adaptation of learning strategies for managing motivation/affect.	Efforts altered based on how much of it is required, seek help and remain persistent.	Change or renegotiate a task. Change or leave context.
Reaction and activation	Examining performance to determine success or failure.	An affective reaction to one's performance.	Reflection on behaviour leading to the performance outcomes.	Evaluation of the task itself and the surrounding learning space.

Zimmerman and Martinez-Pons (1988) investigated and reported on general self-regulation strategies that students undertake for effective learning. These include self-evaluation, organising and transforming, goal setting and planning, seeking information, keeping records and monitoring, environmental restructuring, self-consequence, rehearsing and memorising, seeking social assistance, reviewing records, and others (Zimmerman and Martinez-Pons, 1988). These strategies proved to be highly correlated to student learning improvement. However, technology tools may be vital in assisting and supplementing these strategies (Kitsantas, 2013). These SRL strategies will be used as a framing for the systematic review as they pose a direct impact on learning performance including factors that necessitate self-regulation such as personal, metacognitive and environmental (Zimmerman and Martinez-Pons, 1988).

4. Research Methodology

This research adopts a systematic review technique suitable for investigating technological tools for learning programming as proposed by Kitchen and Charters (2007).

4.1 Research Design

First, the researcher considered various database sources that meet the inclusion criteria and acceptable quality standards. The eligibility criteria and quality check were used to determine whether the sources should be included in the final stages of analysis (Table 2).

Table 2: Overview of the Eligibility Criteria

CODE	Included papers	CODE	Excluded papers
IC1	Must have the functionality to support SRL.	EC1	Do not support SRL.
IC2	Must have the potential to be used by students learning programming.	EC2	Not usable by students learning programming.
IC3	One or more SRL strategies as outlined by Zimmerman and Martinez-Pons (1988) must be supported.	EC3	No clear self-regulation strategy is supported.
IC4	Must have the potential to improve student learning.	EC4	No improvement in student performance was reported.
IC5	Published from the year 2010 to 2022.	EC5	Prior to 2010.

4.2 Information and Database sources

The following databases were consulted – IEEE (Institute of Electrical and Electronics Engineers) Computer Society, Science Direct, ACM (Association for Computing Machinery) Digital Library and Scopus. The following search word combination was used: learning ("Programming" OR "coding") AND "self-regulated learning".

4.3 Risk of Bias

Hammersley (2020) suggests that systematic reviews are subject to publication bias, which is defined as the omission of smaller studies or negative results yielding studies. The methodology process was clearly outlined to ensure transparency and the repeatability of the study.

4.4 Ensuring research quality

The study quality may be achievable by the unbiased presentation of findings which form the basis for internal validity which refers to measures to avoid "systematic errors" External validity refers to the applicability of study effects outside the study (Kitchenham and Charters, 2007, p. 20).

The quality criteria to assess the study quality (adapted from (Kitchenham and Charters, 2007)) are as follows:

- How well does the evaluation address its original aims and purpose?
- How clear and coherent is the reporting?
- Are the results clarified with enough details? (Kmet et al, 2004)

4.5 Data Collection

The search was guided by the search phrases, the field of study and publication type to limit the search scope to retrieve the most relevant studies. Each study was analysed to identify the underlying self-regulatory design features and the effect on students learning. A spreadsheet was used to tabulate and dissect each study to determine the data to be collected. Ethical clearance for the study was granted by the University of South Africa (UNISA).

5. Data Analysis

A total of 819 papers were retrieved with duplicates removed from all the consulted data sources. Through the identification of study relevance and screening of each study title and abstract, the initial number was reduced to 58 studies. The remaining studies were further reviewed and analysed to determine correspondence to the eligibility criteria. These studies had to demonstrate evidence of improved student performance when SRL is applied to any programming concept. To that end, 36 studies were removed. The remaining eleven (n=11) studies were included in the review process. Figure 1 illustrates the systematic review procedure followed.

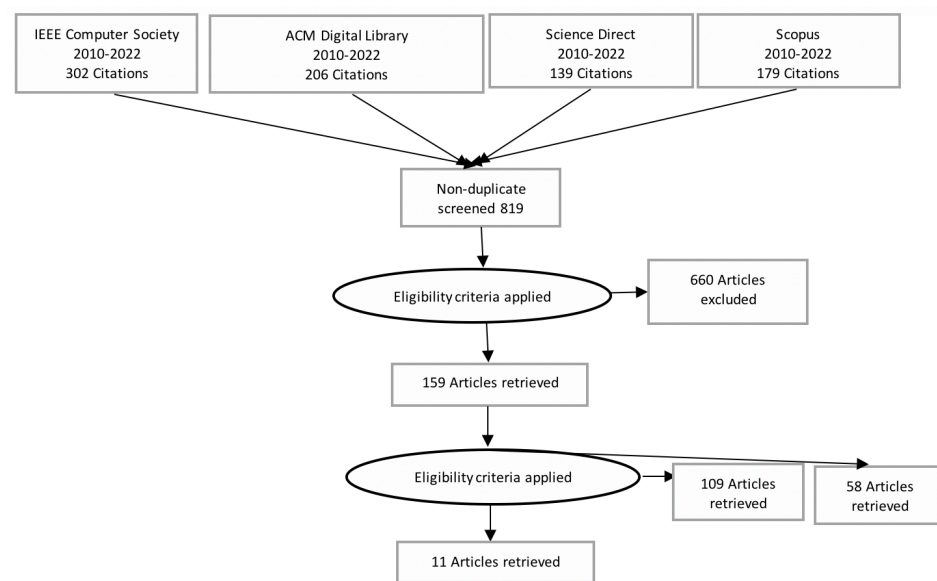


Figure 1: Preferred reporting items for systematic reviews and meta-analyses (PRISMA) diagram (Moher *et al.*, 2010).

Several studies from the literature were reviewed to identify technology-based SRL strategies. For example, SRL strategies improve student performance in learning programming (Huang *et al.*, 2014; Lazar, Sadikov and Bratko, 2017; Keung *et al.*, 2018). Some tools provide students with differentiated methods of problem-solving (Lazar, Sadikov and Bratko, 2017), permit code modification (Keung *et al.*, 2018), track their code attempts (Daradounis *et al.*, 2021) and assess and provide students with feedback in varied forms for self-reflection (Breyman, Mader and Kok, 2020). Several tools were developed to promote SRL in learning to code, which are summarised in Table 4.

Table 4: Tool objectives towards sustaining SRL

Tool	Reference	Objective of Tool
PoliCAT	(Dascalu <i>et al.</i> , 2017)	Assessment and feedback shortcomings are shared with other students on social media where other students can then comment and share their suggestions concerning learning goals including performance results.
SNAP	(Marwan <i>et al.</i> , 2021)	Provides progress monitor through a checklist. Provides progress feedback in a dedicated interface.
Doubtfire++	(Law <i>et al.</i> , 2017)	Students set learning goals. Manage learning. Track activity and learning progress. Document the learning process.

Tool	Reference	Objective of Tool
TA-HELP.ME	(Breymann, Mader and Kok, 2020)	Students seek help and select suitable questions for the required solution.
WPGA	(Hsiao, Huang and Murphy, 2020)	Provides for manual and automated task grading. Feedback and record keeping.
TA	(Yamada <i>et al</i> , 2019)	Students learn based on their preferred physical location. Students wear the device, and their movement is detected. Instructions are given based on a suitable location. Student movement determines the required learning content.
LET'S	(Huang <i>et al</i> , 2014)	Students set their own learning goals. Self-paced activities using learning indicators for completed work and time tracking. Self-evaluation.
E-Journal	(Alhazbi, 2014)	Monitoring attitude and learning. Goal setting. Behaviour monitoring. Self-evaluation.
SRL-LMS	(Selvi and Panneerselvam, 2012)	Students assess their learning with feedback. Performance self-monitoring. Strategies for evaluation.
OLP	(Çakıroğlu and Öztürk, 2017)	Students reply to and ask questions to the instructor and peers. Provides online assessment. Record keeping in video and PDF format. Tracks the number of times a video watched.
DSLAB	(Daradounis <i>et al</i> , 2021)	Provides feedback. Retrievable code records keeping.

By zooming into each tool's features and uses, we identify supported strategies and SRL phases and the possible relationship with the FCM performance. Table 5 demonstrates the design features with the corresponding SRL strategy deployment in the FCM and the context of the self-regulation.

Table 5: Design Features to support SRL Strategies

Strategies	Design Feature	Context of Self-Regulation
Self-evaluation	Enabled automatic self-evaluation. Utilise automated evaluation functionality on built-in or instructor designed assessments.	Monitoring changing task and context conditions.
Organising and transforming	Simplification of complex concepts (e.g., simple diagrams corresponding to complex code). Cater for modifiable learning space suitable for students with uncomplicated alternatives.	Change or renegotiate a task.
Goal setting and planning	Allow for planning and setting of the learning target. Attainable learning outcomes must be identified in advance including clear preparation on how to achieve them.	Perception and task context.
Seeking information	Simplified information search and easy navigation. Avail extra varying content to complement the available material.	Change or renegotiate a task.
Keeping records and monitoring	Keeping track of learned content and with respective outcomes. Provide means to retain content for use at a later stage (e.g., downloads and progress reports).	Monitoring changing task and context conditions.
Environmental restructuring	Suitable learning space or environment to maximise learning ability. Permit and arrange for the preferred learning environment.	Perception and task context.
Self-consequences	Decision-making on suitable consequences based on outcomes, where students will reward/punish themselves for passing/failing. This could be achieved thorough a performance self-monitoring tool.	Evaluation of the task itself and the surrounding learning space.
Rehearsing and memorizing	Provide the opportunity to retain and revise the already learned content. Enable unlimited review of previously completed work.	Change or renegotiate a task.

Strategies	Design Feature	Context of Self-Regulation
Seeking social assistance	Allow individuals to request and obtain assistance from others. Provide means for communication with others through specific channels such as messaging, email and social media.	Change or renegotiate a task.
Reviewing records	Learning content is available for review in multiple locations. Avail multiple complementary sources for thorough preparation.	Perception and task context.

6. Discussion

The identified tools were studied concerning the SRL strategies that may have a positive impact on learning programming. In response to *RQ1 (What technology-based tools could be integrated into programming language courses to promote SRL?)*, this paper considered how the design features of each tool could be effective in promoting the strategies used for SRL as proposed by Zimmerman (1989).

Firstly, the most common SRL strategy promoted by the tools analysed appears to be *Self-Evaluation* of one's learning. Students' self-evaluation is presented in varied forms through tools such as PoliCAT, WPGA, LET'S and OLP. These tools provide task quizzes and assess student code while providing targeted feedback. For the *Organising and Transforming* strategy, SRL-LMS presents learning content in the dashboard, and the information is organised in an easy-to-navigate way. These tools might regulate student cognition as programming requires proper analysis of the given problem (Garcia, Falkner and Vivian, 2018). Regarding the *Goal Setting and Planning* strategy, Doubtfire++ and SRL-LMS are tools used for goal-setting and the creation of study plans through built-in design features. LET'S and E-Journal permit students to set their own learning goals suitable for their study pace while they track time which in turn may provide the needed information to modify their behaviour.

Although the next strategy, *Seeking Information*, is associated with learning through the internet, SRL-LMS allow students to navigate the built-in material and learning content (Lee and Tsai, 2011). The system consists of information for learning online with unlimited availability allowing students to review the learning content when needed. Concerning *Keeping records and Monitoring*, students are expected to use the available resources to analyse the increase in their learning efficiency (Manso-Vázquez and Llamas-Nistal, 2015). LET'S, Doubtfire++, E-Journal, SNAP, SRL-LMS and DSLAB can help with keeping records and monitoring progress. E-Journal and SRL-LMS keep track of the reviewed content and the targeted learning goals to regulate behaviour on studied content or learning goals.

The *Environmental Restructuring* strategy, which is usually related to a physical learning space, may be acquired through system tools (Dembo and Seli, 2016; Garcia, Falkner and Vivian, 2018). For this strategy, TA and LET'S allow students to identify the most suitable learning environment. This may be suitable for context regulation during the forethought phase of learning as students identify suitable learning spaces (Dembo and Seli, 2016). TA-HELP.ME supports the *Seeking Social Assistance* strategy in order to enquire about or supplement learning content to attain learning goals and seek assistance from peers and students through social media. OLP allows students to seek help directly from other sources to regulate their cognition and behaviour when subjected to challenging programming concepts.

The *Reviewing Records* strategy was demonstrated by OLP which helps students to read their notes directly from the system without the need to consult external sources, while LET'S records students learning data for access and analysis at a later learning stage. Students may also use the E-Journal to track learning activities and content. However, while the *Rehearsing and memorising* strategy has a positive effect on learning programming, there was no emerging tool that supports students towards this strategy that was identified within the systematic review. In terms of the *Self-consequence* strategy, SRL-LMS is reported as a tool with potential to support this strategem although there are few details explaining this function.

In response to *RQ2 (What design features should be considered for the adoption of a technological tool to support SRL in a Flipped Programming classroom?)*, this study highlighted some significant technology features that may be required for SRL that could be applied to the FCM. Design features are proposed (see Table 5) with corresponding strategy deployment and context in the FCM. The following linkages between SRL strategies and the design features and tools that could be used within a system to support FCM were drawn. The tools could involve online self-assessment quizzes, targeted feedback, transforming programming code into simpler formats (such as UML), online study plans, tracking of the code editing data, providing hints on code errors, e-journaling

and defining a suitable learning environment. An important design feature is easy navigation of the system tools and content. Additionally social media tools could be useful in supporting students to seek assistance with content knowledge.

Kitsantas (2013) proposed tools concerning the SRL that includes regulation stages such as forethought, performance, and the self-reflection phase. Forethought phase tools may include tools such as web journals (i.e., blogs) and podcasts. These tools may be useful for self-reflection, self-monitoring, self-efficacy and modelling. Performance phase tools include social networks, virtual worlds, administrative tools and online marking tools. The functions and uses of these tools may include communication, collaboration, feedback, simulations, and records administration. The self-reflection phase tools include online grading systems and wikis which are useful for knowledge sharing, record keeping, feedback, collaborations, and discussions. These tools might be useful for self-evaluation, self-satisfaction, peer modelling and help-seeking (Kitsantas, 2013). Garcia, Falkner and Vivian (2018) who conducted a systematic analysis towards identifying computer science SRL strategies, found that self-evaluation emerged as the most supported strategy via automated assessment and feedback mechanisms as was found in this study. However, while the usage of these tools is targeted at the e-learning environment, their usage and application in the FCM remain inconclusive.

7. Limitations and Delimitations

This study is limited to programming self-regulation strategies. Specific programming languages were not taken into consideration; however, the general concepts are applicable to programming. The study is confined to SRL strategies and technological tools. The findings are limited to the databases selected.

8. Conclusion

This study sought to investigate the technology-based self-regulation strategies that students harness to improve their learning. Kumar et al. (2005) note that effective SRL strategies can be a predictor of student performance in programming. Husin, Judi, Hanawi and Amin (2020) argue for technology integration toward learning to program. Learning through technology simplifies learning and evokes the desire to learn (Husin *et al*, 2020). Educators may benefit from this overview of design features and tools to consider when adopting technology based SRL within FCM. Talbert (2014) suggests the following requirements for an effective FCM – open lines of communication, accountability where students take responsibility and demonstrate dedication and well-planned assessments to determine whether learning has taken place before, during and after contact learning sessions. These strategies for FCM should be integrated within the SRL strategies as well to ensure student success.

References

- Alhazbi, S. (2014) "Using e-journaling to improve self-regulated learning in introductory computer programming course", in *2014 IEEE Global Engineering Education Conference*. Istanbul, Turkey 2-5 April: IEEE, pp. 352–356.
- Bergin, S., Reilly, R. and Traynor, D. (2005) "Examining the role of self-regulated learning on introductory programming performance", in *Proceedings of the 2005 international workshop on Computing education research - ICER '05. the 2005 international workshop*, New York, United States, 1-2 October: ACM Press, pp. 81–86. Available at: <https://doi.org/10.1145/1089786.1089794>.
- Breyman, L.E.I., Mader, A.H. and Kok, H.M. (2020) "How can technology enhanced learning improve the efficiency and quality of help seeking and giving for programming tutorials?", in *SEFI 48th Annual Conference Engaging Engineering Education, Proceedings*, Enschede, University of Twente, 20-24 September: Societe Europeenne pour la Formation des Ingenieurs, pp. 668–677.
- Çakıroğlu, Ü. and Öztürk, M. (2017) "Flipped Classroom with Problem Based Activities: Exploring Self-regulated Learning in a Programming Language Course", *Educational Technology & Society*, 20, pp. 337–349.
- Daradoumis, T., Marquès Puig, J.M., Arguedas, M. and Calvet Liñan, L. (2021) "A distributed systems laboratory that helps students accomplish their assignments through self-regulation of behavior", *Educational Technology Research and Development*, 69(2), pp. 1077–1099. Available at: <https://doi.org/10.1007/s11423-021-09975-6>.
- Dascalu, M., Bodea, P., Melania, N., Alecu, G., Marin, I., Mitrea, D. and Ana Maria, N. (2017) *Supporting self-regulated learning via technology tools: a case study in an engineering degree program in Romania*, pp.5054– 5061.
- Dembo, M.H. and Seli, H. (2016) *Motivation and Learning Strategies for College Success: A Focus on Self-Regulated Learning*. 5th edn. New York: Routledge.
- Derus, S.R.M. and Ali, A.M. (2012) "Difficulties in learning programming: Views of students", in *1st International Conference on Current Issues in Education*. Yogyakarta, Indonesia, 15-16 September: Yogyakarta State University, pp. 74–79.

- Falkner, K., Vivian, R. and Falkner, N.J.G. (2014) "Identifying computer science self-regulated learning strategies", in *Proceedings of the 2014 conference on Innovation & technology in computer science education - ITiCSE '14*. Uppsala, Sweden, 21-25 June: Association for Computing Machinery, pp. 291–296.
- Fetaji, M., Fetaji, B., Sukic, C., Gylcan, A. and Ebibi, M. (2016) "Case Study Analyses of the Impact of Flipped Learning in Teaching Programming Robots", *TEM Journal*, 5(4), pp. 401–406. Available at: <https://doi.org/0.18421/TEM53-22>.
- Garcia, R., Falkner, K. and Vivian, R. (2018) "Systematic literature review: Self-Regulated Learning strategies using e-learning tools for Computer Science", *Computers & Education*, 123, pp. 150–163.
- Hsiao, I.-H., Huang, P.-K. and Murphy, H. (2020) "Integrating Programming Learning Analytics Across Physical and Digital Space", *IEEE Transactions on Emerging Topics in Computing*, 8(1), pp. 206–217.
- Huang, T.-C., Shu, Y., Chang, S.-H., Huang, Y.-Z., Lee, S.-L., Huang, Y.-M. and Liu, C.-H. (2014) "Developing a self-regulated oriented online programming teaching and learning system", in *2014 IEEE International Conference on Teaching, Assessment and Learning for Engineering*. Wellington, New Zealand, 8 - 10 December: IEEE, pp. 115–120.
- Husin, N.F., Judi, H.M., Hanawi, S.A. and Amin, H.M. (2020) "Technology integration to promote desire to learn programming in higher education", *International Journal on Advanced Science, Engineering and Information Technology*, 10(1), pp. 253–259.
- Keung, J., Xiao, Y., Mi, Q. and Lee, V.C. (2018) "BlueJ-UML: Learning object-oriented programming paradigm using interactive programming environment", in *2018 International Symposium on Educational Technology (ISET)*. Osaka, Japan, 31 July - 2 August: IEEE, pp. 47–51.
- Kitchenham, B. and Charters, S. (2007) "Guidelines for performing Systematic Literature Reviews in Software Engineering", *Technical Report EBSE 2007-001*, 2.
- Kitsantas, A. (2013) "Fostering college students' selfregulated learning with learning technologies", *Hellenic Journal of Psychology*, 10, pp. 235–252.
- Kumar, V., Winne, P., Hadwin, A., Nesbit, J., Jamieson-Noel, D., Calvert, T. and Samin, B. (2005) "Effects of self-regulated learning in programming", in *Fifth IEEE International Conference on Advanced Learning Technologies*. Kaohsiung, Taiwan, 5-8 July: IEEE, pp. 383–387.
- Lai, C.-L. and Hwang, G.-J. (2016) "A self-regulated flipped classroom approach to improving students' learning performance in a mathematics course", *Computers & Education*, 100, pp. 126–140.
- Law, C.-Y., Grundy, J., Cain, A., Vasa, R. and Cummaudo, A. (2017) "User Perceptions of Using an Open Learner Model Visualisation Tool for Facilitating Self-Regulated Learning", in *Proceedings of the Nineteenth Australasian Computing Education Conference*. New York, USA, 31 January - 3 February: Association for Computing Machinery, pp. 55–64.
- Lazar, T., Sadikov, A. and Bratko, I. (2017) "Rewrite rules for debugging student programs in programming tutors", *IEEE Transactions on Learning Technologies*, 11(4), pp. 429–440.
- Lee, S.W.-Y. and Tsai, C.-C. (2011) "Students' perceptions of collaboration, self-regulated learning, and information seeking in the context of Internet-based learning and traditional learning", *Computers in human behavior*, 27(2), pp. 905–914.
- Maher, M.L., Latulipe, C., Lipford, H. and Rorrer, A. (2015) "Flipped Classroom Strategies for CS Education", in *Proceedings of the 46th ACM Technical Symposium on Computer Science Education*. Kansas City, Missouri, 4-7 March: Association for Computing Machinery, pp. 218–223.
- Manso-Vázquez, M. and Llamas-Nistal, M. (2015) "A monitoring system to ease self-regulated learning processes", *IEEE Revista Iberoamericana de Tecnologías del Aprendizaje*, 10(2), pp. 52–59.
- Marwan, S., Shabrina, P., Milliken, A., Menezes, I., Catete, V., Price, T.W. and Barnes, T. (2021) "Promoting Students' Progress-Monitoring Behavior during Block-Based Programming", in *Koli Calling '21: 21st Koli Calling International Conference on Computing Education Research*, Joensuu, Finland, 18-21 November: ACM, pp. 1–10.
- Moher, D., Liberati, A., Tetzlaff, J. and Altman, D.G. (2010) "Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement", *International Journal of Surgery*, 8(5), pp. 336–341. Available at: <https://doi.org/10.1016/j.ijsu.2010.02.007>.
- Panadero, E. (2017) "A Review of Self-regulated Learning: Six Models and Four Directions for Research", *Frontiers in Psychology*, 8. Available at: <https://doi.org/10.3389/fpsyg.2017.00422>.
- Panadero, E. and Alonso-Tapia, J. (2014) "How do students self-regulate? Review of Zimmerman's cyclical model of self-regulated learning", *Anales de Psicología*, 30, pp. 450–462.
- Pintrich, P.R. (2000) "Chapter 14 - The Role of Goal Orientation in Self-Regulated Learning", in M. Boekaerts, P.R. Pintrich, and M. Zeidner (eds) *Handbook of Self-Regulation*. San Diego: Academic Press, pp. 451–502. Available at: <https://doi.org/10.1016/B978-012109890-2/50043-3>.
- Selvi, S. and Panneerselvam, K. (2012) "A Self-regulated Learning approach for programming language using cloud-based Learning Management System", in *2012 International Conference on Recent Trends in Information Technology*. Madras, India, 19-21 April: IEEE, pp. 191–196. Available at: <https://doi.org/10.1109/ICRTIT.2012.6206810>.
- Sletten, S.R. (2017) "Investigating Flipped Learning: Student Self-Regulated Learning, Perceptions, and Achievement in an Introductory Biology Course", *Journal of Science Education and Technology*, 26(3), pp. 347–358.
- Strayer, J.F. (2012) "How learning in an inverted classroom influences cooperation, innovation and task orientation", *Learning Environments Research*, 15(2), pp. 171–193.
- Yamada, M., Goda, Y., Imamura, R. and Egi, H. (2019) "The Effects of Seat Location-based Teaching Assistant Support System on the Awareness of Self-Regulated Learning and Learning Performance", in *2019 IEEE International Conference on Engineering, Technology and Education (TALE)*. Yogyakarta, Indonesia, 10 - 13 December: IEEE, pp. 625–631.

- Ye, D. and Pennisi, S. (2022) "Using trace data to enhance Students' self-regulation: A learning analytics perspective", *The Internet and Higher Education*, 54, p. 100855. Available at: <https://doi.org/10.1016/j.iheduc.2022.100855>.
- Zimmerman, B.J. (1989) "A social cognitive view of self-regulated academic learning.", *Journal of Educational Psychology*, 81(3), pp. 329–339. Available at: <https://doi.org/10.1037/0022-0663.81.3.329>.
- Zimmerman, B.J. (1990) "Self-regulated learning and academic achievement: An overview", *Educational psychologist*, 25(1), pp. 3–17.
- Zimmerman, B.J. (2000) "Chapter 2 - Attaining Self-Regulation: A Social Cognitive Perspective", in M. Boekaerts, P.R. Pintrich, and M. Zeidner (eds) *Handbook of Self-Regulation*. San Diego: Academic Press, pp. 13–39. San Diego, CA: Academic Press.
- Zimmerman, B.J. and Martinez-Pons, M. (1988) "Construct validation of a strategy model of student self-regulated learning.", *Journal of educational psychology*, 80(3), p. 284.

Late Submissions

Edtech Startups: Determining the Factors Involved in Internationalisation

Keila Malca-Ramirez¹, Linda Marita Cruz-Pupuche² and Franklin Cordova-Buiza^{2,3}

¹ Business Faculty, Universidad Privada del Norte, Lima, Peru

² Faculty of Business Sciences, Universidad Católica Santo Toribio de Mogrovejo, Chiclayo, Peru

³ Research, Innovation and Social Responsibility Department, Universidad Privada del Norte, Lima, Peru

N0010113@upn.edu.pe

lcruz@usat.edu.pe

franklin.cordova@upn.edu.pe

Abstract: In the last 10 years, the connectivity of the human being with technology has become evident all over the world, we are in times of high use of technology in everyday life, as evidenced by the use of an Uber to study an online class with colleagues from other countries. Technology has led to the growth of education in Peru during the Covid-19 pandemic, which has allowed entrepreneurs to have a global perspective by creating enterprises in the education sector with a vision of scaling up to the foreign market. These startups are startups known as edtech startups. In this context, this research aims to determine the factors involved in the internationalisation of startups. The qualitative approach was used with a cross-sectional design based on in-depth interviews with experts and founders of this ecosystem, and a group of founders shared a success story of two startups selected for convenience. Networking and financing. Through innovation, strategies are applied in the startup processes to retain the consumer and obtain high recognition; networking helps to have contacts in all target countries, easy access in the selected market and financing allows sustainability in the market. It is concluded that these most relevant factors cooperate in the entrepreneurial ecosystem achieving a business model with high innovation and technology focused on improving education and at the same time entering the international market.

Keywords: Entrepreneurship, Global Business, Exponential Growth, Peru, Startups, Edtech

1. Introduction

The present research is focused on education ventures where technology is the pillar of their development, these ventures are called startups. "A startup seeks to be a profitable and scalable business model in a faster and easier way" (Blank & Dorf, 2012, pp. 17), through the systematic application of technical knowledge and, they operate in high-tech sectors showing innovative behaviour (Marin-Bello, 2019).

According to an article published by Harvard Business Review, written by Michael Fertik, creator of the start-up reputation.com, the whole world is fast becoming a single market, where money is the universal language that unites society. Single market, where money is the universal language that unites society, and where it has become as easy to profit from international customers as from local ones (Fertik, 2013).

There are several definitions of the term "start-up". According to Steve Blank (known as the as Silicon Valley's master of innovation), a start-up is a temporary organisation designed to pursue a repeatable business model (Fertik, 2013). Designed to pursue a repeatable and scalable business model. The founders of a start-up are called entrepreneurs (Blank, 2010).

In the latest report developed by the Global Entrepreneurship Monitor (GEM, 2017), Peru has obtained 0.37 points in the entrepreneurship index, ranking number five worldwide, and in Latin America as number one. With an average annual unemployment rate of 7%. Entrepreneurship in Peru has always been present, in its beginnings, as a response to the adversities of the country's economic environment, but over time, it developed the skills and confidence in Peruvians to take risks and undertake new businesses.

For the education sector, only 6 Peruvian startups have been ranked in Latin America. The startup Crehana, which has reached more than 3.5 million students in more than 25 countries around the world, Fratal up, was one of the five finalists in the Big Data category in 2014, consists of the creation of a virtual assistant to generate customised learning paths on the web and free of charge, then, Laboratoria, with presence in Mexico, Chile and Peru, Simcase is a virtual education platform that seeks to improve the quality of life of Peruvian children and young people, Sofia is a virtual assistant that provides information on tax and customs issues in a quick and easy way, There is also the Tannder platform that helps to create didactic and creative virtual learning environments, designs content and meaningful learning experiences, and provides tutoring services for continuing teacher training , and finally there is Code, which promotes programming education by providing interactive courses.

(Ministerio de la Producción [PRODUCE], s.f; El banco de desarrollo del Perú [COFIDE], 2021; Asociación peruana de capital semilla y emprendedor [PECAP], 2022).

Edtech has been progressively developing in Peru and is growing steadily thanks to the investment opportunities offered by the government and the high level of entrepreneurship provided by each partner who wants to take their venture idea to the local and global market (Oliva et al., 2022)

The internationalisation process has several perspectives of development that have been analysed by different authors, this study is grouped in three types of perspective: economic, gradual and born global. The faster a startup goes global, the greater its ability to exploit growth seeking opportunities worldwide perspective (Crick & Spence, 2005). For this purpose, It is therefore important to know what are the factors involved in the development of the internationalisation of an edtech startup?

The general objective is to explain the most relevant factors such as innovation, networking and financing involved in the development of the internationalisation of an edtech startup.

2. Literature Review

Throughout the life cycle of a startup, there are 4 important phases involved in the development of a technological venture, starting in the first phase, called the initial phase, in which the product or service is formed, and the startup is analysed. In Figure 1 the author Blank y Dorf (2012) presents other stages of startup development such as the creation of new companies which requires adequate forms of financing.

In gestation and creation, initial investment capital is essential. In the expansion phase, angel investors and venture capital act as bridges before successful companies can tap the capital markets (Madsen y Servais, 2017), thus, this ecosystem tends to opt for new strategies that contribute with high innovation and advanced technology to sustain in the target market (Allison y Browning, 2006).

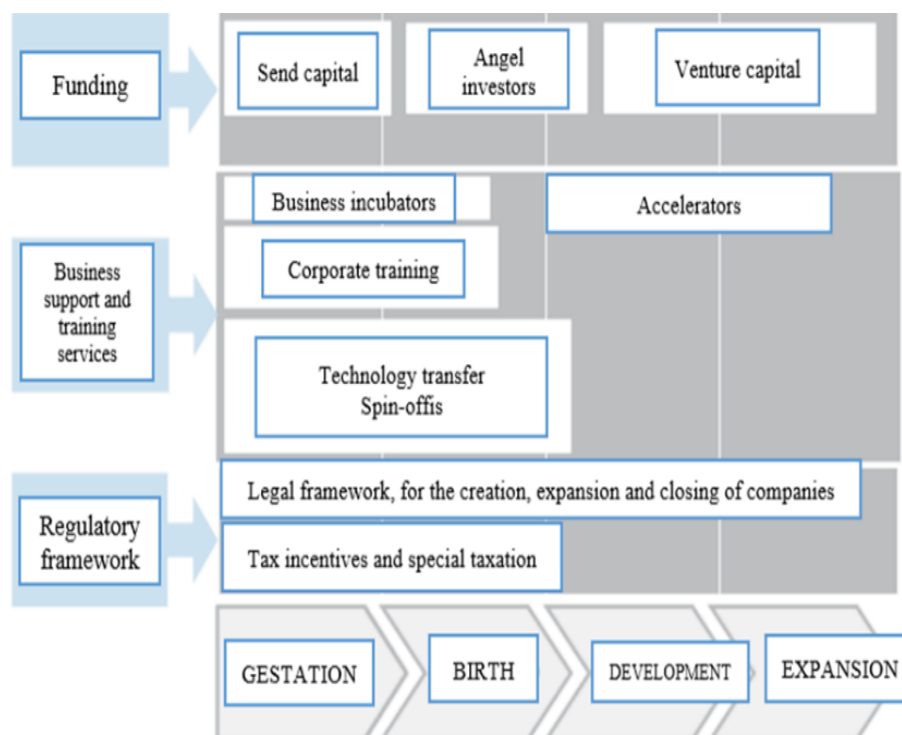


Figure 1: Stages of startup development

Internationalisation is the process of globalisation of a company, that is, when a company projects its activities outside its country of origin. This is done with the purpose of obtaining greater profitability and creating value. According to Canals (1994), the objectives of internationalising a company are threefold: Opening new markets, minimising production costs, and maintaining an efficient production and distribution process. Internationalisation is seen as a process by which companies increase their international involvement (Johanson,

1997), is one of the pillars of the future that is responsible for contributing to the growth of the startup, the generation of value and the economic development of a country.

Internationalisation is the set of operations that generate stable relationships between a company and the international market through a process that requires greater commitment and international perspective (Welch & Luostarinen, 1998).

To date, several methodologies related to the internationalisation of startups have been suggested. According to, Puerto (2010) presents research where he explains the internationalisation process of startups in Madrid, highlighting the following main factors: financing, innovation and marketing network, the results indicate that early internationalisation is key for technology startups. On the other hand, Santos (2014) researcher from the University of Cordoba Spain, analysed an industrial cluster containing companies that have achieved significant presence in international markets, and also sought to determine the key variables that drive local and global success. The study method has a mixed approach, corroborating the validity of networking as one of the main success factors for a company that wants to have a presence abroad.

Sekliuckiene (2019) from Kaunas University of Technology conducted research with the aim of analysing success factors at the start-up stage in international companies. It uses an in-depth qualitative research approach and a multiple case study with 9 cases. The result contributes to a relationship between the early success of new startups, direct experience in the foreign market and entrepreneurial orientation. The contribution of this benefits the understanding of determinants related to entrepreneurship in different business environments and proves the existence of a relationship between the experience acquired by the entrepreneur and success at an early entrepreneurial age (Brouthers et al., 2016).

Within the set, COFIDE (2021) highlights the need for investment to develop innovation and entrepreneurship projects, where more than S/53 million has been invested to support the execution of 470 projects, to promote productive development in 23 regions of the country, including Lima, Arequipa, Junín, La Libertad and San Martín. He also highlights that the State continues to be the main driver of innovation and entrepreneurship in Peru. This author's common logic supports the priority of a startup in the global arena.

On the other hand, PECAP (2022) reports that they are promoting the development of the Peruvian entrepreneurial ecosystem, the deepening of the financing and seed capital market for high-impact innovation ventures, The Alliance is being developed through an alliance with CONFIDE, PECAP and its Swiss entrepreneurship program, where they have as a priority to increase access to venture capital for startups, as well as for the development of Venture Capital funds in Peru (COFIDE, 2021).

The main factors to achieve scalability are innovation, classified as incremental or disruptive, which varies from company to company. The incremental is the value added while the disruptive incorporates improvements in its operation (Christensen et al., 2015; Puerto, 2010). Another fundamental factor is networking, it is present throughout the process of developing a startup, because it solves barriers at the beginning of creating a venture, it also forms strategic alliances with global companies that are likely to influence the external market (Chin et al, 2016). The following factor is found throughout the expansion process, it varies according to the income of a company, in it is used own investment or state investment, it also depends on the type of startup and the investor to find, either private or national, this description mentioned corresponds to the financing (Fernandez, 2020 & Marin-Bello, 2019).

3. Methodology

The research is qualitative and cross-sectional, characterised mainly by presenting an interpretation of the factors of internationalisation of a startup and the relationship between them. For the sample, 6 Peruvian edtech founders from Peru, 1 Chilean expert and 5 Peruvian experts from the startup ecosystem were interviewed in depth. In addition, inclusion criteria were established, minimum 4 years of experience in a public or private institution in the startup ecosystem and representatives who are in the process of internationalisation of their company.

The present study used the in-depth interview technique, the instrument used was the open-ended question guide and also keep the rating response options. The guide was elaborated with questions applied to 6 founders of this ecosystem and general questions to experts in order to gather information on the development factors in the internationalisation of a startup. The guide of questions was divided into two parts; the first part consists of 16 questions to the founders, these evaluate internationalisation, analysing 3 factors (financing, networking and innovation), the second part has 4 questions that evaluate the intervention of the factors within the

educational startup according to the previous experience of the experts. The validation of the interview form was done through the approval of 6 experts on the subject, who analysed the coherence and importance of each of the questions and that they respond to the dimensions of the variable under study. All this data was elaborated in Excel, then exported to Power BI for better visibility, also APA was used for the tables, through which the following results were obtained.

Table 1: Group of interviewees

Interviewees	Number	Features
Founders of edtech startups	6	They are the CEO of the best Peruvian edtech, their startups managed to internationalise in their first years of creation in Latin America and worldwide.
Experts in the startup ecosystem	6	They are professors and participants with more than 4 years of experience in private and national innovation and technology institutions of this ecosystem.

4. Results

In Peru, edtech startups are developed between incubators and accelerators, the interviewees of the expert group detail that in 2021 only 9 startups with scalable growth have been identified. Among them stands out the winner of the COVID-19 challenge project, Fractal up, Crehana who managed to get a record amount in investment operations for 70 million dollars (Fernández, 2020), thanks to this funding he had the opportunity to scale to more than 5 countries and improve the innovation of his startup. On the other hand, Fractal Up is presented as a digital platform that allows to quickly locate videos, applications and massive open web courses that facilitate the study of primary, secondary and pre-university students, through a content map that meets their learning needs (PECAP, 2022).

The interviewees of the founding group indicated that the reason for internationalising their edtech depended on the pandemic, since at that time education became virtual, and for technology companies it was an opportunity. They also highlighted a case example of edtech Crehana, which was born being international, Crehana's parent company is in England and the main destination countries are the USA, Mexico, Chile, Ecuador and Brazil.

On the other hand, the interviewees of the founders and experts agree that there are difficulties when going abroad, because they consider the language as the first difficulty, also the type of currency, since in each country is different, so the startups implemented on platforms the type of currency according to the destination country, other challenges to consider was to know the legal level of the company, review the finances, taxes, hiring as everything is different from the country of origin, Peru.

This qualitative analysis aims to determine the factors involved in the internationalisation of edtech startups. To this end, the interviewees from both groups indicate that the main factor applied was networking, thanks to contact with clients in each selected country, opinion leaders in each country, as well as public relations and the use of different media.

According to networking is extremely important in the development and scalability of the startup, the group of interviewed founders indicates that it favours the entry into new markets, they add an example of the startup Netzun, who made an alliance with Tondero in Peru to connect with people abroad, this edtech operates mainly in Mexico, Colombia, Ecuador, Argentina.

According to innovation, we have the group of interviewed founders where they pre-sent innovation as an important factor for the internationalisation of an edtech, since it helps the customer to maintain brand loyalty, differentiate itself from the competition and be recognised in global destinations. This group of interviewees indicated that without innovation there is no growth; in the technology sector they must innovate every day to maintain the entrepreneurial spirit and have the vision to scale to other markets. They also present an example of Netzun, where they used disruptive innovation, managing online classes, this has allowed low costs, less time and teaching with great professionals.

In this sense, it is highlighted that innovation is a key point, it applies to all stages of a venture. Another example they detail is the edtech Crehana, which produces 10 courses every week, this analyses the impact of the

investment of money, in what metrics it develops and tests to increase participation in the education sector. The expert group interviewees confirm that incremental innovation is based on a previous business model to which they have added value in order to differentiate themselves from the competition. They mention Crehana as an example; it has launched products from scratch with a totally new format and the profitability generated has been excellent.

According to the financing factor, the expert group interviewees add an example of the startup Crehana, since it recently raised series b financing, it is the first series b of the Peruvian startup ecosystem, it is also reported that the main financing of Crehana was led by General Atlantic, a firm dedicated to investing in startups when they are in a growth stage, where they have already evaluated the initial business model.

Also, in this interview the group of founder's report that funding is important at all stages of the startup, this factor helps an edtech to achieve internationalisation quickly, also determine the series of financing with greater use, known as Series A, which is obtained by Mexican funds such as Dylan Capital and Mountain Nazca, as it was presented by several founders with B2B businesses.

Table 2: Selection of international market

Stages	Features
1	Market selection
2	Type of consumer
3	Market growth
4	Government type

According to Table 2, the group of interviewed founders reports that before entering a new market they analyse the main characteristics of their edtech, among them the selection of the target market, the type of consumer to visualise who their product is aimed at, the market growth to know the flow of income and profit they would have and the type of government, this data coincides with the group of interviewed experts, who confirm that from the first stage of a startup it is important to know the international market niche to which their venture will enter.

Table 3: Number of operations and customers abroad

Years	Foreign operations
1	Only in 1 country Netzun
3	2 to 3 countries Netzun
4	More than 3 countries Crehana
5	More than 6 countries Crehana

In table 3 by operations, presents the startup Crehana stands out with foreign operations in more than 5 countries. The presence of a startup is in more than one country, which allows to diversify the risk of a startup and develop a more scalable business model, and obtain a better positioning, greater competitiveness. For both startups, the client countries are more concentrated in Latin America.

In general terms, the main factor that has facilitated and promoted internationalisation is the innovation of the business, by constantly innovating it will differentiate itself from the competition, by the theme of Networking, entrepreneurs have received much of their success abroad thanks to partnerships with global business institutions, as in the current case of Crehana, with Nic Newman, on the other hand, Netzun has been receiving support from accelerators and incubators, such as Wayra and Startup Peru. This topic is fundamental for the founders because it has allowed them to inter-act with specialised mentors and entrepreneurs from other countries, opening up the possibility of new business opportunities and easy access to foreign markets.

Regarding funding, it is argued that it is easier to obtain it if the business is scalable both in the local and international market, as it is one of the necessary factors for every startup, although it is not a relevant factor that prevents internationalisation. For example, Netzun obtained funding thanks to Angel Investors in 2018 which allowed them to program a learning platform, as a result, they had higher sales.

5. Discussion

Within the framework of this research, we had the opportunity to connect with great authors thanks to their experience acquired along the entrepreneurial path that provided us with data to strengthen this study. In one of the interviews conducted for internationalisation criteria, a new variable was found: the global vision of the business. Well, this should be considered for future research, as well as for future entrepreneurs who are starting to connect in the development of a startup, as it is one of the main factors that determines that a startup can internationalise.

For this future variable we have the example of the edtech Crehana, where the group of expert interviewees indicates that from the beginning this startup maintained a global vision with the objective of providing experience and security at the time of acquiring the service and through this allows them to build consumer loyalty. This coincides with the writings of the authors Ganichev & Koshovets (2021), since in his research on the structure of digital markets as a result of covid-19, he also found that security, experience and satisfaction in purchasing and consumption decisions are important characteristics that a company must provide. On the other hand, Rocha et al. (2022) & Cordova & Paredes (2022) argue that SMEs usually strive to achieve the loyalty of technological and constantly changing consumers, these researches highlight that customer loyalty is mainly related to proper communication and rewards received from the company.

Internationalisation influences various sectors, the sector that has had the greatest boom is education. Within the context, the influential factors to internationalise a startup are innovation, networking and financing, which proposes to develop internationalisation in a more efficient way (Gabrielsson et al., 2008; Oliva et al., 2022). The qualitative study has determined the main influential factors for the internationalisation of a company, which are explained in the following lines.

In Cerqueira (2021), networking is considered a fundamental factor, since without networking the entrepreneur cannot operate locally, much less enter abroad, although it is true that it does not guarantee success, but it is the necessary basis for its execution. This coincides with what was mentioned by Debrulle & Maes (2015) since in its application it was found that the proper management of the network of contacts allows the team to learn from other experiences, get feedback and be a main source of recommendations.

In Amorós & Román (2016) they determine that the innovative factor makes it easier to effectively reach future customers, the business, the company itself and each technological area. Innovation is the starting point of any project, improving processes to scale to new markets, since it provides the opportunity for growth. This coincides with what was mentioned by Moen (2022) since in its application it was found that innovation is classified as a differentiating feature of a startup, it should be clear, if it does not innovate the venture declines and it should not happen when they are about to scale to a foreign market.

Blank & Dorf (2012) conducted research with the purpose of establishing the internationalisation process in startups in Madrid, the results indicate that early internationalisation is key for technology entrepreneurship and the main strategies are financing, innovation and marketing network. The contribution of this research favours our independent variable which specifies the important factors for the development of expansion in the competitive market.

In this analysis we have evaluated the current influence of globalisation and trade that have achieved the opening of local economies that is now the whole world, against this we have seen the phenomenon of internationalisation of a company (Blank & Dorf, 2012). Thus, to develop a business model with better chances of surviving the international market, it must rely on factors such as networking, innovation, financing and global vision (Brouthers et al., 2016; Johanson & Vahle, 1997).

6. Conclusion

The overall objective was to determine the factors involved in the internationalisation of an edtech startup, thereby seeking to cooperate in the entrepreneurial ecosystem achieving a business model with high innovation and technology focused on improving education. The most relevant factors related to internationalisation are networking, innovation and financing. Innovation is the basis for the product or service to remain in the competent market, differentiate itself from the competition and have greater customer loyalty, followed by networking, which helps to have quick access to the target market, and financing, which helps to remain in the market and improve the startup.

Likewise, in the interviews, financing has been identified in three ways in which startup founders can obtain funds for the development of internationalisation. These are: Family Friends Fools funding, which is characterised as the first contribution to their equity, seed capital or public entities, and the third funding is obtained from private equity, better known by the group of angel investors. The international market abounds with entrepreneurial ideas that seek to generate profits for their founders. It should be noted that in the last four years, the State and private entities have improved the supply of financing for technological ventures.

On the other hand, the results identify the network of contacts known as networking as a main issue that founders should consider, since it will provide easy access to global markets and interaction with mentors, generate strategic alliances with state and private institutions in order to open new ventures. They suggest looking for information in the chambers of commerce of the country, embassies, the purpose they provide is to connect entrepreneurs with destination countries, making use of this greatly favors entrepreneurs, especially at the beginning of scaling a startup.

Finally, it is determined that the low level of internationalisation is due to the lack of more research, education and development, also for not improving the value proposition, where the objectives provide a solution and differentiate themselves from the competition by developing these characteristics, more edtech startups will be able to transcend locally and internationally. In this sense, thanks to this research, future entrepreneurs will be able to improve the business model they need to develop, considering a global vision, as well as allowing new researchers to advance with a newly discovered variable as mentioned in the results, this will transcend constructive improvements in the startup ecosystem.

References

- Allison, M.A., Browning, S. (2006). Competing in the cauldron of the global economy: tools, processes, case studies, and theory supporting economic development: *International Journal of Technology Management*, 33 (2-3), 130-143. <https://doi.org/10.1504/IJTM.2006.008307>
- Amorós, J.E., Basco, R., Romani, G. (2016). Determinants of early internationalization of new firms: the case of Chile: *Journal of International Entrepreneurship* 12(1), 283-307. <https://doi.org/10.1007/s11365-014-0343-2>
- Asociación peruana de capital semilla y emprendedor. (2022). REPORTE 1ER CENSO DE STARTUPS PERUANAS 2022. <https://www.pecap.pe/reportes2022>
- Banco de desarrollo del Perú. (15 de junio de 2021). COFIDE y PRODUCE lanzan fondo por S/ 70 millones. https://www.cofide.com.pe/noticia_detalle.php?id=65
- Blank, S., & Dorf, B. (2012). El manual del emprendedor: La guía paso a paso para crear una gran empresa. Grupo Planeta. https://theoffice.pe/wp-content/uploads/el_manual_del_emprend.pdf
- Blank, S. (25 de enero de 2010). What's A Start-up? First Principles [Entrada en blog]. Recuperado de <https://steveblank.com/2010/01/25/whats-a-startup-first-principles/> [Consulta: 8 de agosto de 2018].
- Brouthers, K., Geisser, K. & Rothlauf, F. Explicando la internacionalización de las empresas de ibusiness: *Journal of International Business Studies* 47, 513–534 (2016). <https://doi.org/10.1057/jibs.2015.20>
- Canals, J. (1994). La internacionalización de la empresa: como evaluar la penetración en mercados exteriores. MCGRAW-HILL. http://orga.blog.unq.edu.ar/wp-content/uploads/foro_deluni/INTCI_Canals_2_Unidad_1.pdf
- Cerqueira, C., Lamas, C.C.M. & Baranovskiy, S. (2021). Interculturality role in startups internationalization: Eligent Club's virtual Accelerator Programme case. *E-Journal of Intercultural Studies*, 9 (3). DOI: 10.34630/erei.v3i9.4217
- Chin, T., Tsai, S. B., Fang, K., Zhu, W., Yang, D., Liu, R. H., Tsuei, R. T. C. (2016). EO-performance relationships in reverse internationalization by chinese global startup OEMs: Social networks and strategic flexible. <https://doi.org/10.1371/journal.pone.0162175>
- Crick, D., Spence, M. (2005). The internationalisation of 'high performing' UK high-tech SMEs: a study of planned and unplanned strategies: *International business review*, 14(2), 167-185. <https://doi.org/10.1016/j.ibusrev.2004.04.007>
- Christensen, C. M., Raynor, M. E., McDonald, R. (December 2015). What Is Disruptive Innovation? *Harvard Business Review*. <https://hbr.org/2015/12/what-is-disruptive-innovation>. <https://hbr.org/2015/12/what-is-disruptive-innovation>
- Cordova-Buiza, F., Paredes-Vasquez, R. D. P. (2022). Loyalty strategies in Latin American SMEs: A systematic review of scientific literature between 2012 and 2021. Paper presented at the IEEE International Professional Communication Conference, pp. 298-302. doi: 10.1109/ProComm53155.2022.00062
- Debrulle, J., Maes, J. (2015). Start-ups' internationalization: The impact of business owners' management experience, start-up experience and professional network on export intensity: *European Management Review*, 12(3), 171-187. <https://doi.org/10.1111/emre.12050>
- Fertik, M. (25 de enero de 2013). Go International, Young Start-up. *Harvard Business Review*. Recuperado de <https://hbr.org/2013/01/go-international-young-startup> [Consulta: 20 de agosto de 2018].
- Fernández, M. (23 de noviembre de 2020). Startup peruana premiada por el MIT impulsa transformación digital en educación: Andina. <https://andina.pe/agencia/noticia-startup-peruana-premiada-por-mit-impulsa-transformacion-digital-educacion->

- 822372.aspx#:~:text=Tres%20hermanos%20trujillanos%20fundaron%20en,para%20potenciar%20la%20educaci%C3%B3n%20digital, last accessed 2022/6/25
- Gabrielsson, M., Kirpalani, P., Dimitratos, V. H., MSolberg, A., Zucchella, CA. (2008). Born globals: Propositions to help advance the theory: *International Business Review*, 17(4), 385-401. <https://doi.org/10.1016/j.ibusrev.2008.02.015>
- Ganichev, N., Koshovets, O. (2021). Forcing the Digital Economy: How will the Structure of Digital Markets Change as a Result of the COVID-19 Pandemic: *Studies on Russian Economic Development*, 32(1), 11-22. <https://doi.org/10.1134/S1075700721010056>
- Johanson, J., Vahle, J. E. (1997). The International Process of the Firm - A Model Knowledge Development and Increasing Foreign Market Commitments: *Journal of International Business Studies*, 8, 23-32. <https://doi.org/10.1057/palgrave.jibs.8490676>
- Madsen, T. K., Servais, P. (1997). The internationalization of born globals: an evolutionary process: In *International Business Review*, 6 (6), 561-583. [https://doi.org/10.1016/S0969-5931\(97\)00032-2](https://doi.org/10.1016/S0969-5931(97)00032-2)
- Ministerio de la Producción (2020) <https://www.gob.pe/produce>.
- Moen, Ø. (2002). The born globals: a new generation of small European exporters: *International marketing review*, 19(2), 156-175. <https://doi.org/10.1108/02651330210425015>
- Oliva, F. L., Teberga, P. M. F., Testi, L. I. O., Kotabe, M., Giudice, M. D. & Kelle, P. Cunha M. P. (2022). Risks and critical success factors in the internationalization of born global startups of industry 4.0: A social, environmental, economic, and institutional analysis. *Previsión tecnológica y cambio social*. Vol 175. <https://doi.org/10.1016/j.techfore.2021.121346>
- Puerto, D. P. (2010). La globalización y el crecimiento empresarial a través de estrategias de internacionalización: *Pensamiento & Gestión*, (28), 171-195
- Rocha-Vallejos, K. H., Rabanal-Altamirano, S. N., Robles-Fabian, D. A., Cordova-Buiza, F. (2022). Does brand love strictly increase purchase intention? The case of Linio: *Innovative Marketing*, 18(4), 36-4. [http://dx.doi.org/10.21511/im.18\(4\).2022.04](http://dx.doi.org/10.21511/im.18(4).2022.04)
- Santos, L. M. (2013). Factores De Éxito En La Internacionalización De Las Empresas Del Mueble En Andalucía [Tesis doctoral, Universidad de Córdoba]. Repositorio institucional de la Universidad de Córdoba. <http://hdl.handle.net/10396/11794>
- Sekliuckiene, J., Jarosinski, M., Kozma, M. (2019). Entrepreneurial level factors of early internationalization: A cross country comparison: *Engineering Economics*, 30(2), 223– 235. <https://doi.org/10.5755/j01.ee.30.2.21185>
- Welch, S. L., & Luostarinen, R. (1988). Internationalization: Evolution of a Concept. *Journal of General Management*, 14 (2), 34-55. <https://doi.org/10.1177/030630708801400203>
- Global Entrepreneurship Monitor (GEM). (2017). Global Report 2017/18. Recuperado de <https://www.gemconsortium.org/report/50012>. [Consulta: 2 de agosto de 2018].

Empowering Deaf Learners: The Promise of Sign Language MOOCs

Paula Escudeiro and Márcia Campos Gouveia

Games, Interaction & Learning Technologies, Porto Superior Institute of Engineering, Porto, Portugal

pmo@isep.ipp.pt

magia@isep.ipp.pt

Abstract: In the realm of education, deaf students face significant communication barriers that limit their integration and success within intellectual communities. Due to the use of distinct mother languages, a communication gap arises between deaf and non-deaf communities. This poses serious difficulties for deaf students, who communicate primarily in sign language and are unable to fluently read materials written in spoken language. As most didactic materials in higher education are available exclusively in spoken languages, this further limits the opportunities and chances for deaf students to succeed. While technological advancements have made it possible to create tools and services that translate between spoken and sign languages, they are often expensive and not widely available in educational settings. The proposal is a pedagogical model that seeks to overcome these obstacles and foster inclusivity by offering deaf students access to educational resources in their mother language – sign language. This is accomplished using Massive Online Open Courses (MOOCs) paired with automatic sign language translation technology. To demonstrate this model's effectiveness, a digital literacy course for schoolteachers was developed and evaluated within a group of users, including deaf students. The paper discusses the state-of-the-art of digital educational content available to the deaf, the process of translating digital learning materials into sign languages, the specifications needed to structure educational content for the deaf, and an example of the development methodology for creating multilingual learning objects for the deaf. The evaluation results indicate that MOOC is inclusive and positively impacts deaf students' learning outcomes. The proposed pedagogical model has significant implications for improving access to education and promoting inclusivity for deaf students worldwide. By utilizing technological advancements and creating inclusive digital educational materials, it is possible to bridge the communication gap between deaf and non-deaf individuals, thereby enabling deaf students to acquire, expand, and improve their knowledge in various subjects.

Keywords: Deaf Education; Sign Language Accessibility; Technological Advancements; Inclusive Pedagogical Model; Digital Learning Materials for the Deaf

1. Introduction

Education is a fundamental right that should be accessible to all individuals, regardless of their abilities. However, deaf students encounter distinct challenges in education due to communication barriers. These barriers arise from differences between sign languages and spoken languages. Sign languages and spoken languages vary not only in phonology, morphology, vocabulary, and syntax, but also in visual and spatial dimensions. Consequently, deaf students who use sign language often face difficulties in reading and comprehending spoken language.

The digital era has widened the gap between deaf and non-deaf individuals in accessing educational resources. Most educational materials and digital information are primarily available in spoken languages, making them inaccessible to deaf students and limiting their knowledge acquisition.

Deaf individuals face challenges such as the need for sign language translators, difficulties in comprehending scientific subjects, and a lack of sign-language skilled teachers. Technological advancements offer potential solutions by developing tools to translate between spoken and sign languages, but their high cost and limited availability in educational settings leave many deaf students without proper support. Additionally, the minority status of sign language natives further hinders the provision of tailored educational solutions, leading to educational disparities.

Despite these challenges, there has been an increase in the number of deaf students completing high school and pursuing higher education, prompting the need for inclusive strategies that ensure equal access to educational content, enhance communication, and promote digital literacy for deaf students.

This paper seeks to address the aforementioned challenges by proposing a pedagogical model aimed at delivering inclusive educational materials to the deaf population. The model explores the combination of Massive Open Online Courses (MOOCs) with sign language automatic translation technology as a means of bridging the educational gap.

2. Background

In recent years, there have been advancements in improving the accessibility of education for deaf students in Portugal. However, challenges persist (Verma, 2017). The current educational offerings for Portuguese Sign Language (LGP) primarily focus on undergraduate degrees in education and pedagogical sciences, with limited availability of technical subjects in sign language. As a result, deaf students rely on interpreted classes, which hinders their ability to review content and study materials in sign language, making the presence of sign language interpreters in classrooms necessary due to the lack of adequate didactic materials and bilingual teachers. However, interpreters may face difficulties understanding educational complex content, leading to potential distortions in the translation process. Inadequate physical infrastructure and a lack of teaching methods based on sign language and deaf culture further contribute to the exclusion of deaf students from the academic community.

While progress has been made in enhancing educational accessibility, there is a lack of focus on developing Massive Open Online Courses with accessibility as a central concern. Gupta and Fatima (2016) highlighted the barriers faced by deaf learners in accessing e-learning environments and proposed ideas for MOOCs for individuals with hearing disabilities. These barriers include learning management systems not designed in sign language and challenges in communication requirements, course content, and materials.

Several noteworthy studies have addressed accessibility in e-learning systems for deaf and hard of hearing individuals. For example, Alcazar et al (2016) introduced a speech-to-visual approach e-learning system for teaching English to deaf students in the Philippines, resulting in better comprehension and addressing individual needs. Batanero et al (2019) redesigned a Moodle platform to include accessible learning objects for engineering students with sensory impairments, leading to improved academic performance. Esdras and Galasso (2020) designed a bilingual virtual learning platform with various tools to support learning, while Batanero-Ochaita et al (2021) evaluated the accessibility and usability of a learning platform prototype for deaf, deaf-blind, and blind students, receiving positive responses from participants.

These examples highlight the ongoing efforts within the field of digital accessibility for deaf students, emphasizing the importance of developing inclusive educational materials and platforms to support their learning needs. However, further research and development are necessary to address the specific challenges faced by deaf learners and ensure equal access to educational opportunities (Verma, 2017).

3. Methodology

Deaf students face significant challenges in accessing content written in spoken language, which hinders their academic performance. To address this issue, the researchers propose a pedagogical model that combines Massive Open Online Courses (MOOCs) with sign language automatic translation technology to improve educational accessibility for deaf students. The model aims to bridge the communication gap and empower deaf individuals with effective access to educational resources.

To enhance inclusivity, the MOOCs integrate VirtualSign technology, utilizing a 3D avatar for seamless translation between spoken language and sign language (Escudeiro et al., 2013, 2015; Oliveira et al., 2019). The VirtualSign application enables deaf individuals to access digital course content while providing a sound environment for non-deaf participants. The courses incorporate multimedia elements like video editing, image manipulation, animations, and graphics integration to create dynamic and visually engaging learning experiences (Oliveira et al., 2019).

The research model employed within these MOOCs integrates an automatic translation system built on VirtualSign, facilitating bilingual content and interaction for seamless communication between different languages. An audio add-on feature has been implemented to benefit individuals with visual impairments through text-to-speech conversion (Escudeiro et al., 2013, 2015; Oliveira et al., 2019). The MOOCs aim to be user-friendly for deaf students, providing an interactive environment that facilitates content interaction and task completion.

A vital component of these MOOCs is the sign language translation aspect, utilizing the Assistive Communication for Education (ACE) architecture (Escudeiro et al., 2017, Ulisses et al., 2018). This architecture addresses the unique communication settings of both deaf and non-deaf individuals. The sign language translation component incorporates modules for text recognition and sign language translation, leveraging advanced technologies such as Kinect for motion recognition and data gloves for recognizing static hand configurations.

By integrating VirtualSign technology, employing the ACE architecture, and incorporating multimedia elements, the inclusive MOOCs provide a comprehensive and engaging learning experience for deaf individuals while promoting accessibility and inclusivity for learners of diverse backgrounds.

4. Project Evaluation & Results

The inclusive MOOC was evaluated using the Quantitative Evaluation Framework (QEF) (Escudeiro & Bidarra, 2008) to assess its effectiveness and accessibility for deaf users. The evaluation considered three dimensions: pedagogical, ergonomic, and management. Positive outcomes were observed, with the MOOC achieving high ratings in various areas. In the pedagogical domain, it scored 82% for the learning factor and 32% for the evaluation factor. The ergonomic domain received a perfect score of 100% across usability, video/audio integration, and text integration factors, while the management domain achieved 100% in content management and adaptability.

Questionnaires were answered by 23 participants, including 8 deaf users and 15 non-deaf users. Separate questionnaires were prepared for deaf users, focusing on usability, adaptability, and content quality. The responses from both groups were overwhelmingly positive, with no negative responses and a majority selecting "strongly agree," indicating high satisfaction among all users.

The overall product quality received a rating of 82%, demonstrating the effectiveness and potential of the inclusive model in creating educational materials. Areas for improvement were identified, particularly in the pedagogical domain and ergonomic usability, highlighting the need for refinements to optimize the educational experience.

Feedback from users, including deaf individuals, reinforces the researchers' commitment to addressing diverse learners' needs and ensuring accessibility. Over 57% of respondents strongly agreed that the lesson content was accessible, emphasizing the positive impact of inclusive design principles on the learning experiences of individuals with disabilities.

The evaluation aligns with previous research emphasizing the importance of effective web-based education strategies tailored to the deaf community. It also highlights the limited availability of e-learning systems designed for communication between deaf and non-deaf individuals, underscoring the significance of the researchers' efforts in bridging this gap and fostering effective communication and interaction in educational settings.

Overall, the evaluation results, combined with user feedback and existing research, emphasize the importance of advancing inclusive education for individuals with diverse needs, particularly in web-based learning. Ongoing improvements and innovations are necessary to ensure equitable access to educational resources and opportunities for all learners. The findings contribute to the development of inclusive educational materials and underscore the significance of user satisfaction and accessibility in online learning environments.

5. Conclusions

The researchers have introduced an innovative MOOC designed to expand digital educational opportunities for deaf learners. Deaf individuals face clear disadvantages in education due to communication barriers and limited access to digital content and information. The presented inclusive pedagogical model aims to foster the development of inclusive and interactive learning environments, thereby minimizing barriers to knowledge and education.

To ensure the quality of the MOOC and its effectiveness in providing access to digital educational content, the researchers used QEF. This framework guides the development and production of digital content throughout the entire cycle, helping to maintain quality standards. The evaluation results have demonstrated the positive potential of this pedagogical model, although further enhancements are necessary, particularly in terms of evaluation and usability features.

Overall, the proposed pedagogical model presented by the researchers signifies a significant departure from traditional and inefficient methods of communication between the deaf and non-deaf communities. Its aim is to foster inclusivity and overcome barriers that hinder educational settings. By harnessing technology and adopting an inclusive approach, the researchers envision an educational environment that is accessible to all individuals, irrespective of their needs.

References

- Alcazar, V. J. L. L., Maulana, A. N. M., Mortega, R. O., & Samonte, M. J. C. (2016). "Speech-to-visual approach e-learning system for the deaf", *11th International Conference on Computer Science & Education (ICCSE)*, pp. 239-243. DOI: 10.1109/iccse.2016.7581587.
- Batanero, C., de-Marcos, L., Holvikivi, J., Hilera, J. R., & Oton, S. (2019). "Effects of New Supportive Technologies for Blind and Deaf Engineering Students in Online Learning.", *IEEE Transactions on Education*, 62(4), pp. 270–277. DOI: 10.1109/te.2019.2899545.
- Batanero-Ochaíta, C., De-Marcos, L., Rivera, L.F., Holvikivi, J., Hilera, J.R., Tortosa, S.O. (2021). "Improving accessibility in online education: Comparative analysis of attitudes of blind and deaf students toward an adapted learning platform.", *IEEE Access*, pp. 99968-99982. DOI: 10.1109/ACCESS.2021.3095041.
- Escudeiro, P., & Bidarra, J. (2008). "Quantitative Evaluation Framework (QEF)", *RISTI – Revista Ibérica de STI*, pp. 16-27.
- Escudeiro, P., et al. (2017). "Digital Assisted Communication.", *Proceedings of the 13th International Conference on Web Information Systems and Technologies (WEBIST 2017)*, pp. 395-402. DOI: 10.5220/0006377903950402
- Escudeiro, P., et al. (2013). "Virtual Sign Translator", *Atlantis Press*, pp. 290-292.
- Escudeiro, P., et al. (2015). "Virtual Sign – A Real Time Bidirectional Translator of Portuguese Sign Language", *Procedia Computer Science*, pp. 252-262.
- Esdras, D., & Galasso, B. (2020). "Deaf Education in Parallax: The Development of a Collaborative Learning Model", *Revista Brasileira de Aprendizagem Aberta*, 19(1), pp. 437-458. DOI: 10.17143/rbaad.v19i1.427.
- Gupta, P., & Fatima, S. (2016). "Massive Online Course for Deaf and Dumb People", *Proceedings of the 21st Western Canadian Conference on Computing Education*. DOI: 10.1145/2910925.2910945.
- Oliveira, T., et al. (2019). "The VirtualSign Channel for the Communication Between Deaf and Hearing Users", *IEEE Revista Iberoamericana de Tecnologías del Aprendizaje*, pp. 188-195. DOI:10.1109/RITA.2019.2952270
- Oliveira, T., Escudeiro, P. M., Escudeiro, N. F., & Rocha, E. (2019). "Automatic Sign Language Translation to Improve Communication", *2019 IEEE Global Engineering Education Conference (EDUCON)*. DOI: 10.1109/EDUCON.2019.8725244
- Ulisses, J. P. P. S., Oliveira, T., Escudeiro, P. M., & Escudeiro, N. F. (2018). "ACE Assisted Communication for Education: Architecture to support Blind & Deaf Communication", *IEEE*.
- Verma, G. K., 2017. "Education and social integration for all: challenges and responses", In: *Approaches to educational and social inclusion: International perspectives on theory, policy and key challenges*. Routledge, pp. 9-21.

Learning with Moodle and Google Drive: Instrumental Conflicts in Question

Arnaud Zeller and Pascal Marquet

Faculty of Education and Lifelong Learning – LISEC, University of Strasbourg, France

Abstract: Learning management systems (LMSs) are still supporting artefacts by allowing higher education students to conduct learning activities using teaching resources. These artefacts are based on graphical interfaces that display modules and contents. The mediated contents force students to manage instrumental conflicts resulting of a poor integration between didactic, pedagogical and technical artefacts, during the learning activity (Marquet, 2005). This paper investigates the impact of using the LMS Moodle on the realisation of an activity carried out in this same environment, during a business intelligence (BI) course, according to the type of integration of the teaching resources used: resources integrated into the environment and resources external to the environment. After conducting a literature review on the information search task and on learning BI with LMSs, this empirical work (N = 69) examines the effects of the type of integration of said resources on the results obtained in the quiz. The results suggest that the implementation of external resources around an LMS and therefore not integrated into the environment paradoxically enables students to obtain better results on a score in a shorter time, thus improving their ability to act.

Keywords: LMS, Business Intelligence, Interface, Instrumental Conflict, Moodle

1. Introduction

According to Rabardel (1995), an artefact becomes an instrument through transformations that involve itself and the user's patterns of use (Overdijk et al., 2012). The introduction of digital technologies in the learning activity adds an additional level of appropriation to the didactic and pedagogical artefacts: the technical artefact. In a computerised pedagogical situation, the graphical interface of the LMS aims to represent, adapt and make accessible didactic objects. An instrumental conflict designates the failure of the instrumental genesis of at least one of the three artefacts at stake in a teaching-learning situation involving an ILE (Marquet, 2005, 2010, 2019).

This paper focusses on the effect of implementing pedagogical resources in an LMS for carrying out the learning activity. The analytics for each student is collected from Moodle to measure the effect of the integration of content, both inside or outside Moodle, on the scores obtained in a quiz. This is followed by the analysis of the impact of the type of implementation on the time taken to complete the quiz.

2. Literature Review

2.1 The Information Search Task

The task of finding information is central to many areas of human activity. In relevant literature, authors such as Bernstein (1993) distinguish three types of information search: (1) mining, (2) manufacturing and (3) farming. Mining, now known as data mining, is a research activity involving the extraction of information from large containers of data, known as big data. In this type of activity, the relevant information is a set of data that can become a valuable resource once it has been extracted and curated. Manufacturing information retrieval is a second-level search activity aimed at designing or creating a document, often based on the results of previous mining tasks. This type of activity sees the acquisition, refinement, assembly and maintenance of information as part of a continuous, iterative cycle. Farming information-seeking activity is a cycle and a family of continuous and collaborative information-seeking activities that may include the aforementioned activities and that are collectively carried out by groups of people within an organisation in pursuit of common, individual and changing goals depending on the situation. The study on the implementation of an information retrieval task in an LMS by Tricot and Golanski (2002) has enabled the differentiation of four variables, independent of the user or the topic addressed: (1) the repetitiveness of the task, (2) the degree of explicitness of the targets, (3) the location of the targets and (4) the quantity of the targets (Tricot, 1993). This makes it possible to characterise its implementation in an information retrieval system. Once the research results have been obtained and before being able to utilise first-level information, known as data in strategic intelligence, understanding the data is the first challenge that students face. This data is contained in texts of varying degrees of difficulty. These texts are generally expository and rarely narrative. Research into the difficulty of texts and questions shows that obstacles can arise from the organisation of the information and the familiarity with the subject matter (Rawson & Kintsch, 2002), bearing in mind that the subjects used for learning to monitor are based on all disciplines, from medicine

to nuclear energy, not to forget acoustics, the arts or even aeronautics, for example. Authors have shown that the frequency of and familiarity with the words used, as well as their level of abstraction, make texts, more or less, accessible (Beck et al., 1982; Mesnager, 2002). Similarly, the structure of the text (Caccamise et al., 2013) is another dimension to consider when assessing its difficulty.

2.2 Learning Business Intelligence (BI)

Business intelligence can be defined as all coordinated actions of the research, processing, distribution and protection of legally obtained information, useful to economic players in implementing individual and collective strategies (Martre et al., 1994). This activity requires the implementation of information search tasks. This can prove complex in the absence of a precise definition of what business intelligence covers. Marcon and Moinet (2011) underline the complexity and importance of a clear definition, in which data, as a basic material, is at the heart of a dynamic wherein the transition from strategic information to knowledge, from ‘knowledge to act’ to ‘knowing is to act’, is played out. In fact, during the learning process of business intelligence, students often confuse key concepts such as data, information, knowledge and intelligence. However, in this specific field, these concepts refer to the different stages in the processing of basic material for creating value (Degoul, 2001). This discipline relies heavily on online data collection and the use of digital technologies for data analysis, hence the importance of using an LMS.

2.3 Learning BI with Moodle

A recent study on the effect of LMSs on student performance in learning educational assessment (Oguguo et al., 2021) recommends learning and using LMSs such as Moodle. According to Gamage et al. (2022), who analysed 155 articles on LMSs from 2015 to 2020, the studies show that ‘Moodle is a powerful tool used to support learning in a variety of ways’. The authors suggest that ‘there is strong evidence that Moodle increases student engagement, performance and satisfaction, while improving the flexibility of their learning environments’. Research investigating students’ views indicates that students agree that Moodle is easy to use and complements teaching. However, one study did not find a direct relationship between student preferences and academic performance (Cakiroglu et al., 2017). Using an LMS such as Moodle can assist students in learning business intelligence. Pedagogical resources may be integrated into this LMS or external to the environment. In the latter case, the environment simply contains hyperlinks to access them (e.g. links to videos hosted on YouTube). However, these external resources may be in very different formats and based on different graphical interfaces to that of the LMS used. In this case, the reduction of degrees of freedom, aimed at lowering the complexity of the solving process, or the maintenance of orientation to prevent the learner from losing sight of the initially set objective and to continue conducting the main task may be severely hampered despite the use of a central system, which is supposed to support these functions, because of the affordances returned by these environments, perceived or not by the learners, affordances initially returned by signs displayed on their graphical interfaces. Bruillard and Paindorge (2022) suggest that ‘questions of sign are central. Difficulty in understanding them can be a major obstacle to learning’.

This study therefore aims to examine the impact of the type of implementation chosen for a documentary resource in an LMS on the performance of the instrumented activity by the learner. Therefore, the study seeks to answer the following research question: to what extent does the type of integration of a pedagogical resource inside or outside Moodle impact the results obtained in a quiz on the same environment at the end of the activity?

3. Methodology

Recent studies focusing on teaching with LMSs suggest that these platforms and the tools they contain increase engagement, motivation, collaboration (Campbell et al., 2020; Hwang, 2020; Jones et al., 2021), student performance, retention and critical thinking (Alkholy et al., 2015; Ardianti et al., 2020; Bernacki et al., 2020; Cadaret & Yates, 2018; Hempel et al., 2020; Oguguo et al., 2021). Some LMSs such as Moodle contain a learning analytics module that allows conducting research to measure student engagement (Mwalumbwe & Mtebe, 2017).

The present study analyses the traces left by the user of a GUI on Moodle, which includes several modules, from which we chose a PDF player. Moodle automatically collects learning analytics in a dedicated module. Students were asked to take a quiz on Moodle after having studied resources, hosted inside Moodle for the control group and outside Moodle on Google Drive for the experimental group. Answering the questions required studying the

pedagogical resources that contained the answers. Resources could be used by the students during the quiz realisation.

3.1 The Survey

3.1.1 Implementation of resources and performance on the quiz

Regarding the control group, we hypothesise that the integration of resources hosted on Moodle will ease the appropriation of the interface displaying the content and of the content itself, unlike for the experimental group that will have to switch back and forth between the module, the PDF, and Google Drive, resulting in the need to adopt two graphical interfaces producing instrumental conflicts between each other regarding the didactic, pedagogical and technical artefacts present in the learning situation (Marquet, 2005). This study makes the general assumption that, depending on the type of resource implementation, whether external or internal to Moodle, the additional navigation and window management activities in the graphical interface will, for the experimental group having to deal with two environments simultaneously, make it more complex to carry out their instrumented actions, resulting in lower results than those of the control group. We also hypothesise longer activity completion times will be observed for this group.

3.1.2 Sample and procedure

This research was carried out on students enrolled in a course in business intelligence and strategic intelligence at the University of Strasbourg. The activity involved dividing the total 69 participants into either the control or experimental group and required them to study pedagogical resources related to business intelligence. To this end, students had to read PDF documents hosted either inside or outside Moodle. They were asked to go through the resources, taking notes if necessary, and then take a quiz at the end of the activity related to the content studied. The students participated in two sessions, enabling the collection of pre-test and post-test measurements. Attention was drawn to the following variables: V1-SCORE – score obtained in the quiz and V2-TIME – time taken to complete the quiz.

4. Results

4.1 Performances on the Quiz

We initially performed a Levene's homoscedasticity test, which indicated significant homogeneity between the variances of the quiz scores in the pre-test [$F(1, 67) = 0, 91$; $p = 0.34$] and in the post-test [$F(1, 67) = 0, 43$; $p = 0.51$]. A repeated measures ANOVA was performed, with the following conditions: type of resource implementation as a between-subjects factor, pre-test and post-test as within-subjects factors and total scores (V1-SCORE) as the dependent variable. An overall main effect of conditions – type of implementation of the PDF resource was found – $F(1, 67) = 201, 05$; $p = 0.02$ – due to the greater improvement in scores between pre-test and post-test for the experimental group using resources hosted on Google Drive compared with the control group that used resources hosted on Moodle (Tables 1 and 2).

Table 1: Repeated Measures ANOVA – Between Subjects Effects – V1-SCORE

	Sum of Squares	df	Mean Square	F	p
Group	201	1	201.1	5.64	0.020
Residual	2387	67	35.6		

Table 2: Descriptives – V1-SCORE

	Group	N	Mean	Median	SD	Minimum	Maximum
Pre-test V1-SCORE	Control group	33	6.86	5.09	4.44	1.360	18.0
	Exp. group	36	9.76	9.20	4.79	0.700	19.6
Post-test V1-SCORE	Control group	33	12.19	11.44	4.55	4.430	19.6
	Exp. group	36	14.12	15.43	4.40	2.830	20.0

4.2 Quiz Completion Time

The time (in minutes) taken to complete the quiz was subsequently studied. A repeated measures ANOVA was performed, with the following conditions: type of resource implementation as a between-subjects factor, pre-test and post-test as within-subjects factors and quiz completion time (V2-TIME) as the dependent variable. An overall main effect of conditions – type of implementation of the PDF resource – between-subjects was found – $F(1, 67) = 14, 10$; $p < 0.01$ – due to the greater decrease in quiz completion time between pre-test and post-test for the experimental group using resources hosted on Google Drive than that of the control group that used resources hosted on Moodle (Tables 3 and 4).

Table 3: Repeated Measures ANOVA – Between Subjects Effects – V2-TIME

	Sum of Squares	df	Mean Square	F	p
Group	1589	1	1599	14.10	<.001
Residual	7589	67	113		

Table 4: Descriptives – V2-TIME

	Group	N	Mean	Median	SD	Minimum	Maximum
Pre-test V2_TIME	Control group	33	29.3	28.8	9.79	12.92	44.9
	Exp. group	36	23.0	19.9	9.22	9.07	43.0
Post-test V2_TIME	Control group	33	28.7	29.9	7.30	10.65	45.0
	Exp. group	36	21.4	23.6	8.13	7.97	42.5

5. Discussion

The results show that the difference in score is significant between the experimental group and the control group; the experimental group obtained a better score. The difference is also significant between the two groups regarding the time taken to complete the quiz, with the experimental group completing the quiz in a shorter time. This finding contradicts our hypothesis that interface will, for the experimental group having to deal with two environments simultaneously, make it more complex to carry out their instrumented actions, resulting in lower results and longer activity completion times compared with the control group. We suggest that those results can be apprehended as one of the effects of instrumental conflicts found in LMS, which should be apprehended both as a complexifying and a facilitating factor for learning.

Studies on theories of cognitive information processing indicate that our cognitive systems have a limited capacity and that learners must therefore select those that best match their objectives (Clark & Mayer, 2011). Furthermore, the process of finding information with multimedia is complex by relying on the cognitive processes of representation (Mayer, 2005) as well as the process of regulation, analysis and synthesis and which mobilises numerous skills around the identification of a problem, the search for information and the scanning and processing of information (Wopereis et al., 2008). To carry out the instrumented action, we therefore suggest that learners differentiate the tasks of studying resources, from the task of completing the quiz, as these tasks require the use of specific instruments, differentiated by the nature of the task to be completed. The use of a hosting platform such as Google Drive, whose primary purpose is not to assess learners but to make documentary resources available, along with the LMS Moodle, dedicated to carrying out the quiz, encouraged better differentiation of the tasks among the learners in the experimental group, thus enabling them to obtain better results.

In other words, the learners in the experimental group were able to produce actions that met the diversity of criteria they had explicitly expected their actions to meet (Rabardel, 2005). We understand these uses in response to a Moodle misaffordance (Beatty & Nunan, 2004) comprising a feature or property of the object, which diverts the object from its intended use: how can Moodle as an LMS help students achieve better results and succeed by providing documentary resources and simultaneously be responsible for assessing their knowledge in a quiz, in complete impartiality?

The answer to this question invites us to reconsider the issue of integrating a resource in an LMS; integration would not only be apprehended from a technical standpoint, between the search for the best possible

articulation between several educational technologies, but also from an instrumental standpoint, in order to find the best possible articulation between the prescribed task, its requirements, the underlying actions to complete it, and the proposed instruments for carrying it out (Rabardel, 2005).

6. Conclusion

This study evaluates the impact of the implementation of pedagogical resources in the LMS Moodle on the realisation of a learning activity, depending on whether the resources are implemented within the LMS or outside it, on Google Drive. The results reveal that the effects of instrumental conflicts resulting from a problem of integration between didactic, pedagogical and technical artefacts modify the results of action instrumented with an LMS and the means of obtaining them. A greater improvement can be observed in scores between the pre-test and the post-test for the experimental group using resources hosted on Google Drive that were not integrated into the environment, compared with the control group that used integrated resources hosted on Moodle. Those instrumental conflicts are so pervasive that the time taken to complete the quiz between the pre-test and the post-test was shorter for the experimental group, who paradoxically had to use two different environments with graphic interfaces that bore little resemblance in terms of iconography. The limitation of this study is that it only used desktop computers and only one LMS, Moodle, and one cloud storage solution, Google Drive. Further research could be based on mobile terminals using others LMSs and cloud storage systems.

References

- Alkholy, S., Gendron, F., Dahms, T., & Ferreira, M. P. (2015). Assessing student perceptions of indigenous science co-educators, interest in STEM, and identity as a scientist: A pilot study. *Ubiquitous Learning*, 7(3–4), 41–51.
- Ardianti, S., Sulisworo, D., Pramudya, Y., & Raharjo, W. (2020). The impact of the use of STEM education approach on the blended learning to improve student's critical thinking skills. *Universal Journal of Educational Research*, 8(3B), 24–32.
- Bernacki, M. L., Vosicka, L., & Utz, J. C. (2020). Can a brief, digital skill training intervention help undergraduates "learn to learn" and improve their STEM achievement?. *Journal of Educational Psychology*, 112(4), 765–781.
- Bernstein, M. (1993, December). Enactment in information farming. In *Proceedings of the fifth ACM Conference on Hypertext* (pp. 242–249).
- Bobillier Chaumon, M.C., & Clot, Y. (2016). Clinique de l'usage: Les artefacts technologiques comme développement de l'activité, Synthèse Introductive au dossier. *Activités*, 13(2), 1–7.
- Bruillard, É., & Paindorge, M. (2022). Quelques réflexions sur les recherches menées sur les ressources au prisme didactique. *RDST. Recherches en Didactique des Sciences et des Technologies* (26), 9–24.
- Caccamise, D., Friend, A., Kintsch, W., & Kintsch, E. (2013). Measuring text complexity. In *Poster presented at the 23rd annual meeting of the Society for Text and Discourse, Valencia, Spain*.
- Cadaret, C. N., & Yates, D. T. (2018). Retrieval practice in the form of online homework improved information retention more when spaced 5 days rather than 1 day after class in two physiology courses. *Advances in Physiology Education*, 42(2), 305–310.
- Campbell, L. O., Heller, S., & Pulse, L. (2020). Student-created video: An active learning approach in online environments. *Interactive Learning Environments*.
- Cakiroglu, U., Erdogan, F., Kokoc, M., & Atabay, M. (2017). Students' preferences in online assessment process: Influences on academic performances. *Turkish Online Journal of Distance Education*, 18(1), 132–142.
- Clark, R. C., & Mayer, R. E. (2011). Proven guidelines for consumers and designers of multimedia learning. *E-learning and the science of instruction*.
- Degoul, P. (2001). Le projet intelligence économique. In *VSST'2001: Veille stratégique scientifique & technologique: systèmes d'information élaborée, bibliométrie, linguistique intelligence économique (Barcelone, 15-19 octobre 2001)* (vol. 2, p.111).
- Gamage, S. H., Ayres, J. R., & Behrend, M. B. (2022). A systematic review on trends in using Moodle for teaching and learning. *International Journal of STEM Education*, 9(1), 1–24.
- Hempel, B., Kiehlbaugh, K., & Blowers, P. (2020). Scalable and practical teaching practices faculty can deploy to increase retention: A faculty cookbook for increasing student success. *Education for Chemical Engineers*, 33, 45–65.
- Hwang, C. S. (2020). Using continuous student feedback to course-correct during COVID-19 for a nonmajors chemistry course. *Journal of Chemical Education*, 97(9), 3400–3405.
- Jones, D., Lotz, N., & Holden, G. (2021). A longitudinal study of virtual design studio (VDS) use in STEM distance design education. *International Journal of Technology and Design Education*, 31(4), 839–865.
- Beatty, K., & Nunan, D. (2004). Computer-mediated collaborative learning. *System*, 32(2), 165–183.
- Marquet, P. (2005, May). Intérêt du concept de conflit instrumental pour la compréhension des usages des EIAH. In *EIAH 2005 (Environnements Informatiques pour l'Apprentissage Humain)* (pp. 383–388). INRP.
- Marquet, P. (2010). Apprendre en construisant ses propres instruments. *Apprendre vec les technologies*, 121–129.
- Marquet, P. (2019). Le concept de conflit instrumental: Rendre opérationnel une démarche d'ingénierie de conception.

- Martre, H., Clerc, P., & Harbulot, C. (1994). Intelligence économique et stratégie des entreprises. *Rapport du Commissariat Général au Plan, Paris, La Documentation Française*, 17, 82–94.
- Marcon, C., & Moinet, N. (2011). *L'intelligence économique* (2nd ed.). Dunod.
- Mwalumbwe, I., & Mtebe, J. S. (2017). Using learning analytics to predict students' performance in Moodle learning management system: A case of Mbeya University of Science and Technology. *The Electronic Journal of Information Systems in Developing Countries*, 79(1), 1–13.
- Mayer, R. E. (2005). Cognitive theory of multimedia learning. *The Cambridge handbook of multimedia learning*, 41, 31–48.
- Oguguo, B. C., Nannim, F. A., Agah, J. J., Ugwuanyi, C. S., Ene, C. U., & Nzeadibe, A. C. (2021). Effect of learning management system on student's performance in educational measurement and evaluation. *Education and Information Technologies*, 26, 1471–1483.
- Overdijk, M., Van Diggelen, W., Kirschner, P. A., & Baker, M. (2012). Connecting agents and artefacts in CSCL: Towards a rationale of mutual shaping. *International Journal of Computer-Supported Collaborative Learning*, 7(2), 193–210.
- Rabardel, P. (1995). Les hommes et les technologies; Approche cognitive des instruments contemporains (p. 239). Armand Colin.
- Rawson, K. A., & Kintsch, W. (2002). How does background information improve memory for text content?. *Memory & Cognition*, 30(5), 768–778.
- Tricot, A. (1993). Stratégies de navigation et stratégies d'apprentissage: pour l'approche expérimentale d'un problème cognitif. In *Deuxième colloque Hypermédias et Apprentissages* (pp. 21–38). EPI; CUEEP; INRP.
- Tricot, A., & Golanski, C. (2002). Vers une description des tâches de recherche d'information au service de la conception d'objets communicants ou de services. *Objets Communicants*, 175–291.
- Wopereis, I., Brand-Gruwel, S., & Vermetten, Y. (2008). The effect of embedded instruction on solving information problems. *Computers in Human Behavior*, 24(3), 738–752.