INSPIRE XXVI

Delivering Global Education and Impact in Emergencies Using E-Learning

Editors:

J Uhomoibhi,
P Linecar, P Marchbank,
M Ross, G Staples

ISBN 978-1-9996549-5-5
British Cataloguing in Publication Data.
A CIP catalogue record for this e-book is available at the British Library.

Twenty Sixth International Conference
on

Delivering Global Education and Impact in Emergencies Using E-Learning

INSPIRE 2021

CONFERENCE CHAIRS
G Staples, J Uhomoibhi

CONFERENCE DIRECTOR
M Ross

INTERNATIONAL ADVISORY COMMITTEE

G Abeysinghe (Sri Lanka)
S Barikza (UK)
P Burgess (USA)
R Dawson (UK)
FJ Domínguez Mayo(Spain)
R Gevorgyan (Armenia)
L Li (China)
C Long (UK)
F Nilsson (Sweden)
H Rahanu (UK)
M Sheriff (Sierra Leone)
I Stamelos (Greece)
E Bacon (UK)
E Berki (Finland)
S Chaudhary (Nepal)
E Dewar (UK)
E Georgiadou (UK)
P Kingsley (N Ireland)
P Linecar (UK)
N Paltalidis (UK)
D Ojukwu (Nigeria)
A Savva (Cyprus)
K Siakas (Greece)
J Valtanen (Finland)

This volume contains the edited proceedings of papers from the twenty sixth International Conference on Software Process Improvement Research, Education and Training, INSPIRE 2021 held remotely, organised by Solent University and the e-Learning Specialist Group of the BCS, The Chartered Institute for IT.

The objective of this conference is to promote international co-operation among those concerned with e-learning by creating a greater understanding of e-learning issues, and by sharing current research and case studies through academic and industrial experience.

The conference organisers feel that this objective has been achieved. INSPIRE 2021 has attracted papers from international sources, covering a broad spectrum of practical experience and research. The topic areas include the use of e-Learning and tools for schools, HE and the wider public, augmented reality, social media, programming in schools, gamification, cyber security in teaching and learning, case studies in use of e-learning in 2021 in various countries, including Armenia, Bangladesh, Bosnia-Herzegovina, China, Cyprus, Denmark, Egypt, Finland, Greece, Ireland, Kazakhstan, Kenya, Northern Ireland, Romania, Russian Federation, Spain, Turkey, UK, and the USA.

We would like to thank the many people who have brought this twenty sixth international conference into being: the Organising Committee, the International Advisory Committee, particularly for all their hard work in reviewing both the abstracts and the final papers, and the committee members of the BCS's e-Learning Specialist Group.

The organisers would like to thank the BCS and Solent University for their support.

The Editors

CONTENTS

Bihac, Bosnia-Herzegovina), Amela Colic (University of Bihac, Bosnia-Herzegovina), Bozana Tomic (Slobomir P University, Bosnia and Herzegovina), Andreas Savva (University of Nicosia, Cyprus), Vasso Stylianou (University of Nicosia, Cyprus), Saltanat Meiramova (Saken Seifullin Kazakh Agrotechnical University, Kazakhstan), Marwa Abd Elghany (Arab Academy for Science & Technology, Alexandria, Egypt), Nermine Khalifa (Arab Academy for Science & Technology, Alexandria, Egypt), Rita Gevorgyan (Armenian State Pedagogy University, Yerevan, Armenia), Daniela Popa (Transylvania University, Brasov Romania), Jackline Odero (Masinde Muliro University of Science and Technology, Kenya), Umulker Ali (Masinde Muliro University of Science and Technology, Kenya), Maria Panteri (Special Unified Vocational High School and Lyceum of Heraklion, Greece & Cordoba University, Cordoba, Spain), Karen Dennis (Illinois State University, Illinois, USA), Veronika Stoffova (Trnava University, Trnava, Slovak Republic), Dilara Begum (East West University, Dhaka, Bangladesh), Sunil Chaudhary (Norwegian University of Science and Technology, Norway), Maria Plastira (Aristotele University, Thessaloniki, Greece) Demet Soylu (Hacettepe University, Turkey), Margaret Ross (Solent University, UK), Geoff Staples (BCS, UK), Galina Zamaraeva (Vladimir University , Vladimir, Russia), Jury Panov (Vladimir University , Vladimir, Russia), Xu Zhang (Beijing Institute of Technology, China), George Portides (University of Nicosia, Cyprus), Claire McGuinness (University College, Dublin, Ireland), Theodora Valkanou (Copenhagen University, Denmark), Sandra Knezevic (University of Bihac, Bihac, Bosnia-Herzegovina) ***433***

Keynotes

Transdisciplinary Research and Education – A Perspective

Dr. Pratap Chillakanti, PhD, MBA
pratap@rewardscloud.com

Abstract

Transdisciplinary Research and Education is a growing field in many subject domains such as Sustainability, Health and Medicine, Natural Sciences, Social Sciences, Engineering, and Technology. In a globally oriented, complex world, problems can often best be solved by transdisciplinary collaboration. The participants include academic and non-academic actors, community stakeholders, governments, and other leaders, who jointly define the problem and find solutions. Knowledge sharing and mutual learning is integral to transdisciplinary collaboration. Another aspect of such collaboration is the use of the right technologies.

The focus of the presentation is to give a broad perspective of the field of transdisciplinary research and education. Real life examples from industry and academia demonstrate the importance of this growing field. The pertinent issues in educating tomorrow's leaders in transdisciplinary thinking are brought to the forefront. The fundamental role of an educator and the new structure of course and curriculum design are presented. Finally, the role of technology in facilitating transdisciplinary research and education is addressed.

1. Setting the Stage

Covid-19 highlighted the importance of collaborative research and education. Collaboration is now a common model of research the spans academics, industries, and communities. As noted by many researchers and industry practitioners, there is a gap in what educators and schools provide, what students need, and what the community expects in terms of solving practical problems of a society characterized by complexity. There is an urgent need for next generation technology platforms to foster effective collaboration across disciplines to address complex and wicked problems in a society. In addition, there is an immediate need to critically evaluate the existing education paradigms. We should progress towards a model of student-centered active learning that goes beyond the standard learning outcomes to include meta-cognitive abilities. In this context, a strong emphasis is placed on skills and activities that promote collaboration. It should also be noted that today's users are accustomed to a convenient user experience in all aspects of their daily lives as witnessed in using services like Uber, Netflix, Amazon, and others. Educational institutions that can *uberize* and deliver a compelling and convenient experience to their students, researchers, and educators have a significant advantage.

Transdisciplinary Education and Research (TER) is an increasingly significant aspect of solving 21st century challenges facing humanity. These challenges span various domains such as sustainable environment, energy, water, and health care. In today's world, the complexity of the challenges in these domains dictate that the participants include academic and non-academic actors, community stakeholders, governments, and other leaders, who jointly define the problem and find solutions. The collaboration occurs at many levels including intra-organization, inter-organization, public-private enterprise, government-to-government, and country-to-country. Such collaboration is characterized by production and sharing of 1) knowledge artifacts comprising of documents, processes, videos, images, web links, and 2) a variety of tools and technologies that facilitate collaboration, information security, communication, and coordination.

The focus of this paper is to give a broad perspective of the TER field. Real life examples from industry and academia demonstrate the importance of this growing field. The pertinent issues in educating tomorrow's leaders in

transdisciplinary thinking are brought to the forefront. The fundamental role of an educator and the new structure of course and curriculum design are presented. Finally, the role of technology in facilitating transdisciplinary research and education is addressed.

2. Transdisciplinary Collaboration

The first use of the term "transdisciplinary" was in the early 1970s [1]. Nicolescu described transdisciplinarity that is at once between the disciplines, across the different disciplines, and beyond all disciplines [2]. Many distinguished researchers and educators have made significant efforts and proposed approaches to describing transdisciplinarity and contrasting it with interdisciplinary and multidisciplinary terminology over the last several decades. The great contributions of these authors in the development of transdisciplinary research and education are presented in [3], [4], [5], [6], [7], [8], [9], [10], [11], [12], [13], [14], [15], and [16]. A common set of themes, features, and characteristics emerge from these efforts in transdisciplinarity education and research. Table 1 captures these key characteristics.

Ertas [16] defined transdisciplinarity as follows:

Definition: Transdisciplinarity

Development of new knowledge, concepts, tools, and technologies shared by researchers from different family of disciplines including social science, natural science, humanities, and engineering. It is a collaborative process of a new way of organized knowledge generation and integration by crossing disciplinary boundaries for designing and implementing solutions to complex and unstructured problems.

Table 1: Common terms in TER

Complex Problems	Beyond Disciplines
	Integrated Disciplines (Environment, Humanities, hard Sciences, Economics)
Knowledge	Common Knowledge
	Shared Knowledge
	Integration of Knowledge
	Distribution of Knowledge
Collaboration	Interdisciplinary
	Multidisciplinary
	Transdisciplinary

Collaboration is a key aspect of TER. Figure 1 depicts the elements of transdisciplinary collaboration ecosystem.

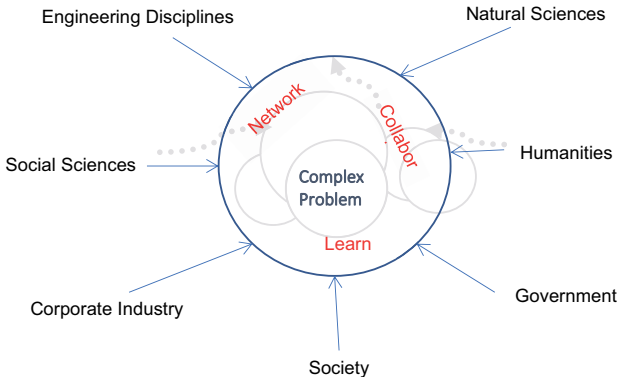


Figure 1: Transdisciplinary Collaboration Ecosystem

Collaboration is the act of working together to achieve a common objective (at personal, group, organizational, national, international levels). The business dictionary defines it as a cooperative arrangement in which two or more parties (which may or may not have any previous relationship) work jointly towards a common goal [17]. In the context of this research, the following definition of Collaboration is used.

Definition: Collaboration (from World English Dictionary)
collaboration (kəˌlæbəˈreɪʃən)
— n (often followed by on, with, etc.)
1. the act of working with another or others on a joint project,
2. something created by working jointly with another or others,
3. the act of cooperating as a traitor, especially with an enemy occupying one's own country.

We can surmise that transdisciplinary collaboration encompasses both 1 and 2 together because the fundamental goal is to create something that goes beyond just the knowledge of one discipline. However, note that the third definition is equally important in transdisciplinary collaboration. In fact, most of the security lapses occur because of malicious insiders [18]. Any transdisciplinary collaboration framework must address security issues that essentially deal with security objectives of Confidentiality, Integrity, Availability, Identity, and Authorization. In its most simple sense, security is "who gets access to what data at what time?" [19].

3. Transdisciplinary Collaboration Examples

Two examples highlight transdisciplinary collaboration. One example, *Decline in Fish Population* [20] demonstrates how the researchers from different disciplines, business leaders in the community, government authorities, anglers, and other community stakeholders came together and collaborated to jointly define the complex problem, hypothesize possible solutions, and participate in other project related activities. The second example, Channel *Incentives*, is the authors' own example from the high-tech industry. This example demonstrates how the cross-functional teams, with expertise spanning technology, business, IT, finance, marketing, and legal collaborated to define and implement a new channel partner incentives solution to engage partners and increase revenue and profitability for a company.

Example 1: Decline in Fish Population

Figure 2 depicts a summary description of the decline in Fish population. The complex problem addressed was a sharp decline in the fish population of up to 60% in many Swiss lakes and rivers several years ago. The analysis of the project resulted in the following observations:

1. It is a complex problem that impacts society.
2. A core team of participants came together from the fisheries authorities, the federal government, and the research institutions.
3. The team held a meeting to discuss the issues and establish a preliminary research goal.
4. They agreed that it was unclear as to what the causes could be and, they emphasized their determination to launch a transdisciplinary research project.
5. A wide spectrum of participants from academia, industry, researchers, and other stakeholders were added to the project team.
6. Community stakeholders were added to the project team.
7. Joint meetings were held to establish the research goals and specific tasks.
8. The transdisciplinary team worked on constructing a joint problem identification with an emphasis on a common understanding and description.
9. Mutual learning facilitated the generation of the joint problem statement.
10. Multiple perspectives were put forth and captured as hypotheses.
11. Majority voting was used to select the hypotheses for further investigation.
12. Multiple sub-projects were initiated to study the issues.

The focus was to understand the societal problem description, the goals of such projects, the participants involved, and the requirements/process/activities that are typically associated with such initiatives. These insights are mapped onto activities and sub-activities in the software tool that was developed to aid in the evaluation of technology platforms for use in transdisciplinary collaborations.

Figure 2. Summary description – Decline in Fish Population

Example 2: Channel Incentives

Figure 3 captures a summary description of the channel incentives project. Many companies in the high-tech industry sell their products and solutions through a network of channel partners. These partners are vendors who sell products and solution from different companies to their end customers. In return, the companies offer them incentives including rebates, discounts, and market development funds. The author is associated with one such incentive program for channel partners in a Fortune 50 company. From Figures 2 and 3, it can be observed that in both projects, common themes emerge, particularly in terms of activities that drive collaborations. It is this common set of activities that are used to specify the technology requirements that drive the evaluation and selection of the appropriate technology for use in transdisciplinary collaboration.

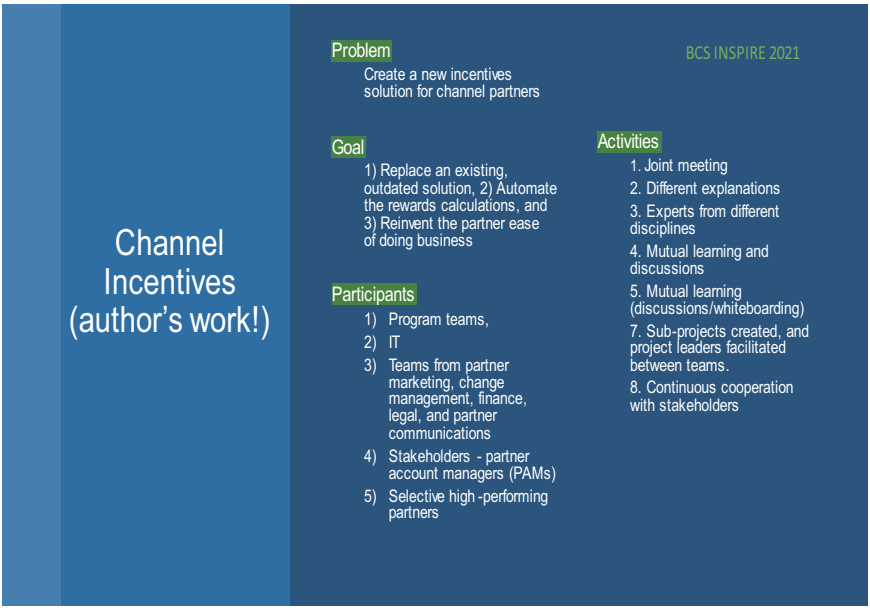


Figure 3. Summary description – Channel Incentives

4. Educators' Role in the Creation of Transdisciplinary Thinkers and Scientists

Education and Research have evolved since the beginning of time. Significant research went into understanding how people learn, what learning objectives mean, etc. Ever since Bloom's taxonomy was proposed to aid educators set the learning objectives driven by domains: Cognitive, Affective, and Psychomotor [21], many educators and researchers such as Myers-Briggs [22], Kolb [23], and Felder [24] proposed innovative learning style theories. The predominant goal of all these approaches is to help educators understand and design their learning content such that it enables effective learning. The Internet boom and associated technology innovations in 1990s and 2000s have dramatically changed the way in which people learn. The technology innovations led to the use of tools like WebEx [25] that ushered the use of asynchronous and virtual learning. In academia, they use learning platforms such as Black Board [26] and Canvas [27] to complement classroom learning with online self-paced learning. In addition, the advent of collaboration tools such as discussion forums, instant messaging, etc. have become effective tools in the hands of millennium learners for collaborative learning. In the last ten years, most learning platforms have integrated discussion forums with their learning management software. In essence, the world is moving toward connected learning experiences. Table 2 captures the evolution of enabling technologies and their impact on advances in TER (measured in terms of Google search results with the keyword transdisciplinary collaboration).

What then is the role of an educator in facilitating student learning to prepare them for effective transdisciplinary collaboration to solve complex problems impacting society? Numerous researchers and scientists have investigated, experimented in their classrooms, and identified the desirable characteristics of a modern educator. Five distinct attributes seem to define the role of such an educator: 1) transition from traditional knowledge mediator to a coach and process facilitator, 2) partnering with students, 3) partnering with faculty across disciplines, 4) partnering with society stakeholders, and 5) rethinking learning objectives, course design, and curriculum design. In the next section, these attributes are demonstrated in the context of learning outcomes and course design.

Table 2: Technology Evolution and Transdisciplinary Collaboration

Search results (TD Collab)	2,230	5,970	14,700	16000	17,7800
Technology	Windows, Java, Internet, Email, Messaging, Web browsers Digital Video, Mobile Phones, Online gaming... Netflix, Amazon, eBay, Google, WebEx, Yahoo …	Broadband internet. iPod. Adobe Flash and YouTube. Windows XP and Office 2003. Open source and free software. Peer-to-peer networking. File sharing. Skype, WebEx, Myspace.	Blogs, portals, intranet, and wikis Wikipedia, Wireless networks. Online learning. Agile software development. Digital Cameras. Digital video streaming. Hybrid vehicles. VOIP. Mobile phones and text messaging. Facebook, LinkedIn, Twitter,	Collaboration technologies. Online learning, Video conferencing, smart boards. Billions of internet users. Quantum computing. GitHub for collaborative source code sharing. Higgs boson discovery. Tesla, Bitcoin	Gravitational waves detected. Scientists view the electron through a powerful electron microscope. Transdisciplinary collaboration in K-12 education and undergraduate / graduate education
Timeline	1995-2000	2000-2005	2005-2010	2010-2015	2015-2020

5. Learning Outcomes and Activity Design

Through systematic literature review, the core skills and core activities in the context of TER were identified. These are depicted in Table 3. Using these core skills and core activities as a framework, educators can establish the desired learning outcomes, and can design appropriate activities in a classroom.

Table 3: Core Skills and Core Activities in TER

Skills Requirements	Activity Requirements	Learner	Teacher	Researcher	Chief Information Officer
Writing	Analyzing problems collaboratively	Collaborate with learners and teachers	Collaborate with learners and teachers	Collaborate with researchers internally	Facilitate security requirements
Collaborative learning	Engage in group discussions	self-directed & on-demand learning	Facilitate class discussions	Collaborate with researchers externally	Facilitate integration requirements collaboratively
Critiquing	Share knowledge	Participate in class group learning activities	Communicate with class and individual students	Create and participate in communities of practice	Assess Vendor from an Infosec viewpoint
Listening & Engagement	Co-produce knowledge	Participate in project group discussions	Conduct online lectures	Engage in discussion forums	
Curiosity	Involve community experts in problem definition and solution generation	Communicate with learners and teachers	Upload courses, tests, and assignments	Upload content	
Group discussion	Participate in communities of practice	Take self-assessments	Facilitate activities to build skills	Mentor learners and other researchers	
Reflection	Collaborative planning	Take graded assessments	Facilitate student reflections	Conduct online seminars	
Interactive communication and collaboration with peers	Seek and give feedback	knowledge share with peers and others	Facilitate student evaluations	Facilitate mutual learning	
Presentation	Produce shared language/vocabulary	Make presentations online	Mentor students	Co-produce knowledge	
	Write critical reflection	Interact with experts and mentors	Conduct class surveys	Work with stakeholders for joint problem definition	

Figure 4 depicts an illustration of using these guidelines to identify the learning outcomes and activity design in a classroom. It should be noted that the illustration also embodies the notion of an educator who is exhibiting the characteristics and behavior of coach/facilitator who is also partnering with students in terms of activity design.

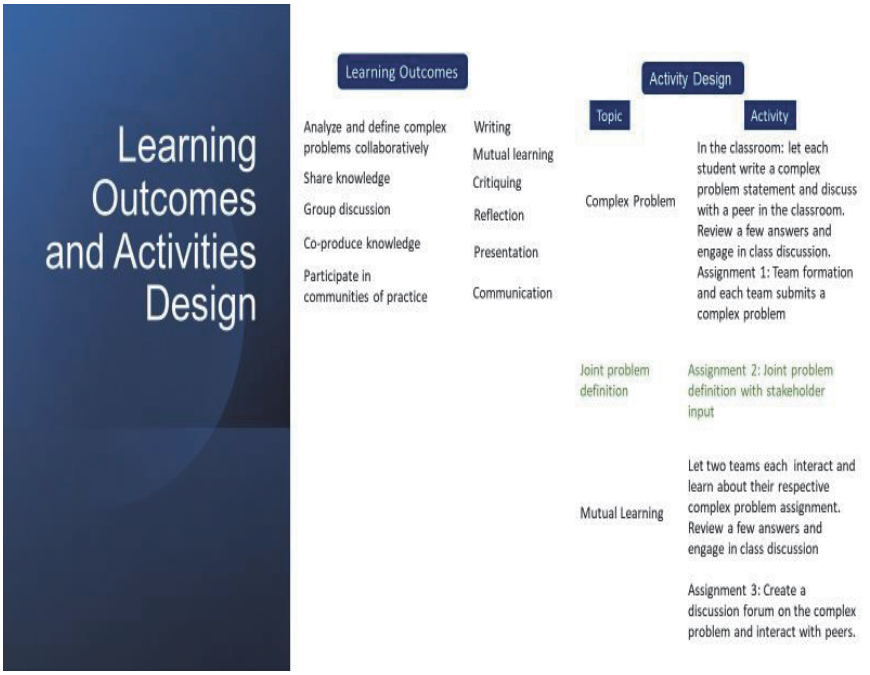


Figure 4. Learning Outcomes and Activities Design

6. Role of Technology in TER

Figure 5 illustrates the technology mapping for the activities prevalent in TER. Using the results of the systematic literature review, real-life project examples, and the author's expertise in active learning and collaboration, the use cases for the various roles were identified and these use-cases were further mapped to the appropriate technologies. A software tool was developed to evaluate technology platforms for use in TER. The technology mapping is reflected in the backend system logic of the tool and served as a supplement to implement evaluation criteria that was produced based on the core skills and core activities identified (Table 3).

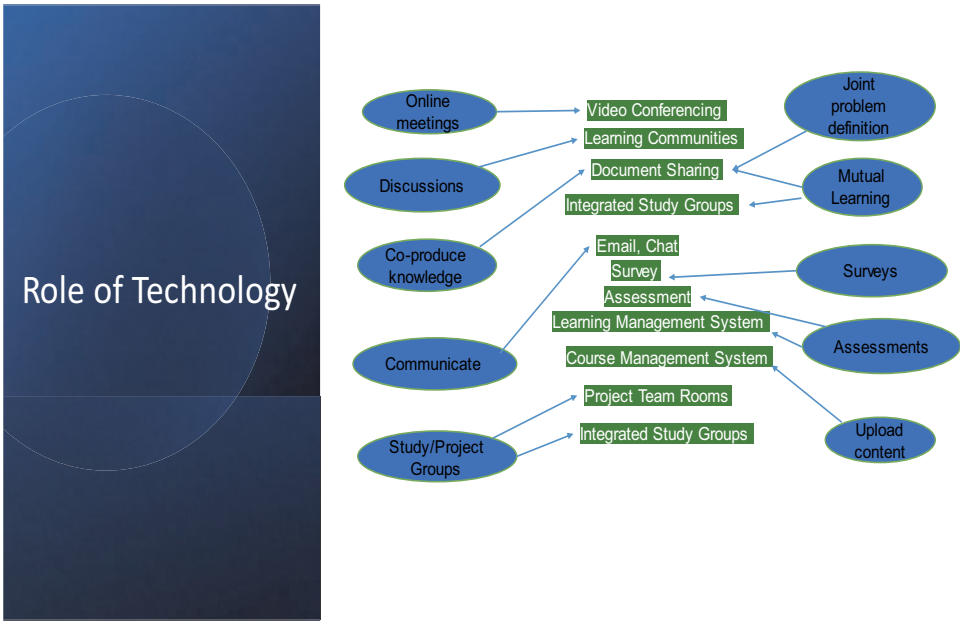


Figure 5. Technology Mapping for Prevalent TER Activities

7. Conclusions

The author's research identified a need to define evaluation criteria for selection of the technology platforms for use in TER. First, through a systematic literature review, core skills and core activities prevalent in TER were identified. These core skills and core activities were used to illustrate how educators can design their course activities to achieve the learning outcomes that are relevant in TER. The research also identified the changing role an educator to train the learners in acquiring the necessary skills to be successful transdisciplinary collaborators in the future to solve society's complex problems. Finally, the research resulted in a software tool based on the core activities and core skills to help in the evaluation of technology platforms for use in TER.

8. Acknowledgements

Dr. Elli Georgiadou was kind enough to review both the keynote presentation and the paper to provide constructive feedback that strengthened both.

9. References

1 L. Apostel et. al., "L'interdisciplinarité – Problèmes d'enseignement et de recherche, Centre pour la Recherche et l'Innovation dans l'Enseignement," Paris, 1972.

2 B. a. a. Nicolescu, "Toward Transdisciplinary Education and Learning," in *Science and Religion : Global Perspectives*, 2005.

3 K. C. Voss, Nicolescu, B., 2002. "Manifesto of Transdisciplinarity. Translated from French by, K.C. Voss," State University of New York Press, Albany, Albany, 2002.

4 D. Stokols, "The Future of Interdisciplinarity in the School of Social Ecology. School of Social Ecology," http//eee.uci.edu/98f/50990/readings.htm, Irvine, 1998.

5 S. Upham, *The Aims of Graduate Education, Keynote address,* Pasadena, CA, 2001.

6 A. Meilich, "System of Systems (SOS) engineering & architecture challenges in a net centric environment," in *IEEE/SMC International Conference on System of Systems Engineering, pp.-5* , 2006.

7 J. T. Klein, "Disciplinary origins and differences," in *Fenner Conference on the Enviromnent: Understanding the population-environment debate: Bridging disciplinary divides*, Canberra, AU, 2004.

8 B. J. Fowers, "From Continence to Virtue: Recovering Goodness, Character Unity, and character Types for Positive Psychology.," *Theory & Psychology,* vol. Vol. 18, no. No. 5, pp. 629-653, 2008.

9 P. M. Senge, The Fifth Discipline: The A11 and Practice of the Learning Organization, Random House, Inc., 2006.

10 S. D. Sheperd, K. Macatangay, A. Colby and W. N. Sullivan, "Educating Engineers, Designing for the Future of the Field.," Carnegie Foundation for the Advancement of Teaching, 2009.

11 J. O. S. a. B. H. Petts, "Crossing boundaries: interdisciplinarity in context of urban environments," in *Geoforum 39*, 2008.

12 C. Karen, "Transdisciplinary Research (TDR) and Sustainability Report," 2008.

13 A. M. T. T. M. a. R. V. Ertas, "Transformation of Higher Education: The Transdisciplinary Approach in Engineering," *IEEE Transactions on Education ,* vol. Vol. 46 , no. No:1, pp. pp. 289-295, 2003.

14 B. E. A. T. D. a. C. I. Gumus, " The Transdisciplinary Product Development Lifecycle (TPDL) Model," *Journal of Engineering Design,* vol. l9, no. 03, pp. pp. 185-200, 2008.

15 D. M. T. E. A. Z. H.-C. F. P. L. W. A. D. F. A. Tate, "Transdisciplinary Approaches for Teaching and Assessing Sustainable Design," *International Journal of Engineering Education,* vol. 26, no. 2, pp. pp.1-12, 2010.

16 A. Ertas, "Transdisciplinarity: Design, Process and Sustainability," *Transdisciplinary Journal of Engineering and Science,* vol. 1, no. 1, pp. pp.30-48, 2010.

17 "http://www.businessdictionary.com/definition/collaboration.html," [Online].

18 G. McGraw, Software Security: Building Security In, Addison-Wesley, 2006.

19 P. Chillakanti, *Course on Secure Product Development for Cisco,* San Jose, 2007.

20 M. e. a. Bergmann, Methods for Transdisciplinary Research. A Primer for Practice, Campus Verlag, 2012.

21 B. B. S, Taxonomy of Educational Objectives, the classification of educational goals – Handbook I: Cognitive Domain, New York: McKay, 1956.

22 I. B. Myers, Gifts Differing: Understanding Personality Type, Davies-Black Publishing;. Reprint edition (May 1, 1995) , 1980.

23 D. Kolb, Experiential learning: Experience as the source of learning and development, Englewood Cliffs, NJ: Prentice-Hall , 1984.

24 L. Felder. R and Silverman, "Learning and Teaching Styles in Engineering Education," *Engr. Education,* vol. 78, no. 7, p. pp 674–681, 1988.

25 Webex [Online]. Available: https://webex.com. (accessed 28/6/2021)
26 Blackboard Teaching and learning "http:/blackboard.com/," [Online]. (accessed 28/6/2021)
27 Canvas Teaching and Learning "https://www.instructure.com," [Online]. (accessed 28/6/2021)
28 A. Kollman T. and Ertas, "Defining Transdisciplinarity," in *The ATLAS T3 Bi-Annual Meeting Proceedings*, 2010.

The Fulfilment of Ethical Duties Required in Overcoming Obstacles to eLearning in a Pandemic

Harjinder Rahanu

Faculty of Science and Technology,
Middlesex University London,
The Burroughs
London, NW4 4BT, UK
h.rahanu@mdx.ac.uk

Abstract

Article 26 of the Universal Declaration of Human Rights affirms that education is a fundamental human right for everyone. In this time of crisis brought about by the outbreak of Covid-19, caused by the Corona Virus (SARS-CoV-2), educational institutions (schools, colleges, and universities) across the globe have discontinued in-person teaching and have switched to blended, and in many cases, solely an online mode of teaching. This conversion from face-to-face learning in a classroom to online learning has been beneficial, yet concurrently has raised a number of challenges.

In the UK, there is a legal duty on local educational authorities, to ensure, amongst other things, that there is an efficient provision of education to meet the needs of the local population, that this service promotes high standards, ensures fair access to opportunity for education and learning, and promotes the fulfilment of learning potential. In January 2020, the UK government introduced a new legal duty on schools, in England, to provide remote education to pupils unable to attend school due to Covid-19.

It is widely acknowledged that law and ethics do have in common certain key principles and obligations. Therefore, the law will clearly apply and lead directly to the appropriate ethical conclusion. However, to rely solely on law as an ethical guideline is clearly dangerous because in certain circumstances bad laws exist, and history is littered with many examples. Inadequate laws may bind rules on society that fail to provide ethical guidance. Such laws may, in some instances, excuse a society from fulfilling certain obligations and duties, or allow a society to justify their unethical behavior.

It is necessary to consider whether stakeholders (e.g. governments, local education authorities, schools, teaching trade unions, educators, parents, guardians, pupils) were or are under an obligation/duty to have done or not have done something. In order to identify these ethical duties, this paper presents a framework, which sets out generic traditional ethical concepts that can be used to flag potential ethical obligations. These are: 1) Quality of life; 2) Use of Power; 3) Risks and reliability; 4) Property Rights; 5) Privacy; and 6) Equity and Access.

A lens is a tool used to bring light to a fixed focal point, and by analogy this framework will be applied to the arguments that present the challenges of deploying e-learning, in order to bring light to a set of ethical duties, a focal point, that will be a set of obligations for various stakeholders. Fulfilling these ethical responsibilities will enable education, in this crisis brought about by this pandemic, to address the issues of accessibility, affordability, flexibility, life-long learning, learning pedagogy, and have educational policy and law that is truly imbued with humanity and unity. This presentation will argue that it is naïve and simplistic to suppose that a solely technological solution will enable the learners to surmount obstacles to online learning in order to improve their life chances. What is required is a more holistic approach, which based the construction and adoption of ethical, cultural, and economic infrastructures. There is evidence that pre-existing socioeconomic inequalities, for example, access to resources such as WiFi, learning spaces, and tutoring, were exacerbated or bought to the fore during the pandemic.

Keywords: eLearning, Ethics, Obstacles to online Learning, Pandemic crisis

1.0 Introduction

In his opening remarks at the media briefing on Covid-19 held on 11th March 2020, the Director General of the World Health Organisation (WHO), Dr Tedros Adhanom Ghebreyesus, declared the outbreak as a pandemic [1]. In order to protect health, minimise economic and social disruption, and concurrently respect human rights, governments and societies around the globe activated comprehensive strategies to prevent infections, save lives and minimise impact.

Social distancing is a conscious increment in the physical gap between people. It was used as a tactic to curb dissemination of the disease. In the UK, Prime Minister Johnson, on 16th March 2020, stated "*now is the time for everyone to stop non-essential contact and travel*", with lockdown measures legally coming into force, in

the England, ten days later [2]; similarly in other countries of the UK. Lockdown measures forced global physical closure of businesses, sport and cultural activities, and educational institutions. Many companies and organisations, migrated to online platforms, in order to continue providing their goods and services. This also included education institutions such as primary and secondary schools; colleges of further education; and universities.

Although the concept of online learning, has a range of meanings attached to it [3], it can be viewed as a term to describe an emerging approach to learn at students' own premise through advanced information-communication technologies (such as Blackboard, Moodle, YouTube, Virtual Reality) either asynchronously or synchronously [4]. Fundamentally, it is the use of the internet and some other important technologies to develop materials for educational purposes, instructional delivery and management of program, and to deliver education. Succinctly put, it is: "*anytime/anywhere access to education made available through the internet*" [5].

The efficacy of online learning must be rooted in the understanding of the benefits and limitations, of which there are many [6, 7]. The crisis-response migration into online learning, raises a number of social, ethical and legal challenges and opportunities, as we battle to eradicate the pandemic. This paper focuses on the ethical issues.

1.1 A Right to Education in a Pandemic

The right to Education is a fundamental basic human right. Article 26: Universal Declaration of Human Rights, declares: "*Everyone has the right to education. Education shall be free, at least in the elementary and fundamental stages. Elementary education shall be compulsory. Technical and professional education shall be made generally available and higher education shall be equally accessible to all on the basis of merit*" [8].

The reasons as to why education is a fundamental human right are outlined by the United Nations Education, Scientific and Cultural Organisation (UNESCO), who forcefully argue, amongst other things, that a right to education ensures the development of a fully rounded human being. Education is a powerful tool in lifting socially excluded children and adults out of poverty and into society; and narrows the gender gap for girls and women. For this human right to work there must be equality of opportunity, universal access, and monitored and enforcible quality standards [9]. Human Rights Watch (HRW) argue that there has been a massive disruption to children's education highlighting the need for governments to devote serious attention and resources to ameliorate, mitigate, and correct the long-standing inequalities in education systems that have been highlighted and exacerbated during the pandemic. Amongst a set of key recommendations, HRW argue that learners continue to be able to exercise this fundamental right to education via affordable, reliable, and accessible internet provided by governments [10]. It is vital to understand that the migration of education to online allows learners to continue to exercise their fundamental basic human right.

In England, there is a statutory duty on schools & local authorities to comply with the law. There is a legal duty on local educational authorities, to ensure, amongst other things: an efficient provision of education to meet the needs of the local population; and that the Service promotes high standards, ensures fair access to opportunity for education and learning, and promotes the fulfilment of learning potential [11]. A temporary continuity direction under the Coronavirus Act, 2020 placed a new legal duty on schools, in England, to provide remote education to pupils unable to attend school due to Covid-19 [12].

1.2 Computer Ethics

The study of computer ethics can be viewed as: "*.... The study of the ethical questions that arise as a consequence of the development and deployment of computers and computing technologies.*" [13]. It is generally recognised that law and ethics do have in common certain key principles and obligations. Thus, the law will apply and lead directly to the appropriate ethical conclusion. However, to rely solely on law as an ethical guideline is dangerous because in certain circumstances bad laws exist [14, 15]. Imperfect laws may bind rules on society that fail to provide ethical guidance. Such laws may, in some instances, excuse a society from fulfilling certain obligations and duties, or allow a society to justify their unethical behaviour. Thus, to solely rely on the law to guide human actions can be dangerous. Ethical judgments simply do not have the same deductivity and objectivity as scientific ones. However, such judgments should be based upon rational ethical principles and sound, carefully reasoned arguments. Normative claims are supported by: "*An appeal to defensible moral principles, which become manifest through rational discourse*" [15]. A normative claim can only be substantiated, and a rational discourse presented, through an appeal to such principles.

Thus, with regard to the ethical issues raised by the development and deployment of eLearning in a pandemic, outlined in Section 2, this paper will present traditional ethical concepts. These will be used to assist in identifying the concerned ethical issues. In Section 3, a number of normative ethical principles are identified, sourced from formal ethical theories. These will be required for the substantiation of a set of ethical duties that are advocated in Section 4 of the paper. It will be argued that these duties must be fulfilled by one or more stakeholders such as: governments, ICT and educational professionals, teaching trade unions, parents, guardians, pupils, etc. The paper will argue that making certain stakeholders, and citizens in general, aware of a broader picture that reveals the ethical context of Education and Technology that we can collectively fight for social justice in our response to deploying eLearning in this pandemic

2.0 Traditional Ethical Concepts

The US Content Subcommittee of the ImpactCS Steering Committee [16] present a framework listing a set of traditional moral and ethical concepts that could be used to flag potential ethical issues in a given case. In terms of personal and professional responsibility, the committee recommended the following six traditional moral and

ethical concepts: 1) Quality of life; 2) Use of Power; 3) Risks and reliability; 4) Property Rights; 5) Privacy; and 6) Equity and Access. In order to become a responsible computer professional, the ImpactCS Steering Committee argued that one must be able to examine the standards for the rightness and wrongness of actions.

The focus of this paper is to look at the issues of Quality of Life, Use of Power and Equity and Access in the development and deployment of eLearning in this pandemic. The respective commentaries for these three ethical concepts are presented in Table 1.

Table 1: Commentaries for three Ethical Concepts

Ethical Concept	Commentary
Quality of Life	Is faster, better, more, always an increase in quality of life for users of technology? Do designers' and decision makers' conceptions of quality of life correspond?
Use of Power	Technology is not totally constrained by physical or mathematical principles, each design decision for that technology is an exercise of power. Need to understand the ethical choices that face both the powerful and the less powerful.
Equity and Access	Careful consideration needs to be given to the extent to which modern technology has divided us into those who have access to the power of technology and those who do not.

The following analysis will reveal the social analysis and ethical issues, across differing deployments of eLearning, which allow for a stakeholder to examine rightness and wrongness.

2.1 Quality of Life

Even though education has migrated online, as a response to Covid-19, it still remains a fundamental basic human right in the now digital world. At a microscopic level, it is of critical importance in improving the quality of life of individual people and organisations; at a macroscopic level it can improve the quality of life for entire nation states in a global information society. The quality of life is improved via the connecting of the two for they allow: self-motivation, self-direction, self-empowerment and self-actuation, cumulatively leading to the development of a *fully rounded human being*.

The Organisation for Economic Co-operation and Development (OECD) argue that the provision of equitable and inclusive access to digital learning resources can, to a large degree, increase the Quality of Life [17]. However, other areas of inclusion and equity during the school closures must also be considered by designers and decision makers. These include:

- Supporting education of disadvantaged students
- Ensuring distribution of food to students
- Ensuring wellbeing of students
- Ensuring provision of social services to students
- Supporting Special Educational Needs (SEN) students
- Addressing emotional needs of students
- Supporting students whose parents have limited command of the language of instruction
- Ensuring social development of students
- Supporting students at risk of violence at home [18].

What is apparent from the above list is that it is a falsehood to suppose that a solely technological solution will enable the learners to surmount obstacles to online learning in order to improve their Quality of Life. This must be understood by decision makers in faculty, amongst academic staff, communities, societies, and local, regional and national governments.

2.2 Use of Power

There is a clear delineation between those who have access to, enjoy and benefit from eLearning; and those who do not. Not all social groups wield power over their own individual lives and are to some extent unable to manage their lives properly. In other words, they are not empowered. School, college and university closures have a very real impact on all students, but especially on the most vulnerable ones who are more likely to face additional barriers. Those living in poverty, geographically remote areas or urban slums, students from ethnic minorities and indigenous communities, immigrant and refugee students, LGBT+ students and students with Special Education Needs (SEN) are particularly exposed by this current coronavirus pandemic [17]. In the UK, studies have revealed that disadvantaged and vulnerable students are significantly less engaged in remote learning. A UK schools study reported that 62% of *vulnerable* students and 58% of students with SEN were less engaged in remote learning than their classmates [19].

In order to become responsible designers, developers and deployers of eLearning, there is a need to steer clear of naïve analysis that states simple access to a computer with broadband access will lead to empowerment. There is a need to understand Information and Communication Technologies (ICTs) and eLearning in the context of poverty and inequality, along the lines of race, socio-economic status, educational attainment, immigration status, sexual orientation, and geography. Only by understanding these power dimensions can ICT and eLearning bring democratisation and liberation to all peoples' lives.

2.3 Equity and Access

An almost universal response to school closures has been the creation of online learning platforms to support teachers, students and their families. However, not all students have the same access to information and communication technologies. This

problem is faced across counties to a lesser or larger degree [20]. Typically, the most vulnerable students might not have access to digital learning resources. During the pandemic, many nations have been using digital pedagogical tools and virtual exchanges between students and their teachers, and among students, to deliver education as educational institutions closed. In response to the challenges they face, countries have developed specific and sometimes innovative policy initiatives, including: partnerships with national educational media and free online learning resources to reach all learners (Good examples include New Zealand, France, Portugal, Columbia and UK); distribution of free electronic devices and learning material (Good examples include Chile, Slovenia, Greece); and the continuity of limited physical educational services for the most vulnerable [17].

There is not just one digital divide but multiple divides which relate to a variety of factors such as: gender; age; 'ethnic clustering'; uncertainty of living/financial conditions; work insecurity, and social insecurity [21]. Many changes have been occurring in identifying vulnerable groups who are subject to social disadvantage as a consequence of age and disability as well as other factors such as low educational achievement, poverty and living in remote rural areas. These groups of people despite living in developed countries, often with strong economies, are not included or not keeping pace with technological developments and opportunities [22]. This pandemic has bought into sharp focus these digital divides.

3.0 Ethical Normative Principles

In the development and deployment of computing technology a number of social, legal and ethical issues can be invoked. Legal issues can be resolved via the use of legal doctrine, which is a framework presenting a set of rules, procedural steps, or tests, through which rulings can be determined in a given legal case. In the same vein the most important ethical issues surrounding the deployment and development of computer technology can be resolved by making a rational appeal to traditional ethical principles and theories and so extend them to the use of new technologies and approaches, such as eLearning. There is a plethora of ethical theories that have been developed throughout history and one or a combination of these can be selected. Fundamentally there are two basic approaches to ethics:

1. **Deontological** theories, define actions as essentially right or wrong regardless of the consequences they produce. An ethical action might be deduced from a duty (Pluralism) or a basic human right (Contractarianism) but it never depends on its projected outcome.
2. **Teleological** theories give priority to the good over the right, and they evaluate actions by the goal or consequences that they realise. Therefore, actions, defined as morally right, are those that produce the best or optimise the consequences of choices, whereas unethical actions are those that do not contribute to the good.

Table 2 presents the normative principles extracted from Deontological theories.

Table 2: Deontological normative principles

Deontology Duty Based Ethics [23]	Deontology Rights Based Ethics [14, 24]
One ought to	The right to
.. keep promises (fidelity)	..know
..Right the wrongs that one has inflicted on others (reparation)	..Privacy
..Distribute goods justly (justice)	..Property
..Improve the lot of others with respect to virtue, intelligence, and happiness (beneficence)	..Security
..Improve oneself with respect to virtue and intelligence (self-improvement)	..Political participation
..Exhibit gratitude when appropriate (gratitude)	..Freedom of expression
..Avoid injury to others (non- injury)	..Freedom of association
	..Not to be discriminated against
	..Fair access to, and development of, communication resources
	..Protection of cultural identity

Three philosophies under the umbrella of Teleology are: **Ethical Egoism** (moral agents ought to do what is in their own self-interest); **Utilitarianism** (operating in the public interest rather than for personal benefit; maximises benefits over costs for all involved, everyone counting equal); and **Altruism** (in benefit for others, even at a cost to yourself) [14].

The deontological normative principles in Table 2, along with the three Teleological approaches, will be used to help substantiate the ethical duties that are advocated by this paper. By fulfilling these responsibilities, we can help education, in this crisis brought about by the COVID-19 pandemic, to address the issues of accessibility, affordability, flexibility, life-long learning, learning pedagogy, and to have educational policy and law that is truly imbued with the concepts of humanity and unity.

4.0 Ethical Normative Principles

Seven duties are suggested below, which, if followed, are likely to lead to ethical design, development and deployment of eLearning. Each rule of thumb is substantiated by citing one or a number of the ethical normative principles, listed in Section 3 above. Often there is a lack of relevant knowledge or inexperience of users regarding the deployment and engagement with eLearning. It is the design/developer/deployer professional's duty to instruct in such circumstances.

Table 3: Seven duties leading to ethical design, development and deployment of eLearning

Ethical Duty		**Normative Principle**
1.	Learning materials need to be made more accessible to learners with disabilities. [17]. **Duty**-Develop Online eLearning Content compliant with Web Content Accessibility (WCAG) 2.1 Guidelines [25]	+Justice, Beneficence & Non-injury. +The right not to be discriminated against & fair access to, and development of, communication resources. +Utilitarianism.
2.	**Duty**-An employer, as the same health and safety responsibilities for home workers as for on-site workers with particular focus on [26]. -Lone working without supervision -Working with Display Screen Equipment -Stress & Mental Health.	+Fidelity, Beneficence & Non-injury. +The right not to be discriminated against & fair access to, and development of, communication resources. +Utilitarianism.
3.	Some parents, e.g., parents of immigrant and refugee students, may not be able to support their children with home-schooling due to their lack of proficiency in the language of instruction [17]. **Duty**-Develop and make available online multi-lingual learning resources.	+Justice, Beneficence & Non-injury. +The right to know; not to be discriminated against; and to fair access to, and development of, communication resources +Utilitarianism
4.	Learning must meet the socio-emotional needs of the learner via the importance of play [17]. **Duty**-Provide social activities, such as virtual games and reading buddies, via online learning platforms.	+Beneficence and Non-injury +Utilitarianism
5.	Online learning provider must support mental and psychological needs of learners. **Duty**-eLearning portals must provide contacts to counselling, health and psychological services.	+Beneficence and Non-injury +Utilitarianism
6.	As the level of poverty increases in the community, the rate of internet accessibilities declined rapidly [27]. **Duty**-educational provider must offer vouchers for free/discounted broadband connection.	+Justice, Beneficence & Non-injury. +The right not to be discriminated against; and to fair access to, and development of, communication resources +Utilitarianism
7.	Pandemic emphasizes need for digital literacy education [17]. **Duty**- Call on agencies to equip people (students, teachers and parents, grandparents) with digital skills. E.g., the British Computer Society (BCS) Essential Digital Skills Qualifications [28].	+Justice, Beneficence & Non-injury. +The right to know; and to fair access to, and development of, communication resources +Utilitarianism

5.0 Conclusions

The objective of applying the ethical framework presented in this paper was to identify and defend ethical stances that can, and should be, taken into account in the design, development and deployment of eLearning in a pandemic. In so doing, the importance of ethical considerations concerning online education in a COVID-19 world can be brought to the attention of various stakeholders, decisions makers and the wider society; thus, helping to raise the visibility and applicability of sensible, realistic, and actionable ethical principles in use.

This paper contributes to the current ethical and philosophical discourse relating to online education in a pandemic. In particular, a set of ethical duties has been proposed which, in turn, will raise the awareness of the ethical issues, and help as a practical guide for designers, developers and end-users of eLearning. For some of these suggested ethical duties UK law applies (e.g., Equality laws, Health & Safety at Work legislations) and leads directly to the appropriate ethical conclusion(s). But to rely solely on law as a moral guideline is dangerous because it may lead to occasions where individuals fail to accomplish their ethical responsibility.

The focus of this paper was limited to looking at the issues of Quality of Life, Use of Power and Equity and Access in the development and deployment of eLearning in this pandemic. Further work could look at broadening the focus to encompass the issues of Risks and Reliability, Property Rights and Privacy.

There is a need to fight for social justice in our response to deploying eLearning in this pandemic. To engage in this battle we need, as a society, to produce more responsible ICT/educational professionals and citizens in general to think of, be more conscious of, a broader picture that reveals the social, ethical, legal and cultural context of Education and Technology. It is a false notion to think that solely technology can pave the road to prosperity because our vision of a technological utopia is driven by ignorance and/or flawed assumptions about race, class, and gender [29]. We, as a society need to understand the complexities of the realities of the have-nots in a pandemic. Decision makers need to be aware that simple access to a computer with broadband access (which in any case is a prerequisite) does not, in itself, endow empowerment, bring justice, or improve quality of life for the have-nots.

6.0 References

1. World Health Organisation (2020). WHO Director-General's opening remarks at the media briefing on COVID-19 - 11 March 2020, Available from the World Health Organisation, at https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020 [date accessed: 28th June 2021].
2. Institute for Government (2021). Timeline of UK coronavirus lockdowns, March 2020 to March 2021, Available from IfG, at

https://www.instituteforgovernment.org.uk/sites/default/files/timeline-lockdown-web.pdf [date accessed: 28th June 2021].
3. Singh, V. and Thurman, A. (2019). How Many Ways Can We Define Online Learning? A Systematic Literature Review of Definitions of Online Learning (1988-2018), American Journal of Distance Education, 33:4, 289-306, DOI: 10.1080/08923647.2019.1663082.
4. Yang, K.C.C. and Kang, Y. (2020). What Can College Teachers Learn From Students' Experiential Narratives in Hybrid Courses?: A Text Mining Method of Longitudinal Data, in Theoretical and Practical Approaches to Innovation in Higher Education, IGI Global, DOI: 10.4018/978-1-7998-1662-1.ch006.
5. Haynes, A.S. (2020). UDL in Action: Implementing Strategies in a Large Online Course, in UXD and UCD Approaches for Accessible Education, IGI Global, DOI: 10.4018/978-1-7998-2325-4.ch004.
6. Rao, N.V. and Rao, P.D. (2020). Online Learning in Education Sector Revealing the Benefits and Challenges, EPRA International Journal of Environmental Economics, Commerce and Educational Management, Vol.7(2), pp 20-23, DOI: 10.36713/epra0414.
7. Bailey, D.R. and Lee, A.R. (2020). Learning from Experience in the Midst of COVID-19: Benefits, Challenges, and Strategies in Online Teaching, Computer-Assisted Language Learning Electronic Journal, Vol. 21(2), pp. 176-196.
8. United Nations (1948). Universal Declaration of Human Rights, Available from United Nations, at: https://www.un.org/en/about-us/universal-declaration-of-human-rights [date accessed: 29th June 2021].
9. UNESCO (2021). What you need to know about the right to Education, Available from UNESCO at: https://en.unesco.org/news/what-you-need-know-about-right-education [date accessed: 29th June 2021].
10. Human Rights Watch (2021). "Years Don't Wait for Them" Increased Inequalities in Children's Right to Education Due to the Covid-19 Pandemic, Available from HRW at: https://www.hrw.org/report/2021/05/17/years-dont-wait-them/increased-inequalities-childrens-right-education-due-covid [date accessed 29th June 2021].
11. Legisaltion.gov.uk (2021). Education Act 1996, Available from the National Archives, at: https://www.legislation.gov.uk/ukpga/1996/56/contents [date accessed: 30th June 2021].
12. The Gazette (2020). Coronavirus - Temporary continuity directions etc: education, training and childcare, The Coronavirus Act, 2020, Provisions of Remote Education (England) Temporary Continuity Direction, Available from The Gazette Official Public Record, at: https://www.thegazette.co.uk/notice/3642261 [date accessed: 30th June 2021].
13. Johnson, D. (1995) Computers, ethics and social values New Jersey: Prentice-Hall Inc.
14. Kallman, E.A. and Grillo, J.P. (1996) Ethical Decision Making and Information Technology: An Introduction with Cases, New York: McGraw-Hill Inc.
15. Spinello, R. (2013) Cyber ethics: Morality and Law in Cyberspace, Jones and Bartlett Publishers, Inc; 5th Revised edition

16. Huff, C., Anderson, R.E., Little, J.C., Johnson, D., Kling, R., Martin, C.D. and Miller, K. (1995). Integrating the ethical and social context of computing into the CS curriculum. An Interim Report from the Content Subcommittee of the Impact CS Steering Committee. In Proceedings of ETHICOMP 95: An International Conference on the Ethical Issues of Using Information Technology, Leicester UK, 28-30 March 1995, Vol. 2, pp. 1-19
17. OECD (2020). The impact of COVID-19 on student equity and inclusion: Supporting vulnerable students during school closures and school re-openings, Available from OECD at: https://www.oecd.org/coronavirus/policy-responses/the-impact-of-covid-19-on-student-equity-and-inclusion-supporting-vulnerable-students-during-school-closures-and-school-re-openings-d593b5c8/ [date accessed: 2nd July 2021].
18. Reimers, F. and Schleicher, A. (2020). A Framework to Guide the Educational Responses to the COVID-19 Pandemic of 2020, OECD.
19. Lucas, M., Nelson, J. and Sims, D. (2020). Schools' responses to Covid-19: pupil engagement in remote learning, Available from National Foundation for Educational Research, at: https://www.nfer.ac.uk/schools-responses-to-covid-19-pupil-engagement-in-remote-learning/ [date accessed: 2nd July 2021].
20. OECD (2020). Learning remotely when schools close: How well are students and schools prepared? Insights from PISA, Tackling Coronavirus (COVID-19): Contributing to a Global Effort, OECD.
21. Mancinelli, E. (2007). e-Inclusion in the Information Society, Network for Teaching Information Society.
22. Whitney, G., Keith, S., Bühler, C. B. Hewer, S., Lhotska, L., Miesenberger, K., Sandnes, S., Frode E., Stephanidis, C. and Velasco, C. A. (2011). Twenty-five years of training and education in ICT Design for All and Assistive Technology. Technology and Disability, 23 (3). pp. 163-170. ISSN 1055-4181.
23. Ross W.D. (2002). The Right and the Good, Clarendon Press.
24. Hamelink, C.J. (2000). The Ethics of Cyberspace, Sage Publications Limited.
25. W3C (2018) Web Content Accessibility Guidelines (WCAG) 2.1, Available from W3C at: https://www.w3.org/TR/WCAG21/ [date accessed: 3rd July 2021].
26. HSE (2021). Protect Home Workers, Available from the Health and Safety Executive, at: https://www.hse.gov.uk/toolbox/workers/home.htm [date accessed: 4th July 2021].
27. Fishbane, L., & Tomer, A. (2020). *As classes move online during COVID-19, what are disconnected students to do?* Available from Brookings, at https://www.brookings.edu/blog/the-avenue/2020/03/20/as-classes-move-online-during-covid-19-what-are-disconnected-students-to-do/ [date accessed: 4th July 2021]
28. BCS (2021). Deliver our digital literacy qualifications, Available from the British Computer Society at: https://www.bcs.org/deliver-and-teach-qualifications/training-providers-and-adult-education-centres/deliver-our-digital-literacy-qualifications/ [date accessed: 4th July 2021].
29. Eubanks, V. (2011) Digital Dead End: Fighting for Social Justice in the Information Age, MIT Press, ISBN: 9780262014984

Decolonizing the Curriculum and Implementing Relevant Education in Africa Using E-Learning

James Uhomoibhi

Artificial Intelligence Research Centre
Faculty of Computing Engineering and the Built Environment
Ulster University, Shore Road, Newtownabbey Belfast, Co. Antrim, BT37 0QB
Northern Ireland, UNITED KINGDOM
j.uhomoibhi@ulster.ac.uk

Abstract

Education is the key to success for individuals and communities anywhere. In the current situation especially in this era of COVID-19 pandemic, education remains important for sustaining physical health and mental wellbeing for people and economic growth of society. With continuing and increasing digital divide, the questions remain, is the education curriculum in Africa relevant? What role is e-learning and how ready are the key players for implementing changes? Decolonizing the curriculum is a movement that started some twenty years ago aimed at ensuring the knowledge and practices of indigenous people were represented in education curricula of post-colonial countries. In recent times this has been reignited by students in South Africa and also in the University of London championed by National Union of Students demanding the placement of indigenous knowledge on equal footing with curriculum from outside. Decolonizing the curriculum provides all subjects opportunities to reconsider teaching matter. This includes who is teaching, what the subject matter is that is being taught and how it's being taught. This keynote lecture explores the origin and meaning of decolonizing the curriculum considering issues of diversification and inclusion. We report on technology in education, curriculum decolonization and the possibilities going forward. Africa is resource rich but has been assessed to be the poorest continent in the world. Access to and the use of education via e-learning as a tool remains vital for rebooting development and growth of communities with a view to promoting knowledge acquisition and economic growth. We report on the philosophy, structure and mode of delivery of education in Africa. We

touch on the influence of culture, history and role of e-learning in ensuring transition from being closed to being an open society and also in facilitating access-on-the-move to people and resources outside Africa. In the light of the recently launched United Nations Sustainable Development Goals, we examine issues of sustainability and rebooting the future. This paper concludes that decolonizing the curriculum requires radical change. There are critical questions to be answered and key factors to be considered if it is to be implemented successfully. E-Learning has and continues to be an important vehicle and a tool that has potential to create the necessary change to achieve success. This does however require all sectors and practitioners to work together at all levels.

Keywords: decolonizing curriculum, e-Learning, sustainable development goals, relevant education, Africa

1.0 Introduction

Education remains a force for good. It provides the key to success in all spheres of life. In the International Covenant on Economic, Social and Cultural Rights (ICESCR) in Africa, the right to education is protected by a collection of international, national and regional legislation [1]. The Committee on Economic, Social and Cultural Rights (CESCR), defines education as a means of attainment of all other rights which should reflect a balance between promoting the physical, mental, spiritual and emotional aspects and the intellectual, social and practical dimensions of education. [2, 3]. An educated person is able to take control of their life and contribute to the development of their state.

Africa is home to diverse sources of natural energy (solar, wind, waves, geothermal, oil and gas), and other forms of natural mineral resources.

Despite having access to this wealth of energy sources, the continent is still referred to as the 'Dark Continent' with little or virtually not enough power for electricity, water, communication and other infrastructures necessary for economic development and sustained growth.

Most developing countries including Nigeria have no well-established e-waste management system for re-cycling of obsolete electrical and electronics products.

The volume of used electronics is large and growing – a consequence of a consumerist society, whose education seems to be based on meeting the needs of the society where it is being provided.

1.1 Decolonizing the Curriculum and Effects of Colonialism

The effects of colonialism has been reported as human disaster, one whose dimension and destructiveness and cataclysm shook Africa to the core tearing the thread of cultural and historical continuity savagely apart into two that henceforward

no one ever thinks of one but two Africa, namely the one before and the one after the holocaust [4].

Decolonization seeks to find the truth about Africa, its culture and its values and its education. Education has to do with control of knowledge. Now the knowledge of Africa seems to be based on three main systems of anthropological science, colonial politics and the 'civilizing mission' [5].

2.0 Education Curriculum and Global Development

In considering the important role of education we examine the role it has played in developed nations such as Singapore, the school's system and the types of curriculum being implemented, be it the colonial curriculum or a decolonized (inclusive) curriculum. This leads to the question: Is the School system and the curriculum in use in Africa outdated? To answer this question, we examine the meaning of education curriculum and distinguishing between the types.

For the purpose of this paper, we see the curriculum as a framework for distribution of knowledge, which should be aligned with notions of diversity and accuracy. The colonial curriculum is characterized by its unrepresentative, inaccessible, and privileged nature. It has exclusionary and depreciatory tendencies. It fails to provide truthful knowledge and discourages many others from engagement with what is on offer through carefully devised means.
The problems associated with this type of curriculum include psychological, educational and societal ramifications, that can transcend beyond the academic environment, a lack of representative teaching which links to feelings of isolation and disconnect amongst staff and student bodies and a highly visible Black Asian and Minority Ethnic attainment gaps with low satisfaction rates tied to mental health issues, and alienation of individuals and groups. It is worth noting that the knowledge produced and access in education irrespective of the type of curriculum used, impacts the way in which students go on to successfully dismantle or uphold, legitimize or reject toxic social and political practices.

The Decolonised (Inclusive) Curriculum considers amongst others the broader diversity of all characteristics such as ethnicity, race. It has an inclusive curriculum framework which amongst others, creates an accessible curriculum, enables students to see themselves and their backgrounds reflected in the curriculum and equips students with the skills to positively work in a global and diverse world. The results and benefits of implementing this inclusive curriculum include improvements of the experience, skills and attainment of all students irrespective of background that are able to participate fully and achieve learning targets at equal rates as well as a reflection of the cultural and social backgrounds of all students and helps students with access to shared knowledge, improve reflective practice and collaborative learning. Decolonising curriculum and delivery informed by other pedagogical practices from around the world is key to achieving this.

2.1 The World Today and Africa

There is an acknowledgement all over the world today of - success and achievement of personalities, the diversity in languages, culture, explore the challenges, examine opportunities and outline possibilities and role of education in rebooting the future taking cognisance of different careers and professions in our society following rapid advancements in technology enable through education.
In the course of this year, 2021, which marks the beginning of the 3rd decade of this 21st century, we see technology and especially E-Learning as a tool that has helped to meet challenges brought about by unforeseen circumstances, be they natural or man-made disasters as well as global health (COVID-19) pandemic. We now live in an era of globalisation. The world has been made small – easy to see, hear, communicate and interact. The mobile phone, internet (web) makes us all equal players on global stage.
However, there is the big challenge of "digital divide", the "digital literates" and those who are not. We have a choice to be either passive or active in life. We either stand aside and watch or take part, join in and play your role.

2.2 Some Key Questions

In addressing issues raised in this paper we identify some key questions to which answers must be sought. They include

- What is education, culture and technology?
- As a person of African descent in Northern Ireland, from where have we come and where are we going?
    - - An historical excursus
- What role and potential has Education, technology especially computing and IT on society?
    - Transition from being closed to being open
    - Access-on-the-move to people and resources inside and outside Africa
    - How is the future being rebooted?
- What makes for sustainable development whilst ensuring viable continuing personal and professional development and economic growth in the face of current globalisation for people of African descent in Northern Ireland?

Education is systematic training and instruction (especially of the young, in school, college, etc.). It is knowledge and abilities, development of character and mental powers, resulting from such training. In developing this further it is vital to distinguish between education and schooling. Culture is advanced development of the human powers; development of the body, mind and spirit by training and experience. It is evidence of intellectual development (of arts, science, etc.) in human society. Culture is a state of intellectual development among a people; particular form of intellectual development. It is an embodiment of all the arts, beliefs, social institutions, etc., characteristics of a community, race, etc. Technology is defined as the study, mastery and utilization of manufacturing and industrial methods; systematic application of knowledge to practical tasks in industry (work and home).

2.3 Africa – Position, Population and Resources

Africa is the world's second largest and second most populous continent, after Asia. About 30.37 million km² (11.7 million sq mi) including adjacent islands, it covers 6% of the Earth's total surface area and 20.4% of the total land area. With about 1 billion plus people (as of 2009) in 54 countries, Africa accounts for about 14.72% of the world's human population. Africa is a resource-rich continent but all its countries are still classified today as developing nations or emerging economies. To put it in in context, Africa is bigger than the USA, Canada and India combined in terms of land or space.

In terms of percentage of world's natural resources, Africa is home to 60% Arable land, 90% Raw material reserve, 40% Gold reserve, 33% Diamond reserve, 95% Platinum reserve. It has manganese, iron, wood, uranium, copper, crude oil etc., yet Africa is seen and continuously labelled the 'poorest' continent in the world.

3.0 Education and Development

Education has a monumental role to play in the development and sustenance of people and society. Higher education institutions (HEIs) play important role in the development of nations and regions around the world. They are the core actors for knowledge creation and the training of new experts. HEIs are responsible for the production of new human capital by amount of talents, building up social capital, human connections and interactions and they affect the cultural life and enrich the quality of the city and society.

3.1 Cognition and Tools: Internet and e-Learning as Tools

The advent of new technologies have seen the use of new technologies in education. This has involved the integration of media types (text, images, video, animations), use of hyperlinks for content navigation and increased level of interactivity with feedback mechanisms between content producer and consumer. This has the advantage of serving as an external memory. Some identified disadvantages are exponential growth in the amount of data and its complex, fast rate of technological development.

There have been changes in work relating to operations and tools. We see automation and massive outsourcing of work to different regions of the world. Information has become abundant and cheap. We are now in a conceptual age with valuation of intuition, creativity, empathy, and artistic thinking. The advent of Web 2.0 has resulted in use of collaborative tools for unleashing creativity at large. Human interaction management has become important, and filters are being put in place to augment people's ability to navigate through their daily problem spaces. In education, there is redistribution of priorities. Given the change in cognition and working skill demand, learning objectives are changing and all domains in the Bloom's model are affected. In the cognitive domain, application and analysis have become more important than remembering. In the affective domain, empathy and

sensitivity have become more crucial when working inter-culturally and in the psychomotor domain there is the focus on learning to use IT and improving verbal communication.

4. Education Curriculum in Africa – Current Perceptions and Relevance

There is a growing concern amongst practitioners, researchers, public bodies and businesses in Africa about the education curriculum being delivered in Africa. Research reports that sub-Saharan African states are comparatively behind other regions in the provision of education [6]. In 2012 sub-Saharan Africa had the lowest regional gross enrolment ratio – 20%. The ratio for North America and Western Europe were 89% and for Central Asia it was 33%. The highest regional number of students not in school in sub-Sahara Africa (approximately 30,000) is almost 3 times that of Asian region. Also, the provision of early childcare education in sub-Sahara Africa stands at 20% compared to 74% in Latin America. All of these are in addition to challenges of high child-marriage rates, adult illiteracy, poverty and political instability and unrest [7, 8, 9, 10, 11, 12].

New approaches are being developed for implementation. Some these include the use of collaborative cross-cultural project work, which involves learning across continents, cultures, languages, time-zones; application of situation-based understanding & analysis of information, that involves disassembling of problems with no initial solutions; right through to the use of visualization and presentation of data, which consist of the ability to make creative and interactive presentations of complex data to increase understanding, for example, Gapminder.

In the light of challenges of the present tomes in relation to sustainability and development, it is understood that a functioning society and business depends on a series of complex infrastructure networks, providing our cities and towns with clean water, transport, energy and the capacity to trade efficiently. An effective economic recovery and sustainable development will also depend on extending infrastructure to those in the world who have been left behind in the past 50 years and who will be exposed to even greater threats in the next 50 years. The issues of importance centres on poverty, climate change and family. This requires focus on first, engineering the poor out of the dark shadows cast by world poverty and the misery it generates. Secondly, engineering the world away from the equally long shadows thrown by an energy and environmental crisis and with global climate at a tipping point. Thirdly and finally on enabling and empowering the family unit to be able to stand, support and exist, supporting self and others.

The world today finds itself slipping into environmental catastrophe with 1 billion without access to safe water, 1.6 billion without electricity, 2.5 billion without safe sanitation, 1 billion without telephone services and 1 billion without all-weather roads. In terms of population and urbanization, the world population is becoming more urbanized (60% by 2025), with the greatest effect in lesser developed

countries. In 2003, the world population was or the order of 5 billion, the split being 3 billion (rural), 2 billion (urban). It is estimated that by 2025 this will increase to 6.6 billion with a split of 3 billion (rural) and 3.5 billion (urban) with the urban growth being a combination of endogenous growth and rural migration. The belief is that most of the population of the future will be accommodated in urban slums that would result in increased poverty, consequent loss of taxation, contribution to costs of infrastructure provision, marginalization and lack of trust in institutions. This would call for a need to rebuild trust, vital partnership and land reform.

5.0 Developing and Rebooting the Future

In the effort to develop and reboot a future for everyone worldwide it is important to realize and not that we are never free and secure until those around us are free and secure. The People of the world cannot be free until Africa and the rest of poor nations in the world are free. There is hope. The future is bright. Education as a fundamental human right and as a process provides the firm ground on which to stand and claim the freedom, working with one another to serve humanity and the world. We must stop competing with one another but instead go out of our way to support each other globally. We must unlearn the bad habits we have been taught and learn and practice the good habit of helping one another. A light exists and shines not for itself but for others to see. Humans are the lights of the world; education is the vehicle and e-learning the fuel. The future of Africa in the world is a promising one, a great and bright future.

5.1 Reaching Out to Africa – Access to Energy and Water Resources

The prerequisites for development are reasonable governance structures, A functioning civil society, an effective local economy and freedom from persecution, conflict and corruption. Monique Barbut, of UNEP affirmed that to help Africa meet its development needs the continent needs energy. The African economies cannot develop without access to ample, reliable, and affordable energy. Lack of energy security feeds into a cycle of poverty. The current challenge is that 60% of Africa's population lack access to electricity. This is about the same percentage that have no access to a reliable clean water supply. In the case of access to water, two billion people worldwide still lack safe drinking water. About 5,000 children still die every day from water-related diseases, The contrasts between the developed and developing worlds could not be starker.

5.2 The Education Curriculum and Contents

The current situation clearly indicates that it is time we concentrate on education and the decolonized curriculum in all subject areas at all levels (primary, secondary, further and higher) of education. There is the need to recognize the needs, desires, aspirations, expectations and plan for a sustainable future. Some of the questions requiring answers include, (i) Have you got the freedom, the time and resources to use now and in the future? And (ii) Are you networked and communicating with one

another to keep your communities, state and the society here and abroad alive and kicking well?

The sustainable development goals (SDGs) need the delivery of effective infrastructure There is the issues of disparity, inequity, and environment justice with communities, within and between countries, across continents and lifestyles be it the case of urban versus rural or artisan versus professional. The present state we find ourselves in the world is one of having to deal with COVID-19 pandemic, climate change and a global economic recession. The challenges of the 21st century described by Prof John Beddington, Chief Scientific Adviser of the UK Government as "the perfect storm" include urbanization, population, food security, poverty alleviation, energy demand, climate change, water demand, counterterrorism, infectious diseases and biodiversity. This has led to the development of a global agenda for the Institute of Civil Engineering that addresses 4 headline issues of (i) education, training and mobilizing the youth through harnessing their energy and commitment, (ii) developing appropriate structures in the industry via capacity building, (iii) putting in place appropriate and equitable standards be they technical, ethical and contractual and (iv) addressing high level issues by focusing on outcomes, upscaling and building effective cross-sector partnerships.

5.3 Sustainable Development and the Education Process

Both the content and the process should be given in-depth consideration. Not shoving more materials into the content is important as well as pulling relevant into the process. Issue of assessment and staff development and guidance are important for the higher education and professional development process. The problems facing Africa as emerging economy include climate change, lack of affordable and sustainable electrical energy, lack of investment in technology, insufficient capital resources, high unemployment rate, lack of enough skilled personnel, poor technology, poor educational system, poor health facilities, poor agricultural methods and lack of sustainable economic growth. At the same time we note the positive impact of information and communication technology (ICT) in developed or advanced countries on economic growth, education, transport, agriculture, banking system, industry, communication, employment, health and entertainment. There is huge potential for use of technology for development. This can be realized if barriers are removed. Some of the constraints facing technology use and implementation in Africa include lack of proper policies and strategies, high cost of the technology, inadequate and unevenly distributed infrastructure, local content and language barrier, lack of private sector involvement in designing ICTs suitable for poor people, lack of human resource capacity, poor import tax regulations, lack of sustainability and lack of adequate, reliable and affordable electricity.

Collaboration between education, business and society should be encouraged. Cultural integration paves way for progress and success in society. Education institutions, communities and business organisations should strive to understand the relationship between world of work, community life and the world of learning. This calls for cultural education and acquisition of skills to engage with and use technology for improvement of life and society. Efforts should be directed at the

process dynamics to identify the challenges and gaps for bridging as well as, the effect and power of the settings, policies and development for employment, education and culture.

5.4 Skills Development of Future Workforce

We suggest that institutions, business and voluntary organisations (such as ACSONI) and the public should work in partnership to develop and deliver a well rounded package of education to equip the present generation and workforce of today and the future with the necessary knowledge and skills required to engage successfully with the world of work and the local and global society .
Investments in the development, training and use of e-learning and associated technology resources for all sectors of society (public, private and voluntary).

Globalisation and life of the 21st century dictate that a variety of skill is required for any given work such as the use of computer mediated communication tools and associated techniques as well as the ability to apply a combination of the traditional processes in the workplace.
There are so many factors that are important ingredients in learning. Some of these include language, students' relation to the dominant culture and motivational state of the learner.
The structuring of knowledge; the role of social interaction; mediating experiences and devices and the institutional meaning attached to learning.
There are instances where the culture of learning may differ. The problem of defining the difference remains crucial and vital to be resolved.

5.5 Education, Culture and Globalisation

Learning can be perceived as a cultural practice, a process, for which tools are required to analyse and understand. Globalisation has had a firm influence on how universities in different countries are packaging learning and on how businesses are taking decisions on what skills they require and how well what work is done. All of these go to facilitate economic growth which over the past few years have been seen to be experiencing some difficulties.

Mixed reality technology has made communication beyond space (location), time and language possible. The mixed augmented and virtual (MAV) reality research laboratory, www.ulster.ac.uk/mavrlab, has been set up as a joint UK/European initiative, for developing and implementing next generation teaching, learning and research applications.

6.0 Conclusion and the Future

To conclude, there is a plethora of issues to consider from the point of view of history, politics, geography, economics etc. knowledge is not confined to one place, time or group of people. It is important to recognize that Knowledge is fluid. In order to transcend epistemological blindness, 'we must not define and confine Africa a priori, racially, geographically or otherwise [13, 14, 15, 16, 17, 18, 19, 20]. Doing so would result in denial of its previous history [21, 22, 23, 24, 25].

We note that education, culture and technology with particular reference to e-learning have impacted society in various ways. Individuals and organizations' knowledge and skills for engaging and interacting with others are crucial for progress in any community/society. The written and oral tradition cultures are different approaches to education, be this the western or the African traditional education, which today technology has helped to highlight.
The drive for sustainable development by people and society can be achieved if education, culture and technology are correctly engineered, understood and applied to improve life and community. There must be engagement at all level and by all authorities with decolonization of curriculum in education. The challenges of racism must be addressed, it must be tackled head-on and resolved. This would allow a focus on issues of development and progress.

E-Learning is shown to be a solution waiting for problems even in times of emergencies such as the current COVID-19 pandemic. However digital divide is an area of concern that must be dealt with by relevant authorities if its full potential is to be realized. The future of Africa is bright. Education could be used as a vehicle for rebooting the future, for reaching the goals and attaining individual and community success and growth.

Decolonizing the curriculum to some may be inspiring or irritating. To many, it brings about the difficult issue of racism and the fragility associated with perception of human as either 'white' or 'black'. For academics and indeed everyone in education, it is important at all times to question what we know and how we know what we know. Conversely, we must also question what we do not know and why we do not know what we do not know. This requires radical change. In particular, it requires academia to face up to and confront the discomfort of selected class privilege to radically rethink what constitutes 'knowledge'. Getting more African scholars into academia and working with them is critical. Working together as one we can aspire and to inspire, we can successfully work to achieve decolonized curriculum that is inclusive that would lead to the provision of useful education for all.

7.0 References

1 CESCR General Comment No 13: The Right to Education (Article 13), 8 December 1999, E/C12/1999/10; Fons Coomans, 'Clarifying the Core Elements of the Right to Education' (1988) 10 Framework 215.
2 UN Committee on the Rights of the Child, General Comment No 1 (2001), Article 29(1): The Aims of Education, CRC/GC/2001/1, para 12.
3 Beiter, Klaus D, The Protection of the Right to Education by International Law (Brill 2005) 56.
4 Van Sertima, Ivan, Black Women in Antiquity (Transaction Books 1984) 8.
5 Mudimbe, Invention of Africa (n 21) 14–36; Nyamnjoh (n 5) 130.

6 UNESCO, 'Education for All 2000–2015: Achievements and Challenges' (UNESCO 2015), (accessed 2/7/2021) http://unesdoc.unesco.org/images/0023/002322/232205e.pdf.
7 Watkins, Kevin, 'Too Little Access, not Enough Learning: Africa's Twin Deficit in Education' in This is Africa Special Report, Access+: Towards a post-MDG Development Agenda on Education (2013) www.brookings.edu/research/opinions/2013/01/16-africa-learning-watkins. (accessed 2/7/2021)
8 Mama, Amina, 'Is It Ethical to Study Africa? Preliminary Thoughts on Scholarship and Freedom' (2007) 50(1) African Studies Review 22;
9 Africa-America Institute, State of Education in Africa Report 2015: Overview of the State of Education in Africa – Early Childhood, Primary and Secondary Education, Vocational and Technical Training, and Higher Education (2015) 6–11: (accessed 2/7/2021) <www.aaionline.org/wp-content/uploads/2015/09/AAI-SOE-report-2015-final.pdf>.
10 Van Fleet, Justin W, K Watkins and L Greubel, 'Africa Learning Barometer' (2012) 1–14: (accessed 2/7/2021) www.brookings.edu/~/media/events/2012/9/17-africa-learning/africa-learning-barometerfinal.pdf.
11 Ambrose, Brendalyn P, Democratization and the Protection of Human Rights in Africa: Problems and Prospects (Greenwood Publishing Group 1995) 67.
12 Brock-Utne, Birgit and Malcolm Mercer, 'Languages of Instruction and the Question of Education Quality in Africa: A Post-2015 Challenge and the Work of CASAS' (2014) 44(4) Compare: A Journal of Comparative and International Education 677.
13 Nyamnjoh, Francis B, 'Blinded by Sight: Divining the Future of Anthropology in Africa' (2012) 47 Africa Spectrum 82.
14 Syrotinski, Michael, Deconstruction and the Postcolonial: At the Limits of Theory (Liverpool UP 2007) 68;
15 Abagi, Okwach, 'The Role of the School in Africa in the Twenty-First Century: Coping with Forces of Change' in Abdi and Cleghorn (n 5) 301;
16 Mudimbe, Valentin Y, The Invention of Africa: Prognosis, Philosophy and the Order of Knowledge (Indiana UP 1988);
17 Mudimbe, Valentin Yves, The Idea of Africa (Indiana UP 1994);
18 Mutua, Makau W, 'Savages, Victims, and Saviors: The Metaphor of Human Rights' (2001) 42(1) Harvard International Law Journal 201–45;
19 Fanon, Frantz and Constance Farrington, The Wretched of the Earth (Penguin Books 1963);
20 Wa Thiong'o, Ngugi, Decolonising the Mind: The Politics of Language in African Literature (East African Publishers 1994).
21 Hallen, Barry, A Short History of African Philosophy (Indiana UP 2009) 38;
22 Anghie, Antony, Imperialism, Sovereignty and the Making of International Law (CUP 2007) 253;
23 Hallen, Barry, The Good, the Bad, and the Beautiful: Discourse about Values in Yoruba Culture (Indiana UP 2000) 2, 50;

24 Francis B Nyamnjoh, '"Potted Plants in Greenhouses': A Critical Reflection on the Resilience of Colonial Education in Africa' (2012) 47(2) Journal of Asian and African Studies 136;
25 Edward Shizha, 'Reclaiming our Memories: The Education Dilemma in Postcolonial African School Curricula' in Ali A Abdi and Ailie Cleghorn (eds), Issues in African Education (Palgrave Macmillan 2005) 67.

Papers

A Gamified Augmented Reality Application for Improving Students' Engagement, Motivation and Knowledge Acquisition

Georgios Lampropoulos[1], Theofylaktos Anastasiadis[2], Kerstin Siakas[3]

[1, 3] Department of Information and Electronic Engineering,
International Hellenic University, Greece
Email: [1]lamprop.geo@gmail.com, [2]siaka@ihu.gr

[1] School of Humanities,
Hellenic Open University, Greece

[2] Department of Physical Education and Sport Science,
Aristotle University of Thessaloniki, Greece
Email: [2]filias@phed.auth.gr

[3] Department of Production – Industrial Management
University of Vaasa, Finland
Email: [3]ext-ksia@uwasa.fi

Abstract

The digitalisation of everyday life has influenced the way 21st century students access information and acquire knowledge. Consequently, students' educational requirements have drastically been modified. Augmented reality can be used as a means to satisfy these unprecedented needs. Moreover, the gamification approach when used in conjunction with augmented reality further enhances the educational benefits. This study presents a gamified augmented reality application which aims at increasing students' motivation, engagement, and knowledge acquisition. For its development process, a co-design approach was followed. According to the results, it was confirmed by both teachers and students that the application was easy to learn and use and increased students' motivation, immersion, and engagement in learning activities, making, thus, the overall learning experience intriguing, enjoyable and creative. Finally, it was observed that the educational process was more interactive, communicative, and engrossing for both teachers and students when the application was used.

Keywords: Augmented reality, Educational technology, Human-computer interaction, Technology-enhanced learning, Gamification, Cross reality

1.0 Introduction

Today's digital age has significantly affected the life and education of the new generation of students who now use Information and Communication Technologies (ICTs) on a daily basis. Moreover, the exponentially growing number of data created due to the rapid increase in sensor and machine-to-machine data [1], social media rising popularity and the constantly increasing amount of user generated content [2] have drastically affected the frequency and the way in which ICTs are used in everyday life [3]. It is an obvious fact that due to the rapid technological development, the educational system struggles to meet the new educational requirements of today's students [4], while simultaneously the need for basic education is becoming more and more intense [5]. In addition, nowadays, students develop and mature in modern and flexible communities using technology applications daily, hence they constantly handle digital information, seek to be directly connected, require prompt responses and social interaction and prefer experience-based learning [6]. Consequently, their educational needs for more effective and meaningful learning are becoming really demanding [7]. Moreover, in order for students to develop higher-order thinking skills, they should engage in more meaningful learning based on research and experience which will have real value both for them personally and their communities [8]. Therefore, the need to review and reform education is imperative.

The use of contemporary technologies and applications in education can contribute significantly towards this direction. Cross reality technology which includes hardware and software used to create virtual reality, augmented reality, mixed reality, and cinematic reality is gradually growing in popularity in the educational section. More specifically, augmented reality aims at creating a mixed reality in which both real and virtual objects co-exist by providing prompt access to rapidly flowing information which becomes meaningful and "alive" as it is embedded in the appropriate spatial and time framework [9]. Particularly, augmented reality refers to technological applications of computer units which offer new ways of interacting with both the physical and digital world and enrich users' physical environment with additional virtual objects which are perceived by the users through their senses [10]. Moreover, augmented reality enables users to interact with both the virtual and the real world in a seamless way which is a significant difference between it and virtual reality which fully immerses users in virtual environments [11].

In the light of the new educational requirements, new approaches such as gamification can be used in conjunction with cross reality to create more interactive, engaging, and motivating experiences. The gamification approach can be regarded as the specialised use and application of game design elements and game principles on topics and content that are not necessarily related to gaming. In particular, gamification concerns the application of game elements and mechanisms and experiences to non-game content in order to increase user motivation and engagement so that they can achieve their goals [12]. In this way, the processes look more like games and users who complete them are rewarded

accordingly. In order to increase the motivation for student involvement, gamification exploits people's desires for social prestige, achievement, competition and their need to be members of a social and inclusive community.

The aim of this study is to showcase how gamified augmented reality applications could improve the overall learning experience when used as an educational tool in a student-centred way. Therefore, this study goes over related work (Section 2) and presents an educational application which was developed with a view to increasing students' motivation and engagement as well as its development process which followed a co-design approach in Section 3. Furthermore, the results of the assessment regarding the usability and learnability are presented and analysed in Section 4. Finally, after discussing the main findings (Section 5), suggestions for future directions are provided (Section 6).

2.0 Related work

Many studies have showcased the benefits of using augmented reality applications in educational settings. More specifically, Billinghurst [12] and Lee [13] carried out studies in which they analysed the use of augmented reality and of tangible interfaces in education in detail as well as the positive impacts and benefits it can yield. Bower et al. [14] went over the use cases of augmented reality both in society and in education as well as the pedagogical potentials augmented reality offers. Additionally, Akçayır and Akçayır [15] and Chen [16] carried out systematic literature reviews regarding the augmented reality advantages and challenges when it is used in educational settings.

In their study, Wu et al. [17] analysed the challenges, opportunities, and current status of augmented reality in regard to its utilisation in education. Furthermore, they identified the key features and affordances of augmented reality systems and applications and presented instructional approaches. Finally, they suggested solutions to various challenges and highlighted that viewing augmented reality as a concept is more productive than viewing it as a technology. Furthermore, Hantono et al. [18] went over the use of augmented reality in education and conducted a meta-review analysis in order to highlight its developmental trends as well as some interesting and useful topics to be further explored.

Yuen et al. [19] provided an overview of the use of augmented reality in education. Moreover, they examined the recent developments of augmented reality, explored its impact on society and evaluated its implementations in teaching, learning and education in general. Additionally, Diegmann et al. [20] conducted a systematic literature review regarding the benefits yielded by the application of augmented reality in educational settings. Their study used the five directions indicated in [19] and came to the conclusion that each one is more likely to lead to certain benefits.

Radu [21] conducted a meta-review and cross-media analysis concerning the use and application of augmented reality. Furthermore, based on the analysis, a

heuristic questionnaire for evaluating the educational potential of augmented reality experiences was created and presented. Phon et al. [22] focused on the impact of collaborative augmented reality in education and conducted a literature review regarding its usage and potential applications in educational contexts.

3.0 Application Description

In order to fulfil and satisfy young pupils' educational needs and requirements and to design, customise and develop a gamified augmented reality application, it was of an utmost significance to involve pupils in the design process and comprehend their perspectives. Co-designing with pupils and students facilitates the comprehension of their needs and has a positive impact on designing collaborative learning experiences as they influence the final result in a positive and creative way [23, 24]. Consequently, we opted to utilize cooperative inquiry, which is a co-design approach suitable for pupils of young age [25]. Pupils, students and teachers were involved in the overall development process.

The Vuforia Software Development Kit (SDK) and Unity Editor were used to develop the specific application. In order for pupils to enjoy multimodal learning environments even by simply using low-end devices, the need for specialised equipment and software requirements was minimised. With a view to increasing flexibility and extensibility, the application was not designed to recognise a specific book or page but to recognise a specific fiducial marker which makes it easier to implement the application in various use cases besides a specific subject without requiring any further intervention.

In order to reinforce the overall education process, increase students' and pupils' engagement and motivation and improve their knowledge acquisition and comprehension of the concepts and subjects being taught, the particular application offers them the potential to fully interact with virtual three-dimensional (3D) objects and buttons which are not user interface elements of the actual application but exist only in the virtual environment. Students and pupils have the potential to create an immersive virtual environment in which they can interact, play, and collaborate with their peers while learning and creating new experiences.

More specifically, the aim of this application was to enhance pupils' understanding of the planets of our solar system by offering them an interactive virtual learning environment and providing them with useful dynamic information in a user-friendly way. As the application involved primary education pupils, the main attributes selected for its design and development were usability, learnability, fun, interactivity, accessibility, and simplicity. An example of this application is depicted in Figure 1.

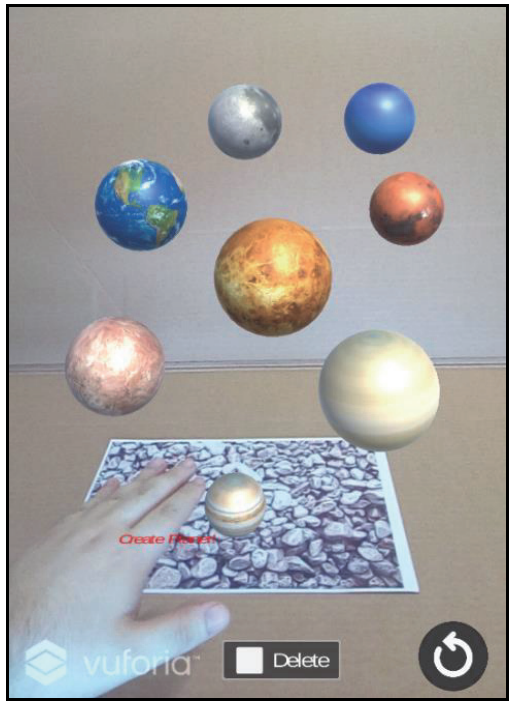


Figure 1: Gamified augmented reality application.

4.0 Application Assessment

Undoubtedly, learnability and usability are significant factors in every application even more so when the application is to be applied in educational settings and involves students of young age. Therefore, the evaluation of these specific factors can be considered as necessary. After being presented the application specific aims, characteristics and target group and having tested the application, twelve higher education students from the Department of Information and Electronic Engineering of International Hellenic University were asked to assess the application by filling in the System Usability Scale (SUS) questionnaire [26]. Table 1 presents the mean values and standard deviation of their responses while their responses are presented in Table 2.

Even though the SUS questionnaire is a robust and reliable assessment means, even for studies with a smaller number of participants, the small number of participants and their familiarity with modern technology and devices must be highlighted. The final SUS Score of the application was 81.7. Based on the results, the students regarded the application as a useful, functional simple and easy to learn tool which can be used successfully used in educational settings.

Table 1: SUS questionnaire - Mean Values and Standard Deviation

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Raw Score	SUS Score
Mean	3.5	1.6	4.4	1.4	3.8	1.6	4.6	1.4	3.8	1.4	32.7	81.7
Std.	0.7	0.7	0.7	0.5	0.9	0.7	0.7	0.5	0.8	0.5	2.5	6.3

Table 2: SUS questionnaire - Participants' Responses.

No.	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Raw Score	SUS Score
1	3	1	4	1	5	1	5	1	4	1	36	90.0
2	2	3	5	1	3	3	5	1	2	1	28	70.0
3	4	1	5	2	4	1	4	2	3	1	33	82.5
4	4	1	4	1	4	2	5	2	4	2	33	82.5
5	3	1	5	2	4	1	5	1	3	1	34	85.0
6	3	2	5	1	4	2	3	2	4	2	30	75.0
7	4	2	5	1	5	1	5	2	4	2	35	87.5
8	3	2	4	2	3	2	5	1	4	2	30	75.0
9	4	1	5	1	2	1	4	1	4	1	34	85.0
10	4	1	4	2	5	2	5	1	5	1	36	90.0
11	4	2	4	1	3	2	4	1	4	1	32	80.0
12	4	2	3	2	4	1	5	2	4	2	31	77.5

6.0 Discussion

With the aim of improving students' engagement, motivation and knowledge acquisition, a gamified augmented reality application was developed. The application focuses on Greek primary education pupils of sixth grade and the subject of Geography, the chapter "Our solar system" in particular. The specific chapter is overwhelmed with information that pupils have difficulty in visualising and comprehending without having any previous experience or knowledge of the topic. Therefore, the application provides students with 3D model representations which are fully interactive in the virtual environment and offer additional information for each case.

Augmented reality enables students to collaborate and communicate with their peers in real-time mixed reality environments [27] and to interact with real and virtual objects and as a result, it maximises students' learning experiences [28]. Moreover, the gamification approach affects students' behaviour and attitude towards learning and enhances their engagement and motivation [29] and when used properly, it is beneficial to both the instructor and the students [30]. Consequently, by using augmented reality and gamification, we focused on enriching the overall learning experience by increasing students' engagement and

motivation, improving their knowledge acquisition and retention as well as enhancing their critical thinking and their ability to better comprehend hard concepts.

The teachers who participated in the development process and tested the application with their pupils, stated that it was easy to learn and use the application and that they noticed that pupils were more motivated, immersed and engaged in learning activities when using the augmented reality application. Moreover, the pupils who took part found the application and the overall learning experience intriguing, enjoyable and creative. All in all, based on the sample tests which were conducted during the development process, it was observed that the teaching and learning process was more interactive, communicative, and engrossing for both teachers and pupils when the application was used.

7.0 Conclusion and Future work

With a view to showcasing how gamified augmented reality applications could improve the overall learning experience and enhance students' motivation, engagement and knowledge acquisition when used as an educational tool in a student-centred way, a gamified augmented reality application was presented. The development process followed a co-design approach and its usability and learnability were evaluated.

Based on the results, the application was easy to learn and use, increased students' motivation, immersion and engagement in learning activities and made the overall learning experience intriguing, enjoyable and creative. Finally, it was observed that the teaching and learning process was more interactive, communicative, and engrossing for teachers, pupils and students.

Future work will aim at improving this specific application and applying it in educational settings to assess its effectiveness and the kind of impact it has on the total learning experience. Furthermore, qualitative and quantitative studies in cross-cultural settings will be conducted so as to further comprehend how the educational community evaluates the use of augmented reality in education.

8.0 References

1. Lampropoulos, G., Siakas, K., & Anastasiadis, T. (2019). Internet of Things in the Context of Industry 4.0: An Overview. *International Journal of Entrepreneurial Knowledge, 7*(1), 4-19. doi: 10.2478/ijek-2019-0001
2. Makkonen, P., Lampropoulos, G., & Siakas, K. (2019, November). Security and privacy issues and concerns about the use of social networking services. *In E-Learn: World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education. Association for the Advancement of Computing in Education (AACE)*. New Orleans, Louisiana, US, pp. 457-466. https://www.learntechlib.org/primary/p/211113/

3. Lampropoulos, G., Siakas, K., & Anastasiadis, T. (2018). Internet of Things (IoT) in Industry: Contemporary Application Domains, Innovative Technologies and Intelligent Manufacturing. *International Journal of Advances in Scientific Research and Engineering, 4*(10), 109-118. doi: 10.31695/ijasre.2018.32910
4. Leadbeater, C. (2008). *What's Next?: 21 Ideas for 21st Century Learning*. Innovation Unit, 1-76.
5. Prensky, M. (2001). Digital natives, digital immigrants. *On the horizon*, *9*(5), 1-15.
6. Anastasiadis, T., Lampropoulos, G., & Siakas, K. (2018). Digital Game-based Learning and Serious Games in Education. *International Journal of Advances in Scientific Research and Engineering, 4*(12), 139-144.
7. Lampropoulos, G., Siakas, K., Makkonen, P., & Siakas, E. (2021). A 10-year longitudinal study of social media use in education. International Journal of Technology in Education (IJTE), 4(3), 373-398. doi: 10.46328/ijte.123
8. Scott, C.L. (2015). *The Futures of Learning 3: What kind of pedagogies for the 21st century?*. UNESCO Education Research and Foresight, 1-21.
9. Caudell, T. P., & Mizell, D. W. (1992). Augmented reality: An application of heads-up display technology to manual manufacturing processes. In *Hawaii international conference on system sciences* (pp. 659-669).
10. Lampropoulos, G., Keramopoulos, E., & Diamantaras, K. (2020). Enhancing the functionality of augmented reality using deep learning, semantic web and knowledge graphs: A review. *Visual Informatics, 4*(1), 32-42.
11. Zhou, F., Duh, H. B. L., & Billinghurst, M. (2008, September). Trends in augmented reality tracking, interaction and display: A review of ten years of ISMAR. In *2008 7th IEEE/ACM International Symposium on Mixed and Augmented Reality* (pp. 193-202). IEEE.
12. Hamari, J., Koivisto, J., & Sarsa, H. (2014, January). Does gamification work?--a literature review of empirical studies on gamification. *In 2014 47th Hawaii international conference on system sciences (pp. 3025-3034)*. Ieee.
13. Lee, K. (2012). Augmented reality in education and training. TechTrends, 56(2), 13-21.
14. Bower, M., Howe, C., McCredie, N., Robinson, A., & Grover, D. (2014). Augmented Reality in education–cases, places and potentials. Educational Media International, 51(1), 1-15.
15. Akçayır, M., & Akçayır, G. (2017). Advantages and challenges associated with augmented reality for education: A systematic review of the literature. Educational Research Review, 20, 1-11.
16. Chen, P., Liu, X., Cheng, W., & Huang, R. (2017). A review of using Augmented Reality in Education from 2011 to 2016. In Innovations in smart learning (pp. 13-18). Springer, Singapore.
17. Wu, H. K., Lee, S. W. Y., Chang, H. Y., & Liang, J. C. (2013). Current status, opportunities and challenges of augmented reality in education. *Computers & education*, *62*, 41-49.

18. Hantono, B. S., Nugroho, L. E., & Santosa, P. I. (2018, July). Meta-review of augmented reality in education. In *2018 10th international conference on information technology and electrical engineering (ICITEE)* (pp. 312-315). IEEE.
19. Yuen, S. C. Y., Yaoyuneyong, G., & Johnson, E. (2011). Augmented reality: An overview and five directions for AR in education. *Journal of Educational Technology Development and Exchange (JETDE)*, *4*(1), 11.
20. Diegmann, P., Schmidt-Kraepelin, M., Eynden, S., & Basten, D. (2015). Benefits of augmented reality in educational environments-a systematic literature review. *Benefits*, *3*(6), 1542-1556.
21. Radu, I. (2014). Augmented reality in education: a meta-review and cross-media analysis. *Personal and Ubiquitous Computing*, *18*(6), 1533-1543.
22. Phon, D. N. E., Ali, M. B., & Abd Halim, N. D. (2014, April). Collaborative augmented reality in education: A review. In *2014 International Conference on Teaching and Learning in Computing and Engineering* (pp. 78-83). IEEE.
23. Alhumaidan, H., Lo, K. P. Y., & Selby, A. (2015, November). Co-design of augmented reality book for collaborative learning experience in primary education. In *2015 SAI Intelligent Systems Conference (IntelliSys)* (pp. 427-430). IEEE.
24. Druin, A. (2002). The role of children in the design of new technology. *Behaviour and information technology*, *21*(1), 1-25.
25. Guha, M. L., Druin, A., & Fails, J. A. (2013). Cooperative Inquiry revisited: Reflections of the past and guidelines for the future of intergenerational co-design. International Journal of Child-Computer Interaction, 1(1), 14-23.
26. Brooke, J. (1996). Sus: a "quick and dirty" usability scale. *Usability evaluation in industry*, 189.
27. Lampropoulos, G., Georgiadou, I., Keramopoulos, E., & Siakas, K. (2020, July). An educational augmented reality application for improving knowledge acquisition. *In BCS Quality Specialist Group's Annual 25th International Conference on Software Process Improvement – Research into Education and Training (INSPIRE XXV) conference*, British Computer Society (BCS), UK, pp. 193-202.
28. Kesim, M., & Ozarslan, Y. (2012). Augmented reality in education: current technologies and the potential for education. *Procedia-social and behavioral sciences*, *47*, 297-302.
29. Kiryakova, G., Angelova, N., & Yordanova, L. (2014). Gamification in education. Proceedings of 9th International Balkan Education and Science Conference.
30. Huang, W. H. Y., & Soman, D. (2013). Gamification of education. *Report Series: Behavioural Economics in Action*, *29*.

Challenges and Prospects of Augmented Reality Learning Environment (ARLE): An Assessment of Applications, Recent Developments and Needs for STEM Education.

P. J. Van den Broek[1], J. O. Uhomoibhi[1,2,3], J. Liu[1,3], P. Joseph-Richard[4], D. Barr[5]

[1]Artificial Intelligence (AI) Research Centre, Ulster University, BT37 0QB, Northern Ireland, UK
Van_Den_Broek-P@ulster.ac.uk

[2]School of Engineering, Ulster University, BT37 0QB, Northern Ireland, UK
j.uhomoibhi@ulster.ac.uk

[3]School of Computing, Ulster University, BT37 0QB, Northern Ireland, UK
j.liu@ulster.ac.uk

[4]UU Business School, Ulster University, BT37 0QB, Northern Ireland, UK
p.joseph-richard@ulster.ac.uk

[5]School of Education, Ulster University, BT37 0QB, Northern Ireland, UK
jd.barr@ulster.ac.uk

Abstract

This concept work seeks to explore the challenges and prospects of enhanced Augmented Reality Learning Environment (ARLE), focused on Science, Technology, Engineering and Mathematics (STEM) education within Northern Ireland (NI) post primary education. Currently we are in a digitally transformative society driven by the Internet of Things (IoT) and Artificial Intelligence (AI), leading to continual evolutionary advancements in smart living. This includes smart education and the genesis of Smart Learning Environment (SLE). Augmented Reality (AR) is a key technology that has the capability to meet SLE requirements, providing contextual, any time, any place, self-directed and learner-centered learning experiences. By integrating data analytics, through AI, educational affordances, using AR, can be enhanced in an iterative way, leading to the development and deployment of a scalable, effective and more easily and widely accessible ARLE. Previous research into use of

ARLE in STEM subjects has generally been small scale, of short duration and singular in nature. There has been a lack of consistent, suitable and scalable platforms for the creation and hosting of customisable, and contextual AR applications in education. In response this concept work proposes an iterative, and cyclical methodological framework, for the deployment of a more encompassing and immersive ARLE, where pedagogically appropriate AR is deployed in a collaborative and constructive way with teachers as key stakeholders. The Unity 3-D game engine is proposed to be used to deploy AR applications, which will be hosted on currently existing online digital platforms. This is particularly apposite during a period of online distance learning at all levels, due to the ongoing COVID-19 pandemic.

Keywords:

Augmented Reality (AR), Augmented Reality Learning Environment (ARLE), Smart Learning Environment (SLE), Science Technology Engineering Maths (STEM), Internet of Things (IoT).

1.0 Introduction

"I believe that the integration of information technology in education will be further accelerated, and that online education will eventually become an integral component of school education." The words of Wang Tao, Vice President of Tencent Cloud and Tencent Education, as quoted by Li and Lalani [1], when weighing up the potential positive benefits that online and remote education can offer. This was in response to the sudden disruption in education worldwide caused by the ongoing global COVID-19 pandemic of 2020-2021, shifting education from physical and more traditional spaces to online and remote delivery. As Li & Lalani [1] pointed out the pandemic resulted in 1.2 billion children in 186 countries being affected by school closures by March 2020. Such closure of physical face to face education has been, and is, ongoing in many countries around the world. This has highlighted the importance of placing education within more relevant modern paradigms, as part of smart living, predicated on current and evolving industrial ages, with a greater focus on AI and the IoT.

If not yet in the Industrial Age 5.0, in which AI is becoming a bigger factor in analysing big data streams to improve efficiencies and outcomes in work, life and education [2], we are in the Industrial Age 4.0. This uses technology, founded on the IoT, to maximise efficiencies related to human activities through data management, systems, communications, and interactions [3]. The IoT is driving advances in smart working, living and education through the emergence of disruptive technologies, which when integrated into education are digitally transformative [5]. This can help catalyse, the identified necessary paradigm shift into SLE, facilitating interactions with education anytime and anyplace. Alongside this, a shift from more traditional, and still widespread, didactical rote learning pedagogies [6] to those that facilitate

development of critical 21st Century skills, including adaptability and problem solving can evolve.

AR is one such emergent and disruptive technology that has potentially powerful educational affordances. Effective use of AR, as part of well thought out and designed SLE, has the capability to provide contextual, any time any place, self-directed, student-centered collaborative situated learning experiences, particularly in the STEM domain. AR can also leverage a greater focus on identified critical 21st Century skills and personality growth necessary in today's transformative smart digital society [2]. This concept paper examines the challenges and prospects of integrating AR applications within SLE, leading to the genesis of ARLE, using a conceptual framework, to improve the educational affordances and efficiencies provided. To do this this, the following is explored:

- The affordances, challenges and limitations that AR applications hosted within SLE / ARLE as part of STEM education facilitate.
- The introduction of a conceptual framework for the development and deployment of a more collaborative, immersive and scalable ARLE.

2.0 Background

2.1 Developments – SLE: AR and the Genesis of ARLE

The world is now in the second wave of digitalisation in which AI, focusing on understanding and analysing data to improve outcomes, is playing an increasingly important role in smart living and education [2]. The increasing use of AI in education has the potential to favourably affect the teacher student relationship through better understanding of learners and more focused provision of personalised, or precise education [7]. As Holmes et al [8, p. 179] state:

"Whether we welcome it or not, AI is increasingly being used across education and learning contexts. We can either leave it to others—the computer scientists, AI engineers and big tech companies—to decide how artificial intelligence in education unfolds, or we can … adopt a critical stance, to help ensure that the introduction of AI into education reaches its potential and has positive outcomes for all. "

To maximise educational efficiencies and affordances as part of overall approaches to smart living, and smart education, SLE need to be deployed effectively. Smart education includes advanced learner profiling methods, development of active, self-directed, or learner-centered, responsible learning contexts through implementation of disruptive technologies, and the integration of mobile applications and analysis tools [9]. SLE are new educational constructions that involve "an efficient interplay of pedagogy, technology and their fusion towards the betterment of learning processes" [10, p. 1]. Modern SLE transcend space and time. Unconfined by physical walls they can be responsive to learners needs and contexts, in which social connections play a key role, facilitated by advances in technological applications. From this it can be argued that an overriding tenet of SLE involves human feelings and outcomes, as opposed to performance only, which has led to the genesis of

Human Artificial Intelligence (HAI) [11]. SLE, although dependent on technology and AI, need to be learner centered where human connections and interactions are vital constructs. Put another way SLE and the tools within them are participants in human intelligence which is distributed person to person and person to environment [12]. As Dron [12] argues, as well as being implicitly linked to collaborative and constructivist approaches, this is a key construct within connectivist pedagogies, which are leveraged by the increase in adjacent possibilities afforded by the internet. Connectivist pedagogies are premised on the argument that teaching and learning resides in humans and non-human structures and systems; learning involves creation and connection, not just construction; learning is both personal and social in nature, and; learning is enhanced through connections to larger networks [12]

AR is a key disruptive technological application that has the capability to facilitate SLE through use of mobile applications and analysis tools. Disruptive technologies evolve over time from a small base to disrupt and displace traditional practices [13]. Disruptive educational technologies displace, or augment, more formal and standardised educational paradigms traditionally used for knowledge construction [14,15]. AR which overlays augmented, or virtual, constructs onto the real world in 3-D [16, 17, 18, 19] is part of the virtuality continuum, which ranges from real to virtual environments [20]. AR lies between real and augmented virtuality. Due to the provision of flexible learning environments and effective tools that provide immersive multimodal environments enriched by multiple sensory features, learning can be enhanced, through exposure to AR applications [21] within an ARLE.

With the correct application of AR SLE, or ARLE, can be created that supply rich immersive teaching and learning experiences, thereby improving analysis, conceptualisation and collaboration skills dispersed across time and space [22, 23, 24]. Outcomes for learners can be improved through the creation of powerful situated learning experiences that facilitate collaboration and allow multiple perspectives to be examined that assist in students' motivation and learning [25]. Situated learning involves authentic contexts, activities and assessment eased by modeling, mentoring and peripheral participation [25]. This facilitates a sense of reality, learning by entertaining, raises motivation and provides more efficient and meaningful learning environments [26]. Such concepts are apposite to science education and help make the learning of science easier. The introduction of 3D visual aids into the teaching of invisible phenomena that cannot easily be examined – they are abstract – makes such teaching more effective [27], furthering students' understanding of more difficult concepts and subjects [28]. In turn cognitive capacities can be increased, due in part to the reduced cognitive load placed on students [29].

2.2 Effective Implementation of ARLE – Challenges and Future Needs

As highlighted in the preceding section SLE can be leveraged by effective implementation of AR applications. When AR applications are the chosen disruptive

technology implemented into the learning environment such environments can be termed ARLE.

Several key challenges, in addition to teacher efficacies and lack of professional learning (PL) in the effective use of SLE, or in this case ARLE, have been identified [9]. These include the effective use of data analytics to boost the teaching and learning process and the use of profiling methods inherent in AR applications when applied in learning contexts. AR, when enhanced by the IoT has the potential to integrate analysis tools, including data analytics to improve such learning experiences in an iterative process, through the provision of powerful, contextual, in-situ learning experiences alongside discovery of the connected nature of extant information in the real world [10]. With greater convergence of AR and the IoT with AI, efficiencies and affordances in smart education and more broadly smart digital living in general can develop. The IoT is a system that integrates all devices into the network, managed via the web and provides real time information and interaction with its users [4]. This indicates that there is potential to integrate AI with educational processes, especially in online and distance learning that facilitate adaptive and personalised learner-centered experiences through SLE [13], or ARLE.

By focusing on more personalised learner-centered modes of education more explicit teaching and learning activities can evolve, leading to precision education. Precision education has been defined as an approach to research and practice concerned with tailoring preventive and intervention practices to individuals based on the best available evidence [30]. Precision education uses four steps: diagnosis, prediction, treatment and prevention, to arrive at tailored personalised interventions [11]. Shifting to precision education will lead to pedagogical shifts, which by necessity will include smart learning activities as well as smart assessments grounded in technology. The integration of AI, and more specifically HAI can potentially facilitate this [11]. The affordances that AR can leverage within such precise educational pedagogies within SLE, or more specifically ARLE, are potentially significant. This is especially so in relation to personalised learner-centered educational experiences that allow learners to progress at their own pace in response to feedback provided by AR applications using AI and data analytics. In this manner such AR applications can help diagnose students' engagement, motivations and learning patterns [31, 32]. Potentially this allows educators better understanding of the effectiveness of their content, leading to enhancements in tailoring such content to individual student's needs.

Studies into the efficacy of AR in chemistry, and STEM. are encouraging, although limitations and caveats exist, both at post primary and university levels. These include mixed results, the lack of widespread, especially longer term, studies, and the lack of well-designed integration into pedagogies. Although evidence points to the positive educational affordances provided by TEL, including improving learning efficiencies, facilitating a greater focus on identified critical 21st Century skills and personality growth in a digital society [2], such evidence can be anecdotal and based on myths as opposed to sound research [33]. The key point here is that on their own digital technologies may not be the golden bullet in raising educational outcomes for

all learners. What is as important as the actual technologies and how effective and efficient they are in raising educational affordances, is how such technologies are integrated into teaching and learning [2]. Implementation cannot be on an ad hoc basis. It needs to be designed and incorporated into effective pedagogical learning experiences, a point made by Sweller [34, p. 1], when stating that, "technology-based instruction used without reference to the instructional design principles that flow from human cognition is likely to be random in its effectiveness."

This highlights the importance of teachers' confidences, knowledge and efficacies for successful integration of technology [2] which is often lacking. Teachers need well developed cognitive skills in pedagogical content and technological knowledge for successful implementation of technological applications into SLE, as well as the necessary mindset and time [33, 35]. Due to the fusion of pedagogy and technology SLE have a correlation with Mishra & Koehler's TPACK model [34] in which they argue that for successful integration of technologies into educational settings development of technological, pedagogical and content knowledge is required. This is a challenge for time pressed teachers, significant numbers of whom have less developed efficacies in the use of ICT, and are lacking in any PL, resulting in a shortage of TEL and a lack of effectively implemented SLE. The OECD Teaching and Learning International Survey (TALIS) in 2018 highlighted this. Findings include that on average within the OECD countries only 53% of lower secondary school teachers used ICT within teaching and learning activities on a frequent or always basis. Perhaps, more tellingly only 60% of said teachers had received PL in ICT in the year prior to the survey with 18% identifying a high need in this area [36]. This is a key area that hinders the effective use of SLE and TEL.

This applies to the implementation of AR, in the creation of ARLE, and how it can be used more productively to develop students' engagement and conceptualisation of key aspects in STEM education, enhanced by data analytics and AI to supply anytime anyplace feedback *(AfL)*. By integrating pedagogically appropriate AR applications, affective and cognitive aspects of learners can be enhanced through personalised learner-centered and collaborative learning, through connectivism, in general. More specifically core skills applicable to STEM domains including development of spatial ability, conceptual understanding, practical skills, and scientific inquiry learning can be leveraged.

There has also been a lack of suitable and consistent platforms for educators to create and host customisable contextual and relevant educational experiences [4], as well as the time needed to prepare pedagogically valuable educational experiences enhanced by AR. This potentially leads to ARLE which are narrow where the seemingly ad hoc implementation of AR applications can be viewed as having little intrinsic value. In this way potential educational affordances are negated. The use of AR in SLE has the potential to be viewed as a "gimmicky" solution [37, p. 14], and may interfere with the intended learning outcomes. This is potentially shown by overall effect sizes on the effects of technologies ranging from .30 and .35 being reported from several meta-analysis studies [38, 39], indicating that such positive affordances are not as pronounced or evident in raising student outcomes.

To further leverage AR use in SLE, or ARLE, pedagogically appropriate AR applications need to meet and include intended learning outcomes (ILO), support learning through collaborative and constructive methods, and enhance cognitive abilities [12]. ILO are what learners are expected to know, understand, and do at the end of the learning activity [40]. Such ILOs are apposite to education at both university and post primary level, and determine the teaching and learning activities, in this case the AR applications within the ARLE. This lack of ILO's has also hindered the leveraging of the potential cognitive benefits that SLE, can and do provide [41]. To maximise the educational efficiencies that can be provided in online immersive SLE a high degree of representation fidelity and inclusion of contextual aspects, such as teacher – learner dynamics, realism, information sources and levels of interactivity are needed, alongside provision of primary, secondary, and tertiary courseware [41]. In virtual learning environments (VLE), which can be viewed as early iterations of SLE, primary courseware has been defined as conceptual learning; secondary courseware as instructional interactions where the flow of information is influenced by learners' actions and; tertiary courseware as dialogue between teachers and learners around learning and assessment [41]. In a more relevant and effective ARLE secondary courseware involves interactions with AR learning applications and tertiary courseware can potentially be facilitated through AI integrated into the AR applications that helps provide feedback, facilitating personalised precise education.

2.3 Effective Implementation of ARLE – Context and Rationale

This concept paper argues that to maximise efficiencies and affordances in the provision of precision education through the implementation of AR applications creating effective ARLE, AR needs to be treated more as an overall concept [32, 42]. In this way the focus shifts to a more holistic collaborative exercise involving teacher input, as opposed to a technical design issue. By doing this it is envisaged a more encompassing, consistent, accessible, pedagogically appropriate, and scalable ARLE can be developed and deployed, hosted on an already existing online platform. This will facilitate the hosting of an expanding library of collaboratively and appropriately designed AR applications for teaching and learning interactions with chemistry and wider STEM subjects, within the NI post-primary education sector. The platform to be used will be the virtual Science Lab, developed by Ulster University [43], followed by the MAVRLAB developed between Ulster University, the Abdus Salam International Centre for Theoretical Physics (ICTP), Trieste-Italy and Santasco SrL, Regio Emilia, Milan–Italy [44]. Using these pre-existing online platforms access to ARLE and interaction with the appropriately developed learning experiences, will be widened, not only in direct face-face sessions, but also with online delivery. Data collated by Google Analytics, from the Science Lab VLE from a 5-day period in April 2020 indicate that 724 users accessed this lab, from 26 countries around the world [43]. This indicates the potential that this platform has in widening access. The secondary data presented in section 4.0, looking into the potential affordances of SLE in NI education prior to the setting up of the online Science Lab VLE [43], further augments the rationale behind this proposed work.

A conceptual methodological framework is introduced for the proposed deployment of AR applications on the aforementioned online platforms, creating a scalable ARLE. This framework is founded on previous deployed ARLE which consider simple interfaces and scalability, and the ability to host an expanding library of AR applications [45], alongside consultation with educators in the design and implementation as critical factors [46]. In other words, AR needs to be treated more as an overall concept. The proposed methodological framework can be viewed as an evolution of the ARLE model developed by Gagrish et al [47]. This model uses the acronym ADDIE to describe the fundamental constructs. These constructs are an analysis of the needs (A); the design and development of the AR app (DD); the implementation of the AR app (I), and the evaluation of the AR app (E).

3.0 Proposed Methodological Framework

The proposed methodological framework for the implementation of this ARLE involves consultation and collaboration with key stakeholders, specifically teachers, in the initial stage. The ARLE will be designed, developed, and implemented using an agile, iterative, and cyclical double layered IDEA framework, or model., shown in Figure 1.

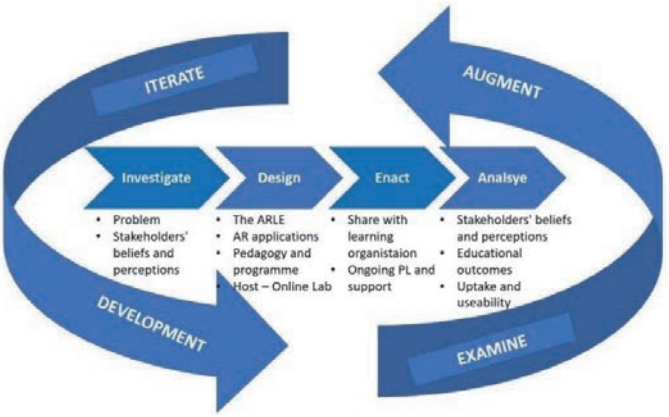


Figure 1: IDEA Framework for ARLE development and deployment

In the investigate phase semi-structured interviews and online surveys would be used to evaluate teachers' understanding of both SLE and AR, and more specifically a potential ARLE, aimed at post primary STEM education in general, and chemistry in particular. From this initial evaluation, moving to the design phase a focus group will be initiated to help configure an initial direction for development of the ARLE through an AR application to be trialed through the ARLE. This will involve appropriate use of ILO's which will determine the nature of the AR application to be used, with AI helping to provide feedback. This will lead onto the enactment of the ARLE through the hosting of the initial AR application onto the online platforms,

and how it is disseminated to the stakeholders, alongside any ongoing PL. Subsequently an analysis of the effects of the ARLE and any changes on stakeholders' beliefs and perceptions around the efficacy of the ARLE, including cognitive aspects would be carried out. The second IDEA layer to the model will involve ongoing iteration, development, examination, and augmentation of the ARLE, allowing for pedagogically appropriate AR applications to be added to the ARLE on an ongoing basis, with longer term cognitive aspects of the enhanced ARLE to be determined.

The AR applications, in the design phase, will be built using the Unity 3-D game engine, which is the most cost effective, flexible, and sustainable solution for the development of both AR and VR applications [48] . Unity is a software framework, that provides a set of tools for "developers around the world to create rich, interactive, 2-D, 3-D, VR and AR experiences" [49], negating the need for the construction of virtual spaces from the ground up [50]. Figure 2 shows how the process of AR application development fits within the IDEA framework, depicted in Figure 1.

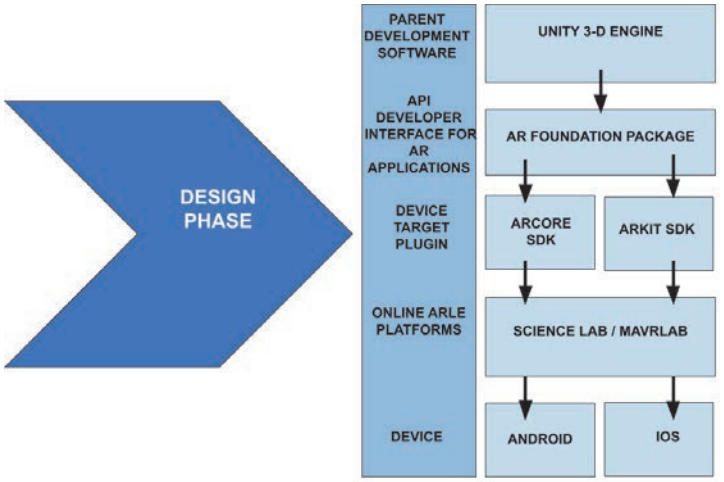


Figure 2: The Development of AR Applications within the Design Phase

To create AR applications within the Unity 3-D game engine the AR Foundations package is installed from the package manager registry located under the windows tab. The AR foundations package provides the interface for working with AR applications by defining a multi-platform API that allows you to work with functionality common to multiple platforms [51] by providing scripts, in C#, assets and prefabs needed as the basis for AR applications. To build to specific devices, plugs ins located within the package manager registry, need to be installed. To build to Android devices the ARCore XR plug in is required, whereas the ARKit XR plug

in is required to build to IOS devices. Once the AR application has been completed it can be built to the target device and shared and accessed on the ARLE platform.

Figure 3 shows an AR application project within Unity, in the early stages of development, being built for Android. However, by changing the player settings, and if the relevant plugs in are installed the application can be targeted to other devices. To run the AR application in Unity all the necessary assets, prefabs and game objects are added through the hierarchy, which is shown on the left had side of Figure 3. AR Session controls the lifecycle and configuration options for AR sessions [52]. AR Session Origin is the parent for the AR setup. The AR Session Origin game object contains a camera and any other game objects created from detected features, such as planes or point clouds, and transform trackable features into their final position, orientation, and scale [52]. In Figure 3 the AR session origin 'game object' has been selected. This is shown in the inspector, on the right-hand side of Figure 3, where the necessary scripts are provided and assigned to the AR Session Origin to manage the addition, updating, and removal of game objects that represent planes, point cloud, and reference points. Raycasting allows you to determine where a ray (defined by an origin and direction) intersects with a trackable [52], which is any object that can be tracked and anchored in the real world.

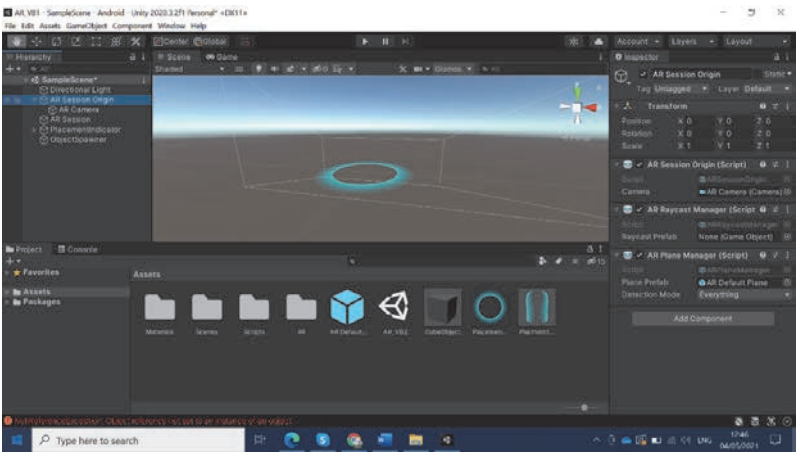


Figure 3: Unity Window Showing AR Project

4.0 Results

Due to this concept work being in the very early iteration the framework has not yet been deployed. Secondary data has been presented that highlights the challenges and potential benefits that can be leveraged from hosting of the ARLE on scalable pre-existing online platforms, in this case the Science Lab virtual lab [43]. This data was collected through eSurv.org surveys disseminated via social media to stakeholders within the post primary education sector in NI, including the Belfast, North Eastern, South Eastern, Southern and Western Educational Authorities [43].

Figure 4 shows the teacher responses to their use of various TEL in post primary STEM education in NI, in 2020. It can be determined that the use of AR in teaching and learning is not occurring to any degree. This provides scope for the further development and deployment of AR applications, especially when pre-existing use of tablets and smartphones, that the AR applications will be built to, is already evident.

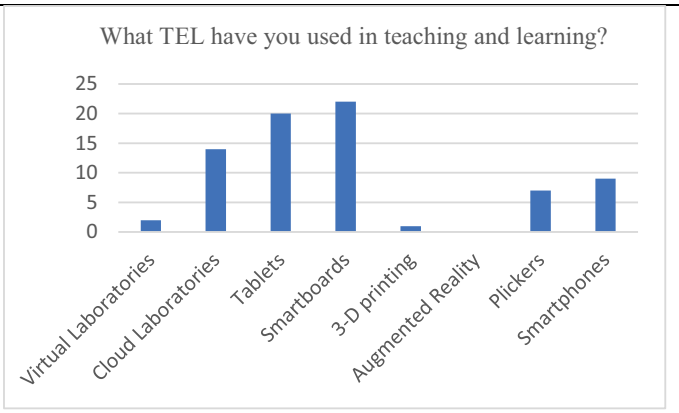


Figure 4: Use of TEL in NI post primary schools [40]

Teachers' willingness to engage with TEL is also another key factor in the success of the ARLE, and as Figure 5 shows, teachers in NI post primary education are willing to engage with TEL through PL. Although the sample size is relatively small the positive responses to wanting to undertake TEL PL are overwhelming. This has positive implications for the proposed development and deployment of ARLE using the proposed framework.

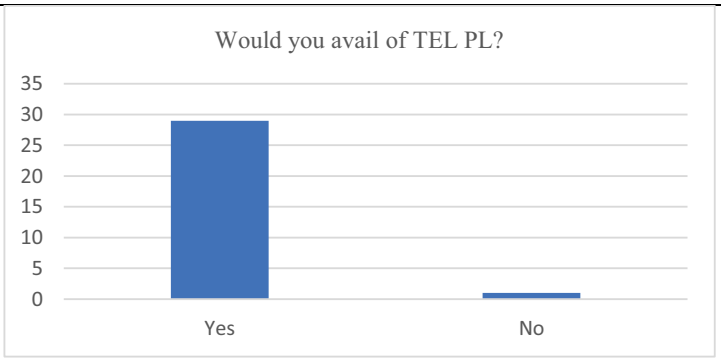


Figure 5: Teachers' demand for TEL PL [40]

Results also show that the potential opportunities afforded by AR can be leveraged through hosting on the proposed virtual platform, creating a scalable ARLE. This is highlighted in Figure 6, which shows the number of teachers and parents surveyed who would utilise the Science Lab platform which will be the parent repository for the deployment of the AR applications.

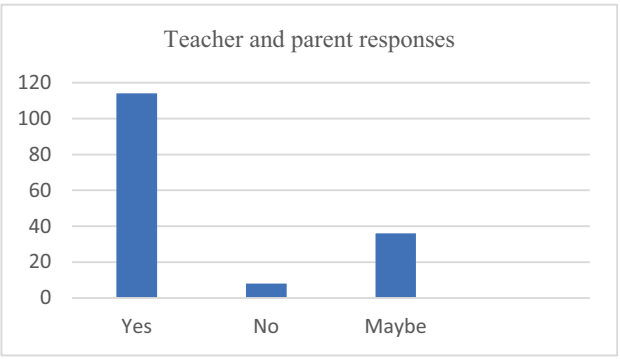


Figure 6: Willingness to utilise the online platform [40]

Results from the parents' perspectives are significant as they indicate the likelihood of access and use of ARLE outside the physical classroom. Figure 7 shows Parents' responses only.

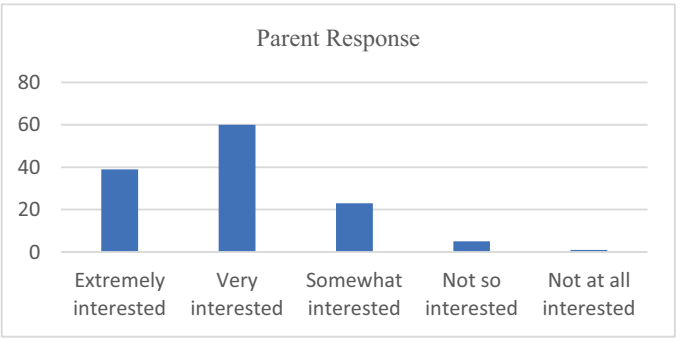


Figure 7: Willingness to utilise the online platform [40]

This willingness of parents to engage with the online platform provides scope for remote access to the proposed ARLE, which when combined with parents' views on their children's efficacies with emerging technology, shown in Figure 8, further enhances the potential for successful implementation of, and interaction with, ARLE.

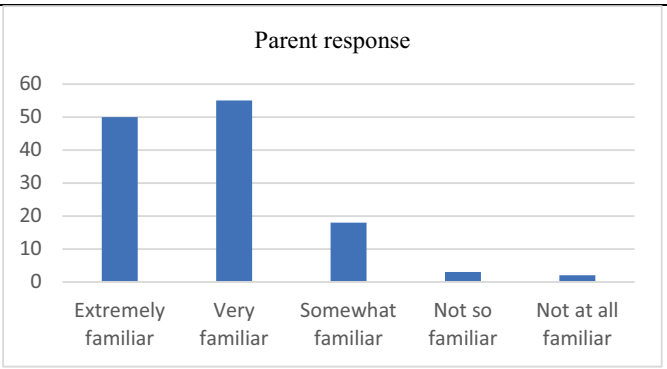


Figure 8: Parents perspective on children's familiarity with emerging technology [40]

5.0 Discussions

Although the situation in the education sector, like many others is challenging at this time due to the ongoing COVID-19 pandemic, it also provides an opportunity in shifting learning environments to online, more readily accessible platforms that can facilitate access to learning activities, from anywhere and at any time, where teachers and learners can interact. The results from the surveys carried out by O'Dwyer & Uhomoibhi [43] indicate the positive opportunities for leveraging ARLE in NI post primary STEM education, although challenges undoubtedly exist, including the seeming lack of awareness, exposure, and interaction with AR, as shown in Figure 4. Reasons for the lack of AR use in NI post primary education are potentially numerous, although teachers' unfamiliarity with AR, and lack of PL in use of, are potentially significant contributory factors.

However, it is envisaged that the choice of conceptual methodological framework, including the use of Unity 3-D, that is proposed to evaluate this issue, leading to the deployment of ARLE would ameliorate this. Such a collaborative and constructive approach would provide PL that would allow learning to be applied to practice, a necessity for effective PL [53], as well as the requisite support needed for implementing new technologies [54]. By taking part in appropriate PL, which the survey results indicate teachers are open to, barriers to effective implementation of TEL, in this case ARLE, can be broken down. Such barriers include lack of training, support and resources, alongside teachers' views on the technology in question and its value to teaching and learning and their self-efficacy [55].

Although Unity's build and run protocol allows content to be viewed and 'played' on a variety of platforms with the 'press of a field' through its' player and build settings PL would still be required. Although teachers in the NI educational context have expressed a willingness to undertake relevant PL (refer to Figure 5), such PL adds to the already time constrained working environment. A lack of time and increased workload is a recognised barrier to teachers when implementing new practices [56, 57], such as collaborating on the implementation of ARLE. However,

due to the ease of use of Unity, such PL would not be overly onerous. In a survey using semi-structured interviews Foxman [58] reported users' satisfaction with the interoperability and ease of use, with rudimentary projects being publishable within 30 minutes from scratch.

In time this framework can potentially extend to a more widespread collaborative, constructivist and connectivist approach to learning interactions where students take some ownership of building AR applications contextual to their learning. In this way the move to facilitate the development of computational thinking and problem-solving skills in learners, inherent to STEM educational development, through enhanced AR can potentially be leveraged, as argued by Nguyen & Dang [59].

Furthermore, the development of increasingly realistic and complex simulated environments, facilitated by Unity 3-D, has enabled the development of diverse and effective SLE that are rich in visual, physical, task, and social complexity and are helping drive recent evolutions and research in AI [60]. Using Unity to develop and deploy AR, with its built in AI, through ARLE, allows for interactive and collaborative learning processes between the learner and the learning environment [59], thereby leveraging learning activities and potentially facilitating personalised precision education.

6.0 Conclusions

This concept paper explored the challenges and prospects of ARLE which are becoming more important paradigms in delivery of education. This has been further highlighted by the ongoing COVID-19 pandemic. As a result of some of the identified issues associated with current ARLE a conceptual framework for the proposed development and deployment of a scalable ARLE in NI post primary STEM education has been introduced, to be hosted on pre-existing online platforms. Secondary data from NI education sector highlights the potential opportunities that ARLE can provide in STEM education. This framework proposes a collaborative and iterative process in which stakeholders, specifically teachers, are key agents in the deployment of AR apps into the ARLE, considering that the teacher's role in effective implementation and integration of technology into teaching and learning environments is critical. As Wright [61] argues effective TEL opportunities do not happen without a teacher's deliberate pedagogical actions though creation of learning spaces that promote interaction, collaboration and critical thinking using TEL in authentic ways. This is as equally true for the effective implementation of AR apps in the evolution of ARLE.

In this framework AR applications with a focus on STEM subjects, will be developed using the Unity 3-D game engine, due in no small part to its ease of use and interoperability. Unity, as the quintessential platform tool [58] provides all the necessary tools to build 2-D and 3-D virtual worlds through the Unity Editor user interface. This includes AR applications which through the AR Foundation package, and the ARCore and ARKit plug ins, available through the registry, can be built to both Android and IOS devices through the same project.

7.0 References

1 Li, C. and Lalani, F., (2020). The COVID-19 pandemic has changed education forever. This is how. In *World economic forum* (Vol. 29). Li, C. and Lalani, F., 2020. Available at: <https://www.weforum.org/agenda/2020/04/coronavirus-education-global-covid19-online-digital-learning/> [Accessed 2 June 2021].

2 Seufert, S., Guggemos, J. and Sailer, M. (2021). Technology-related knowledge, skills, and attitudes of pre- and in-service teachers: The current situation and emerging trends. *Computers in Human Behavior,* 115

3 Winanti, F. L. Gaol, T. A. Napitupulu, H. Soeparno and Trisetyarso, A. (2018). Learning Framework in the Industrial Age 4.0 in Higher Education. *In: - 2018 Indonesian Association for Pattern Recognition International Conference (INAPR)*. 227-232.

4 Martín-Gutiérrez, J., Mora, C., Añorbe-Díaz, B. and González-Marrero, A., 2017. Virtual Technologies Trends in Education. *EURASIA Journal of Mathematics, Science and Technology Education*, [online] 13(2), pp.469-486. Available at: <https://www.ejmste.com/download/virtual-technologies-trends-in-education-4674.pdf> [Accessed 2 June 2021].

5 Ochoa Fernandez, C. J. (2020). Special Session—XR Education 21st. Are We ready for XR disruptive ecosystems in education? *2020 6th International Conference of the Immersive Learning Research Network (iLRN), Immersive Learning Research Network (iLRN), 2020 6th International Conference of the,* 424-426.

6 Harari, Y.N. (2018). *21 Lessons for the 21st Century*. Random House.

7 Leahy, S. M., Holland, C. and Ward, F. (2019). The digital frontier: Envisioning future technologies impact on the classroom. *Futures,* 113

8 Holmes, W., Bialik, M. and Fadel, C. (2019). Artificial intelligence in education. *Boston: Center for Curriculum Redesign*.

9 Lytras, M., Visvizi, A., Daniela, L., Sarirete, A. and Ordonez De Pablos, P., 2018. Social Networks Research for Sustainable Smart Education. *Sustainability*, [online] 10(9), p.2974. Available at: <https://www.researchgate.net/publication/327159823_Social_Networks_Research_for_Sustainable_Smart_Education> [Accessed 2 June 2021].

10 Shoikova, E., Nikolov, R. and Kovatcheva, E. (2016). Smart digital education enhanced by AR and IoT data. University of Library Studies and Information Technologies (BULGARIA)

11 Yang, S. J. H, Ogata, H., Matsui, T., and Chen N.-S. (2021). Human-centered artificial intelligence in education: Seeing the invisible through the visible. *Computers and Education: Artificial Intelligence*.

12 Dron, J. (2018) Smart learning environments, and not so smart learning environments: A systems view. *Smart Learning Environments,* 5 (1), 1-20.

13 Siddhpura, A., V, I., and Siddhpura, M. (2020). Current state of research in application of disruptive technologies in engineering education. *Procedia computer science*, *172*, 494-501

14 Furió, D., González-Gancedo, S., Juan, M.-C., Seguí, I. and Costa, M. (2013). The effects of the size and weight of a mobile device on an educational game. Comput Educ 64:24–41

15 Sanabria, J. C. and Arámburo-Lizárraga, J. (2016). Enhancing 21st century skills with AR: using the gradual immersion method to develop collaborative creativity. *EURASIA J Math Sci Technol Educ 13(2):487–501.*
16 Akçayır, M. and Akçayır, G. (2017) Advantages and challenges associated with augmented reality for education: A systematic review of the literature. *Educational Research Review,* 20 1-11.
17 Kezim, M., & Ozarslan, Y. (2012). Augmented reality in education: current technologies and the potential for education. *Procedia-Soc Behav Sci* 47:297–302.Kidd SH, Crompton
18 Azuma, R.T. (1997). A survey of augmented reality. *Presence: Teleoperators & Virtual Environments,* 6 (4), 355-385.
19 Azuma, R., Baillot, Y., Behringer, R., Feiner, S., Julier, S. and MacIntyre, B. (2001). Recent advances in augmented reality. *IEEE Computer Graphics and Applications, Computer Graphics and Applications, IEEE Comput.Grap.Appl.,* 21 (6), 34-47
20 Milgram, P. and Kishino, F. (1994). A taxonomy of mixed reality visual displays. *IEICE Transactions on Information and Systems,* 77 (12), 1321-1329.
21 Papanastasiou, G., Drigas, A., Skianis, C., Lytras, M., & Papanastasiou, E. (2018). Virtual and augmented reality effects on K-12, higher and tertiary education students' twenty-first century skills. *Virtual reality: the journal of the Virtual Reality Society*, 23(4), 425436.
22 Billinghurst, M., and Kato. H., (1999). Collaborative mixed reality. In 'mixed reality – merging physical world and virtual world.' *Proceedings of the International Symposium on Mixed Reality (ISMR '99),* March 19-21, 1999, Yokohama, Japan, 261-284.
22 Kauffman, H., (2003). Collaborative Augmented Reality in Education
24 Pan, Z., Cheok, A. D., Yang, H., Zhu, J., and Shi, J. (2006). Virtual reality and mixed reality for virtual learning environments. *Computers & Graphics, 30*(1), 20-28.
25 Dede, C. (2009). Immersive interfaces for engagement and learning. *Science (New York, N.Y.),* 323(5910), 66-69.
26 Wenger, E. (1998). Communities of practice: Learning, meaning, and identity. Cambridge, England: Cambridge University Press.
27 Sahin, D. and Yilmaz, R.M. (2020). The effect of augmented reality technology on middle school students' achievements and attitudes towards science education. *Computers & Education,* 144
28 Arici, F., Yildirim, P., Caliklar, Ş and Yilmaz, R.M. (2019). Research trends in the use of augmented reality in science education: Content and bibliometric mapping analysis. *Computers & Education,* 142
29 Wu, H.-K., Lee, S. W.-Y., Chang, H.-Y., and Liang, J.-C. (2013). Current status, opportunities and challenges of augmented reality in education. *Computers & Education*, *62*(C), 41-49.
30 Cook, C. R., Kilgus, S. P., and Burns, M.K. Advancing the science and practice of precision education to enhance student outcomes (2018*). Journal of School Psychology,* Volume 66, pp 4-10. ISSN 0022-4405.

31 Iqbal, M.Z., Mangina, E., and Campbell, A. G. (2020). Exploring the use of augmented reality in a kinesthetic learning application integrated with an intelligent virtual embodied agent. *In proceedings of the 2019 IEEE International Symposium on Mixed and Augmented Reality Adjunct (ISMAR-Adjunct*), Beijing, China, 10–18 October 2019; pp. 12–16
32 Xiao, J., Xu, Z., Yu, Y., Cai, S. and Hansen, P. (2016). The design of augmented reality-based learning system applied in U-learning environment. In *International Conference on Technologies for E-learning and Digital Entertainment* (pp. 27-36). Springer, Cham.
33 Kirschner, P.A. (2015). Do we need teachers as designers of technology enhanced learning? *Instructional Science,* 43 (2), 309-322.
34 Sweller, J. (2020). Cognitive load theory and educational technology. *Educational Technology Research and Development,* 68 (1), 1-16.
35 Mishra, P, and Koehler, M. (2008). Introducing technological pedagogical content knowledge. *Teachers Record 9.*
36 Schleicher, A., 2020. The impact of covid-19 on education insights from education at a glance 2020. *Retrieved from OECD. org website: https://www. oecd.org/education/the-impact-of-covid-19-on-education-insights-education-at-a-glance-2020. pdf.*
37 Pellas, N., Fotaris, P., Kazanidis, I., and Wells, D. (2019). 'Augmenting the learning experience in primary and secondary school education: a systematic review of recent trends in augmented reality game-based learning', *Virtual Reality*, 23(4), pp. 329–346. doi: 10.1007/s10055-018-0347-2.
38 J-PAL. (2019). Will technology transform education for the better? https://www.povertyactionlab.org/publication/will-technology-transform-education-better.
39 Tamin, R. M, Bernard, R. M., Borokhovski, E, Abrami, P. C, and Schmid, R. F. (2011). What forty years of research says about the impact of technology on learning, *Review of Educational Research*, 81(1), pp 4-28.
40 Biggs, J. (2003). Teaching for quality learning at university: What the student does. 2nd Edition. Buckingham: Society for Research into Higher Education: Open University Press
41 Fowler, C. (2015). 'Virtual reality and learning: Where is the pedagogy?', *British Journal of Educational Technology*, 46(2), pp. 412–422.
42 Alkhattabi, M. (2017). Augmented reality as e-learning tool in primary schools' education: Barriers to teachers' adoption. *International Journal of Emerging Technologies in Learning,* 12 (2), 91-100.
43 O'Dwyer, J. and Uhomoibhi, J. (2020). Virtual laboratories and practical STEM education: Issues of development and deployments including benefits and challenges. *INSPIRE XXV*, p.179.
44 Onime, C., Uhomoibhi, J., Wang, H. and Santachiara, M. (2021), "A reclassification of markers for mixed reality environments", *International Journal of Information and Learning Technology*, Vol. 38 No. 1, pp. 161-173. https://doi.org/10.1108/IJILT-06-2020-0108

45 Saritha, R.C., Mankad, U., Venkataswamy, G. and Bindhumadhava Bapu, S. (2018). An augmented reality ecosystem for learning environment. *2018 IEEE International Conference on Advanced Networks and Telecommunications Systems (ANTS), Advanced Networks and Telecommunications Systems (ANTS), 2018 IEEE International Conference on,* 1-6.
46 Wojciechowski, R. and Cellary, W. (2013) Evaluation of learners' attitude toward learning in ARIES augmented reality environments. *Computers & Education,* 68 570-585.
47 Gargrish, S., Mantri, A. and Kaur, D.P. (2020) Augmented reality-based learning environment to enhance teaching-learning experience in geometry education. *Procedia Computer Science,* 172 (9), 1039-1046.
48 Peters, E, Heijligers, B., de Kievith, J., Razafindrakoto, X., van Oosterhout, R. Santos, C., Mayer, I., and Louwerse, M. (2016). Design for collaboration in mixed reality: Technical challenges and solutions. In 2016 8th International Conference on Games and Virtual Worlds for Serious Applications (VS-GAMES), pp. 1–7, Sept 2016. doi: 10.1109/VS-GAMES .2016.7590343
49 Unity public relations fact page. (n.d.). Retrieved from https://unity3d.com/public-relations. [Accessed 28 April 2021].
50 Ward, J. (2008). What is a game engine? GameCareerGuide.com. Retrieved from https://www.gamecareerguide.com/features/529/what_is_a_game_.php
51 Docs.unity3d.com. 2021. *About AR Foundation | AR Foundation | 4.1.7*. Retrieved from https://docs.unity3d.com/Packages/com.unity.xr.arfoundation@4.1/manual/ [Accessed 28 April 2021].
52 Docs.unity3d.com. (2021). About AR Foundation/Package Manager UI website. Retrieved from https://docs.unity3d.com/Packages/com.unity.xr.arfoundation@2.0/manual/index.html?_ga=2.226222846.294655839.1619615222-876942306.161961522. [Accessed 28 April 2021].
53 Timperley, H., Wilson, A., Barrar, H., and Fung, I. (2007). *Best evidence synthesis iterations (BES) on professional learning and development*. Wellington, NZ: Ministry of Education.
54 Avidov-Ungar, O., and Forkosh-Baruch, A. (2018). Professional identity of teacher educators in the digital era in light of demands of pedagogical innovation. *Teaching and Teacher Education,* 73, 181-191.
55 Ertmer, P. A., Ottenbreit-Leftwich, A. T., Sadik, O., Sendurur, E., and Sendurur, P. (2012). Teacher beliefs and technology integration practices: A critical relationship. *Computers & education*, *59*(2), 423-435.
56 Reeves, D. (2012). *Transforming professional development into student results*. Alexandria, Va.: ASCD.
57 Wylie, C. (2013). Secondary schools in 2012: Mina findings from the NZCER national survey. Wellington, N.Z. *New Zealand Council for Educational Research*
58 Foxman, M. (2019). United we stand: Platforms, tools and innovation with the unity game engine. *Social Media+ Society*, *5*(4), p.2056305119880177.

59 Nguyen, V.T. and Dang, T. (2017). Setting up virtual reality and augmented reality learning environment in unity. In *2017 IEEE International Symposium on Mixed and Augmented Reality (ISMAR-Adjunct)* (pp. 315-320). IEEE.
60 Juliani, A., Berges, V. P., Teng, E., Cohen, A., Harper, J., Elion, C., Goy, C., Gao, Y., Henry, H., Mattar, M. and Lange, D. (2018). Unity: A general platform for intelligent agents. *arXiv preprint arXiv:1809.02627*.
61 Wright, N. (2010). E-Learning and implications for New Zealand schools: A literature review. *New Zealand Education Research Council.* Report to the Ministry of Education, 2010. http://www.educationcounts.govt.nz/publications

8.0 Appendix. List of Abbreviations

List of Abbreviations used

ADDIE	Analysis, Design, Development, Implementation, Evaluation
AfL	Assessment for Learning
AI	Artificial Intelligence
API	Application Programming Interface
AR	Augmented Reality
ARLE	Augmented Reality Learning Environment
HAI	Human Artificial Intelligence
ICT	Information and Communications Technology
ICTP	International Centre for Theoretical Physics
IDEA (i)	Investigate, Design, Enact, Analyse
IDEA (ii)	Iterate, Develop, Examine, Augment
ILO	Intended Learning Outcome
IoT	Internet of Things
MAVRLAB	Mixed Augmented and Virtual Reality Laboratory
NI	Northern Ireland
OECD	Organisation for Economic Co-operation and Development
PL	Professional Learning
SLE	Smart Learning Environment
STEM	Science, Technology, Engineering and Mathematics
TALIS	Teaching and Learning International Survey
TEL	Technology Enhanced Learning
TPACK	Technological, Pedagogical and Content Knowledge
VLE	Virtual Learning Environment
VR	Virtual Reality
XR	Extended Reality

The Role of Gamification in a Software Development Lifecycle

Neil Gordon[1], Mike Brayshaw[2], John Dixon[3], Simon Grey[4], David Parker[5]

[1]Department of Computer Science & Technology, University of Hull,
Cottingham Road, Hull, HU6 7RX, U.K.
[1]n.a.gordon@hull.ac.uk
[2]m.brayshaw@hull.ac.uk
[3]john.dixon@hull.ac.uk
[4]s.grey@hull.ac.uk
[5]d.j.parker@hull.ac.uk

Abstract

Teaching Software Engineering students raises a number of challenges; in particular that student developers typically demonstrate behaviours that run counter to good software development. These include failing to plan properly, failing to develop their software in a structured manner, and failing to meet specified deadlines (so called "student syndrome"). Consequentially, students exhibiting these behaviours are more likely to disengage from their studies. Even where submissions are made, they tend to be lower in quality, and may not demonstrate the true capabilities of the individual. Such alienation and disengagement is amplified by the current context of learning in a pandemic, with a wall of digital communication technology coming between teachers and learners.

In this paper, the authors will identify how gamification approaches can be applied to software development education, and how they can help to better motivate and educate future software developers through computer managed delivery and assessment. As motivation is a key factor, motivational properties known in computer gaming are applied within the new context of a software engineering lifecycle. The role of intrinsic and extrinsic motivation for developers is considere.

The gamified techniques identified are further enhanced with an Agile type approach. This has been particularly critical during 2020/21 where the shift to fully online learning for previously face to face taught students has placed new pressures on students and staff. A

feedback-led rapid prototyping style of teaching that allows for adaptive and effective teaching practices is also described. Finally, complimentary case studies on the use of approaches within a university environment are evaluated.

Keywords: Gamification, student syndrome, computing education.

1.0 Introduction

This paper considers an approach to the education of university Software Engineering students that attempts to blend Gamification, Agile Software Development Practices, and Flexible Learning with feedback-led rapid prototyping. This is in response to the behaviours of novice software developers, such as student syndrome [1], and how we can look at the role of intrinsic and extrinsic motivators [2]. We also consider some of the environmental factors of the 2020/21 Covid-19 pandemic and the benefits of an Agile approach [3].

In order to set the context, we shall start by outlining each of the component approaches and methodologies. We then show how we have used them, both individually and in blended form, to a range of Undergraduate and Masters courses within the current context using an action research methodology. Finally, reflection and evaluation is presented that shows from an action perspective what we have learned as researchers using these interventions and how we have changed the outcomes and experiences in each of the case studies for our students.

1.1 Engagement

Given the context of this research one of the key issues is getting students involved and engaged in their learning. The rapid move to online teaching presents a massive set of problems, both practical in terms of hardware and connectivity but also engagement with the material to be taught. The move from Face2Face to online means that we must look at new means to engage our students. These techniques must also scale for large cohorts of students (our largest cohort here was 150 students). The approaches that we adopt in this paper are, in part, a direct response to that challenge.

Engagement with learning has a wide variety of descriptions and definitions [4], though generally is linked to how motivated students are, as evidenced by the effort and time they apply to their studies. Finding ways to engage students is thus linked to motivating students to actively work on their own learning. One significant challenge of engagement is in identifying activities and evidence by which it can be measured, but which do not have undesired effects themselves An example of an undesired effect is where students respond to measures such as attendance monitoring or monitoring of opening a resource, when the students know they are being observed and may behave in an affected manner e.g. to simply register then leave an event, or to open then immediately close a resource [5].

1.2 Gamification

One of the challenges in Higher Education – arguably more so than in earlier stages of education – is that engagement can be considered optional by the student. This can result in a lack of commitment to learning opportunities and a reluctance to complete formative or summative work. Conversely, one of the desirable attributes of games is that successful games are engaging by definition. The only purpose of a game is to engage the player in play. Deterding proposes a definition of gamification as *"the use of game design elements in non-game contexts"* [6]. Gamification in education looks to apply some of the effective cues and mechanisms from games to engage students. Approaches that can be effective include allowing for multiple attempts, giving immediate feedback, and providing some form of reward (such as points, badges and leader boards). For a more complete analysis of how games mechanics map onto Higher Education teaching practices, see [7].

At its core, gamification provides a layer of extrinsic motivation to engage in activities that move towards a desired outcome. McGonigal identifies some common traits in games, namely having a goal, rules, a feedback system, and voluntary participation [8]. In the educational context this can map on to learning outcomes and how to do this is achieved, feedback could be via marks or game rewards (e.g. Badges, Levels, Awards, and Prizes) and enthusiastic participation in the learning activity. Issues can arise when the extrinsic motivation is not well aligned with the underlying goals of the activity. For example, Visaria et al [9] describe how a student's active engagement with an attendance monitoring system does not necessarily lead to their active engagement with teaching material. It could be argued that summative assessment of a student's knowledge or ability is separate from a student's process of learning. In that case, the assessment provides an additional extrinsic goal and a feedback system through and summative marks.

Perhaps more worryingly, Pink [10] warns of a number of undesirable effects of extrinsic motivators – including a reduction in intrinsic motivation. That is to say that if a student is intrinsically motivated to learn about a particular topic, then giving them an extrinsic motivator, like assessment marks, may reduce their existing intrinsic motivation. By offering students marks for engaging in learning they may become less likely to learn independently for the sake of learning alone than with additional incentive.

Psychologist Csikszentmihalyi recognised the concept of flow as a state of optimal engagement [11], identifying that in order to achieve flow through a given activity, the challenge presented by that activity must be well suited to the ability of the individual engaged in that challenge, and that individual must receive immediate feedback through their engagement with the challenge – improving their skill through deliberate practice. This indicates a need for flexible and personalised learning.

1.3 Agile Development

Our next approach uses Agile Software Development. As a software engineering methodology, agile can be characterized as an iterative development with self-organising teams that explore the problem and build a solution (see Figure 1). This allows for the incremental delivery of a product [12].

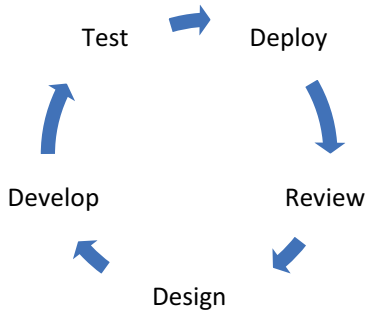


Figure 1: Agile Development

Agile is distinct from some traditional software development methodologies, which generally follow a more linear process with a full problem statement being used to define the requirements, that then lead to the product being developed, which is then tested (see Figure 2).

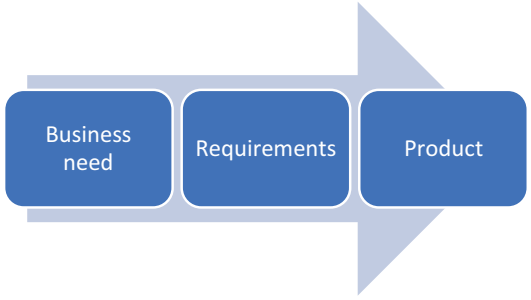


Figure 2: Traditional Software Development

Agile development can also be framed as a formal process to gamify software development. A backlog of desirable software features represents a daunting software development challenge. This challenge is broken down into more manageable smaller parts known as sprints, thus ensuring that each part is at an appropriate level for the software development team to be productive. Feedback is built-in to the process on multiple levels of resolution. The adoption of test-driven

development practices gives individual developers confidence that they are implementing features without inadvertently introducing problems later on, burn down charts give feedback on the productivity of the team over each sprint, and allows the level of challenge to be adjusted to suit the skills of the team. Overall development progress is clear as the backlog of features to be implemented is reduced, and the list of features that have been implemented increases throughout the project.

1.4 Flexible Pedagogy

Flexible pedagogy provides a framework for considering how to make learning truly student centric [13] with the intent to give students choices in how, where, and when to study. From a practical perspective, enabling these choices requires suitable tools, and can be provided with the appropriate use of technology, enabling students to access resources and be assessed in flexible ways [14].

1.5 The Student Context and Delays in Work

Two key problems for software development are student syndrome, and Parkinson's Law. As noted earlier student syndrome is characterized as leaving tasks until close to a deadline, waiting until the last moment when an action is required [15]. This is also a known phenomenon in software development, and can be problematic within agile processes [16]. In an educational setting, getting it wrong can lead to missing deadlines and potentially failing the task, a module and even degree programme [17]. Parkinson's Law [18] notes that work often expands to fill the available time and resource. The impact of this on student software development is considered later.

1.7 Covid-19

One of the much-used terms by governments and institutions – including in higher education – beginning in 2020 has been that of being agile in response to the COVID-19 crisis, though not necessarily in an appropriate nor successful way [19]. The 2020/21 pandemic has seen the shut-down of face-to-face teaching across institutions and across the world, with a rapid and unexpected cessation of standard teaching. One approach used in education to adapt to and respond to these challenges has been to adopt a flexible learning approach, facilitated through technology [20]. This has raised issues about access to computer technology and has raised the requirement for minimum level of internet access. Institutions have adopted online only learning, often adapting assessment as well as other temporary fixes, including passing/condoning students without necessarily any validation that students have completed work.

2.0 Teaching and Software Development

Keeping up to date with the rapid pace of change in the technology sectors sets a particular challenge for Computer Science higher education providers. Student expectations generally tend towards the cutting-edge to boost degree usefulness [21], with obsolete or outdated topics causing significant student dissatisfaction [22].

Employers also actively seek graduates with up-to-the minute skills, requiring quick adaptation of university courses [23]. We will explore how Agile is useful for the educator; however, it also provides a visible exemplar for students who are likely to need to utilise Agile techniques in their professional practice.

2.1 Agile Module Development

With time at a premium for many educators, redeveloping a full course or module to take advantage of the advances in the domain is prohibitive. Even if this action is taken, large swathes of the content is likely to be outdated within a short timeframe. By applying techniques from the Agile toolkit, the module can be constantly redeveloped on a rolling cycle. Regular evaluation and feedback from students provide a dynamic "to-do list" (backlog) from which items can be taken as time allows. A large group of students providing feedback can provide a valuable snapshot of importance, allowing item prioritisation and ensuring that focus is given primarily to areas where learners are most keen for development. As a side-product, areas which regularly slip to the bottom of the prioritised list may indicate concepts which are 'timeless' (e.g. general theory) and therefore not in need of update. Alternatively, and especially where feedback indicates disinterest, low-priority items can be evaluated for removal where they may have become redundant.

2.2 Engagement via Collecting Feedback

Several techniques are applied to collect feedback and ideas from students as a means to enhance engagement. End-of-semester anonymous reviews provide an opportunity for Likert questions on quality and appropriateness of specific areas (assessment, course speed, etc.) whilst also requesting freeform feedback. This technique is valuable to help determine key areas to change in the subsequent year but is not rapidly responsive and has little impact on those who have provided the feedback. These students lose out on any benefit from providing their views and may therefore lack awareness of their participation in the Agile cycle. This subsequently reduces the likelihood of their engagement and increases dissatisfaction: "my feedback isn't acted upon". Partnering end-of-semester reviews with mid-semester reviews helps to increase both the quantity of feedback and the opportunities to add to and refine the backlog. In addition, by taking feedback before the content has all been delivered, high-priority changes can be made which positively affect the students' learning. To this end we applied Agile approaches to give flexible responses and rapid feedback to our students.

2.3 Closing the Feedback Loop

Closing the loop conventionally means to act upon the feedback, thus incrementally improving the value of the teaching, to inform students of actions taken or intended and to evaluate the effectiveness of actions taken [24]. By establishing this visibility

of positive and rapidly reactive change we are able to affirm the value in student involvement and show that their input has real impact on their teaching and learning. This, in turn, makes participation in providing future feedback more likely and therefore more strongly engages the students in the Agile process. Furthermore, given the value placed on student voice in the UK National Student Survey (NSS), awareness of how staff value and respond to feedback is also valuable from an institutional perspective. Proactive identification of where feedback has been acted upon has driven an increase in feedback quantity and quality and, where action is taken little and often, regular and perceptible change can be observed, announced and evaluated readily: "I'm returning to this topic based on feedback...", "This topic area was added as it was requested in feedback", "I have redeveloped last week's slides to add some more examples after some feedback, is this useful?", etc...

3.0 Modified Module Delivery

This approach was adopted by the authors in 2020 to tackle the problems faced with the rapid and unanticipated move to entirely online teaching for multiple modules, within a Software engineering programme. These include the following 5 action interventions (the complimentary blended approaches used are indicated in square brackets):

- level 4 (first year) approximately 150 students on mathematical underpinning, and also on professional and legal requirements [Gamification, Flexible Learning]
- level 6 (3rd year/honour's stage) approximately 40 students on advanced software engineering [Gamification, Flexible Learning]
- level 6 (3ed year/honour's stage) 80 students on Distributed Systems [Agile style interaction and feedback]
- level 7 (Masters) approximately 20 students on component-based software engineering [Agile Methodology and feedback]
- level 7 (Masters) approximately 30 students on Commercial Development Practice [Agile Methodology and feedback, Gamification]

The teaching is based on an agile cycle and the following highlights the key aspects mapped in to the categories already explored.

3.1 Engagement

As noted earlier, engagement is a challenge in higher education, and can be especially problematic in large cohorts. One way to address this is to use data and indicators to help identify where students are failing to engage and may need prompting. In the context of online delivery, this can be through making use of learning analytics, with a focus on where students are actually doing activities. For example: attempts at formative tasks and quizzes, how far they are contributing to community activities such as discussions, and whether they appear to be progressing.

For the modules this year, one approach that worked well was to include formative quizzes so students could indicate their progress with programming and other activities within their modules.

3.2 Gamification

Some gamification approaches to engagement include using quizzes that align with the taught material, and which give immediate marks back to students to help them understand their own progress, akin to the score/high score concept within a game. Utilising banks of questions and/or computer-generated questions, means that these can be done multiple times – similar to the approach of multiple lives/attempts in a game. High score tables (even where anonymous) can assist students in understanding what is possible – as their own ideas of this can be far removed and their own self-assessment of their performance can be inaccurate. Creating dependencies within module materials – so that students should complete one activity before being able to start the next, is also effective in assisting students in understanding the recommended learning journey: akin to many games where completion of some challenges opens up others.

3.3 Front-Loaded Teaching in 'The Tutorial Room'

In project modules, often the focus is on the development of a product or set of artefacts that are expected to be delivered over the course of many months. Much of the knowledge required to succeed in the project needs to be learned and practiced before it can be effectively applied. Rushing to start before key elements, such as project management and the impact of architectural decisions are fully understood, can lead to diminishing returns. Mistakes made early on are hard to rectify, particularly as deadlines loom and restarting becomes impractical. It may also be that the appearance of sunk-cost inhibits such changes. Front-loaded teaching and opportunities for practicing techniques in a consequence-free but intensive first few weeks ensures students have core skills ready to select and utilise when they are required. This has been applied successfully with approximately 30 Masters (level 7) students on a commercial development practice group project. The method is comparable with the concept of a tutorial room in digital gaming [25]. Players are exposed to core game mechanics in a safe environment and given opportunities to practice. This has two beneficial effects: the participant is made aware of what is possible and is then able to be more completely immersed in future tasks. Even where concepts are not fully embedded, to the point of immediate recall and application, exposure ensures awareness that facilitates a return to the taught content when required. It is therefore critical that teaching material is highly available and easily searchable. This is achieved through upload to online digital learning technologies and appropriate signposting in lectures, workshops and forums. Completing the front-loaded section of the module quickly ensures that students can start to make concrete progress on the project. However, two conflicting issues arise, especially when taught content is online: boredom or disengagement leading to slow progress through the tutorial room and a delayed project start, or rushed tutorial room with little retained understanding. Gamification techniques were applied, including:

- providing rewards for progressing through the content (score/high score and rewards – e.g. valuable project information released only upon completion)
- introducing dependencies and barriers to continuation (minimum quiz score before moving on to next section)

This helped to maximise engagement and prevented rushing and superficial learning. Additionally, progress through content is easily monitored by checking quiz returns and number of attempts. This facilitates identification of struggling learners who may benefit from intervention.

3.4 Agile Development

The agile approach was helpful in managing modules and programmes within the context of Covid-19, where teaching and assessment had to be adapted, thus requiring a combination of review, planning, developing and then delivering. This often came in to tension with institutional quality approaches as considered below.

In some modules, especially those with large scope and where technologies move quickly (e.g. level 6, 3rd year/honour's stage, approximately 80 students on distributed systems), these two mechanisms have been partnered with a permanently open, simple and (optionally) anonymous feedback collection system. This online survey allows learners to give immediate observations and comments – both positive and constructive. The existence of this option is reintroduced at the start of every taught session and students are invited to participate proactively in the rapid Agile redevelopment of the teaching.

3.5 Delays in work

When developing software, students frequently exhibit behaviours that are contrary to effective project management, including where this intersects with carrying out other aspects of their studies. This demonstration of "student syndrome" is shown where they hand in work at the last minute, or even beyond the deadline which can lead to penalties (including zero marks being awarded). For some, this problem is exacerbated by the lack of the formality and routine of face-to-face campus learning. Providing recommended due dates to supplement the actual final deadline can help, though there are still many students who are missing the deadlines.

3.6 Flexible Pedagogy

Applying flexible pedagogy in the online variants of the modules subsequent to the Coronavirus lockdown, there are several aspects that were implemented that provide flexibility:

- Where: material and class interaction being provided as webcasts, allows students to participate where they wish;

- When: the recording of sessions allows for flexibility in when to participate, along with the ability to pause and replay, allowing for control of pace. This flexibility of pace was also applied to assessment, with a series of fixed automatic extensions: so students who missed one deadline would automatically be allowed to submit at the next one;
- How: offering a variety of resources, from live webinars, recorded content, written materials, and interactive workbooks all offer a variety of approaches for students to choose what works most effectively for them. Again, this also applied in some cases to assessment: as time progressed and opportunities for assessments varied, students had different assessments made available. For example, team projects in some modules became individual projects (with elements to demonstrate how to organize and plan for team activity, even where that does not happen in practice).

3.7 Quality Processes for Education

The agile approach to teaching is in direct tension with the more linear approach that institutions tend to use for their programme and module update and approval processes. These processes reflect the long-standing nature of a degree: but make rapid responses difficult, and can be a barrier to innovation and change. Another challenge with traditional educational quality processes is that it can constrain assessment practices: especially when it comes to offering alternative assessment choices by a student.

3.8 Covid-19.

The Coronavirus pandemic of 2020/21 has highlighted the challenges, where institutional responses to the rapidly evolving situation tended to generate more bureaucracy, with forms to plan mitigation on delivery and assessment that fell behind the rate of change of other activity. Moreover, planning ahead meant that decisions on timetabling, delivery and assessment patterns were being made prior to any review of the current experience. This emphasizes the need to be able to adopt a truly agile approach to module and programme delivery to allow rapidly adaptive responses. The challenge is how to do that without reducing quality.

4.0 Evaluation

The following table illustrates how we have evaluated the changes that we have made using our blended approaches. For each cohort we have indicated the approaches taken for that particular cohort. We have then indicated the outcomes of these approaches both in terms of the researcher(s) carrying out the changes but also for the outcomes of the students who were participants in this change.

Table 1: Gamification and Flexible Interventions.

Student Cohort / topic	Intervention Action	What the Researcher Learnt	Outcomes for Students
Level 4 (first year). Approx. 150 students on mathematical theory, as well as professional and legal requirements	Gamification, Flexible Learning	Student engagement improved with the used of quizzes with rapid feedback. Helpful for staff to monitor engagement, and to contact those who seemed to be dis-engaged.	Students found the feedback helpful, and improved regular work. The opportunities for different learning resources (flexible) supported a wider range of students.
level 6 (3ed year/honour's stage) 80 students on Distributed Systems	Gamification, Agile Interaction and Feedback	Student engagement increases with clear evidence that the tutor is tracking progress and achievement through weekly quizzes. Students who do poorly or do not participate are easy to identify and support. Feedback quantity and quality improves when students are more integrated into the process.	Satisfaction improves when iterative, perceptible module improvements are based on student feedback and priorities: a year-to-year 24% increase in average overall satisfaction and 47% increase in the "Staff have made the subject interesting" category were recorded when this approach was applied.
level 7 (Masters) approximately 30 students on Commercial Development Practice	Gamification, Agile Interaction and Feedback	Students' progress through a 'tutorial room' section of front-loaded teaching, are able to make faster, more error-free progress on projects. Engagement and fast progress is particularly noticed when barriers to progression (e.g. dependencies and quizzes) are partnered with rewards for progression.	Agile is a core component of a degree associated with software development. When asked to rate their understanding of Agile at the start and end of the module, Students registered a 41.7% improvement. Formal teaching is restricted to one intensive front-loaded week but 97.5% of students agreed that they have improved due to their experience in this module.

4.0 Conclusions

Our aims were to raise the bar both in terms of experience of students and outcomes for them in learning Software Engineering. We did this with Gamification taking a core role but being used in a blend with other techniques like Agile Development, Flexible Learning, and the considered use of Feedback. From the outcomes noted in the above table we can note that we are able to demonstrate that engagement can be improved, with corresponding improvements in retention and attainment.

In regard to the agile model for module (and program) delivery we found that it can be an effective way to manage education during a crisis: though that needs support from institutional processes and systems to allow for academic judgement and for truly adaptive and agile approaches.

What the whole study has done is show that Gamification, Agile Software Development Practices, and Flexible Learning with feedback-led rapid prototyping as techniques in their own right can make valuable contributions to the pedagogical mix. They were also shown to be valuable in the rapid changes caused by the pandemic. What will emerge after COVID is an interesting question? Many of the changes, for example in flexible learning, that have been necessitated by the global situation have situation have worked well. So, the resultant modus operandi that emerges may be a mix of both a return to traditional forms of teaching but also the retention of techniques that proved themselves in the crisis. We have here argued how combining flexibility, gamification, and agile interaction can have a role in this mix.

5.0 References

1 Smith, D. (2010) The effects of student syndrome, stress, and slack on information systems development projects. Issues in Informing Science and Information Technology, 7, pp.489-494.

2 Rigby, S., and Ryan, R.M. (2011) Glued to Games, Peaeer (Oxford, England), ISBN 978-0-31336225-5

3 Laanti, M., Similä, J., & Abrahamsson, P. (2013). Definitions of agile software development and agility. In European Conference on Software Process Improvement (pp. 247-258). Springer, Berlin, Heidelberg.

4 Groccia, J. E. (2018). What is student engagement?. New Directions for Teaching and Learning, 2018(154), 11-20.

5 Gordon, N.A. and Grey, S. (2018) Approaches to Measuring Attendance and Engagement. New Directions in the Teaching of Physical Sciences, (13).

6 Deterding, S., Dixon, D., Khaled, R. and Nacke, L., 2011, September. From game design elements to gamefulness: defining" gamification". In Proceedings of the 15th international academic MindTrek conference: Envisioning future media environments (pp. 9-15).

7 Gordon, N., Brayshaw, M. and Grey, S. (2013) Maximising gain for minimal pain: Utilising natural game mechanics. Innovation in Teaching and Learning in Information and Computer Sciences, 12(1), pp.27-38.
8 McGonigal, J., 2011. Reality is broken: Why games make us better and how they can change the world. Penguin.
9 Visaria, S., Dehejia, R., Chao, M.M. and Mukhopadhyay, A., 2016. Unintended consequences of rewards for student attendance: Results from a field experiment in Indian classrooms. Economics of Education Review, 54, pp.173-184.
10 Pink, D.H., 2011. Drive: The surprising truth about what motivates us. Penguin.
11 Csikszentmihalyi, M. and Csikzentmihaly, M., 1990. Flow: The psychology of optimal experience (Vol. 1990). New York: Harper & Row.
12 Laanti, M., Similä, J., & Abrahamsson, P. (2013, June). Definitions of agile software development and agility. In European Conference on Software Process Improvement (pp. 247-258). Springer, Berlin, Heidelberg.
13 Ryan, A. and Tilbury, D. (2013) Flexible pedagogies: New pedagogical ideas. Higher Education Academy, London.
14 Gordon, N. (2014) Flexible pedagogies: Technology-enhanced learning. The Higher Education Academy, pp.1-24.
15 Shoen, F. (1998) Interfaces in Computer Science and Operations Research: Advances in Metaheuristics, Optimization, and Stochastic Modeling Technologies. Journal of the Operational Research Society, 49(2), pp.183-184.
16 Smith, D. (2010) The effects of student syndrome, stress, and slack on information systems development projects. Issues in Informing Science and Information Technology, 7, pp.489-494.
17 Gordon, N.A. (2016) Issues in retention and attainment in Computer Science. York: Higher Education Academy.
18 Gutierrez, G.J. and Kouvelis, P. (1991) Parkinson's law and its implications for project management. Management Science, 37(8), pp.990-1001.
19 Janssen, M. and van der Voort, H. (2020) Agile and adaptive governance in crisis response: Lessons from the COVID-19 pandemic. International Journal of Information Management, p.102180.
20 Huang, R.H., Liu, D.J., Tlili, A., Yang, J.F. and Wang, H.H. (2020) Handbook on facilitating flexible learning during educational disruption: The Chinese experience in maintaining undisrupted learning in COVID-19 Outbreak. Beijing: Smart Learning Institute of Beijing Normal University.
21 Giannakos, M. N., Pappas, I. O., Jaccheri, L., & Sampson, D. G. (2017). Understanding student retention in computer science education: The role of environment, gains, barriers and usefulness. Education and Information Technologies, 22(5), 2365-2382.

22 Kasurinen, J. (2018). Software Engineering Expectations. Proceedings of the 2018 Workshop on PhD Software Engineering Education (SWEPHD2018)
23 Chetwynd, F., Aiken, F., & Jefferis, H. (2018). Reflections on the 2017 HEA STEM conference: graduate employability challenges and solutions. Higher Education Pedagogies, 3(1), 490-494.
24 Shah, M., Cheng, M., & Fitzgerald, R. (2017). Closing the loop on student feedback: the case of Australian and Scottish universities. Higher Education, 74(1), 115-129.
25 Chiapello, L. (2016). From “spectator knowledge” to “pragmatic knowledge”: how a philosophical understanding of knowledge can help create better video game tutorials. Communication présentée à la conférence The Philosophy of Computer Games Conference: Knowledge, Valletta, Malta.

Elements of Gamification – An Empirical Mapping of Studies to Game Elements

Konstantinos Ntokos

Faculty of Business, Law and Digital Technologies, Solent University
East Park Terrace, Southampton SO14 0YN
Kostas.dokos@solent.ac.uk

Abstract

The goal of this article is to conduct an empirical systematic review on 40 recent studies in Higher Education that have used gamification in some way to engage students with a focus on the used game elements. Additionally, an attempt will be made to empirically map out all the identified game elements in each of the studies, which modules they were used in, the sample size, in what aspect as well as whether they were effective, as stated by the authors of the case studies. The scope is the fields of computer science and game development, as those fields are closely related as both are software oriented. This empirical systematic investigation will lead to data from which certain patterns showcasing best-practice use of such gamification techniques emerge.

Keywords: Gamification, Higher Education, Game Elements, Empirical,

1.0 Introduction

While this article conducts a systematic empirical review on 40 case studies where academics have implemented gamification in their teaching practice, we will not be focusing on the effects of gamification as much as we will be focusing on the game elements used. A game element is a concept that is not to be confused with game mechanics. Game mechanics involve direct actions that players take in games, such as jumping, shooting and running. Further to this, game mechanics specifically are used in Game Based Learning, a technique that is directly using video games to teach. Game elements on the other hand can be seen as building blocks for games. Example game elements are “points”, “badges”, “leaderboards”, “choice” or “levels”. Academics use game elements in order to apply gamification in their modules. Each game element is unique in what it does and how it should be used. Furthermore, each element has a unique purpose. For example, the “points” element

is used to reward students with certain behaviours in a learning activity [1], while the "lives" element act as a loss-aversion mechanic, where students try to avoid a negative outcome in a learning activity in order to not lose lives [2]. "Time" on the other hand can be used to add pressure and excitement in a given learning activity [3], while "Choice" provides students with the feeling of autonomy – a motivating factor according to Self-Determination Theory [4].

This is part of an ongoing research project that is specifically aligned towards Game Development and Software Development courses, group projects and student engagement in video game development courses. While the results are encouraging and indicate that academics use more game elements in the teaching process other than the typical points, badges, leaderboards triad, (also known as PBL Triad) opportunities for further research are also discovered as all the complex variables of gamification, being "mode of delivery", "creativity", "frameworks", "duration" and "tangible objects" can all be simplified through technology-enhanced learning and educational technologies in general. Further to eLearning, careful analysis and dissection of given game elements may also provide insights in the Game Design field, as a better understanding of complex game elements can be turned into interesting game mechanics that can foster enhanced game experiences.

It's already shown in the past that gamification can potentially be one remedy to the problem of student "disengagement", even with caveats [5], and the goal of the paper is to empirically map all used game elements, to identify the frequency across Computer Science and Game Development courses in order to solve that problem, similar to systematic studies done in the past [6, 7]. Gamification is the process of using game elements into a non-gaming context in order to motivate someone in a given activity [8]. But which elements really?

For this project, the authors have gathered data from various papers and case studies from the fields of computer science and game development. The data were then analysed as to the context and type of gamification applied, the number of iterations or cohorts affected, whether it was effective and which game elements were used exactly. As such, a mixed methods approach was followed based on which both quantitative data (elements, frequencies, cohort sizes, iterations) and qualitative data (student responses, contexts, gamification technologies or approaches) were collected. Common patterns were revealed among these case studies and provided a context which provides information on how to optimally use it to gamify a computer science or game development course (or module).

The selection criteria for the cases were based on the following conditions: The cases must be focused in one of the following fields: software engineering, computer programming, game development, game design, game art, animation. Furthermore, we used the keywords "Gamification", "Higher Education" and "Case". A further use of keywords such as "Games", "Game Design" or "Game Development" were used to pinpoint games-related cases specifically. The keywords were used in ACM, ResearchGate, Google Scholar and IEEE repositories. There was no limitation in

student samples, or publication periods. The sample size consisted of 137 papers and 40 fulfilled this simple criterion.

2.0 Case Study Mapping

While related gamification studies have been done in the past [5, 6, 7], in our case we will focus on two different types of studies: Game Development related and Computer Science related. While game development is the focus of this paper, it is apparent that the field is very software-oriented. As such, besides the fact that many theoretical concepts are shared between game-development and computer science, students are learning specific software packages. Programmers focus on Visual Studio, Unity3D and Unreal Engine, while artists are learning 3DsMax, ZBrush and other. Students in both disciplines also learn about project management (game production), software engineering and other concepts. The gamification strategies used in one overlap with the other, as both disciplines are technical and software-oriented education. The same also applies in the field of Game Design.

The data collected will be about the following:

1. The course or module where gamification was applied in, for the investigated case.
2. The game elements used in the case.
3. The student sample size.
4. The way gamification was applied (the method).
5. The outcome of the learning experiment.

For game-development related case studies there are 12 identified cases from 2011 to 2017 (Table 1). The ordering of the cases is chronological.

Table 1. Game development cases

Case ID	Contributor	Gamification Application	Subject Matters(s) Applied	Gamification Results
1	[9, pp. 75-102]	Students allowed to create characters. XP System using additive marking. Optional quests available. Industry people as raid bosses. Competition through physical games.	Game Design N = 25	Positive
2	[9, pp. 183-194]	Narrative-Driven Role-Playing experience. Gamification through points, avatars, story and world creation. Boss fights and gamified activities worth XP and have meaning to the story.	Character Design N = 23	Positive
3	[10]	XP System, Compulsory and Non-Compulsory Activities. Use of JustJeopardy: Quiz software based on Jeopardy TV Show.	Game Design, Animation N = 24	Positive

Case ID	Contributor	Gamification Application	Subject Matters(s) Applied	Gamification Results
4	[11]	Steampunk-themed online learning platform with currencies, XP points, leaderboards, elective puzzle challenges, reward & badge systems	2D Game Design & Development N = 43	Positive
5	[12]	A Framework that provides positive and negative reinforcement based on behavior during group-work. Yellow cards to issue warnings, Red cards to punish students and remove rewards.	Game Production N = 62 (Control Year) N = 74 (Trial Year)	Positive
6	[13]	GradeQuest: A Mobile Application that gamifies the classroom, incorporating characters with backstories and progression through XP points. Furthermore, it features elective quest system of varied challenge.	Game Design N = 17	Mostly Positive
7	[14]	Gamified activities that generate XP points, with optional activities for bonus XP. Personalization apparent with character and story elements.	Game Interactions N = 21 Computer Games N = 35	Positive
8	[15]	Like the above	Computer Games N = 35	Mixed
9	[16]	Mobile-Powered 6-Semester gamification transforming students to "gamedecs" – Game Detectives. Powered by gamified activities linked to XP, avoidance of negative outcomes, special powers, characters and storylines.	Game Design N = N/A	Work In-Progress
10	[17]	Character System for Students which develops in three dimensions: Knowledge (Practice Tests, Exams), Charisma (presence in sessions) and Experience (Projects). Points can be awarded per dimension which is linked to a group of activities.	Games Unit N = 195 (grouped with case 11)	Mixed
11	[17]	Students elect to do traditional exam style assessment or weekly gamified assessment. Lives system reinforcing loss-avoidance motivation.	Games Unit N = 195 (grouped with case 10)	Positive
12	[18]	Gamified activities powered by role-playing technique where students took the roles of developers. Additional design elements were the classic PBL triad using the GradeCraft tool.	Unreal Programming N = 19	Positive

For Software Engineering, Programming and Computing-related case studies we have identified 28 cases from 2011 to 2018. They are numbered 13 to 40 (Table 2). Like in table 1, the ordering is chronological.

Table 2. Software Engineering & Programming Cases

Case ID	Contributor	Gamification Application	Subject Matters(s) Applied	Gamification Results
13	[19]	JFDI Academy: Adventure in Star Wars Universe, Storytelling via Comics. Mission-based. Includes optional missions. Students were Jedi knights acquiring XP.	Programming N = 51	Positive
14	[20]	XP System that fed into increasing levels of students corresponding to marks. Public leaderboard with transparent badges support. Theoretical and Lab Challenges. Both time-limited.	Information Systems & Computer Engineering N=52, 62, 41, 35, 52 (Five Years of Tests)	Positive
15	[21]	The Four-Week Challenge is an intro to the course. Series of Team Challenges with the goal of making a mobile game. Team Leaderboard on school foyer maintains pace. Social interactions are promoted. All activities generate points.	Computing N = N/A	Positive
16	[22]	Q-Learning Game Platform: where students gather points in a 100-point scale based on Work Activities (MC Quiz, Peer Assessment), Planning Activities (Introducing / Assessing Questions) and Social Activities (Blogging, Social Notifications).	Programming N = 22	Positive
17	[23]	6-Week Extreme Programming Challenge with weekly goals. Assessment focused on the team, not the individual.	Extreme Programming N=50	Positive
18	[24]	eMgage: Mobile Learning Application uses traditional PBL mechanics.	Software Engineering N = 10	Positive
19	[25]	A Badge-System integrated on the TRAKLA2 online eLearning environment.	Algorithms and Data Structures N = 281	Slightly Positive
20	[26]	Multiple gamification mechanics implemented in a traditional course making the learning activities more interesting. Choice provided for final assignment.	Software Engineering N = 28	Positive

Case ID	Contributor	Gamification Application	Subject Matters(s) Applied	Gamification Results
21	[27]	A modular board game that teaches concepts based on Bartle's Taxonomy of player archetypes. Boards represent concepts taught and can be combined to form bigger boards. Cards represent knowledge-related questions and affect marks.	Business Informatics N = 24	Positive
22	[28]	Classgame: gamification tool for formative assessment for software engineering education. Features content unlocking, 3-star rating per challenge. Challenges vary in MC Quiz (Knowledge), Programming (Hard Skill) or Peer Assessment (Soft Skill). Stars awarded based on a variant of Certainty-Based Marking, where students stake lives.	Object Oriented Programming N = N/A	N/A
23	[29]	Gamified online course using the self-defined SPARC framework with either individual or team-based challenges categorized into onboarding, midgame and endgame performance phases. Each challenge provided points, the accumulation of which provided academic bonuses.	Software Engineering N = 60	Positive
24	[30]	Gamification Learning Framework (GM1.0) incorporating roleplay terminology into the curriculum	Algorithm Design Data Structures Programming N = 46	Positive
25	[31]	"Gamified": an educational platform with additive grading schemes and all educational terms replaced with gaming vocabulary. All students are role-playing as heroes. Each course is represented as a game world. Topics are chapters of a grand story, heroes earn XP, lab activities are campaigns, and groupings are treated as guilds. Completion of quizzes, homework or activity provide the same amount of XP regardless of quality of work. Guilds make groupings a requirement and the role of General and Leader also provide interesting mechanics.	Algorithm Design and Analysis N = 33 (2014) N = 27 (2015) Computer Organization N = 52 (2015) N = 36 (2016)	Positive
26	[32]	A gamified Software Engineering course evolving around the use of badges with hidden requirements and leaderboards. Students would like badges to be converted to grades.	Software Engineering N = 18	Positive

Case ID	Contributor	Gamification Application	Subject Matters(s) Applied	Gamification Results
27	[33]	A gamified version of a traditional course using multiple game elements such as points (XP), badges, levels, quests, challenges, feedback, progression, even content unlocking. All this is powered through a narrative.	Software Engineering N = 30	Positive
28	[34]	A gamified system utilizing a personality model based on a single dimension of the Five Factor Model (FFM) that is using various game elements such as the PBL triad but also levels, feedback, avatars.	Object Oriented Design Methodology N = 57	Positive
29	[35]	A gamified programming course using flipped classroom technique to apply the PBL triad including avatars.	Programming N = 26 (14 students with Flipped variation)	Positive
30	[36]	A study that maps the use of game elements to specific goals such as learning, motivating, mastering. Multiple game elements and results from both students and experts.	Programming N = 30	Positive
31	[37]	Gamification of programming education through gamified collaborative learning platform, ViLLE. Offers rounds in the format of Tutorial, Exam or Normal Exercise rounds.	Algorithms and Programming N = 193	Positive
32	[38]	A technique involving tangible objects (cards) in which students were asked to solve algorithmic problems by mixing and matching code blocks on cards. This was completed collaboratively.	Programming N = 14	Positive
33	[39]	A gamified approach to learning algorithms and programming by incorporating PBL triad with levels, progress bars as well as a plethora of learning games such as HotPotatoes, Games and LevelUp plugins for Moodle.	Algorithms & Programming N = 22	Positive
34	[40]	A gamification engine using repetition-based online self-assessment methods to gamify its content, which also allows setting up personalized learning paths through the assessment. Further enhancements were leaderboards, points, badges, levels and time mechanics.	Programming N = 23	Positive
35	[41]	Playful learning activities on programming concepts using SMARTIES and 6D Frameworks.	Programming N = 12	Positive
36	[42]	"ProLounge": An online gamified eLearning application used to teach programming skills with mobile counterparts. There are Learning and Assessment phases.	Programming N = 47	Positive
37	[43]	Gamification through Badges built-in on Moodle for Programming course.	Programming N = 71 (Year 1) N = 280 (Year 2)	Positive

Case ID	Contributor	Gamification Application	Subject Matters(s) Applied	Gamification Results
38	[44]	A Gamification System used to teach Software Engineering through three main elements: A Competitive Challenge, Levels of Learning and Hackathons.	Software Engineering (Not Tested)	N/A
39	[45]	"GamiCRS": A 14-Day Gamification Experiment on Software Design course where students improve their code readability skills.	Code Readability N = 81 (Focus) N = 80 (Control)	Positive
40	[46]	A Gamified Traditional course using the following components: Moodle Logs, Levels, Badges, Weekly Surveys, clearly visualized achievement and mastery per topic through points.	Web Design & Programming N = 37 (Focus) N = 38 (Control) N = 108 (2nd Year)	Mostly Positive

After reviewing all 40 case studies, all found game mechanics were mapped (Table 3) (Table 4) (Table 5).

Table 3. Identified Game Elements (From Game Studies)

Elements	Case Studies											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Points / XP	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
Badges				✓					✓	✓		✓
Leaderboards			✓	✓		✓	✓	✓	✓			✓
Levels	✓	✓		✓		✓	✓	✓	✓			
Quests	✓	✓				✓			✓		✓	
Competition	✓	✓		✓	✓		✓	✓				✓
Collaboration	✓	✓		✓		✓	✓	✓				
Choice		✓	✓	✓		✓				✓	✓	✓
Story	✓	✓		✓		✓	✓		✓			
Time				✓								
Clear Goals		✓		✓		✓	✓	✓				
Reward System				✓	✓		✓			✓	✓	
Progression		✓		✓					✓	✓		
Currency				✓					✓			
Feedback				✓			✓					
Challenge						✓					✓	
Abilities						✓			✓			
Avatars	✓	✓				✓	✓	✓	✓	✓		
Luck								✓				
Virtual World	✓	✓										
Boss Fight	✓	✓						✓	✓			
Lives									✓		✓	
Hall of Fame / Status						✓			✓			
Roleplaying		✓										✓

Table 4. Identified Game Elements (CS Studies 13-28)

Elements	Case Studies															
	13	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**
Points / XP	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
Badges	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓
Leaderboards	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓		✓
Levels	✓	✓	✓	✓	✓			✓	✓	✓	✓		✓		✓	✓
Quests	✓	✓	✓						✓	✓	✓		✓		✓	
Competition			✓		✓			✓	✓				✓			
Collaboration	✓		✓	✓	✓			✓					✓		✓	✓
Choice	✓							✓					✓			
Story	✓												✓		✓	
Time		✓						✓	✓		✓					
Clear Goals	✓							✓	✓	✓			✓			
Reward System					✓						✓	✓	✓		✓	
Progression			✓						✓	✓			✓		✓	✓
Currency																
Feedback	✓			✓					✓	✓	✓		✓		✓	✓
Challenge		✓	✓		✓				✓	✓	✓		✓		✓	
Abilities																
Avatars	✓												✓			✓
Luck																
Virtual World												✓	✓			
Boss Fight															✓	
Lives								✓								
Hall of Fame / Status			✓	✓				✓						✓		
Content Unlock										✓					✓	
Roleplaying																

Table 5. Identified Game Elements (CS Studies 29-40)

Elements	Case Studies											
	29	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
Points / XP	✓	✓	✓		✓	✓		✓			✓	✓
Badges	✓	✓			✓	✓		✓	✓		✓	✓
Leaderboards	✓	✓			✓	✓					✓	
Levels		✓			✓	✓		✓		✓		✓
Quests												
Competition										✓		
Collaboration			✓	✓						✓		✓
Choice												
Story												
Time		✓	✓			✓						
Clear Goals		✓								✓		✓
Reward System								✓				✓
Progression		✓			✓					✓		✓
Currency												
Feedback		✓	✓				✓	✓		✓	✓	
Challenge		✓	✓							✓		
Abilities												
Avatars	✓	✓									✓	
Luck												
Virtual World												
Boss Fight												
Lives												
Hall of Fame / Status		✓										
Content Unlock								✓				
Roleplaying							✓			✓		

From identifying specific game elements out of these 40 case studies we can now start formulating "recipes" on all the possible game elements that could be used in game development courses and software-oriented courses in general.

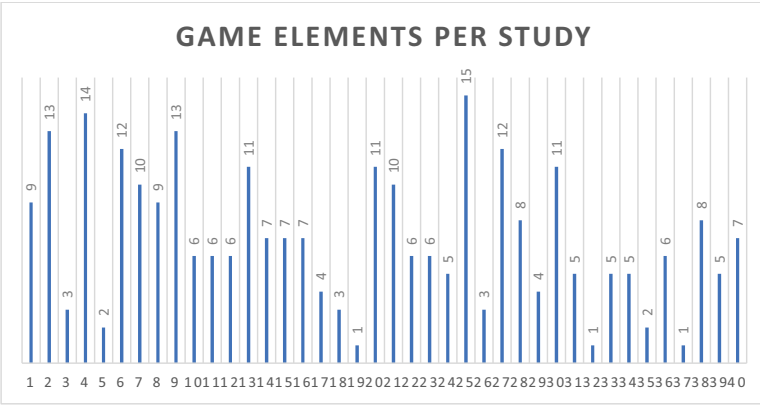


Figure 1. Game Elements per Study

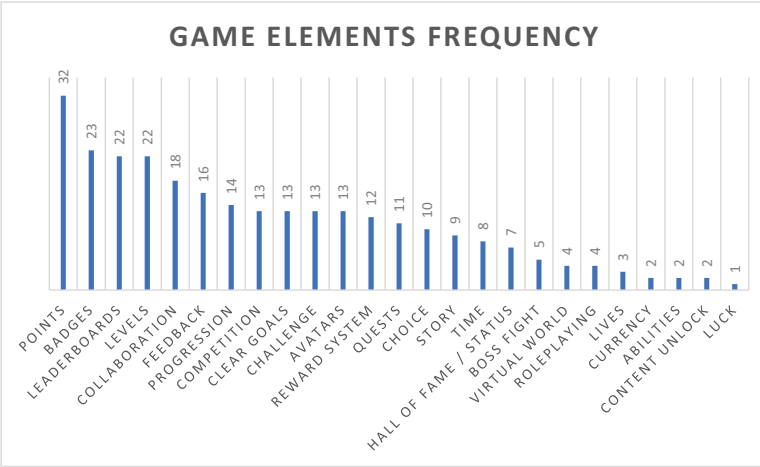


Figure 2. Game Element Frequency (Overall)

3.0 Study Results

In this section we have collected the results observed from the case studies. Preliminary results from dissecting these case studies include the following:

Top 5 Game Elements in popularity and frequency: We immediately notice that the PBL triad (Points, Badges, Leaderboards) is on the top with Points being the most common of all three with 32 cases out of 40 using them (80%). Badges and Leaderboards follow, which are also on par with levels. In 4th 5th and 6th spots we see Collaboration, Feedback and Progression while the 8th spot is shared with Competition, Clear goals, Challenges and Avatars. 9th spot goes to the Reward System while the top 10 finishes up with Quests.

Minor Differences in most frequent game elements between Games & Computer Science courses: The top three most used elements vary a bit. Points is popular in both Game Development courses and Computer-Science courses, with a leading difference in game development (1st is points with 10 cases, 2nd is levels and avatars with seven cases and 3rd place is leaderboards, competition, collaboration, story with 6) but a very slight lead in Computer-Science (22 cases with points, 20 with badges, and 16 cases with leaderboards).

Gamification is multi-faceted in delivery formats: Gamification can be applied on any type of course, across all settings: traditionally in class, via blended learning (class & Learning Management Systems) and completely online (remote teaching, distance-learning).

Objects and other components can be used to gamify: Gamification does not necessarily mean that game elements will be used within the planned activities. Sometimes it could be a tangible object such as a couple of cards, other times it could be modular board games or class-wide roleplaying activities [50].

Gamification can be technology enhanced: Some have implemented it using integrated plugins on their VLEs, others have used mobile or web apps and games. Some have used specialized training software to automate the process.

Academics are not reluctant to try out game elements other than PBL: The PBL Triad (Points, Badges, Leaderboards) is wildly popular, yes, but academics do not fear trying out other game elements as well. Furthermore, some academics have implemented gamification by not using any of the elements of the PBL triad.

Gamification can improve one or more learning metrics: Gamification indeed helps increase student motivation, satisfaction, engagement, attendance, participation and achievement by looking at the possible outcomes of each of the cases. This aligns perfectly by the fact that all those metrics are inherently connected to student motivation [48]. Sometimes the results are slightly positive, other times more than that, but not a single case has had a negative result on the student perception of gamification.

Creativity fuels better gamified modules: Some creative ideas around the world only recorded within a few years range indicate gamification will produce some very interesting case studies in the years to come when the practice has been refined.

Gamification has no set duration: Gamification can be run as an in-class experiment for a couple of hours, days, weeks, months, the entire semester, academic year or even the entire course a student is studying with the right structures and academic team coordination in place.

Seven game elements on average per case: On average seven game elements are used within 40 case studies. Among these case studies, the top-two cases (in terms of frequency) are using 15 [31], and 14 [11]. Two studies share the 3rd position [9, 16] with 13 elements. Out of these a Computer-Science study is on the 1st place while the other three cases come from Game Development.

Potential of discovering new or better use of complex game elements: Emerging techniques such as using digital games, mobile applications or performing Role-Play in class should be explored further as there is a lot of potential for research. Role-Play especially derives from Role-Playing teaching technique. What if Role-Play was used in the classroom, away from traditional PBL and adopting practices from the modern tabletop RPGs [49]? What if instead of roleplaying the developer or the client, you get to roleplay a character [47]?

Gamification can extend beyond frameworks: Not everyone followed a structured approach in designing gamification. Some used well-known frameworks, others used game design approaches, but others just used some elements straight into their everyday prep and had the same impact and positive results.

4.0 Conclusions

Academics should get into gamification and try out different things in their classes. It has been proved in the case studies of this paper that gamification can increase motivation, attendance, engagement, achievement, and satisfaction all in one. As the main contribution in the field, this paper has identified emerging patterns for best-case use of gamification game elements. This can be further expanded upon in future papers where each game element can be analysed in depth.

Another interesting part that could and should be researched further, beyond the traditional “does gamification work” type of research project is the human factor behind it. How do students respond to gamification? Do they like it? Do they hate it? Do they adapt? Do they adhere to the rules? How can academics monitor its’ effectiveness and student engagement and participation? Finally, a very interesting foundation of this would be the PBGL framework, a pre-diagnosis of whether the gamification technique used would be effective and approved by the students [51].

Some interesting discussion for future research could include:

- Automating the administration time required for gamification during prep and in-between the sessions through Technology-Enhanced Gamification Software.
- Dissecting into Game Elements, one-by-one. Best case scenarios for each.
- Gamifying entire courses: A consistent gamification structure supporting every module across a course from welcome week to graduation ceremony.
- Cross-Discipline gamification or solid gamification systems that can be used out-of-the-box in multiple disciplines that are different in philosophy from each other (i.e. Medicine, Law and Maritime Engineering)
- Interesting and daring implementations of pre-existing or new game elements through more case studies.

We are hoping that this paper will be a reference point for any academic wishing to incorporate gamification in their classroom to teach game development. We are looking forward to future research, new frameworks and new case studies that can spread gamification practice across higher education.

5.0 References

1 E. D. Mekler, F. Brühlmann, K. Opwis and A. N. Tuch, “Disassembling Gamification: The Effects of Points and Meaning on User Motivation and Performance,” New York, USA, 2013.

2 S. Şengün and S. Ozturkcan, “Gaining Reward vs. Avoiding Loss: When Does Gamification Stop Being Fun?,” in Emerging Research and Trends in Gamification, IGI Global, 2016, pp. 48-71 doi: 10.4018/978-1-4666-8651-9.ch003.

3 A. Marczewski, Even Ninja Monkeys Like to Play: Unicorn Edition, 2018.

4 R. Ryan and E. L. Deci, “Intrinsic and extrinsic motivations: Classic definitions and new directions,” Contemporary Educational Psychology, vol. 25, no. 1, pp. 54-67, 2000.

5 J. Hamari, J. Koivisto and H. Sarsa, “Does Gamification Work? - A Literature Review of Empirical Studies on Gamification,” Hawaii, USA, 2014.

6 S. Šćepanović, N. Žarić and T. Matijević, “gamification in higher education learning – state of the art, challenges and opportunities,” Belgrade, Serbia, 2015.

7 D. Dicheva, G. Agre, C. Dichev and G. Angelova, “Gamification in Education: A Systematic Mapping Study,” Educational Technology & Society, vol. 18, no. 3, 2015.

8 S. Deterding, D. Dixon, R. Khaled and L. Nacke, “From Game Design Elements to Gamefulness: Defining Gamification,” Tampere, Finland, 2011.

9 L. Sheldon, The Multiplayer Classroom: Designing Coursework as a Game, 1st ed., Cengage Learning PTR, 2011.
10 P. de Byl, “Can Digital Natives Level-Up in a Gamified Curriculum?,” in ASCILITE - Australian Society for Computers in Learning in Tertiary Education Annual Conference, 2012.
11 S. O'Donovan, J.Gain and P.Marais, “A Case Study in the Gamification of a University-level Games Development Course.,” East London, South Africa, 2013.
12 H. Caton and D. Greenhill, “The Effects of Gamification on Student Attendance and Team Performance in a Third-Year Undergraduate Game Production Module.,” Porto, Portugal, 2013.
13 B. De Schutter and V. Abeele, “Gradequest—Evaluating the impact of using game design techniques in an undergraduate course.,” Florida, USA, 2014.
14 M. Sillaots, “Achieving Flow through Gamification in the Course of Computer Games,” Copenhagen, Denmark, 2014.
15 M. Sillaots, “Gamification of Higher Education by the Example of Computer Games Course,” Lisbon, Portugal, 2015.
16 M. Mochocki, “Gamedec. UKW: A case of edu-gamification for game designers,” in 2015 International Conference on Interactive Mobile Communication Technologies and Learning (IMCL), Thessaloniki, Greece, 2015.
17 A. Ptak, T. Lis and P. Bajdor, “Modern educational methods - gamification at schools of higher education in poland,” in Proceedings of the 22nd International Academic Conference, Lisbon, Portugal, 2016.
18 B. R. Maxim, S. Brunvand and A. Decker, “Use of role-play and gamification in a software project course,” in 2017 IEEE Frontiers in Education Conference (FIE), Indianapolis, IN, USA, 2017.
19 B. Leong and L. Yanjie, “Application of Game Mechanics to Improve Student Engagement.,” Singapore, 2011.
20 G. Barata, S. Gama, J. Jorge and D. Gonçalves, “Improving Participation and Learning with Gamification.,” Stratford, ON, Canada, 2013.
21 N. Mitchell, N. Danino and L. May, “Motivation and Manipulation: A Gamification Approach to Influencing Undergraduate Attitudes in Computing.,” Porto, Portugal, 2013.
22 M. B. Ibáñez, C. Delgado-Kloos and A. Di-Serio, “Gamification for Engaging Computer Science Students in Learning Activities: A Case Study,” IEEE Transactions on Learning Technologies, vol. 7, no. 3, pp. 291-301, 2014.
23 B. Akpolat and W. Slany, “Enhancing Software Engineering Student Team Engagement in a High-Intensity Extreme Programming Course using Gamification.,” Klagenfurt, Austria, 2014.
24 A. Bartel and G. Hagel, “Engaging Students With a Mobile Game-Based Learning System in University Education.,” Istanbul, Turkey, 2014.

25 L. Hakulinen, T. Auvinen and A. Korhonen, “The Effect of Achievement Badges on Students’ Behavior: An Empirical Study in a University-Level Computer Science Course,” International Journal of Emerging Technologies in Learning, vol. 10, no. 1, pp. 18-29, 2015.
26 V. Uskov and B. Sekar, “Gamification of software engineering curriculum,” in 2014 IEEE Frontiers in Education Conference (FIE) Proceedings, Madrid, Spain, 2014.
27 B. Taspinar, W. Schmidt and H. Schuhbauer, “Gamification in Education: A board game approach to knowledge acquisition,” in International Conference on Knowledge Management, ICKM 2016, Vienna, Austria, 2016.
28 M. Fuchs and C. Wolff, “Improving programming education through gameful, formative feedback,” in 2016 IEEE Global Engineering Education Conference (EDUCON), Abu Dhabi, United Arab Emirates, 2016.
29 A. Mora, E. Planas and J. Arnedo-Moreno, “Designing game-like activities to engage adult learners in higher education,” in TEEM '16 Proceedings of the Fourth International Conference on Technological Ecosystems for Enhancing Multiculturality, Salamanca, Spain, 2016.
30 X. Cui, Z. Zhang and L. Sun, “Research and implementation of role-playing teaching mode supported by gamification,” Journal of Physics: Conference Series, vol. 887, no. 1, 2017.
31 A. Topirceanu, “Gamified learning: A role-playing approach to increase student in-class motivation,” in 21st International Conference on Knowledge Based and Intelligent Information and Engineering Systems, KES2017, Marseilles, France, 2017.
32 M. R. d. A. Souza, K. F. Constantino, L. F. Veado and E. M. L. Figueiredo, “Gamification in Software Engineering Education: An Empirical Study,” in 2017 IEEE 30th Conference on Software Engineering Education and Training (CSEE&T), Savannah, GA, USA, 2017.
33 P. G. F. Matsubara and C. L. C. D. Silva, “Game Elements in a Software Engineering Study Group: A Case Study,” in 2017 IEEE/ACM 39th International Conference on Software Engineering: Software Engineering Education and Training Track (ICSE-SEET), Buenos Aires, Argentina, 2017.
34 M. Denden, A. Tlili, F. Essalmi and M. Jemni, “Educational Gamification Based on Personality,” Hammamet, Tunisia, 2018.
35 A. Rojas-López and E. G. Rincón-Flores, “Gamification as Learning Scenario in Programming Course of Higher Education,” Las Vegas, NV, USA, 2018.
36 F. L. Khaleel, N. S. Ashaari, T. S. M. T. Wook and A. Ismail, “Gamification-based learning framework for a programming course,” Langkawi, Malaysia, 2018.
37 E. Kaila, M.-J. Laakso, T. Rajala and E. Kurvinen, “A model for gamifying programming education: University-level programming course quantified,” Opatija, Croatia, 2018.

38 M. Carreño-León, F. Álvarez-Rodríguez, A. Sandoval-Bringas and Y. Camacho-González, “Gamification technique for teaching programming,” Tenerife, Spain, 2018.
39 L. Begosso, L. C. Begosso, D. Cunha, J. V. Pinto, L. Lemos and M. Nunes, “The Use of Gamification for Teaching Algorithms,” Poznan, Poland, 2018.
40 Y. A. Permana, D. S. Kusumo and D. Nurjanah, “Gamification for Learning Basic Algorithm,” Bandung, Indonesia, 2018.
41 F. H. C. Silva, A. M. Toda and S. Isotani, “Towards a link between Instructional Approaches and Gamification - A Case Study in a Programming Course,” 2018.
42 B. Kumar and K. Sharma, “A Gamified Approach to Achieve Excellence in Programming,” Jalandhar, India, 2018.
43 L. Facey-Shaw, M. Specht and J. Bartley-Bryan, “Digital Badges for Motivating Introductory Programmers: Qualitative Findings from Focus Groups,” San Jose, CA, USA, USA, 2018.
44 S. Schefer-Wenzl and I. Miladinovic, “Teaching Software Engineering with Gamification Elements,” International Journal of Advanced Corporate Learning, vol. 11, no. 1, 2018.
45 Q. Mi, J. Keung, X. Mei, Y. Xiao and W. K. Chan, “A Gamification Technique for Motivating Students to Learn Code Readability in Software Engineering,” Osaka, Japan, 2018.
46 D. Kermek, M. Novak and M. Kaniški, “Two years of gamification of the course — Lessons learned,” Opatija, Croatia, 2018.
47 K. Ntokos, “The Blackthorn Manor: A Case Study in Teaching Software Engineering for Computer Games Courses Using CodePlay Framework,” Comput Game J, 2020.
48 K. C. Williams and W. Caro, “Five Key Ingredients for Improving Student Motivation,” Research in Higher Education Journal, vol. 12, pp. 104-122, 2011.
49 K. Ntokos, “Swords and sorcery: a structural gamification framework for higher education using role-playing game elements,” Research in Learning Technology, vol. 27, 2019.
50 K. Ntokos, “CodePlay: A Tabletop Role-Playing Game System used in Teaching Game Programming Using Content Gamification,” Comput Game J, 2020.
51 K. Ntokos and D. Lamprinou, "PBGL: Personality Based Gamification in Learning", 2021

Learning and Gaming in a Media Enriched Prolog MOOC

Mike Brayshaw[1], Phininder Balaghan

[1]Department of Computer Science & Technology, University of Hull,
Cottingham Road, Hull, HU6 7RX, U.K.
[1] m.brayshaw@hull.ac.uk

Abstract

In this paper we look how Massively Open Online Courses (MOOCs) can shed new light onto how to teach the logic programming language Prolog. Prolog often proves problematic to teach because of features like unification, backtracking and the use of recursion. Here we employed a rich media MOOC Toolkit to augment an already widely used Web Based Prolog Tutorial. Above this we present two key additional features. Firstly, we wished to explore how to investigate motivation as a key design concern to delivery of this material. To achieve this we used explicit tactics like the novelty of the approach and interactive techniques like gamification. Secondly we looked to software visualisation. A feature of the approach is an emphasis on a clear and consistent model of the virtual machine and the story of language execution, taking a strong influence from Eisenstadt and Brayshaw. In addition to the material we added code-stepping tracing, graphical quizzes and YouTube animations. The MOOC was deployed on a second year undergraduate AI Course over and 8 month period. An evaluation using a cohort of 80 students was undertaken and the results reviewed. Overall the MOOC was well received but the visualisation were given a more neutral response.

Keywords: MOOCs, Visualisation, Gamification, Programming Education, E-Learning

1.0 Introduction

There are some long standing problems in teaching programming languages. Prolog is a mainstream language with distinct challenges. It is notoriously difficult to learn [1, 2, 3, 4]. If you look at trees of the development and evolution of programming languages, Prolog stands apart. Most of the standard control concepts (`if-then-else`, `do-while-until-forever`, `for-x-in-l`, `switch/case`, `forall`, `foreach`) were understood and deployed in 1950/60s languages ranging from ALGOL to LISP. When confronted with a new language, a common technique is to how to code these familiar concepts, noting syntactic novelties, and then continuing in a familiar algorithmic manner. None of these cornerstone building blocks are present in Prolog. Indeed, the very pillars of a Prolog programmers' armoury are recursion and backtracking – programming concepts that can be hard to understand for a neophyte and not typically deployed by a seasoned software

engineer. The paradigm of logic programming is a land that not many programmers journey through and even less dwell.
The educational mix has changed radically since the 1990's. We now live in a world of webinars and mixed reality (real and virtual) teaching. Massively Open Online Courses (MOOCs) have arrived as a delivery technique for online learning resources (https://www.mooc-list.com/). They are widely offered by universities to deliver courses https://www.edx.org/school/mitx, https://www.theuniguide.co.uk/advice/choosing-a-course/moocs-massive-open-online-courses-explained and degree based studies e.g. http://www.open.ac.uk/courses/choose/mooc-busman). Virtual Learning Environments (VLEs) often include MOOC extensions to their provisions (e.g. https://www.canvas.net/). Within this context we chose to revisit the undergraduate teaching of Prolog and look at how we could use a MOOC to look at this problem afresh, within the context of a Traditionally Delivery Course – a blended approach [5]. Before we go on however we will start with a discussion of why Prolog needs a separate and distinctive treatment and why it is qualitatively different from the class of procedural programming languages.

1.1 Why Prolog is Different? Logic Programming is a Distinct Paradigm

Prolog is a logic language which is composed of facts about the world and rules that allow inference about those facts. It is in effect a theorum prover to which the user proposes goals – as programs – to which Prolog attempts to find whether these things are either true or false. It is thus by its very nature alien to other main stream programming languages in the way it works and treats user solutions.

1.1.1 Lack of Explicit Control Features and the heavy use of Recursion

Prolog does not have the standard set of iterative control statements. Novices often hunt for the standard `do while`, `for` or `until` iterative statements conventions present in so many other languages. Instead Prolog uses recursion and backtracking to achieve similar means. The net effect of this is that we cannot read (or write) Prolog programs by looking for such surface scaffolding cues. In conventional code browsing/reading we can use such waymarks to work out what is going on. This is not the case in Prolog, and the use of recursion, a slippery concept for the neophyte programmer, complicates the issue. For example consider the following.

```
squash([],[]).  /* squash of empty list is empty list */
squash([A|B],List):-   /* A list? */
     A = [_|_],
     squash(A,SA),
     squash(B,SB)
     append(SA,SB,List).
squash([A|B],Lists):-   /* where A is  atomic or term */
     squash(A,C),
     append([A],C,List).
```

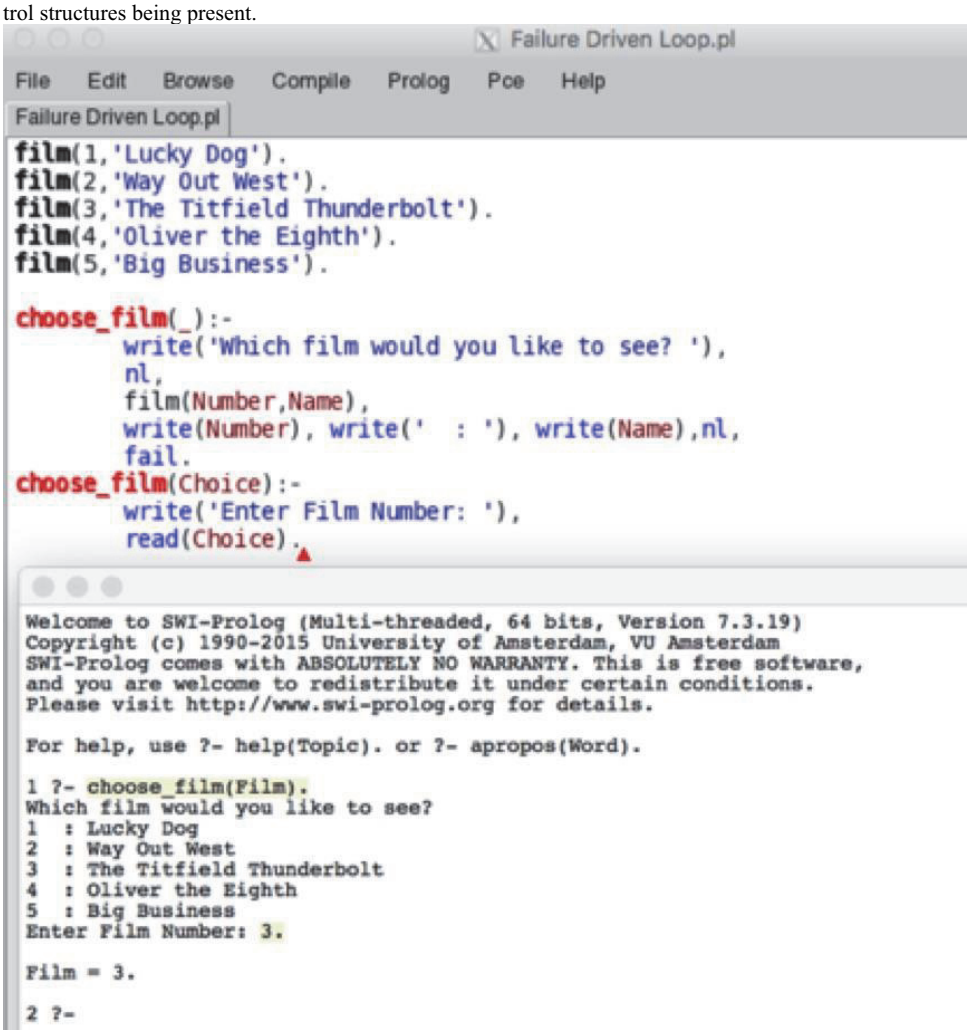
Not only does it rely on top and tail recursion (recursing both on the head structure but also on the tail) to achieve its looping behaviour – but even the naming is given by the programmer. That the different clauses, and their order, implicitly give the control sequence. There is no extrinsic semantics that the programmer can readily interpret. Compare this with another AI Language like LISP and the control is extrinsic and more obvious

```
(defun squash (l)
     (cond ((null l) nil)
           ((atom l) (list l))
           (t (append (squash (car l)) (squash (cdr l))))))
```

Note also the order of the test conditions. Prolog executional pragmatics orders how they should be implicitly authored. Compare this with the easier, more natural logic of the LISP program.

1.1.2 Backtracking

Being a logic programming language this will mean the if a particular branch of the proof tree ends in a dead end then Prolog will backtrack meaning that it will find the last point in the proof tree where an alternative path can be found (the last OR choice in the search) and start searching this new path. As a result program execution is vastly altered from a sequentional progress through lines of code. Indeed bugs are often the unintended result of programs executing code that was never intended because backtracking has resulted in branches of code being traversed when the coder never envisioned that they would be. This however can be exploited by the programmer to make new types of *failure driven* loops, again without any explicit control structures being present.



1.1.3 Advanced Control Features

One of the most commonly misunderstood control features is that of the Prolog 'Cut'. This is used to prevent further backtracking. It freezes the search at the point of invocation and removes further 'or' choices (e.g. using other clauses to solve your query) for the particular predicate at this invocation in the depth first search. The logic in itself defeats many programmers. Further it is often abused by programmers in their attempts to stop Prolog backtracking and render it a language like others

they know. If this is combined with the lack of explicit control then this compounds the problem. Consider the following very useful program.

```
same_var(foo,X):- var(X), !, fail.
same_var(X,Y):- var(X), var(Y).
```

This program checks if the two variables are the same. If they are not the same the cut in the first clause means that the second clause is never looked at. If they were the same variable then binding then first variable to foo would have the consequence of binding X to foo also, so the var/1 test would fail. Otherwise they can't be the same hence the cut/fail ensures failure of the overall goal. If we get to the second clause (which in effect is protected by the first) we just have to check that they are both variables e.g. make sure someone hasn't typed in `?- same_variable(foo,foo).` All this control information is implicit and obvious to an expert and baffling to a novice.

1.1.4 Style of Interaction

Rather than a Compile/Run style modus operandi the interaction takes place via an interpreter style window (though in modern Prologs the code is compiled rather than actually interpreted). Thus the style of interaction with the code is different (although it has modern similarities with IDLE/Pythons shells). Other common programming concepts are also broken. Prolog's notion of variables is at odds with most other languages. For example let us consider the use of variables in a C-family language - we might increment a variable by saying something like

```
x =+ x + sum
```

The first difference in Prolog is that the operator = means do the terms unify, differing from the traditional equality semantics. Thus

```
?- loves(john,mary) = loves(X,Y).
X = john
Y = mary
?-
```

To add confusion the method of quantification of a variable in Prolog is different. When you bind a variable in Prolog to a value it retains that value for the whole scope of that clause or top level goal. So if X = 20 it has this value for the whole encapsulation of X, thus saying

```
X is X + 1
```

means to Prolog

```
20 is 20 + 1
```

which is false. This type of overgeneralizing from other language leads to users writing programs like

```
factorial(X,Y):-
     factory((X-1),F),
     Y is F * X.
```

Rather than the correct

```
factorial(X,Y):-
     X1 is X – 1,
     factory(X1,F),
     Y is F * X.
```

If you want to change the value of something you have to use a new variable, hence X1 above.

1.1.5 Common Misconceptions of Prolog

[4] presented a taxonomy of Misconceptions of the Prolog Interpreter which are a combination of misunderstandings of the Prolog machine and mapping errors from other programming languages. In detail they noted the following common misconceptions.

- Search Misconceptions

Pointer Errors both for a Predicate and a Program (spotting the correct continuation point in a predicate or overall Prolog program)
Magically taking Facts before Rules or Rules before Facts
Meta-analysis of the correctness of the proof overriding Procedural Semantics.

- Backtracking Misconceptions

Try Once and Pass (i.e. fundamentally not understanding backtracking = no going back!)
Redo from Left (from start of clause rather than backtracking to the last OR choice point)

- Cut related Errors

The Transparent Cut (the cut has no effect)
Errors in the scope of the cut
The Grandfather Cut – the cut fails the grandfather goal not just the parent goal.
Cut fails the whole program not just the predicate in which it is contained.
The cut *initiates* backtracking

- Variables and the Cut

The interaction between variable bindings and the Cut.

- Flow of Control and Variables.

Wrong division of labour between backtracking and unification
Undo all variable on failure
Logic Programming specific variable encapsulation errors.

- Predicate footprint errors

Typically calling the predicate with the wrong number of arguments (aka arity errors). Believing that providing the name is right Prolog will figure things out…….
These unique features and potential potholes for novices mean that Prolog is different to learn compared to other languages and has led to its unique treatment in the literature. The work presented here aims to build upon this older work but in the new light of modern delivery methods.

1.2 Teaching Prolog

To tackle the above, we had two other distinct starting points. We employed a widely used internet-based Prolog Tutorial [5] – used with permission. This did provide us with a base set of materials to use. In the work reported here, we wish to refresh the delivery of this material via a MOOC and look to see how we could improve the interaction including the incorporation of additional motivational devices such as game interaction. Secondly, we wished to revisit the use of software visualisation and its role in teaching Prolog. This builds upon previous work in capturing the dynamics of execution and features; like backtracking and recursion [1. 2]. The use of such multimedia was called into question at the time [7] however times and users have changed. We are now much more used to escaping from a VT100 terminal experience. The dawn of MOOCs allows us to go back to this approach and explore it efficacy in a modern context. Modern users are changed since this work was first anticipated and we thus decided to revisit in a contemporary format.
A key approach adopted here is the story of the virtual machine and how it behaves [8],[9]. This is particularly important in a complicated language like Prolog [10, 11, 12]. The Transparent Prolog Machine (TPM), [1] was a cradle to grave story, that accounted for the execution of Prolog which could then be used both for novices and experts alike. This uniquely included all features of the language. It was employed in course material, BBC produced videos and a commercially released

software development environment. MRE [13, 14] was a development of TPM for both Prolog and parallel logic programming (PARLOG) [15]. It sought to streamline the notation of the TPM, whilst offering multiple perspectives that were strictly rooted in a common execution narrative. The visualisation used in this MOOC aimed to directly build upon those used in MRE. The visualisation of Prolog is updated in line with the new work, but the underlying aim of showing a transparent and true virtual machine remain centrally core.
User Interface (UI) and User Experience (UX) have greatly changed since pre-Internet days. It is thus timely to revisit this work. The notion of studying online now has old roots in University Correspondence Courses, Open Universities and more recently in Internet delivery e,g [16]. Modern approaches to blended learning development e.g. [5], reflect a much more pedagogical range and media rich mix. Rather than a single focus or ideological conviction, their aspiration is to adopt a blend of sources to personalise to individual needs and taste. In the work presented here we wish to focus on the following new aspects of blended new learning – MOOCs, Motivation, Software Visualisation and Gamification. Our blend also involves a hybrid of online and traditional on campus content.

1.3 Prolog Code, Code Stepping and Tracing

An important part of an overall cohesive and holistic approach is to provide a MOOC that not only supports educational material but also a detailed account of program execution. Here we wanted to revisit earlier work e.g. [17] and see if users have changed with the advent of a rich multimedia world. Much of the original work was located in a place and time where vt100 style terminals was the norm for interaction when coding. Mullholland (ibid) had found that students were not helped by software visualisations using TPM and preferred text based accounts. One explanation of this is that the visualisation is just one other thing to learn. They are having to learn the target programming language and on top of a visual notation. A possible way to improve this is if the graphical account is more tightly bonded to the textual account so to be one single story not two systems.
TPM was modified so that the Fine-Grained (AORTA) View is updated to be wholly consistent with the Coarse Grained View after the approach taken for MRE in [14]. This move in its own right cut down the amount of notation to learn. This is again an attempt to tighten the single story being told.

2 Massively Open Online Courses (MOOCs)

A major new game changer has been the revolution of delivery of new educational media via MOOCS. MOOCs deliver not just online materials in the way that VLEs do, they offer additional services such as gamification and other motivational devices. Because of this, it is now common place for Universities to offer such provision and pundits predict the trend to grow (BBC, in 2016, http://www.bbc.co.uk/news/business-36703778). This emancipates education, allowing it to be delivered everywhere that has an internet connection. This is frequently for free and from a high standard, august institutions. For example, Stanford University Artificial Intelligence course reports 160 000 enrolled students with 23 000 going on to getting a certificate on successful completion.

There are a number of existing MOOC engines/shells. Amongst them are:

- edX is a MOOC founded by Harvard and MIT (https://www.edx.org/) in 2012 and currently has 85 educational partners. It is a freely available open source platform and has a wide variety of courses available.
- Canvas (https://www.canvas.net/) A cloud native Learning Management System(LMS) that embodies flexible working both for teachers and learners. This allows group working for students, a common dashboard with integrated social media and a strong take on the importance of data analytics.

- FutureLearn, https://www.futurelearn.com, claims over 2,564,816 are currently learning using the FutureLearn system. They offer courses from a wide variety of universities and other cultural bodies. FutureLearn is wholly owned by the Open University (UK).
- FUN, https://www.france-universite-numerique-mooc.fr , is a French MOOC designed to be used by French Universities and their partners worldwide.
- Coursera, https://www.coursera.org , as of 2021 claims to have 1630 courses. All of its courses are available for free however it has a "Signature Track" that allows students to pay for accreditation – if students want to earn University credits or certificates to show to Employers they can pay for this service.

MOOCs allow you to access the information in any particular location, as long as you have internet access. This means that they can form part of the world of Ubiquitous Computing (Ubicom) [18]. Ubicom decouples the link between physical location and participation in learning. It also offers internet interaction with the media affordances that go with it. It is thus a step change from traditional VLEs [19, 20, 21, 22]. This has seen the wide adoption of MOOCs in Higher Education for example see https://www.mooc-list.com/ and by major Universities, e.g. Stanford University http://www.gsb.stanford.edu/exed/, Harvard University https://www.edx.org/school/harvardx and Edinburgh University at http://www.ed.ac.uk/studying/moocs.
MOOCs can be grouped into two types – ones that are more oriented on interaction, process or social computing (labelled cMOOCs), and ones that are oriented on content provision or didactic focused (labelled xMOOCs). xMOOCs may contain recordings of lectures or special made material [23] and could feature famous Professors or other Tele-Dons. In our work, rather than seeking value added from famous Tele-Dons, we have focused on software visualisation and gamification as approaches to provide extra motivational elements. However, [24] considers the above dichotomy to be too simple and proposes eight types of MOOCs. The work undertaken here fits three of the MOOC types that he has proposed – it is a transfer MOOC in that it takes existing material, albeit from previously separate sources, and synthesises them into an unique approach, an asynchronous MOOC that was accessible at any time from its URL and a mini-MOOC that focused on a particular presentation of one University course. For this reason, the completion rate for this MOOC did not differ from a specific course in a typical year. Therefore, it does not suffer from common MOOC completion problems (e.g. see [25], for discussion of completion and quality issues). Specifically, the delivery device used had the affordances of a MOOC and thus it was made clear to the students that they were using a MOOC.

2.1 Engagement and Motivation

Engaging and motivating students is always going to a major factor in system design [26]. The learning literature has been dominated by cognitive aspects of the learning journey [27] at the expense of overlooking the affective system and the importance this has in the learning approach. One approach is to explicitly try and make an intelligent adaptive system that has an explicit model of emotions, for example a motivational strategy production system [28, 29]. The problem with this approach is that it is very hard to do like its forerunner user modelling in the cognitive domain [30]. The approach taken here is that of TPM and MRE to solve the problem in the interface itself. By providing a rich environment we aim to provide appropriate scaffolding [31, 32] to meet both cognitive and affective needs.
[33] have proposed a Self-Determination Theory that frames motivation studies, so rather than being a rigid model it reflects the person and the timing. It is one that is based on rewards and can be applied in our context of learning. Motivations can have *intrinsic sources*, *extrinsic sources* or linked to the cognitive issues of the individual and their social development. This later concern allows for individual differences to be modelled. This is all driven by three basic needs or traits, namely *autonomy, competence* and *relatedness*. These issues can be considered in the interaction overall and built into specific components.

Games can be enthralling and provide rich levels of motivation [34]. As Rigby and Ryan point out, this may involve not just positive emotions but ones of anxiety and frustration too. These characteristics alone present alluring wants to the designers of online education provision. [35] argues that gaming is an essential element of culture. The very act of being in a culture is a game. The presentation of self in a life context can be interpreted as a game [36, 37] notes that all games have the potential to be learning vehicles. The online world on its own is often lonely [38] and distance learning can be an isolated experience [39]. The interactive experience of games is one way to mediate against this. Putting this together with social computing, a MOOC can provide additional opportunities in terms of synchronous and asynchronous user messaging, both text and video. This not only offers new game based affordances for student-tutor interaction but also peer-to-peer student support and peer group scaffolding. Such rich interaction is also motivating us here to combine new learning environments and gamification.

2.2 MOOC Implementations

There are a number of MOOC shells that enable the provision of MOOCs. These provide the underlying functionality of the MOOC which can then be populated with the education material of the hosting University or College. The material is usually provided for free. However to be assessed and/or to progress to an overall exit award, e.g. a Bachelors or Masters degree, usually has to be paid for.
A feature of the work presented here is how a MOOC could be used in a traditional setting without concerns for distance or mlearning. The students were given an edX MOOC as an add on to an existing course.

3.0 The Prolog MOOC

The start of this project was to look at the provision of a MOOC to be delivered on a Raspberry Pi. For this reason, it was decided that the Open Source edX would be the vehicle of choice. As the project evolved, the goal shifted to making the MOOC the main VLE for teaching Prolog on our second year Artificial Intelligence course. This course is part of a Computer Science degree and in the year 2014/5 had 80 students. The raspberry pi had limiting processing power and could only support single users. For this reason, we deployed the edX MOOC onto a virtual machine on the Department's cloud.

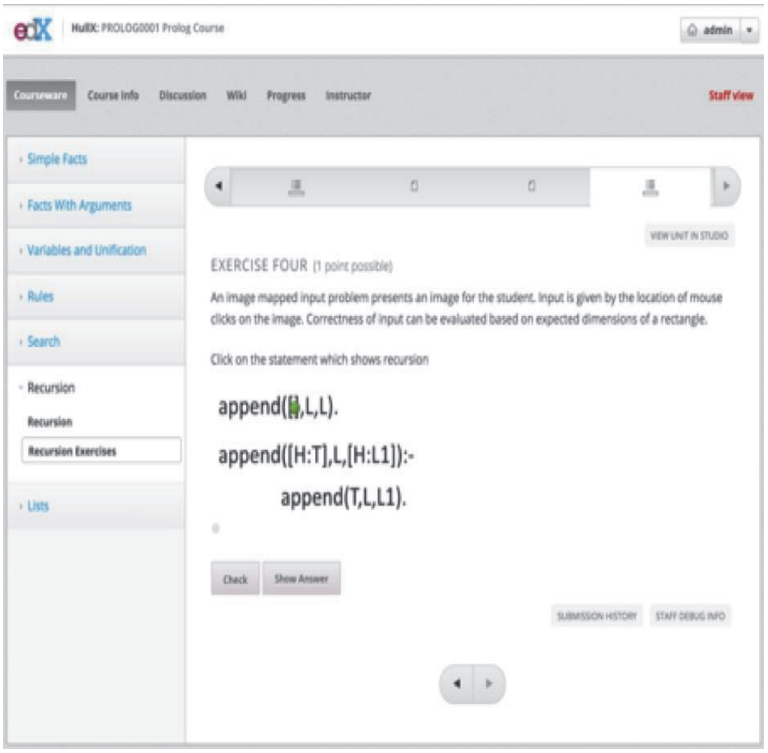


Figure 1 An example webpage of the MOOC in action. While this is the "staff" view, it is extremely similar to the student view, the main difference being the removal of the staff debugging tools

Figure 1 displays a screenshot of a webpage of the MOOC. The screenshot shows a staff view of an exercise currently being undertaken. It is very similar to the view of the student, whereby the only exclusion is the staff debugging tools on the bottom right hand of the screen. The task illustrated requires the student to click on the part of the program that represents the recursive call.

The top of the screenshot in Figure 1 shows the navigation available to the user. This navigation bar has various different webpages that each serve a different purpose. The courseware contains the various different weeks and lessons to cover throughout the course. The course info contains a general overview of the course. The discussion section allows the user to post in a forum, and discuss any issues that may or may not have arisen. The wiki is an area whereby the staff can post more information, or further reading about the topics covered in the courseware. In progress, the user is given their current progress in covering the topics in the MOOC. These include both graded and ungraded exercises. We will be focusing on the courseware section of the MOOC.

The courseware consists of weekly topics. These weekly topics contain lessons. Lessons typically include things like videos, readings, interactive questions, game elements and others.

The weekly topics are on the left hand panel in the screenshot in Figure 1. An example of a weekly topic would be the *Recursion* or *Rules* headlines. A weekly topic can contain numerous lessons, such as the *Recursion* and *Recursion Exercises*, which also can be accessed on the left hand side of the screen. Within the lessons, various exercises can be accessed. These can be found in the bar surrounded by arrows in the top-centre of the screen. They can be clicked through at any time. The exercises can be graded exercises, as shown in Figure 1, or they could be informative, as shown in Figure 3.

The exercise in Figure 1 shows an image mapped input problem which can be classified as a gamification problem. The student has to click on a location within the image where the answer is correct. The student's click is signified by a green dot. The staff member can set the "input box" of the question, essentially the box where the student has to click for the answer to be correct. Exercises can be repeated by the student. This can invoke a "have another go" game like spirit [40] to try and improve their previous scores.

For each exercise the student can "check" answers. The amount of times the students can check answers can be limited, but are set to unlimited as default. If the student is correct then a green tick is shown, similar to the correct answers in Figure 2. If an answer is incorrect, a few more options become available. Firstly, a red cross is used to signify an incorrect answer, again shown in Figure 2. A "Show Answer" button can also be shown, which will show the correct answer. This can be disabled, or changed into a "Hint", which will instead give a hint to the student.

To add software visualisation to the MOOC, we created various different animations. These were created by combining a PowerPoint presentation with a screen-recording tool. The animations were then converted into MPEG movies and then linked via YouTube with the MOOC. An example screenshot of an animation can be seen in Figure 4. The movies illustrated the examples in the course but with a code stepper also featured to tie the code and animation closer together as illustrated in Figures 2 & 3.

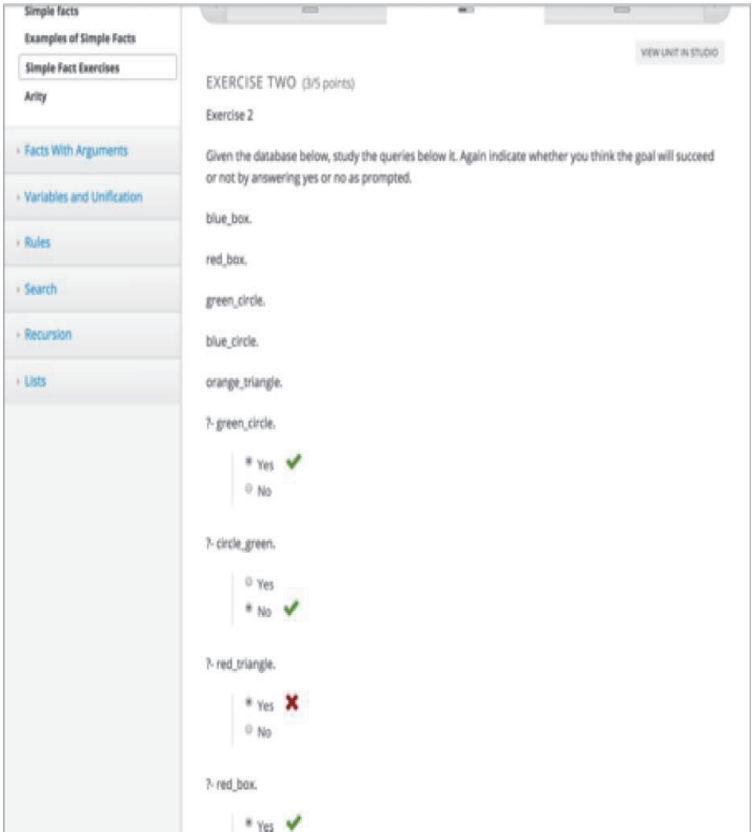


Figure 2 A Quiz Exercise. On line quizzes used as motivation devices. Like a classic arcade game you can have another go to see if you can go one better.

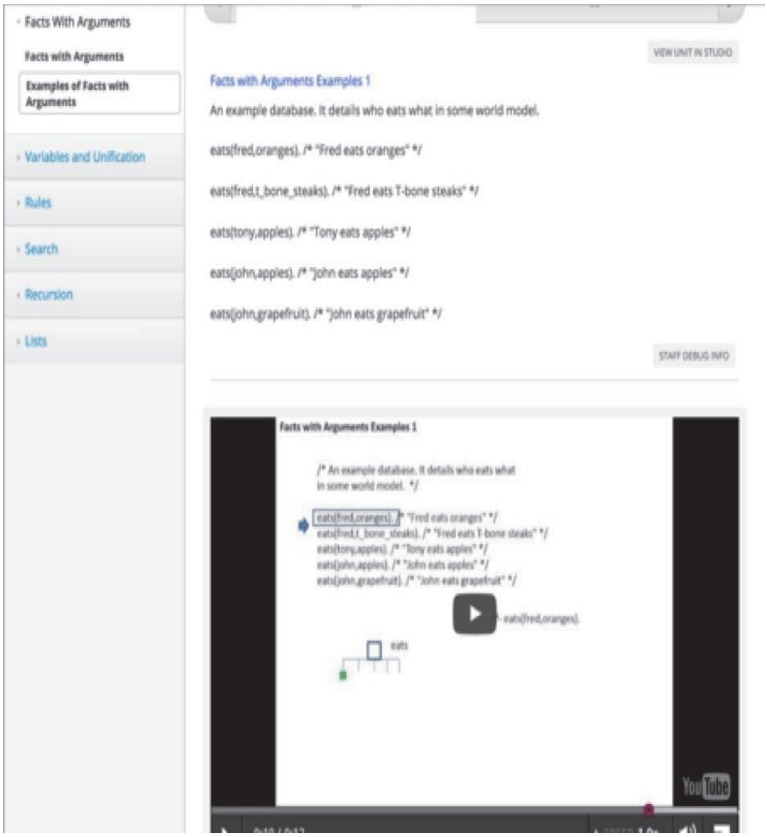


Figure 3 An example of a MRE Fine Grained View showing the execution of the goal ?- eats(fred, Oranges). and the successful match with the first clause.

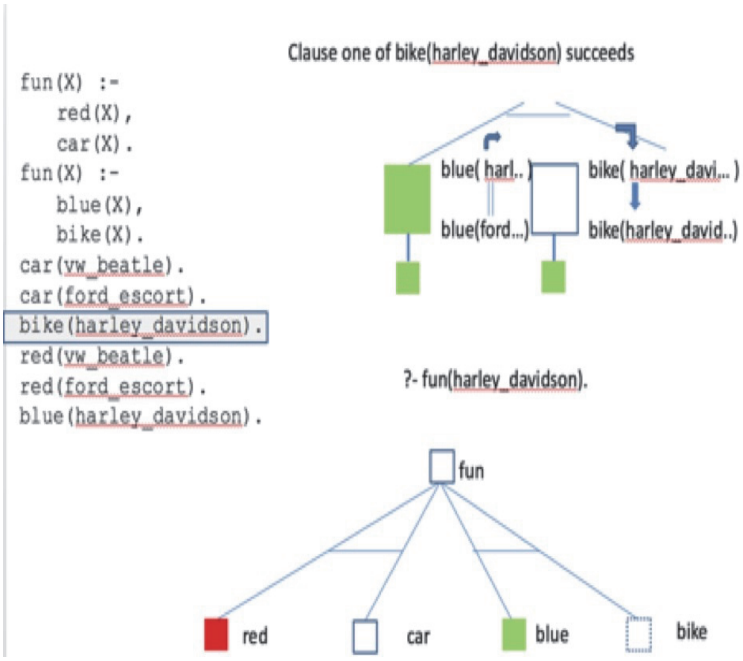


Figure 4 An mid-execution snapshot of the fun/1 program showing on the left the conventional code stepper which is attempting to prove the goal bike(harley_davidson) and its matching using the highlighted fact. The Fine Grained View (showing individual clause unification) is at the top right, whilst the lower view is the Coarse Grained View showing the state of the program execution and backtracking history.

3.1 Motivation and Gamification

One of the key insights into getting students to buy into course material is motivation and engagement. At the time the course was being run MOOCs were much in the headlines. The students were told that:

- We would be using a MOOC for the course
- It would be the first undergraduate MOOC used in the University at the time
- This was a motivating factor. We intended that this would add extra impetus given the current zeitgeist.

A second motivating factor was for the activity to be enjoyable and fun. Prolog gets a bad press not least within the student body. We were thus keen to get game elements into the material. By placing game activities into the MOOC we wanted to increase the student's engagement within the tutoring environment. Examples are shown in Figures 1 and 5. These involve a sorting game and a pointing game.

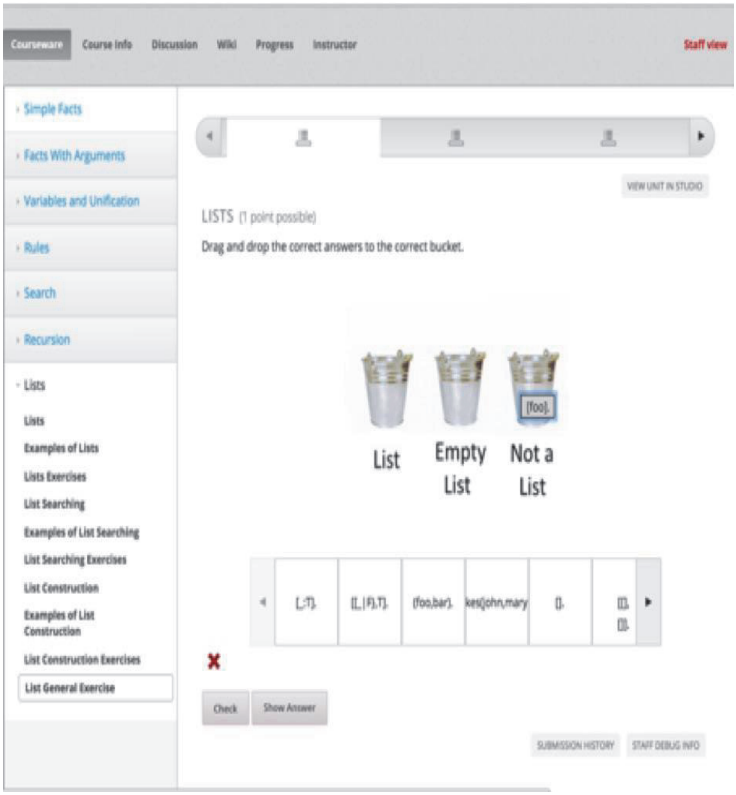


Figure 5 A Sorting Game. The goal is to correctly drop the items in the menu below into the appropriate bucket.

Key issues of autonomy (the students chose when to use the MOOC, how often and where), competence (both in terms of achievement and also game dynamic) and relatedness were thus present in the basic design.
The course ran successfully during in both Semesters of the Academic Year.

4.0 Evaluation

We evaluated the performance of the MOOC. At the end of the 9-month course, students were asked if they had use the MOOC. 40 out of 80 registered students had positively responded. Of the others they typically reported that they had not engaged with extra material, had not looked for it or had not completed the course. Those that had used the MOOC were asked to complete a simple evaluation questionnaire. This included general and specific features of the MOOC. The questions, responses and reflections upon them are as follows.

The first question asked the student if they have used the MOOC. If they responded positively we present their responses to the remaining questions in Figures 6, 7, 8 and 9. Responses for the remaining questions were via a five bar Likert scale which we have summarised into Positive, Negative, and Neutral responses. Of the 40 responses we got 4 were excluded from the final data as they have not followed the experimental instructions and their responses were ambiguous in interpretation.

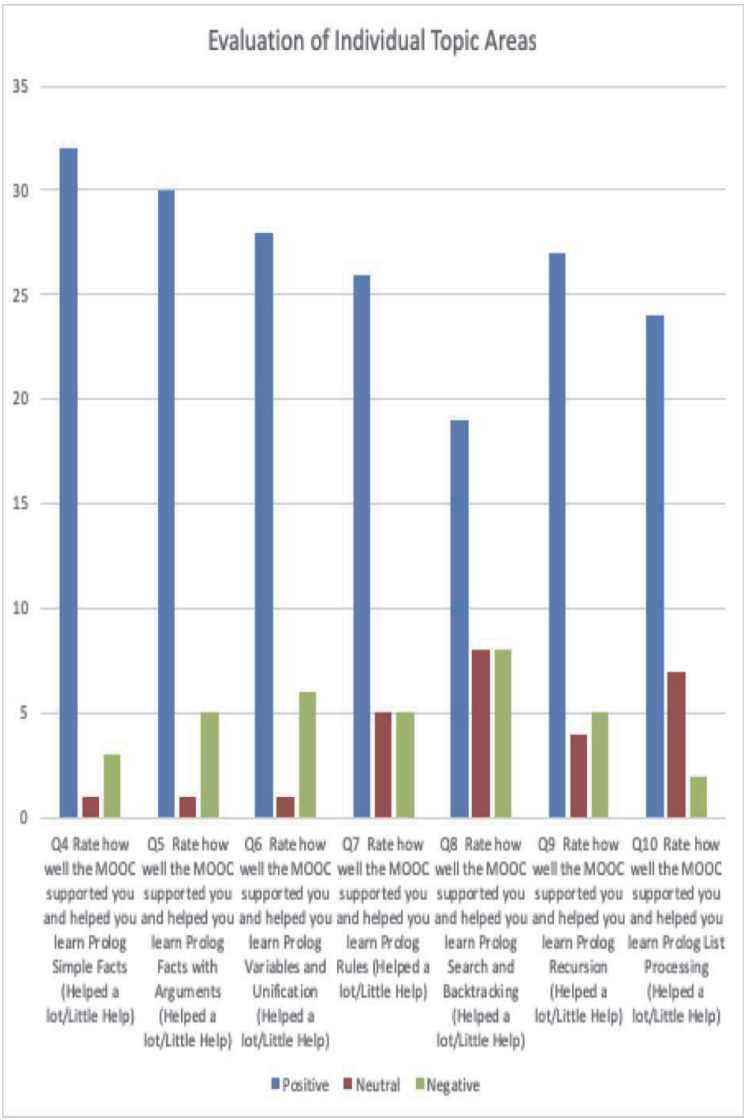


Figure 7 Showing questions along the bottom and responses on the top. Note the logic of the Likert Scale (Little Help/Lot of Help or Lots of Help/Little Help) was reversed on occasions to encourage question engagement but this is omitted for clarity.

The evaluation focused on each particular topic element in the MOOC material. These are the weekly topics in the Prolog MOOC. The story for all weeks are consistently positive. The majority of people found the MOOC to be helpful particularly for the more basic elements. This includes to a lesser degree the problematic issues of recursion and backtracking which are known to be difficult areas. It was hoped that the more dynamic elements of the execution story would have been helped by the visual story as shown in the animations but there is no clear evidence of this.

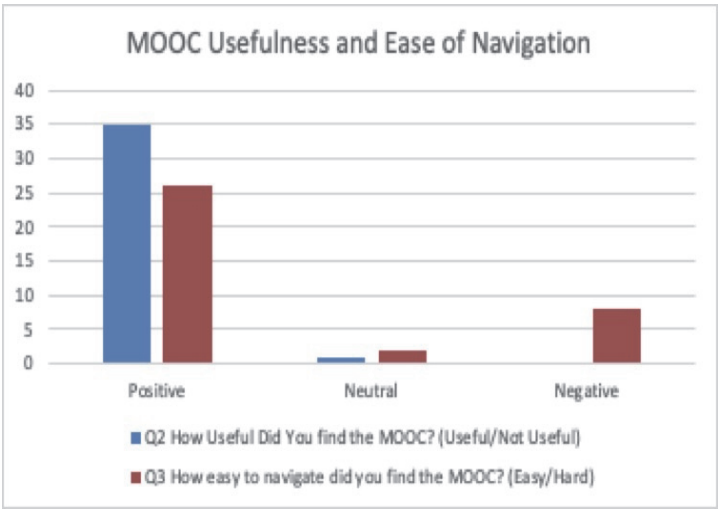


Figure 6 Questions 2 and 3 are shown at the bottom of the figure and the responses in the bar chart.

Figure 6 shows that they all found the MOOC to be useful although there were some minor navigational problems. This was the first time they would have come across EdX so maybe part of this may be in part due to novelty. While all the navigational features were present on each page, this is still an area needs looking at again.

In Figure 7 we then went into particular topic elements in the course and looked as to how they viewed.

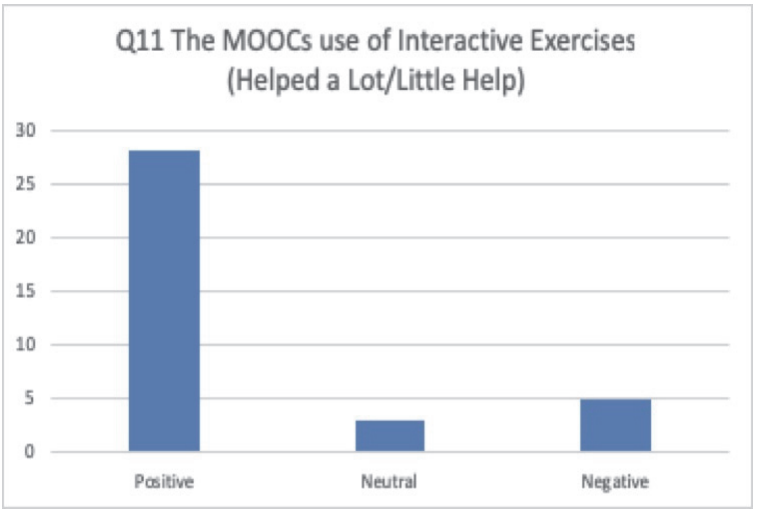


Figure 8 The Use of Interactive Exercises like the Sorting Game

The interactive Exercises included quizzes and other games. These seem to be well liked and provided popular. as shown by Figure 8.

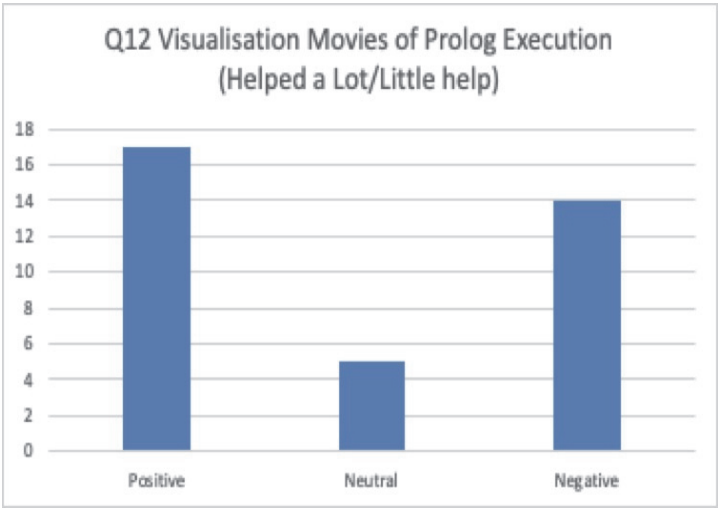


Figure 9 How Users Perceived the Usefulness of the Movies of Prolog Execution

In Figure 9, the jury seems totally split by the use of the visualisation techniques. What was not captured was how many people had actually engaged with them. The majority, 17 out of 36, were positive. One unsolicited comment was that they would have benefited from a soundtrack. The same animations were also used in the lectures with accompanying explanation, and went down well. A comment added to the questionnaire was that they would have been better if they had the commentary as given in the lectures. This would be consistent with the notion that the extra notation is potentially yet more to learn on top of the language itself. An accompanying soundtrack, telling students what the animation is telling might mitigate this, emphasising the single story we wish to tell, and will be investigated on the next iteration of this work.

5.0 Conclusions

The work presented here has two distinct strands. One was to investigate a MOOC within a classics classroom context and see how it could add to the UX noting the motivational impact that it can make. To this end the MOOC was well received by the students, as revealed in the evaluation. They reported it helpful in all aspects of the target syllabus. Overall they reported it as being very useful. A second strand of the work looked at media enhanced aspects of the MOOC, specifically to focus on revisited work on software visualisation and looking at what impact factor this may have as another motivational tool. The intuition here was that concrete visual models of the virtual machine in action could help neophyte programmers gain a better understanding of the workings of the target programming language. The additional overhead of yet more to learn would be offset by advantages that this brought. The changes in user's affordances to multimedia since the original conception of the work, the escape from command lines and VT100s, was also taken into account. Broadly the additional media went down well, thought there was a split in the results. Tighter integration and a spoken sound track to the trace material would be good avenues to pursue in the future. In this respect this is therefore the first pass of work to revisit TPM/MRE and update it to see if it can be made to strike a new relationship with a modern audience in a modern media rich environment. Taking both strands together one of the key features that we wished to investigate here is motivation and how a Classroom MOOC might be used as a suitable device to deliver this. If you have enthusiasm and class motivation behind you these are important facilitators in successful educational delivery and the work reported here is part of our ongoing efforts to investigate and aspire to achieve those goals.

6.0 References

1. Eisenstadt, M., and Brayshaw, M. (1988) The Transparent Prolog Machine (TPM): an execution model and graphical debugger for logic programming. *Journal of Logic Programming*, **5**(4),pp. 277-342, *ISSN 0743-1066*
2. Eisenstadt, M., and Brayshaw, M. (1989) An integrated textbook, video, and software environment for novice and expert Prolog programmers. In E. Soloway and J. Spohrer (Eds.) *Studying the novice programmer.* Hillsdale, N.J.: Lawrence Erlbaum Associates, *ISBN 0-8058-0002-6*
3. Du Boulay, B., Brna, P, and Paine, H *Learning to Build and Comprehend Complex Information Structures: Prolog as a Case Study*. Stamford, CT: Ablex, 1999. ISBN: 1-56750-434-5
4. Fung, P., Brayshaw, M., du Boulay, J.M.B., and Elsom-Cook, M.T., (1990) A Taxonomy of Novices misconceptions of the Prolog Interpreter. *Instructional Science,* **19**, pp. 311-336, *ISSN 0020-4277*
5. llen, B. (2007) *Blended Learning Tools for Teaching and Training.* ISBN: 978-1-85604-614-5, Facet Publishing, London, 20-07
6. Brayshaw, M. (2000) A Short Prolog Tutorial, widely available around the world see for an example http://www.doc.gold.ac.uk/~mas02gw/prolog_tutorial/prologpages/ *[Accessed 7/4/21]*
7. Mulholland, P. (1995) A framework for describing and evaluating Software Visualization Systems: A case-study in Prolog. PhD Thesis, Knowledge Media Institute, The Open University.
8. du Boulay, B., O'Shea, T.M., and Monk. J., (1981) The black box inside the glass box: Presenting computing concepts to novices. *International Journal of Man-Machine Studies*, 14:237-244.
9. Eisenstadt, M., (1983) A User-Friendly Software Environment for the Novice Programmer, *Comms ACM*, **26**(12), December, ISSN:0001-0782
10. Bundy, A., Pain, H., Brna, P., and Lynch, l. *A Proposed Prolog Story*, Research Report 283, University of Edinbugh, 1985.

11. Brna, P., Bundy, A., Pain, H., and Lynch, L. (1987) Prolog Tools for Prolog Environments, , in J.M. Hallamd and C. Mellish (Eds), *Advances in Artificial Intelligence*, Chichester:Wliey
12. Pain, H., and Bundy, A., (1987) What stories should we tell novice Prolog Programmers? In R Hawley (Ed), *Artificial Intelligence Programming Environments*, New York:Wiley.
13. Brayshaw, M. (1991) An Architecture for Visualising the Execution of Parallel Logic Programming. *Proceedings of the Twelth International Joint Conference on Artificial Intelligence (IJCAI-91).* Los Angeles: Morgan Kaufmann.
14. Brayshaw, M. (1993) MRE: A Flexible and Customisable Program Visualisation Architecture, In J. Alty, D. Diaper, and S. Guest, (Ed.) *People and Computers VIII*. Cambridge University Press.
15. Gregory, S., (1987) *Parallel logic programming in PARLOG: the language and its implementation*, Addison-Wesley, Reading, MA, ISBN 0-201-19241-1.
16. Eisenstadt, M., Brayshaw, M., Hasemer, T. and Issroff, K. (1996) Teaching, Learning and Collaborating at an Open University Virtual Summer School. In *Remote Cooperation: CSCW Issues for Mobile and Teleworkers*. (ed. A. Dix and R. Beale) Springer, London.
17. Rajan, T.M., (1990) Principles for the Design of Dynamic Tracing Environments for Novice Programmers, *Instructional Science*, **19**, pp. 1-29.
18. Brush, AJ, (2014) The UbiComp Community, http://www.sigchi.org/communities/ubicomp, [Accessed 1st November 2018].
19. Goldberg M W, (1997) *WebCT, a tool for the creation of sophisticated web-based learning environments* (demonstration) [Online], ACM. Available: http://portal.acm.org/citation.cfm?id=266057.266195&coll=Portal&dl=GUIDE&CFID=16355218&CFTOKEN=76882829 [*Accessed 7/4/21*].
20. Beauvoir P et al, (2004) *RELOAD Reusable eLearning Object Authoring & Delivery: Reload Editor & Content Packaging: A Quick Start Guide* [Online],]
21. Dalziel, J. R. (2006) Lessons from LAMS for IMS Learning Design, *Proceedings of the Sixth IEEE International Conference on Advanced Learning Technologies ICALT '06*, ISBN: 0-7695-2632-2, pp. 1101 – 1102.
22. The Sakai Foundation, (2008) About Sakai, (Online), Available: https://sakaiproject.org/ [*Accessed 7/4/21*],
23. Jona, K. and Naidu, S. (2014) MOOCS: emerging research, *Distance Education*, **35**(2), pp.141-144.
24. Clark, D. (2013). MOOCs: Taxonomy of 8 types of MOOC. Retrieved on 8 June 2016 from http://donaldclarkplanb.blogspot.co.uk/search?q=MOOCs:+taxonomy
25. Hayes, S. (2015*) MOOCs and Quality: A Review of the Recent Literature, UK Quality Assurance Agency for Higher Education (QAA)*.
26. Coates H. (2006) *Student engagement in campus-based and online education: University connections.* Routledge, ISBN 0-415-39395-7
27. Anderson J R and Jeffries R, 1985, *Novice LISP Errors: Undetected Losses of Information from Working Memory, Human Computer Interaction*, **1**, 107-131
28. du Boulay, B., and del Soldaro, T. (1995) Implementation of Motivational Tactics in Tutoring System, *Journal of Artificial Intelligence in Education*, **6(**3),pp. 337-378.
29. du Boulay, B., and del Soldaro, T. (2016) Implementation of Motivational Tactics in Tutoring System: 20 years on, Int Journal AI in Education, **26**, pp. 170-182
30. Self, John, (1994) The Role of Student Models in Learning Environments, AAI/AI-Ed Technical Report No. 94 in *Transactions of the Institute of Electronics, Information, and Communicaion Engineers*, E77-D(1), 3-8.
31. Wood, D., Bruner, J., & Ross, G. (1976) The role of tutoring in problem solving. *Journal of Child Psychology and Child Psychiatry*, 17, 89−100.
32. Vygotsky, L. S. (1959) *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.
33. Deci, E., & Ryan, R. (Eds.), (2002) *Handbook of self-determination research*. Rochester, NY: University of Rochester Press., ISBN 1580461565

34. Rigby, S., and Ryan, R.N., (2011) *Glued to Games: How video games draw us in and hold us spellbound*, Praeger, (Santa Barbara, CA), ISBN 974-0-313-36224-8
35. Huizinga, Johan , (1955) *Homo ludens; a study of the play-element in culture*. Boston: Beacon Press. ISBN 978-0-8070-4681-4.
36. Goffman, E., (1959) The Presentation of Self in Everyday Life, University of Edinburgh Social Sciences Research Centre. ISBN 978-0-14-013571-8. Anchor Books.
37. Blow, J., (2008) GDC: Blow's Ten New Challengers for Game Design, URL http://www.gamasutra.com/php-bin/news_index.php?story=17535#.UPW2bmdgj0U (Accessed 7/4/21).
38. Turkle, S. (2010) Alone Together: Why we expect more from Technology and Less from Each Other, Basic Books. ISBN 0465031463.
39. *Willems, J.* (2007) *The Loneliness of the Distance Education Student [online]. In: Stepping Stones: A Guide for Mature-aged Students at University. (Ed Jill Scevak, and Robert Cantwell): ACER Press, 83-92. Availability:* http://search.informit.com.au/documentSummary;dn=361659693144693;res=IELHSS *ISBN: 9780864314147* [Accessed 3/7/16],
40. Gordon, N., Brayshaw, M. and Grey, S. (2013) Maximising Gain for Minimal Pain: Exploiting Natural Game Phenomena: Utilising Natural Game Mechanics. *Innovation in Teaching and Learning in Information and Computer Sciences* **12**(1), 27-38, DOI: 10.11120/ital.2013.00004

Gamification Toolbox for Academics: Identifying Best Practices for using Game Elements in Higher Education

Konstantinos Ntokos[1]

[1]Faculty of Business, Law and Digital Technologies, Solent University,
East Park Terrace, Southampton SO14 0YN
Kostas.dokos@solent.ac.uk

Abstract

Game elements are integral components of gamification, (such as points, badges, choice or rewards) not to be confused with game mechanics from video games (such as jumping, shooting etc.). Each element serves a different purpose. The article is a follow-up from a previous study in Solent University around gamification where recent case studies (N=40) were scrutinized on how gamification was used to improve the learning experience and the students' motivation. For each of these cases, the game elements were identified, as well as the way they were implemented in teaching. As a result of this, trends and best practices started to emerge, creating a pattern. The focus of the article is to become a gamification reference, listing identified features and best practices for each game element. Every game element has a unique use in the higher education context, depending on the class size, the academic's past experiences, the subject matter, the cohort, and even timetabling. Some of the game elements can easily be implemented in face-to-face or online teaching as a one-off activity, however others require more thinking and planning beforehand, requiring significant intertwining with the entire unit's schedule, activities and even assessment. Gamification is difficult to be implemented by someone with no prior experience, and additional reading is required to obtain an improved understanding of the game elements it has. This is an attempt to demystify this process and make gamification more accessible to all higher education academics.

Keywords: Game Elements, Point, Badge, Leaderboard, Higher Education

1.0 Background

Gamification is an experiential design process that adds game elements to a non-game context, making it more engaging. Therefore, gamification is about designing engaging experiences, fuelled by game-design that aids to improve immersion on any non-gaming context [1]. This concept is sometimes confused with Game-Based Learning. Game-based learning (GBL) is when learning occurs through a virtual gaming world like educational or serious games. This is a video game genre where the game cultivates an ideal virtual learning environment in which the player can achieve mastery on specific learning material.

The questions academics have is "Does gamification work?" It was shown in the past that gamification can work, has a positive impact on student participation and has seen significant increases in attendance, engagement and achievement [2]. Our goal is to identify the elements we can use in our units to improve motivation, and how to use them.

Another question is whether it's worth being used. While some students may argue that it doesn't make a difference because they could pass a unit with or without gamification, research suggests that it has multiple benefits in learning [3]. Some of those benefits include behavioural changes [4] and overall engagement improvement besides the students' performance. This has a ripple effect for higher attendance [5] and satisfaction [6]. Besides, gamification of a unit is a holistic approach to the entire cohort, aiming to improve the performance of as many students as possible, including those who borderline fail. Even a small improvement is still an improvement, thus making gamification worth it.

This is an attempt to contribute by identifying which game elements exist, in order to create a "gamification toolbox" from which academics can use the best-suited game elements to enhance motivation of their student cohorts in their units. As researchers suggest, albeit gamification started with a focus in computing and HCI disciplines, it has recently become multi-disciplinary [7].

2.0 Research Methodology

Forty case studies (N=40) were collated and analysed according to how each academic used gamification elements in his/her units. 12 studies came from game-development oriented units and 28 came from general software engineering and programming disciplines. The reason, such disciplines were selected, was because it was the requirement of our research project in the computer games course at Solent University. Keywords such as Gamification, Higher Education, Software Engineering were important to limit the scope of cases.

For each of these cases, the application of gamification was examined, and all used game elements were empirically identified. After aggregating all the data, it was possible to draw out a graph related to the frequencies of each game element present (Figure 1) as well as identify common trends, examples to avoid and best practices that emerged. The examples to avoid or best practices to follow were generated based on the outcomes of the learning experiments as recorded in the case study by the academics.

As a follow up of this case study review, based on the generated data, best practices and traits can be identified. This paper attempts to answer the following research question: What out-of-the-box game elements of gamification are currently available for academics in Higher Education and how can they be used?

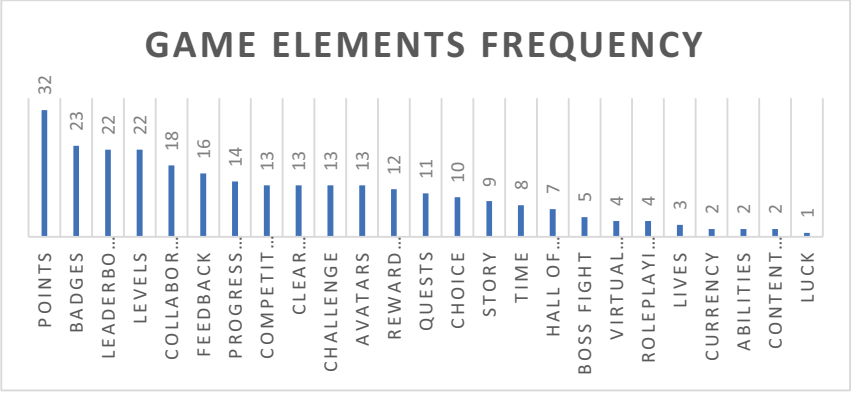


Figure 1 - Game Element Frequency (Overall)

3.0 Anatomy of Gamification: Game Elements

By studying these cases we have discovered different ways a game element can be used in the classroom. Not every game element has the exact same use, and before anything is applied in either online or face-to-face teaching must be carefully validated and monitored to clarify whether it has the expected results. The elements will be listed in order of descending frequency as found in the investigated cases.

Starting off with the "PBL triad" as introduced by Werbach & Hunter, Points, Badges and Leaderboards [8] are by far the most used game elements, due to their simplicity in implementation.

3.1 Points

The Points element provides visual and immediate feedback to students. In games, the higher score we have (and thus the more points we have) the better we are performing. In-game actions award us points. Consequently, if a player earns a lot of points by doing an action, this is already feedback from the game; he/she is performing well and he/she is awarded for it with a high score. Getting less points is the game's way of saying that maybe we should try something else in order to score higher. Higher points mean that a specific game task was completed in higher accuracy (more headshots over limb/body shots in a shooter game), speed (who shots first), or efficiency (neutralizing more enemies). The same principle can be used in learning experiences.

In a typical assignment or learning activity, the tutors could award students more points proportionally to the achievement of the learning outcomes [40]. This happens when the work is marked at the final summative. However, in games, players get points and constant feedback (+30pts, +50pts etc.) as they play. They know if they perform well and they adjust their effort. In learning this doesn't usually happen. Feedback is not 100% guaranteed to be followed or read, if the tutors provide it post-submission. The mark does not help either. They are wondering why they got that award and there are not any indicators to steer them or adjust their behaviour. Points are a great way to provide solid and immediate feedback on how well the student performed in an on-going basis. There are certain best practices involving points in academic contexts (Table 1).

Table 1 - Best Practices and Features: Points

Feature	Example
Linked to activity completion	+20 for submitting an assignment +10 for attending class +50 for writing a script +200 for completing a mini project
Linked to activity performance	+100pts for scoring 90-100, +50pts for 70-90 etc. in an assignment.
Linked to grading	More points could mean a higher mark for a semester for the students. If used, the system should be fair.
Frequency of award	Ad-hoc in-between sessions or during the sessions.
Award receptors	Individuals or teams
Method of award	Manually on paper or automatically through digital tools.
Great Synergy with other elements	Levels & Character – Points can be awarded as experience points (XP), a common term from role-playing games, which then increase the level of their imaginary characters, becoming stronger.
Transparency	Students are motivated if they know beforehand exactly which activities generate points, and how many points, as this makes the point system fully transparent.

3.2 Badges

Badges are the second component of the PBL triad. This is another way to provide visual indication that a student is good at, fast, or accurate at a very specific task. Badges are also closely tied with the concept of achievements in video games.

Achievements are awarded to players for satisfying specific requirements of difficult tasks. They typically have clear conditions that players need to meet. Though, some players consider a game truly mastered when every single achievement is completed [9]. Missing some of the achievements indicates that the game is not truly mastered yet and certain tasks need to be done to get a 100% completion.

Same principles apply in learning (Table 2). Badges indicate all the difficult or interesting tasks a student needs to do to master the concepts of a unit. Achieving 100% completion in a unit indicates 100% mastery of the learning content. Students who are also gamers, particularly "achievement-hunters" will immediately sink into this. Every badge must be collected, especially since receiving the badges is also a form of feedback as well.

Table 2 - Best Practices and Features: Badges

Feature	Example
Linked to activity completion or performance	Awarding a badge for a high mark. Awarding a badge for completing an optional assignment.
Linked to professional behavior	Awarding a badge for attending all classes or submitting early in a formative assignment.
Can be missed	At the academic's discretion, a badge can be missed, giving it more value if received. For example, "participate in the quiz on week 7". Missable badges should not be linked with marks.
Linked with a tangible reward	While it can be optional and appeal to badge collectors, badges can be linked with a reward.
Linked with marks	Earning badges can increase a student's marks, which will make badges very appealing.
Accessibility	Learning must provide equal opportunities for all students, and if marks are linked with badges, then they must be attainable by all and not be missable due to unforeseen circumstances.
Difficulty	Badges can be categorized based on difficulty.
Synergy with points	Earning badges can also earn points. Optionally, points can vary according to the difficulty of the badge (20pts for easy, 50pts for medium, 100pts for hard difficulty badges).
Transparency	Like point systems, the badge pre-conditions must be transparent. Students must know the requirements to get the badge. This improves motivation and promotes a certain kind of behavior that students must demonstrate to earn the badge.
Communication	Clearly communicate the awarding platform for badges to students. If awards appear on the forums or a VLE, it is the academic's job to ensure everyone is active there.
Display Collection	Each student should be able to display his/her badges. Visualizing how many badges a student has is a clear indication of progress because through the eyes of a gamer, having 30 achievements out of 60, means you have mastered 50% of the content.
Structure	A badge needs a name, a description, an icon, and clear requirements.

3.3 Leaderboards

Leaderboards originate from old school arcade games, which had players competing on various video games, getting high scores so they could appear on top of the leaderboards that recorded their points once the game was over. Players would play the same game on the same arcade machine back then, to see their name on the top 10 scorers of the game's leaderboard while others would keep playing to be the first name. The fact is hundreds of players would register a score in that game but only the top 10 would make it on the leaderboard. The leaderboards were subliminally setting the bar for everyone playing that game to motivate them to keep trying to become better at playing it, until eventually they appeared in the leaderboard. Learning scenarios benefit from this as well, with learners competing for mastery, improving their feeling of autonomy, competence, enjoyment and presence [10]. Leaderboards can motivate people if implemented in an appropriate way (Table 3).

Table 3 - Best Practices and Features: Leaderboards

Feature	Example
Metric-based Ranking	Leaderboards can use a metric such as Levels, Points, Badges or another countable metric to create a ranking.
Duration	Semester-wide, showing totals per student, or weekly, resetting on a weekly basis, providing incentive for "weaker" students to catch up.
Accessibility	Leaderboards should always be accessible at any time through digital/physical formats.
"Status" Element	Students appearing on top of the leaderboards acquire bragging rights, which can be motivating.
Scale	Can show students in the entire class (Class-wide) or show the strongest in each group (Group-wide). Competing against your team-mates can be more motivating than the entire class, especially if you are in the lower end.
Filtering	Not everyone should be displayed on the leaderboard, but only a rough 30-50% of the top of the class. Displaying all students can be demotivating for the "weaker" ones.

3.4 Levels

Levels indicate the degree of power in games, typically Role-Playing Games (RPGs). In this context, the term "level" does not refer to the year of study our students are (Level 4, 5 etc.) but refers to the game element [39]. Higher-level enemies are stronger than lower-level enemies. The next level is always harder than the previous level. A higher-level item is more potent than a lower-level item. As such, the same rules apply in the academic context (Table 4).

Table 4 - Best Practices and Features: Levels

Feature	Example
Challenge Indication	Activities of trivial difficulty could be labelled as “Level 1” and a harder one could be “Level 5”
Progression Indication	Like typical video games, progressing through the levels, you progress through the game’s content. • Level 1: Class Tutorial • Level 4: Formative Assessment • Level 7: Peer Critique Activity • Level 10: Final Assignment
Mastery Indication	Getting higher grades will give students points which become experience points (XP) and when they acquire a lot of them, they “level up” and improve. A higher-level student indicates a student with higher degree of mastery over a certain unit/course.
Relation between Difficulty and Mastery	Students who are level 12 may attempt a level 12 activity knowing that it is closer to their skills. Just like a hero in a role-playing game fights a similar level monster to acquire experience and “level up”.

3.5 Quests

In Role-Playing games, Quests indicate a mission that a character must undertake to either become stronger, acquire more XP, or progress through the story. They are given to the heroes by specific non-player characters (NPCs) known as Quest-Givers. A quest is usually designed with specific implications on the game’s plot and is bound to rewards, such as gold (currency), and XP (points). Quests are classified as “main” and “side” quests. Main quests progress the story of the game, while side-quests are secondary stories, with no relation to the main quest, but provide optional bonuses.

In learning contexts (Table 5), quests can indicate formative assignments (side-quests) or summative (main-quests). A quest can have specific requirements and can contain interesting rewards, well-designed enough for students to put the additional effort in. Good quest systems have a strong thematic link [11] [12] [13].

Table 5 - Best Practices and Features: Quests

Feature	Example
Quest Parallelism	Multiple quests can be available at a time providing a number of options to students. This improves the students’ motivation due to the degree of freedom (Autonomy). However, this adds to the academic’s workload.
Temporal Availability	Quests can be available only at specific timeframes. Time always adds a sense of urgency.
Outcome-Oriented	Quests must be linked with the learning outcomes of each unit.

Trackable	Quests should be easily trackable in terms of progression. This can be done with a series of requirements or a step-by-step methodology.
Structure	Quests should belong in a thematic narrative, have clear goals, completion requirements and rewards (could be points, badges).
Quest Chain	Quests can be linked together, forming a quest chain. Future quests unlock when prior ones are finished. This is also linked with "Content Unlocking" element.

3.6 Competition & Collaboration

Competition and Collaboration are elements that enable students interacting with each other. In gaming contexts, we have co-op and PvP (Player versus Player) multiplayer game modes. Some players really enjoy multiplayer scenarios, while others prefer single-player games [9]. The interactivity that occurs while playing the games is the focal point. This is another dimension that players enjoy when playing games. In a learning context, the interactivity can foster the development of a student to be more dynamic, innovative and creative as required by the modern industries [14]. There are many ways we can achieve interactivity, by adding both competitive (Table 6) and collaborative (Table 7) activities. Both collaboration and competition can last a couple of minutes, half a session, two weeks, or the entire semester.

Table 6 - Competition activity ideas

Feature	Example
Leaderboards	It is in the nature of the leaderboards to foster competition.
Quiz	Quizzes are a great way to implement competition and test the students' theoretical knowledge around specific concepts.
Games	Either physical or digital, can use a combination of mental, physical, and social skills. Can also be linked with taught concepts as a way of assessing, simulating or understanding them.
Group Activities	Involves individuals or teams against each other in order to complete an activity. The party that completes the activity faster, more accurate, or better than the other party wins a reward.
"Talent-Show like" activities	Similar to challenges seen in talent shows, discipline-specific activities with learning or assessment as the main goal could be incorporated in class, if such challenges can be linked to the learning outcomes.

Table 7 - Collaboration activity ideas

Feature	Example
Teamwork	A simple jigsaw activity, a group project, a group presentation
Simulation	Whenever possible, simulation of real-life work conditions, such as turning the classroom into a TV or Game studio (for film and game development courses).
Role-Play	Students taking up specific roles in their chosen industry and role-play set scenarios with specific scripts known beforehand. Can be used to teach and assess.
Live Briefs	Students can feel a sense of "higher purpose" when working together on a real-life problem set by externals.

3.7 Choice

Autonomy is a motivating factor according to Self-Determination Theory [15]. The element of Choice helps learners and players express freedom and motivates, as it appeals to their drive of autonomy. All kinds of video games offer choice somehow. In platformers it is your choice when and where to jump. In a first-person shooter, you have a choice of weapons and a choice of either flanking, storming, or sniping enemies from distance. In RPGs you have the choice of weapons, magic, armor, and even which quests to do. In late adventure games, the choices you make alter the outcome of the story. Choices are appealing to gamers of all types, as it gives them a sense of control (of their character, their story, and, ultimately, their experience). In learning, choice can have many forms, but can be equally motivating (Table 8).

Table 8 - Best Practices and Features: Choice

Feature	Example
Multiple Formative Assessment	Provide choice of formative assignments in terms of quantity and difficulty. Students will have a lot of "quests" to pick up, of varied difficulties, which provide choice to the students. Engagement will increase if they are all linked to rewards, which are proportional to the difficulty of the task.
Exam Questions Options	During written or online exams, allow students to pick which questions to answer, i.e. four out of seven, or one question per group of three.
Modular Assessment Briefs	Each brief can have interchangeable sections that can be taken in and out, still producing a quality product. Each "module" could have two or three variants that all adhere to the same learning outcomes, but the students choose which ones to do.
Expression	Based on UDL [16], academics can allow for multiple types of expression on a given assignment, as all students express themselves differently, or are at a disadvantage regarding specific assignments (due to Dyslexia, Asperger's etc.). For example, a presentation can be swapped with a report or a video and vice versa.
Student-generated Assessment	The ultimate form of freedom, where students can create their own assessment brief. This can be useful in cases where a part of the assessment brief is generic enough to have any form. A way to execute this would be through role-playing game outcomes translated into briefs.

3.8 Narrative

The element of Narrative can be applied on the learning content of any unit, should be directly linked to a theme, a rich storyline, characters that live in a virtual world and should allow the students to project themselves on the characters (avatars). Characters can have abilities which influence what characters can do and provide uniqueness. Creating narrative in a learning context is like designing campaigns for tabletop role-playing games or stories that can be used within RPG video games out of the box. Story is one of the four integral parts of a game and is a collection of all

of the above elements, as suggested by game designer Jesse Schell's concept of elemental tetrad [17].

3.9 Theme

Academics can provide a theme for their unit and students to explore. The theme should be the underlying cover for character, story, ability, virtual world elements, making the entire unit more appealing to students [18]. Themes could be something generic as "Sci-Fi", "Fantasy" or something specific such as "Lovecraftian Cosmic Horror" [19]. Furthermore, the theme could be drawn from well-known franchises, such as "Game of Thrones", "Star Wars", or "The Avengers".

3.10 Story

Academics should provide a meaningful story for the theme they have. They can either pick up a great story from online, or write one on their own, but it is important that students are involved with that story, and all student-created characters are part of it. Stories not only improve the learning experience [20], but can also be used in many ways, vastly changing the classroom dynamics according to Kapp [21] (Table 9).

Table 9 - Best Practices and Features: Story

Feature	Example
Based on Groups/ Individuals	• Units that are assessed individually could have students who control a single character go through their own story. • Group settings call for a story that involves four or five characters in a class. • Groups can also control a single character which can foster "Collaboration" as well.
Scale	• Stories can span over the entire cohort, with everyone involved and the stories of characters intertwining with each other. • Stories can also be completed per character, with no overlap with other stories whatsoever.
Story Generation	• Pre-determined using scripts. • Dynamically generated from students. • Hybrid format where students can alter scripted stories through choice.

3.11 Character (Avatar)

Characters (Avatars), another important game element, allow students to take up a personality to project themselves to, as if it was a blank canvas. Characters should be incorporated to allow unique ways of expression. Students will feel more in-sync with their game characters and will immediately start to care more about the unit proportionate to the number of activities that their characters are involved with.

Character abilities can determine special actions characters can take. Sometimes abilities only influence the story outcome (escaping a dungeon, defeating an enemy), but other times they influence the classroom. For example, Mages can "Teleport" out of class, Rogues can "dodge" a wrong answer to a question, and Warriors can "shield" their team-mates from questions by answering it themselves. All these concepts are already in use by Classcraft [22]). Regarding characters and abilities there are two very important rules:

- Students should be able to create their own characters.
  The degree of customization is proportionate to the degree of connection between the character and student [23]. More customization equals to more freedom and motivation [24].
- Characters can have traits which correspond to specific skills.
  For example, writing code (Strength), answering quizzes correctly (Intelligence) or working in groups (Charisma).

3.12 Virtual World

The virtual world element is part of creating the imaginary world the experience will take place and is part of a process known as "worldbuilding" in the game design discipline [25]. The experience is enhanced if all the places generated in the virtual world play a part in the story of the game. Furthermore, some places should be linked with online resources similar to how Lee Sheldon has structured his game design courses [26]. For example, there could be a village that has a library, a city hall, a tavern. The library could be linked with reading material for the unit, the city hall is where assessments are uploaded, and the tavern is where students can get additional quests to improve their skills and earn more XP.

3.13 Roleplaying

Roleplaying is a complex game element, according to which players are traditionally taking the role of a character and enact their actions. When controlling a character, players should not project their personality on them, even though that is challenging. Roleplaying is very motivating regardless of the context that is being used. Typical role-play scenarios put the students in a real-life situation, and they are learning from the experience but in a gaming context they would be roleplaying their virtual character that they created [27]. Further research can focus on this mechanic teaching through the gaming mediums, such as traditional tabletop RPGs like Dungeons & Dragons [28].

3.14 Time

Time is a game element that adds pressure. In video games, time forces player to act faster to complete an objective, especially if more points are accumulated for doing so. Escape rooms provide players with a time limit to solve puzzles. Within learning contexts this is already implemented in time-constrained assignments, such as written exams or presentations (Table 10). In the right contexts, time-pressure is making a learning activity more engaging [29] and appealing to the motivational

drive of mastery which comes from Self-Determination Theory's "competence" element [15].

Table 10 - Activity Ideas for Time

Feature	Example
In-Class Hackathons	The fastest team to write, create or design an artefact will earn more points.
Time-Constrained Activities	Applies to any activity. Time adds pressure, increasing the students' focus and making the activity more engaging (some cases).
Timed Quests	When combined with time, a quest provides a timed context within which the students can "pick-up" and "turn-in" specific quests given from Non-Player Characters (NPC). Timed quests are useful when the goal is quick mastery or understanding a concept before an activity that relies upon knowledge.

3.15 Goals/Objectives

Clear Goals can be an element on its' own. Players generally like to know what they should be doing at any given time, which is why quest log systems are an important feature in video games. The same rules apply for learners. Clarity is vital; hence, great goals should follow the SMART goals principle [30] (Figure 2).

Specific	Detailed description of the goal with as few words as possible and as clear as possible. Explains **What** the students have to do. It's the reason students appreciate checklists.
Measurable	Ensures an activity is trackable, providing **Confidence** to the student, knowing how close they are to completion. This reduces frustration and improves focus for the student.
Attainable	Defines **How** goals can be achieved, provides students with clear completion criteria (when an activity ends). Finally, defines the level of challenge.
Relevant	Goals should reinforce skills that are relevant and **Worthy** of the student's time. This drives the student to complete the activity for personal learning versus just for marks.
Time-Constrained	Goals should have a deadline, establish a sense of urgency, and answer the question of **When.** That provides a timeframe for students to plan ahead.

Figure 2- SMART Goals

3.16 Rewards & Feedback Systems

Reward Systems are critical in video games. Players play games around that concept. In general, every single action performed in a video game provides instant feedback and reward, which keeps players into the game [31]. Accumulating points because something was executed in the appropriate way is providing both reward (points) and feedback; since we got points, we can learn that we did something right. When a player loses points or dies, the same happens; we get punished by losing points, because we did something incorrectly. This occurs in many ways. Figuring out a strategy to defeat a hard monster, rewards us with having it defeated. The feedback we are getting from causing a lot of damage or surviving longer means we should adopt that strategy. Getting a new stronger weapon or progressing to the next level is a reward itself. In the learning process, similar scenarios can occur (Table 11).

Table 11 - Best Practices and Features: Rewards & Feedback

Feature	Example
Positive Reinforcement	Students should be rewarded for everything they do. Negative reinforcement does not work well as punishment should not be part of the gamification experience (unless loss-aversion mechanics are in place). It is better to be awarded (positive outcomes) or not awarded at all (negative outcomes).
Immediacy	All actions should receive immediate feedback, whether positive or negative, whether with an award or not.
Multiple Award Formats	Awards can or cannot be directly related to the taught material and can have many formats: • Points (Towards a Leaderboard or the next level) • Badges • Health (or Lives) • Currency • Items (for Character Avatars) • Unlocked Content (Quests, Abilities, etc.) • Grades
Multiple Feedback Formats	Feedback comes in many forms: • Verbal feedback given in-class • Written feedback given after an assignment • Nodding when a student asks a question. • Physical gestures, like a pat on the shoulder • A simple “good job”.

3.17 Progression

Progression mechanics have a strong motivating power, because they help a player clearly visualize how close they are in completing an objective [32], which keeps the player in an experience of “flow” [33]. The same applies to learners in a learning context (Table 12).

Table 12 - Features and Best Practices: Progression

Feature	Example
Synergy with Levels	A Progress Bar is a great indicator of how much XP it will take to reach the next level visually. This also works great with the student's anticipation to level up, as when close to the next level students tend to push themselves a bit more, just enough to reach the level quicker. This leads to a slight performance boost.
Map	Drawn maps are a great way to plot a student's journey through the learning content. The student can see how much he/she has progressed and how much more is left.

3.18 Virtual Currency / Resource Gathering

Currency is another gamification mechanic that is related to the rewards element. Players receive currency as they play the game. In survival games, this comes in the form of ammunition. In strategy games it would be gold, lumber, and meat. In RPG games, it is equipment, gold, and health. Certain resources are more valuable than other resources. In learning contexts, a virtual economy needs to be laid out foundationally giving meaning to virtual currencies [34]. Once we define whether we need a currency system, some rules need to be established (Figure 3).

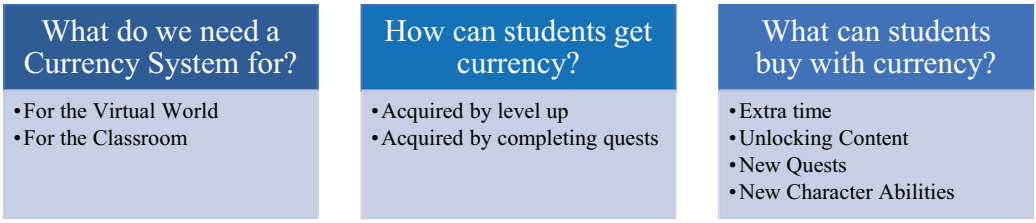


Figure 3 - Currency Systems Rules

3.19 Luck

Luck, according to the 40 case studies, is a rare game element, as the learning process should not be affected by randomness. However, there are some interesting ideas (Table 13) that could fit the Luck element into the learning experience.

Table 13 - Ideas for Luck Mechanics in Classroom

Feature	Example
Luck-of-the-draw mechanic	The next question will be asked towards a random student in the cohort. The student may then attempt to answer the question. This mechanic can be combined with both point and life systems, where the outcome of a question affects their points or lives in a negative (or positive) way.
Activity Roulette	Luck can affect the nature of the next upcoming activity. It could be a random activity out of a pool of ten but with no difference as to which comes up, as all activities fulfil the exact same learning criteria.
"Beginner's Luck"	When a student is presented with a very positive outcome during the unit (or an activity) he/she gets a feeling of "epic purpose" and believe they have an advantage over others. This motivates them to engage and improve their performance [35].

3.20 Boss Fights

Boss Fight is a game element that is used for difficult tasks. In video games, boss fights signify the end of a level. When a boss is defeated, players get stronger, but enemies get stronger too. After several enemies are defeated, or a good amount of the level has been explored, another boss fight will occur. This is a game loop that repeats, until the final boss fight which is the final challenge of the game, which is a vital part of video games.

Likewise, in education, boss fights can be a very challenging task that may require the full effort of students to beat and receive a reward, such as passing a unit. Academics can put a challenging task that requires groups to work together to complete, and "beat the game" or pass the unit [36]. Sometimes, boss fights can also be "raids", where the entire cohort must collaborate on a challenging group task. As an example of this, we can imagine a series of questions in a quiz that accumulate correct answers from the entire class as "damage" to the boss with 200 health points; meaning 200 correct answers from the entire class is enough to defeat the boss, which is similar to how Lee Sheldon implemented an interesting boss fight in his character design unit [26].

3.21 Lives

Lives are part of loss-aversion game elements, where motivation comes in the form of avoiding a negative outcome [37]. In games, players start with several lives. Every time their character "dies", they "lose a life". Once all lives are lost, the game is over. As such, lives are a very precious resource that players fight to keep. Lives are the only resource that can take a player from the beginning to the end of a video game. In learning, students will be given a number of lives. Should they lose all their lives, they have failed the unit. However, losing a life in a learning context should

be much harder (Table 14). This type of motivation ensures that students perform better in order to avoid losing marks.

Table 14 - Features and Best Practices: Lives

Feature	Example
Communication	When a lives system is in place, students should be fully aware of: • What lives are, and how they work. • How much they cost grade-wise. • How they are lost or gained.
Implementation Variant (Hearts)	Instead of lives, we can use "hearts". Depending on the students' actions, they can either lose half, a whole, or several hearts.
Implementation Variant (Health)	"Health Points" can also be used like points, but they are a more manageable resource, as characters can have for example 100 health points. When these points reach zero, there is a penalty (up to the tutor).
Replenishment System	This system provides ways for students to recover lives/hearts or health to increase their motivation. Activities which recover health on successful performances are appealing to students, especially if higher health is translated to more marks by the end of the unit.

3.22 Content-Unlocking

Most content is initially locked. However, if the players beat the existing content, new content will be unlocked, such as new characters in a fighting game. Unlocking content is motivating itself and has similar feelings to receiving achievements, but the reward is more tangible. This is directly linked to progression mechanics as well [38]. In learning scenarios, content unlocking can be used to support scaffolding of students learning, similar to the levels or quests elements. Chained quests with ascending difficulty can be unlocked with either a passing mark in a previous quest or an accumulation of resources. Besides, there is also Synergy with currency systems, as various unlocks can be "bought".

4.0 Conclusions

The study has contributed in the field by providing a toolset of game elements, to be used out-of-the-box or with adjustments, directly into higher education. With appropriate use of game elements, academics can improve student attendance, satisfaction, and performance for their cohorts. Furthermore, for each of the identified game elements, this paper has provided indicative uses and best practices for efficient implementations in face-to-face or online teaching.

The main drawback of the gamification toolset comes in the form of time. Academics need time to decide whether to use game elements in their units, and how to adjust them in their field, cohort, and delivery mode. Additional time is needed for the design of the learning experiment as well as the monitoring and validation.

On the other hand, students themselves may not necessarily accept gamified versions of their courses. Participating in a game should always be optional and not forced [21]. Another possible limitation is that the "toolbox" may be incomplete in its' current state, requiring more information on the existing game elements or adding new ones as they are used by academics.

In terms of future work, building up on the limitations, it would be beneficial to find a way to automate the use of gamification to reduce the time spent, perhaps through Technology-Enhanced Learning or Learning Management Systems. Additionally, the "toolbox" can be improved with precise data from more academics trying out the different game elements in different contexts.

5.0 References

1 S. Deterding, D. Dixon, R. Khaled and L. Nacke, "From Game Design Elements to Gamefulness: Defining Gamification," Tampere, Finland, 2011.

2 J. Hamari, J. Koivisto and H. Sarsa, "Does Gamification Work? - A Literature Review of Empirical Studies on Gamification," Hawaii, USA, 2014.

3 G. Kiryakova, N. Angelova and L. Yordanova, "Gamification in education," Edirne, Turkey, 2014.

4 L. Hakulinen, T. Auvinen and A. Korhonen, "The Effect of Achievement Badges on Students' Behavior: An Empirical Study in a University-Level Computer Science Course," International Journal of Emerging Technologies in Learning, vol. 10, no. 1, pp. 18-29, 2015.

5 G. Barata, S. Gama, J. Jorge and D. Gonçalves, "Improving Participation and Learning with Gamification.," Stratford, ON, Canada, 2013.

6 C. Tsay, A. K. Kofinas and J. Luo, "Enhancing student learning experience with technology-mediated gamification: An empirical study," Computers & Education, vol. 121, 2018.

7 N. O'Donnell, D. Kappen, Z. Fitz-Walter, S. Deterding, L. Nacke and D. Johnson, "How Multidisciplinary is Gamification Research? : Results from a Scoping Review," 2017.

8 K. Werbach and D. Hunter, For the Win: How Game Thinking Can Revolutionize Your Business, Wharton Digital Press, 2012.

9 R. Bartle, "Virtual Worlds: Why people play.," Massively Multiplayer Game Development, vol. 2, pp. 1-16, 2005.

10 J. T. Bowey, M. V. Birk and R. L. Mandryk, "Manipulating Leaderboards to Induce Player Experience," New York, USA, 2015.

11 S. O'Donovan, J.Gain and P.Marais, "A Case Study in the Gamification of a University-level Games Development Course.," East London, South Africa, 2013.

12 B. Leong and L. Yanjie, "Application of Game Mechanics to Improve Student Engagement.," Singapore, 2011.

13 B. De Schutter and V. Abeele, “Gradequest—Evaluating the impact of using game design techniques in an undergraduate course.,” Florida, USA, 2014.
14 V. Camilleri, L. Busuttil and M. Montebello, “Social Interactive Learning in Multiplayer Games,” in Serious Games and Edutainment Applications, M. M., O. A. and J. L., Eds., London, Springer, 2011, pp. 481-501 doi:https://doi.org/10.1007/978-1-4471-2161-9_23.
15 R. Ryan and E. L. Deci, “Intrinsic and extrinsic motivations: Classic definitions and new directions,” Contemporary Educational Psychology, vol. 25, no. 1, pp. 54-67, 2000.
16 D. Rose and A. Meyer, “ Teaching Every Student in the Digital Age: Universal Design for Learning.,” Alexandira, VA, 2002.
17 J. Schell, The Art of Game Design: A book of lenses, 3rd ed., A K Peters/CRC Press;, 2019.
18 F. Parker, “Role-Playing the Caper-Gone-Wrong Film in Fiasco,” Analog Game Studies, vol. 2, no. 2, 2015.
19 H. Lovecraft and J. A. Weinstock, The call of Cthulhu and other dark tales, New York: Barnes and Noble, 2009.
20 S. W. McQuiggan, J. P. Rowe, S. Lee and J. C. Lester, “Story-Based Learning: The Impact of Narrative on Learning Experiences and Outcomes,” in Intelligent Tutoring Systems, W. B.P., A. E., N. R. and L. S., Eds., Berlin, Heidelberg, Springer, 2008, pp. 530-539.
21 K. Kapp, The Gamification of Learning and Instruction: Game-based Methods and Strategies for Training and Education, John Wiley & Sons, 2012.
22 S. Young, D. Young and L. Young, “Classcraft,” 2013. [Online]. Available: https://www.classcraft.com/. [Accessed 2019].
23 N. Worth, “Players and Avatars: The Connections between Player Personality, Avatar Personality and Behavior in Video Games,” Ontario, 2015.
24 S. A. D. Gandhimathi, “Learner Autonomy and Motivation - A Literature Review,” Research on humanities and social sciences, vol. 6, pp. 80-83, 2016.
25 T. Heussner, T. K. Finley, J. B. Hepler and A. Lemay, The Game Narrative Toolbox, 1st ed., Routledge, 2015.
26 L. Sheldon, The Multiplayer Classroom: Designing Coursework as a Game, 1st ed., Cengage Learning PTR, 2011.
27 K. Ntokos, “CodePlay: A Tabletop Role-Playing Game System used in Teaching Game Programming Using Content Gamification,” Comput Game J, 2020.
28 G. Gygax and D. Ameson, Dungeons & Dragons, Lake Geneva, Winsconsin, United States: Tactical Studies Rules, Inc, Wizards of the Coast, 1974.
29 A. Marczewski, Even Ninja Monkeys Like to Play: Unicorn Edition, 2018.
30 P. J. Meyer, Attitude Is Everything: If You Want to Succeed Above and Beyond, 1st ed., Paul J. Meyer Resources, 2003.

31 H. Wang and C.-T. Sun, “Game Reward Systems: Gaming Experiences and Social Meanings,” Utrecht, 2012.
32 HCI Games Group, “Level Up! The role of progression for gameful design,” 2016. [Online]. Available: https://medium.com/gameful-design/level-up-the-role-of-progression-for-gameful-design-ce7a87e2b70. [Accessed 20 5 2020].
33 M. Csikszentmihalyi, Flow: The Psychology of Optimal Experience, 1st ed., New York, NY: Harper Perennial Modern Classics, 2008.
34 Y. Chen, T. Burton, M. Vorvoreanu and D. Whittinghill, “Cogent：A Case Study of Meaningful Gamification in Education with Virtual Currency,” International Journal of Emerging Technologies in Learning (iJET), vol. 10, 2015.
35 A. Coppens, “Gamification Mechanic Monday: Beginners Luck,” 2019. [Online]. Available: https://www.gamificationnation.com/gamification-mechanic-monday-beginners-luck/. [Accessed 22 1 2020].
36 L. Algavi, N. Desyaeva, E. Kilpelyaynen and V. Irina, “Gamification In Education: Boss Fight,” Moscow, 2017.
37 S. Şengün and S. Ozturkcan, “Gaining Reward vs. Avoiding Loss: When Does Gamification Stop Being Fun?,” in Emerging Research and Trends in Gamification, IGI Global, 2016, pp. 48-71.
38 Accessally, “5 Gamification Examples in marketing to enhance your digital learning business,” 2016. [Online]. Available: https://accessally.com/blog/gamification-examples-in-marketing/. [Accessed 25 2 2020].
39 E. Mekler, F. Brühlmann, K. Opwis and A. Tuch, "Do points, levels and leaderboards harm intrinsic motivation? An empirical analysis of common gamification elements," Toronto Ontario Canada, 2013.
40 E. D. Mekler, F. Brühlmann, K. Opwis and A. N. Tuch, "Disassembling Gamification: The Effects of Points and Meaning on User Motivation and Performance," New York, USA, 2013.

Higher Education Institutions' Websites: Attracting to Study or Homogenously Boring?

Oksana Razina, Mohammed Al-husban,
Shakeel Ahmad and Margaret Ross

Faculty of Business, Law and Digital Technologies, Solent University
Southampton, East Park Terrace, Southampton, Hampshire, SO14 0RN
oksana.razina@gmail.com, mohammed.al-husban@solent.ac.uk
shakeel.ahmad@solent.ac.uk, margaret.ross@bcs.org.uk

Abstract

The key for any website in the first place is the content. It has to be at least relevant, recent, entertaining and aesthetically written and presented, while also providing useful information. Software and technology go next with gamification, leading the way. Companies are currently evaluated by their websites, and this procedure often takes a couple of minutes, if not milliseconds. Higher Education Institutions (HEIs) are no different. With a decreasing population of eighteen-year olds entering HE, the everchanging financial situation, both in the UK and worldwide, and an increasing number of universities, creating a unique position in the HE market to achieve the required student recruitment is essential for survival. This paper presents the outcome from the thorough qualitative evaluation of websites for the selected five Post-92 institutions in the South East of England over four years. The work indicates general features noted on all HEI's websites, user experiences and issues. Finally, the paper suggests some key actions to potential strategic improvement.

Keywords – Digital Content Strategy, Content Marketing, Content Analysis, Big data, Higher Education

1.0 Introduction

Severe competition in a complicated market situation requires higher education institutions (HEIs) to adapt to the new digital marketing position, as the websites are currently the first point of information for prospective students [1]. Recent national and international experiences of continuous periods of lockdown emphasise the importance of the quality content presented on the educational website even more. The HEIs are presented in the situation, when each of them is viewed, evaluated and judged marginally and often merely on the basis of the quality of the online data, the presentation/design and the actual content. In the majority of cases, prospective students access universities via Home and Course pages. Technologically savvy users require modern software and technology; powerful social media presence; original, educating and entertaining content; hence, overall – a new way of digital thinking for organisations. This directly relates to the HEIs' quality online presence, particularly in terms of the brand image, reputation and student recruitment objectives; and despite the significant research efforts, institutions are struggling to keep up with the pace [1]. Thus, it is crucial to ensure the content on these pages is relevant, recent, exciting and valuable to the target audience.

2.0 Methodology

The research objective was to investigate if there was a digital content strategy in the design and presentation of content on HEIs' websites, as well as to identify, where possible, if there were any processes, procedures, roles and responsibilities, related to content creation and management at the selected higher education institutions.

The researchers had been collecting the online data during a four-year period, 2017-2020. Every week, on Mondays, the researchers accessed Higher Education Institutions' websites and took print screens from these websites of the home pages only. This primary data collection included ten HEIs, i.e., equally from Post-92 and Russell Group institutions, using 'Snipping Tool' software. The study was targeting Post-92 institutions, although the data from the other HEIs allowed the researchers to additionally compare the received results, when/if required. Thus, the data for the latter group had been added after year one of the collection, i.e., from 2018. Additionally, the researchers were taking an HTML copy of the actual page for every university, saving the page electronically. This also assisted in the quick search on the received pages, when/if it was necessary to use.

To investigate the phenomenon of educational digital content strategy required the researchers to consider using mixed methods approach to ensure the analysis was conducted through a variety of lenses in order to reveal multiple facets of the phenomenon [2]. The methods included Case Study, Thematic Analysis and Content Analysis.

Case Study research here had been selected to ensure the real-time phenomenon was researched in its natural settings, rather than relying on "derived" data [3], i.e., "investigated within its naturally occurring context" [4, p.388].

Therefore, among other features, case study approach "assumes that examining the context and other complex conditions related to the case(s) being studied are integral to understanding the case(s)" [5, p.4]. The case studies method had not been selected randomly, the researchers opted instead for the "intentional form of selection" [6, p.27] of the competing universities.

Content Analysis was used to evaluate the actual content on the website pages, as it delivers systematic and objective way of explaining and quantifying phenomena [7, 8]. The process comprised of three main phases: (1) *the preparation phase* involved data collection for content analysis; and (2) *the organisation phase* covered "open coding, creating categories and abstraction" [9, p.109]. The latter allowed the formulation of a general description of the research topic through generating categories [10, 11, 12]. In the final, (3) *the reporting phase*, the results were defined "by the content of the categories describing the phenomenon using a selected approach" [13, p.2].

Thematic Analysis was used for "identifying, analyzing, and reporting patterns (themes) within data" [14, p.6]. This descriptive method assisted in reducing the collected data in a flexible way and efficaciously conformed with other data analysis methods [15]. The process included such stages as: familiarisation with, coding, reviewing, generation, defining and naming the themes. The first stage included a thorough overview of all the received data, prior to the actual analysis, comprehensive familiarising with all the collected data. Then the data had been labelled and coded. The researchers subsequently grouped and collated it in accordance with the themes as a condensed overview of the main points of content. This inductive approach allowed for the data to determine the themes from the patterns, not offering preconceived themes, based on theory or existing knowledge. The process evaluated two types of content categories, i.e., (i) the themes, which had been revealed by the researchers during the research process, when evaluating the websites, and (ii) the standard sections of the pages, categorised by the actual pages' creators. The final stage of defining and naming the themes involved formulation of succinct and clearly explicable names. The researchers had to repeat the whole analysis four times to ensure the evaluation brought the same results, as repeating of the evaluation process is recommended by experts for the internal consistency [16, p.100, 17, p.812]. The final stage included the researchers' analytical conclusions from the data presented as codes and then themes.

The researchers had been evaluating five UK Post-92 institutions (The University of Brighton, Solent University Southampton, The University of Chichester, The University of Portsmouth and The University of Winchester) in the South East and summarised the following.

The Findings

3.1 Topics under the identified categories

To present the data in the evaluated tables, the researchers grouped the topics into eighteen categories (**Table 1**), which were self-explanatory, where, for instance, the *Partnerships* topics reflected all the data related to the universities' business and social partnerships with HEIs, businesses and/or other social groups/entities. The examples here could be working together with several other Higher Education Institutions in the UK on a conference or community project, business partnerships and collaborations with other international universities in other countries.

The *Entertaining/developing content,* for instance, delivered the topics for entertaining, though not marketing, content (apart from the Virtual Reality tours, which were also included here), as well as/or developing articles. The latter educated the user, without advertising, for the purpose of enjoyment. There was, for example, an article, called 'Five TV sitcoms to help get you through lockdown' during the lockdown. This category also included any thought-provoking articles with interesting topics for discussion, i.e., for instance with experts, though non-event related. The *Funded projects (for students)* described the opportunity received by the existing/current students with the financial support from the university towards the possibility of creation/accomplishing their current projects, whereas the *Funding for studies* indicated scholarships, which were available, at the time of the research, to prospective students.

Table 1: Topics on the websites

CATEGORIES
Apprenticeships
Partnerships
Courses/New courses
Entertaining/developing content
Events at university
Facilities
Final-year student secure employment
Funded projects (for students)
Funding for studies
Funding for university
Graduates/Alumni (projects/achievements)
Official accreditations/awards (incl. TEF)
Research at university
Students' employment experience
Students' projects/experience/awards
Teaching excellence/projects/awards
University's participation in an event
University's response to an event

The *Official accreditations and awards* category included articles written on any awards and achievements, received by the university itself, e.g., TEF (Teaching Excellence Framework) and THE (The Higher Education) awards. The *Students' projects/experience/ awards* category indicated, for instance, an example of a student's (or student group's) participation in an external event as an attendee of a conference or as the event organiser. The *University's participation in events* highlighted such topics as the university's staff and students' participation in the London Marathon; while the *University's response to an event* indicated university's position, reflecting and/or participating in events like Coronavirus (COVID-19) and 'Black History Month'.

The researchers must recognise that, taking the circumstances, the topic *Universities' response to event* might be higher during the period selected for evaluation, due to Coronavirus (COVID-19), when every HEI chose to participate, as well as other organisations with social and public responsibilities.

The information mentioned in such categories as *Research at university* and *Events at university* both could have been divided into two: (1) advertising research and (2) entertaining and developing data regarded as research. There was a number of exciting articles on a variety of topics, which could have been interesting to the prospective students, particularly the applied research experiences and environment-related research articles. The events also contained many Postgraduate pieces of content, which, most likely, would have not been of any interest to potential Undergraduate students. The *Apprenticeship* and *Graduates/Alumni (projects/achievements)* categories included other fields, which could have been positioned, under other categories, for instance, under *Events at university*, etc. The researchers, however, intentionally kept the data separately, to avoid the irrelevant implications to the research aims. The researchers also decided not to use 'Other' section, as in their opinion, it is never clear what categories could stand behind the notion, thus it would not be satisfactory for any discussions.

3.2 Main sections and compulsory data on the home pages

There was an obvious similarity in the overall attitude to the display of the information online for all five institutions. Generally, there were standardised information fields positioned on the footer of the page and on the header as a menu. The middle part always contained university-/course-related information and news, though presented differently. It could be summarised that the main sections contained the following:

(1) Main menus, which were located at the very top of the page
(2) Then usually there was a banner carousel with image(s), typically changing with regular time laps in seconds, or a video, automatically played on the page opening
(3) On the footer of the page, there was standardised information about an institution, namely: information for different parties (partners, media, conference organisers, Alumni), social media, A-Z options, contact details, freedom of information, sitemap, full address, about the site, log in options (if the site was used as an entry to the staff and/or students intranets), other websites, buildings and facilities, awards, nominations, recognitions and official memberships.

The rest of the space was divided into other fields, i.e.,
(4) Research activities
(5) Courses (including direct links to Postgraduate and International) and the course search
(6) Marketing data (new buildings, 'Why this University?', Clearing, information about the university, accommodation and similar)
(7) Some contained an events section, which was typically separate from the news, it included internal events at university, e.g., Open Days

(8) News related to university as an external entity and external events
(9) News at university.

The researchers noted that the compulsory information provided on the main page mostly related to the legal requirements, e.g., sections like 'about the university', 'freedom of information', legal registration, i.e., privacy and cooking policy, full institutional address, the contact telephone number and email, etc. Some of the institutions also decided to display their awards, achievements, accreditations and professional memberships, e.g., Teaching Excellence Framework (TEF) Gold, Silver and Bronze, 'Disability confident employer' and 'Armed forces covenant'. Particular professional memberships and accreditations, related to courses/fields only, were normally displayed on the actual Course pages. The institutions also mutually agreed to display belonging to social media accounts as a compulsory data. It was voluntary, not legally compulsory to display this information.

Any statistical data was not necessarily compulsory, but would be expected from the users, when the courses/institutions were evaluated. It supposed to provide the description and opinion of the courses and was expected to be on the Course pages. The data was either displayed by the institution itself or projected automatically in agreement with the National Student Survey (NSS) results from their system. In the first years, the universities were displaying all the data – positive and negative; while later, despite using the same system to display the statistics from the NSS system directly, the institutions could choose to display only selected data, obviously the one which illustrated the institutions in the good light, e.g., 100% of students are satisfied with the course overall, 90% of students agree that the lecturers are good at explaining things, 85% of students are in a professional/managerial job at six months, and similar. This would normally be displayed on the Course pages only.

3.3 Calendar, news and events

As would be expected from a Higher Educational Institution, most of the time, the content on their websites was clearly based on the UCAS key deadlines, e.g., Clearing and results publication, as well as an Academic Calendar, e.g., Freshers' welcome week and Graduation. This was relevant to all institutions. On the Home website pages, the researchers had also noticed some celebration of particular historical events, e.g., anniversary of Higher Education, 'Black History' month and 'D-day' (National British Military Celebration).

The rest of the calendar events were based on the national events related to universities, e.g., National Student Survey (NSS) preparation and results, league table and awards, again related to higher education. Likewise, the institutions, unsurprisingly, were writing more about successful cases, e.g., about received national and community awards, nominations and/or other achievements.

Some of the events were planned community and university events, such as 'Pride' or LGBT (the promotion of the self-affirmation, dignity, equality and increased visibility of lesbian, gay, bisexual, and transgender people as a social group) and

'Volunteers' week', i.e., the events their staff and/or students participated in and/or planned to attend. This was anything from industry-related activities to art installations and festivals. The institutions were also writing about the final-year events, which indicated successful student projects and invited businesses and potential employers to attend, based on the subjects/courses offered by the institutions. Some of the content, nonetheless, was reactive, being only partially (if at all) planned with no knowledge of the potential outcomes, e.g., negative/positive mentioning of the institution in any media sources and outcomes of the political elections, etc. Some of the reviewed HEIs also had regular publications on their home pages, for instance, 'Monthly research roundup' and 'Highlights of the year'.

The News area was an essential part of the Home page, as it was the only one providing live content, as the rest of the content was marketing material. News Industry practitioners emphasise that "The homepage communicates what a brand is. The basic idea is…to provide a service to readers besides being an index of everything the site has published…" [18].

Figure 1 indicates the allocation of the News articles among the identified categories for two reviewed periods. Among the biggest categories were *Events at university*, particularly in the second year, to which HEIs allocated nineteen per cent in the first year and twenty per cent in the following year. The issue, however, had been in the quality of presented content, as, in the majority of cases, it had been related to the invitations to the Open Days and Clearing, which was disappointing, particularly in comparison to Russell Group institutions, who offered a wide variety of lectures, seminars and other exciting events. Moreover, none of the universities advertised live events, seminars, webinars, external events live attendance and broadcasting these. This was only done after the events.

The next big category was *Official accreditations/awards (incl. TEF)* category, particularly in the first year, receiving 18% in the first and 13% in the second reviewed year. The issue was that, in the main, it had only been related to the mentioning of the TEF (Teaching Excellence Framework) award, and some rare statistics.

The *Entertaining/developing content*, which was the third most popular category, received fourteen and twelve per cent, respectively. The category, nonetheless, sounded more thrilling than it actually was. The researchers had to take into account any possible attempts of the entertaining content, which, in reality, had not actually been there. The category mostly included banner videos, available on the Home pages and some rare articles, which could be seen as such.

Another category, which fully deserved attention, was *Students' projects/experience/awards*. The articles accounted for eleven per cent in each year, with a slightly smaller number of the actual pieces of content during the second reviewed year, i.e., seventy-nine and seventy per cent, respectively. The researchers enjoyed reading these articles. Despite this, the quality of the articles could had been more entertaining and detailed.

It is obvious that the aim of the headlines is expected to be attention-grabbing, while the details could be, and often are, taken to another page, where there is enough space to tell the full story. This was the case for all the reviewed institutions (with some rare exemptions).

There, however, had always been a sense of reporting in these articles that was not thought-provoking and/or developing content for the reader. The articles did not intend to create an engagement, but a one-way conversation – we have been there, achieved this and that, etc. Even when the readers were contributing to the discussion, no one was there to support the conversation. It would be fair to mention that, nonetheless, that was the only institution offering an opportunity for feedback.

Furthermore, the stories are often expected to be quite short, punchy and shareable, following new trends with adolescents' attachment to social media and their own positioning in the world. If prospective students, when seeing content on a university's website, agree with the institution, i.e., in terms of the official statements, actions, values and opinions, these students would be happy to be associated with this HEI and be more likely to share this content, which would further create the necessarily engagement, which would, eventually, lead to the final purchase, i.e., becoming a student there.

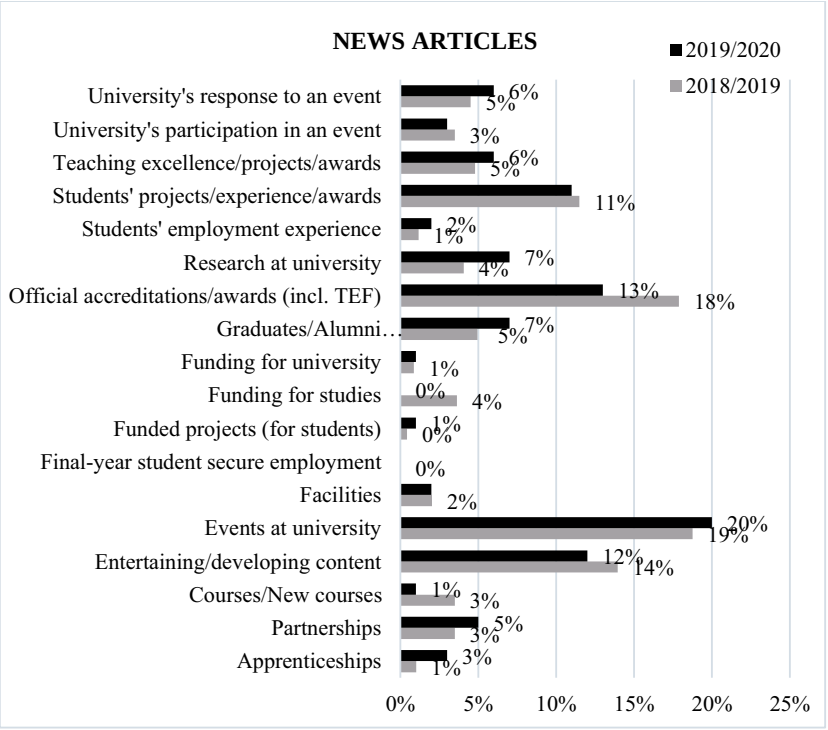


Figure 1: Allocation of articles in the News sections, 2018/19 and 2019/20

3.4 Homogeneity in the content

There was, however, clear homogeneity in the appearance and content of the reviewed institutions' websites. Apart from the main sections and the content listed in the above-mentioned categories, there was also other content, which had been published on all universities' websites.

> All the HEIs, for example, invited prospective applicants to visit their institutions on Open Days, to find a course and similar options, based on the Academic Calendar.
>
> On all the websites, universities also asked the readers to consider/imagine being at their city and university.
>
> Another topic, repeated on the Home pages, was the invitation to identify the reasons for selecting this place and the institution, called 'Why [*city*/*university*]?' The text was again often used on a banner with a link to another page.
>
> One more topic encouraged the prospective students to act to become a part of these institutions, i.e., selecting the HEI for studies.
>
> Similarly, these Higher Education Institutions altogether suggested to see/acknowledge them as special and interesting places, creating an interest for the users to be there.
>
> The market changes forced modern Post-92 universities to use commercial marketing more and more often. This section, in particular, suggested a number of examples, applied by the selected universities on their Home pages. Every institution at some point, particularly during the Clearing period, offered various messages, from 'Applying for [*year*] entry?' and 'Last chance to apply' to 'It's not too late to apply'.
>
> The researchers also noticed that during the selected period, all the institutions had been advertising their facilities, in particular their new buildings.

The researchers summarised some of these topics in the below **Table 2** to highlight the evident homogeneity in the content of the Home pages.

In terms of technical points, the homogeneity continued in the visual presentation. As such, during particular time periods, institutions followed similar methods, and there were clear tendences in their approaches to presented content. 2018, for instance, indicated the change, when a number of institutions started to use several banners as a carousel at the beginning of the home pages.

Table 2: Repeated topics on the Home pages for all universities.

HEI	TOPIC: Consider being at this CITY and at this UNIVERSITY
a	'Belong at Brighton' and 'EXPLORE 2020: a place where you'll belong'
b	'At the heart of the city' and 'Explore Solent'
c	'Picture yourself at Chichester' and 'Picture yourself here' and 'Chi Life'
d	'Take a virtual tour of Portsmouth. Explore the city and the University from wherever in the world you are'
e	'Winchester, simply one of the best places in the UK' 'Picture yourself at Winchester. Campus and city life'
HEI	**TOPIC: Identify the reasons for 'WHY THIS CITY/ UNIVERSITY?'**
a	'A place like no other. Start your adventure. Choose Brighton'
b	'Why choose Solent?'
c	'Why Chichester?'
d	'Why Portsmouth?'
e	'Why Winchester?'
HEI	**TOPIC: ACT to select this institution**
a	'Plot your course. Start your adventure. Choose Brighton'
b	'Start your story at Solent Open Day'
c	'Call our Clearing Hotline'
d	'It's your chance to explore the University and the city this year, so book now'
e	'Be the difference'
HEI	**TOPIC: Think that this HEI is a SPECIAL and INTERESTING place**
a	'Things look different from here. Talk to us about Clearing'
b	'Get inspired at our [*month*] open day. Book now' and 'Ambitions you can believe in'
c	'Chichester changed my life'
d	'Student life in Portsmouth'
e	'Explore Winchester. Take a virtual experience tour'
HEI	**TOPIC: COMMERCIAL MARKETING**
a	'Be here this year'
b	'Last chance for Clearing. Apply now'
c	'It's not too late to apply' and 'There's still time to apply'
d	'Get ahead of Clearing. There's no need to wait until Clearing opens - talk to us today about how to apply' and 'It's not too late to apply for [*year*]/ There is still time to apply. Apply now'
e	'Is what you're doing today getting you closer to where you want to be tomorrow?'
HEI	**TOPIC: ADVERTISING OF THE NEW FACILITIES**
a	'Open Day. Falmer Campus. Brighton. Date. Book now'
b	'Our new sports complex'
c	'Explore Two Beautiful Campuses' and 'Tech Park officially open'
d	'See the plans for our new building. Take a virtual tour of our new 13-storey building and find out more about the winning architects'
e	'Opening Spring 2020. Explore our new building'

NB: a = The University of Brighton
b = Solent University Southampton
c = The University of Chichester
d = The University of Portsmouth
e = The University of Winchester

As such The University of Brighton displayed three images; The University of Chichester, Solent University and The University of Portsmouth all offered 4-6 images each, while The University of Winchester already presented a video. At later stage Solent University moved to having only one banner image and The University of Chichester presented a video, throughout mostly the whole period of this research. Another example was in the homogeneity in displaying of news items. During 2018, The University of Portsmouth and The University of Chichester had four pieces of news in the allocated area. Solent University and The University of Brighton soon followed this tactic. A worse situation was presented by The University of Winchester, which merely allocated two pieces in this area. The University of Portsmouth, however, displayed incredibly disappointing tactics by removing the news section off the Home page for a period of almost one year, then returned it for several months, and in 2021 again removed it, allowing only marketing material to lead the way.

3.5 Technical points

Institutions did not replace their website designs often, approximately every two to five years. This was also evidenced in the Russell Group's institutions, as Imperial College London, King's College London, The University of Oxford and The University of Cambridge also had not significantly changed their institutional websites since 2018. The researchers can state this, as during the same period they collected the data for five Russell Group institutions alongside the Post-92, though the received data is not attached here, due to not being directly related to the topic of discussion. Throughout the whole period, only one Post-92 institution changed their website software and appearance completely; and another institution also made this change, just six months before the print screens were initially taken, i.e., in 2016.

Tracking/conversion leads. This part, preferably, would have provided a review of the conversions, leads, click-through rate, open rate, cost-per-sale and other available metrics through 'Google Analytics' and/or any other programmes/systems/software. The evaluation, unfortunately, was not possible from the external access, as this information was strictly confidential and not accessible, due to highly sensitive data. The researchers can confirm, however, that each institution requested cookies to be accepted before using their sites and used 'Google Analytics' (including 'Google Tag Manager') for the tracking and evaluation of the digital data. This was a highly positive move, as the data was available for tracking the customer behaviour and could be used for the user research.

Accessibility and screen adaptivity. The accessibility of the content was one of the key parts of this evaluation. The researchers attempted to access the data from the various devices, i.e., PC, Tablet, iPad and Apple and Android mobiles, using different browsers (Chrome, Explorer, Firefox and Safari), to ensure all information was accessible, readable and adaptable to the requirements of the device user. In the majority of cases, the content was easily accessible and searched through. Regrettably, in some cases, the information was incorrectly displayed, when minimised.

There was also an issue with accessing videos, as some universities offered an image banner instead, when a user accessed the university's Home page from their mobile. It was not really useful, as the young generation not only seem to express their visual preferences as the key, but also would be more likely to be looking for the choices on their mobiles.

The use of images and videos in the banners. The majority of institutions prefer to offer a carousel of banners on their home pages, near the top of the page. The similarity was evident in the visual and technical parameters, i.e., several large images displayed at a speed of seconds in sequence at the top of the page and located just after the main menu header. The difference was in the actual number of images in the carousel (**Tables 3** and **4**). As an example, a university had a carousel of six banners, and, within a month, changed them to three, four or five banner images. Later in the year, the HEI had removed the whole carousel and replaced it with a video or one banner image, e.g., 'Clearing is now open'. Next week (or the week after) the previous settings were returned back to the page. There seemed to be no logical explanation for the strategy here (apart from the Clearing period). Not only was the quantity different for different institutions, but also the number of banners in the carousel was different within the same institutions.

The researchers also noticed that institutions tend to re-use the same images in the carousel, though in a different order. During the review, this practice was evidenced throughout the websites of every institution, not only for the images in the banners. The Russell Group institutions also offered a video as one (or two) of the five or six carousel banners, e.g., The University of Oxford. The video, nonetheless, was not automatically played but allowed the user to decide if to play it. This approach would be preferred by the researchers, as it not only allows the user to choose to watch (or not) the offered material, but also does not delay the page download. The images were also used in other places on their own or as part of a group.

Most of the images and videos seemed to be professional, none of which, however, were created using user generated content (UGC), which could be created by users and/or students themselves. There were also clear issues, on some HEI's websites, with the banner images presented online, as some of them were not adaptable to the screen size changes, i.e., when the screen size was made smaller, the text and everything else on the page became smaller, though not the images. Some of the text was also incorrectly displayed in these cases, i.e., the text was only partially seen. Two institutions had also changed their logos during the reviewed period, though had not managed to change them at the top of the websites' tabs for weeks. Some of the videos were also of much poorer quality or at least contained parts of a video of lesser quality.

The length of the proposed videos differed, one of the universities, on certain dates, was placing short videos (nine seconds each); whereas the other institution had much longer videos (twenty-five seconds). Apart from the banners, there was no tendency of using videos in other places on the Home pages. It was no different on the Course pages.

Table 3: Images and videos in the carousel banners

2017 -2020 HEAD BANNERS ON THE REVIEWED UNIVERSITIES' HOME PAGES

HEI	June 2017				July 2017					August 2017				September				October 2017					Nov 2017				Dec 2017				January 2018					Feb 2018				March 2018				April 2018					May 2018			
w/c	5	12	19	26	3	10	17	24	31	7	14	21	28	4	11	18	25	2	9	16	23	30	6	13	20	27	4	11	18	25	1	8	15	22	29	5	12	19	26	5	12	19	26	2	9	16	23	30	7	14	21	28
1 - 5	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
6	3	3	3	2	2	1	2	1	1	1	2	2	1	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	5
7	1	1	1	1	1	1	*1*	1	1	1	1	1	1	1	1	1	*1*	1	1	1	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
8	2	3	4	4	4	4	5	5	5	5	5	6	5	5	6	6	6	6	6	4	4	3	3	3	3	4	4	3	3	4	4	4	3	4	3	3	3	3	4	2	5	7	6	6	6	5	5	5	6	6	6	6
9	5	5	5	5	4	4	5	5	5	5	5	5	5	5	5	4	4	4[1]	4	5	5	5	5	5	5	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
10	8	8	8	9	10	11	11	11	11	11	11	11	11	11	11	11	10	9	9	9	9	9	9	9	9	9	V1	V1	V1	V1	V1	V1	V1	V1	V1	V1	V1	V1	V1	V1	V1	V1	V1	V1	V1	V1	V1	V1	V1	V1	V1	V1

HEI	June 2018				July 2018					Aug 2018				Sept 2018				October 2018					Nov 2018				December 2018					Jan 2019				Feb 2019				March 2019				April 2019					May 2019			
w/c	4	11	18	25	2	9	16	23	30	6	13	20	27	3	10	17	24	1	8	15	22	29	5	12	19	26	3	10	17	24	31	7	14	21	28	4	11	18	25	4	11	18	25	1	8	15	22	29	6	13	20	27
1	X	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	X	4	4	4	4	4	4	4	4	4	2	2	3	1	3	4	4	4	4	4	4	3	5	5	4	4	4	4	4	5	5	5	4	2	4	3	4	3	3	4	3	3	3	3	3	3	3	3	3	4	4	3
3	X	4v	4	4	5	5	4	5	3	4	3	4	3	5v	3v	3	5	4	4	4v	4	4	4	4	4	4	4	5	3v	4v	3	3	3	3	3	4v	4	4	5	3	3	3	3	3	3	3v	3	4	4	3	3	5v
4	X	1	1	1	1	1	*1*	1	1	*1*	1	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	1	1	1	V	V	V	V	V	V	V	V	V	V	V	Vs	Vs	Vs	Vs	Vs	Vs	Vs	Vs
5	X	3	3	4	3	3	4	4	4	4	4	4	4	4	4	3	3	4	4	3	3	3	3	3	3	4	4	3	4	3	4	4	4	4	3	3	3	3	4	3	4	3	2	3	3	3	3	4	4	3	3	3
6	4	3	3	3	3	2	2	4	4	4	4	3	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	2	3	3	3	3	3	3	4	3	3	3	3	3	3	3	3	3	3	3	3	3
7	1	1	1	1	1	*1*	1	1	1	1	1	1	1	1	1	1	1	1	1	*1*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
8	4	5	5	6	7	7	7	4	4	4	4	4	4	4	3	3	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	2	2	2	3	2	2	3	3	3	3	3	2	3	3	3	3	3
9	5	5	5	5	5	5	5	4	4[1]	4	4	4	4	4	5	5	6	4	4	4	4	4	4	5	5	5	6	5	6	6	6	6	6	6	6	6	6	5	5	5	5	5	6	5	5	3	3	3	3	4	5	6
10	V1	V1	V1	Vs	V2	V2	V2	V2	V2	V2	V1	V2	Vo	V2	V1	Vs	V2	V2	V1	V2	V2	V2	V2	V2	V2	V2	V2	V1	V2	V1	V2	Vs	V1	Vs	V1	Vs	V1	V1	V2	Vs	Vs	Vs	Vs	Vs	Vs	Vs	Vs	Vs	Vs	V1	V1	V2

HEI	June 2019				July 2019					Aug 2019				Sept 2019					Oct 2019				Nov 2019				Dec 2019					Jan 2020				Feb 2020				March 2020					April 2020				May 2020			
w/c	3	10	17	24	1	8	15	22	29	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	25	2	9	16	23	30	6	13	20	27	3	10	17	24	2	9	16	23	30	6	13	20	27	4	11	18	25
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	3	3	4	3	3	3	3	3	3	3	4	4	2	3	3	1	1	*1*+	1+	3	1+	1+	1+	1+	3	4	3	3	3	3	2	2	3	3	3	2	2	2	3	3	3	3	3	2	4	3	4	4	4	3	3	3
3	4	5	4v	4v	5	3	4v	4v	4	3	4	4	4	4	3v	4	5	4	5	4	4	4	3	3	3	3	3	4	3	3v	3v	2	4	3	3	3	3	4	3	4	3	3v	4v	4v	5	4	4	4	5	4	4	5
4	Vs	Vs	Vs	Vs	Vs	Vs	Vs	Vg	Vg	1	V	V	V	Vs	Vs	Vs	Vs	Vs	Vs	*V*	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	1*	1*	1**
5	3	3	3	3	4	4	3	4	3	3	3	3	3	4	4	3	4	4	4	4	4	4	4	4	3	3	4	4	4	4	4	4	4	3	4	3	4	4	5	3	3	3	1*	1*	1*	1*	1*	1*	1*	1*	1*	1
6	3	3	3	3	3	2	2	V1	V1	V1	V3	V3	V3	V3	V4	V4	V4	V4	V4	Vo	Vo	Vo	V3	V3	V4	V4	V4	V4	V4	1	1	Vp	V4	V4	V4	V4	V4	V4	V4	V4	V4	V4	V5	V5	V5	V5	V5	V5	V5	1	1	1
7	1	1	*1*	1	1	1	1	1	1	1	1	1	1	1	*1*u	1u	1u	1u	*1*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
8	3	3	3	3	4	4	4	4	4	4	5	6	4	4	4	3	3	3	3	3	3	V[1]	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V
9	5	5	5	5	5	5	5	4	5	5	5	5	4	5	5	4	5	5	5	5	5	5	6	6	5	5	4	6	6	6	6	6	5	4	4	4	4	5	5	5	5	3	5	5	5	5	5	5	6	6	6	6
10	V2	V2	V1	V1	V1	V1	V1	V1	V2	V1	V2	V2	V1	V1	V1	V2	V2	V2	V2	V2	V2	V2	Vg	Vg	Vg	Vg	Vg	Vg	Vg	Vg	Vg	Vg	Vg	Vg	Vg	Vg	Vg	Vo	Vo	Vo	Vo	Vo	V1	V1	V1	V1	V1	V1	V1	V1	V1	V1

HEIs:

1-Imperial College London
2-King's College London
3-The University of Oxford
4-The University of Southampton
5-The University of Cambridge
6-The University of Brighton
7-Solent University Southampton
8-The University of Chichester
9-The University of Portsmouth
10-The University of Winchester

Table 4: Images and videos in the carousel banners. Abbreviations used in Table 3

ABBREVIATIONS USED IN THE TABLE			
Abbreviation	Meaning	Abbreviation	Meaning
X	Data not collected	V	Video (one only, automatically played, no banners)
1+	Arrows available, though not possible to use	V1, Vg *etc*	Different types of videos
1**	Coronavirus		
Italics	This type indicates a change, e.g., the quantity remained the same but the banner image has been replaced with a new one	V-	Video with a note: e.g. 'We are open for Clearing' (overtaking all, as notes on Coronavirus)
¹	New website	Vg	Graduation video
4v	4 banners, where one of them is video	Vo	Open Day video
1u	'University of the Year' shortlisting	Vs	Short video

Banners' image speed and flexibility. Carousels of banners often contained the options for the users to go through the images at their own pace. This way, one university was allowing the users to select a particular banner image or move to the next slide; while on the other universities' pages, the Home page user had to wait to see a particular image, as the system did not allow making a choice and did not even indicate the total quantity of these banners. One of the institutions seemed to offer this option, as it was visually seen, though in reality only one of the options was actually available, i.e., backwards and forwards buttons did work, and it was not possible to select the required one, e.g., image two of four or three of five, etc.

There are no official standards in the industry for the speed with which banner images in the carousel should be expected to change. Even though the universities usually offered the change (from one banner to the next) within seconds, the difference for the banners ranged from four to fifteen seconds (**Table 5**). The average speed was approximately 6.8 seconds. The carousel banners on one of the institution's website, despite looking like the others, had not changed at all (the researchers were waiting from thirty minutes to one hour), unless the user clicked on the arrow themselves. This was the worst-case scenario. The researcher would not recommend doing this, as the approach could cause unfortunate user frustration.

Length of Home pages. The length also significantly differed – no standards again. During 2019-2020 Academic Years, the Home pages for The University of Oxford, The University of Chichester and The University of Portsmouth had six main sections on their websites; while Imperial College London, King's College London, Solent University, The University of Brighton and The University of Cambridge already had seven. The University of Winchester and The University of Southampton had the biggest number, i.e., eight and ten, respectively. The length of the website pages had also been changing with time, i.e., it happened when the institutions changed their software into a new one, presenting new websites. Surprisingly, the tendency was not similar, as the Course page of Solent University became longer and the page of The University of Portsmouth, contrariwise, became shorter.

Table 5: The speed in carousel banners for various universities, 04/01/2019

Nr	HEI	Times in changing images
1	Imperial College London	10 seconds
2	King's College London	8 seconds
3	The University of Oxford	15 seconds
4	The University of Southampton	35 seconds video
5	The University of Cambridge	6 seconds
6	The University of Brighton	Do not change, only by clicking
7	Solent University Southampton	N/a, the movement of circles: 4 seconds
8	The University of Chichester	4 seconds
9	The University of Portsmouth	4.5 seconds
10	The University of Winchester	25 seconds video

Search Engine Optimisation (SEO). Previous market research suggests that the digital journey to the required content has to be quick and short, particularly for the user from the key target audience. The lower the number of steps and the time (measured in seconds) to get the required data, the better. That is why, the leading role should have been allocated to the navigation and SEO (search engine optimisation). From this point, the navigation had become exceedingly significant, in terms of time and logical location. The primary search for the key target audience is finding a course to study. Therefore, the researchers additionally undertook a test on the home pages of the selected five institutions in September 2017, and the results clearly indicated SEO issues for all the institutions but one. There were two types of experiments.

(1) *Intuitive search.* In the first experiment, the researchers were making a search for a word 'computing' in slow motion, waiting to see if, during the typing in the search field, an educational website started to offer any options related to the search. This test revealed that only one institution offered intuitive search, where the results revealed all the relevant and available courses before the completion of typing, i.e., the HEI provided a list of undergraduate and postgraduate courses, containing the searched item in the names of these courses. The results even included a list of courses, where the searched item had not even been included at the beginning of the name for the course. Furthermore, in addition, the options offered the courses, whose names did not contain the searched item at all, although they were related to the field of computing, e.g., *CISCO Accreditation*. The institution indicated high professionalism in this matter, highlighting the in-house software engineer's work in this field, as this online facility was not merely offered as a part of the purchased software.

(2) *Searching for a part of a word.* In the alternate experiment, the researchers typed a part of a word, e.g., 'comput', and clicked on the 'Enter' button to see what results would have been provided. Here the results indicated a better outcome. Three out of five HEIs, displayed what was required.

> The other two universities, unfortunately, did not show any results at all. Even when the search requested the word 'computer' (written in full).
>
> Furthermore, one of these universities' results was clearly not focused on the key target audience's needs, as it resulted in anything, which contained this word, rather than offering only relevant and available courses, making the received results quite complicated for processing.

Similar searches in other fields – 'sport' and 'social work' – revealed the same results. The researchers repeated both experiments in March 2020. Surprisingly, the results still indicated the same issues for most of the searches. One of the latter institutions, however, started to offer the intuitive option. The search, nonetheless, did not present any results in the second experiment, only asking 'Did you mean *computer*?' which added an additional step in the search for the users. If the user, nevertheless, was still there to click on the option, the received results were pleasantly neat, which was not ideal but still much better adapted to the needs of the key target audience. The other two institutions had already suggested a list of the relevant and available courses for this incomplete search. Three out of five HEIs, nonetheless, still did not, regrettably, offer intuitive search provision.

There had also been an issue for mobile phone users with finding a course on one of the universities' websites. After requesting a search, the mobile user had to scroll down three times to get to the button labelled 'Undergraduate'. This seemed to create major inconvenience.

Moreover, if clicked on, the search presented courses in alphabetical order, likewise, the results displayed only some courses. There was no opportunity to view all the courses or at least an A-Z list. When the search was conducted for the word 'computer', although being intuitive, the system only offered the courses containing this word, not related courses, i.e., *BSc (Hons) Computer Aided Design*, not *BSc (Hons) Software Engineering*, which were actually available at the same time.

The received results also provided a long page, although there was no easy to choose list, rather excessive amount of information, related to each of the options, making it hard to go through the available options. The search for 'computing', nevertheless, provided all the required results.

To add, some of the data presented at the very top of the results, i.e., that, which was not relevant to the course list, should have been sorted differently. It could be simplified, though it again required additional click on 'courses' to filter these results.

The researchers need to emphasise that users have to go through a number of institutions' websites to make their choices; and making it harder would not bring the HEIs desired outcome, i.e., student recruitment.

3.6 Other significant issues and findings

The issues relating to all universities can be summarised very briefly below.
Apart from the other points, mentioned in this work, there were/was:

Poor quality content, whereas the Russell Group institutions managed to present much richer text and offered wider variety of the events

Published news articles did not change for weeks

No changes in the websites' software for years, hence – no Content Audit

Uses of the TEF awards and similar in one of the News spaces for weeks

Duplications in the News sections of the data from the head banners

Hardly any videos on the Home and Course pages, apart from two head banner videos used by two institutions

Mistakes in the written information, including repetitions and punctuation and inconsistent spelling, even within the same document

No user generated content (UGC) and opportunities to feedback

Uses of the same images for different courses and topics, not necessarily related, and often positioned immediately next to each other

Negligence in the updating of the outdated information, inviting to act on the events, which occurred in the past, i.e., no longer existed

Re-use of the same images for years (even after the reviewed period)

Barely any student views, feedback and/or citations, with some institutions even re-using the citations in 2021 from 2017 (including the same images)

Almost no photographs of the relevant facilities and students using them

Unchanged content since 2018 on most of the Course pages. Excessively long Course pages, overloaded with text blocks, most of which was hard to process and barely any infographics, graphs, tables or other ways to simplify the data (apart from the basic tabs, which, in some cases, still displayed the rest of the information when selected)

The creation of engagement between the prospective students and the university was not the priority for the institutions

Mutual data replication among HEIs, monitoring the competitors' changes.

Evaluation and Discussion

Following the evaluation process, the researchers could summarise the following points.

3.7 No long-term Digital Content Strategy

The overall review of these home pages indicated the absence of the strategic long-term digital content planning. There had been merely selective publishing during the small periods, reflecting particular events, such as, for instance articles on apprenticeships during the National Apprenticeship Week in February, which did not really indicate quality planning. Apart from the actual visual similarity, the researchers noticed that none of the five reviewed institutions offered much content, which would have presented creative text and images by the means of gamification. This would also be highly relevant for younger generations, which HEIs should also start to consider targeting, at a much earlier age, possibly, with access to a separate website from the main Home pages. This approach could have attracted the users to visit the website again and again, until the final university selection. The news articles also did not really differ, mostly consisting of pretentious advertising and marketing, i.e., from informing the webpage visitors about the new facilities (i.e., newly built buildings), invitations to "discover" new courses and Open Day visits, guaranteeing accommodation, some "flashy" statistics and institutional awards. Even those articles, which appear to show university's concern and participation in various research topics/findings, in reality appear to be mostly related to the marketing of these institutions.

Moreover, the accountability of the news and the institution could be under question, if there are only grandstand materials, creating the need for the website visitors not to trust and, possibly, to search further for realistic information. The content on the webpages, in general reminded one of the business approaches, i.e., a transaction with the list of what is on offer and to be expected, rather than opening an exciting world of higher education, which could welcome those, who are adventurous enough to join. In the UK HE market institutions explain 'Why us?', while the prospective students are making a choice. Surprisingly, the actual things, which would be the key for prospective students, were rarely presented, e.g., real-life student projects, graduates' employment; connections and projects with the local and key National businesses; wider opportunities than merely ordinary jobs, that they would expect to get after graduation; more information about facilities and their industry requirements/fulfilment; as well as exciting experiences during studies and the meeting of key industry professionals. It should be essential to provide more images; as well as real persons speaking; real persons' contribution to the website; and authentic feedback on studies and other experiences. It would also be useful to invite the readers into various discussions, e.g., at least environmental and societal issues (which are currently so popular among the targeted Generation 'Z') to identify their opinions and to propose the position of the university in relation to these, ensuring that there is a two-way dialogue and encouraging feedback and suggestions.

3.8 Quality content, sequency, regular and limited publications

Most of the reviewed institutions did allocate a significant amount of data to the *Entertaining/developing content*, the issue, however, was with the actual content. There could have been more development offered in the areas of sequent publications and gamification. Throughout the years 2017-2020, the HEIs presented some interesting articles, though, normally, these would be unconnected pieces of content. There were some good quality items, though no sequence or unfinished material to encourage the user to return. If there was a content strategy, the universities would not only write about the key topics, thus engaging the interest of the key audience and ensuring timely delivery, but also have more space for these articles and this would have been done regularly. Amongst other data, there, for instance could have been articles relating to the students' social and academic life. The choice of the data being videos, audio or text could depend on the type of course and the produced material, though a number of adolescents currently prefer videos.

The key for this data would not only be in the introduction of new knowledge, specific to academia, but also in the sequency of publications, in order to "hook" the website user and in the non-availability of all the data in one go, by inviting the readers to return to the site to read more on a regular basis. This way, potentially, creates a feeling of attachment to this institution, and possibly the habit of regularly visiting their webpage with the growing intention of being a part of this experience and this institution, and to, eventually, act on the desire to apply. Only one institution presented an exemplar of content project, where every week the university offered to do a task, preparing prospective students for applying to join a Higher Education institution. The project provided exciting material, information about events and useful external links, videos and informative knowledge. Despite being outstanding, this, however, was still not enough for productive publishing. Time is also essential here. "For a website, time is a more indirect cost, because users don't get paid to surf the Web. But still, life is short, and you only have so many hours in the day. … users… are still conscious of their time and don't like wasting it" [19]. Thus, the information needs to be easily accessible from all devices, easily found, read and processed. The HEIs should also consider preparing the data for skim readers, as the prospective students will have to read through a number of educational websites.

3.9 Digital Marketing of HE in Social Media

Social media is a new source for brand discovery, enhancing awareness and credibility. "More than a quarter of users follow brands they're thinking of buying something from" and "are willing to have branded content on their newsfeeds" [20, p.23]. This area could also be considered for development and involvement of relevant influencers, providing the resources are available and not just an indication of SM memberships. The original research included a thorough review of this matter, though it is omitted here, due to the size of the paper.

3.10 Data visualisation and 'Quartz Curve'

Data visualisation is another issue here, as graphs, tables, charts, images and interactive solutions can simplify the perception of large and/or complex online data. Online presentation of content is also the key, as "Developing and popularising useful and attractive new formats could make news stories more recognisable when aggregated and consumed on other platforms, and provide more compelling reasons for people to visit the source sites and apps" [21]. This, in particular, relates to the long articles on the Home and Course pages.

In terms of the length of the news articles, Nielsen Norman Group, already in 2007, suggested via "information foraging" sort of "diet selection", i.e., to have mixed news articles, mixing short and long stories, as the readers in this case will get the most "benefit" [19]. The website visitors prefer reading "shorter stuff that's focused, creative and social with a really good headline. It doesn't mean it's unsubstantial. It just means it's really clear about what's interesting and focuses on that" [18]. Additionally, website users appreciate lengthier and more analytical pieces with a depth of topic, which are also suggested by the News Industry professionals [22].

Among other innovative ideas, the 800-word article styles, however, still dominate amid the news prepared forms. On the other hand, the research, conducted by 'Quartz' (online global business news), presented in 2014, evaluated the negative direction of the impact of the legacy of print on digital storytelling, i.e., the study revealed that there was a correlation between the word count for a piece of content and the reader's willingness/desire to engage with the story, i.e., to share this content via social media accounts. The research introduced so called "Quartz Curve" phenomenon (**Figure 2**) and found that the format for digital articles' size between five hundred and eight hundred words is not the best one to use. The content in this case gets less attention, as these articles are either too short to go into sufficient detail, or excessively long to be read fast [23].

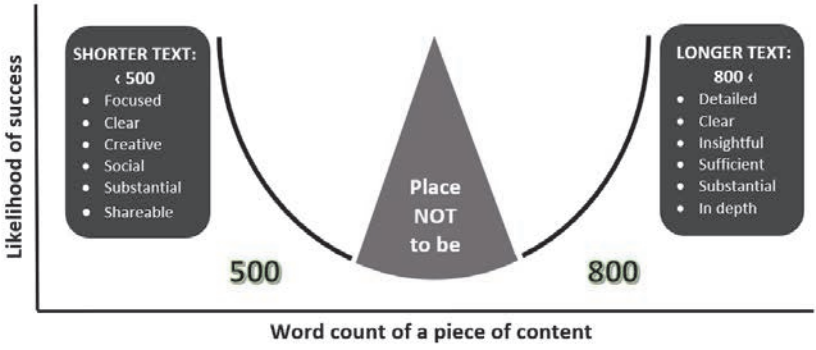


Figure 2: "Quartz Curve" adapted from the Kevin Delaney, 'Quartz' Co-Founder, 2015

In evaluating the Home pages, the researchers discovered that the length of the articles for different institutions varied significantly. The researchers took one week as an example for the review, which suggested the following word numbering. The results revealed a wide spectrum of numbers 296, 297, 395, 405, 410, **553, 626, 657, 731, 745, 798**, 892 and 1,184-word stories. This wide-variety spread had been representative throughout the studies. Amending the articles to the suggested lengths would be also beneficial.

Overall, experts also suggest considering various other points instead, i.e., if a piece of content is smart, brings new information, provides a payoff and if it is worth sharing [22]. It had been suggested to "Start with overviews and short, simplified pages. Then link to long, in-depth coverage on other pages" to ensure the text serves both type of the readers, [19].

Further research, however, emphasised that Generation 'Z' preferred reading "a story all in one place". These recent findings, among others, also suggested that these readers "want to skim, but dig deeper when they're interested", which supports the idea of having a mixture of different-length pieces of content. The work also highlighted the biggest issue for this generation, as "young people are trying to navigate a difficult path between information overload and FOMO (fear of missing out)". The news on the universities' websites become essential in this respect, as it is, realistically, the only space and opportunity for the HEIs to publish live material, which, more than others, requires creating an engagement. Digital news specialists also suggested that the consumption of this content is also heavily based on the gamification – "And anecdotally, the more playful we made our prototypes the more engaging our participants found them — even if we didn't always get the interaction quite right". The majority of the Generation 'Z' readers prefer getting news via text, though it depends on the context and the story. Surprisingly, the research also found that "video was consumed more at home". The research additionally revealed several other useful points, which should be subsequently used by the HEIs. The Generation 'Z' participants, for instance preferred having an option of embedded text, as it assists in clarification of something unfamiliar. The participants also liked having the option of watching a video, a short or long story to read or the 'skip' option. The participants also highlighted the need for help in creating an opinion, thus the option with both sides of opinions with videos had also been appreciated [24].

The researchers here could suggest placing different videos for the courses, whereby the students/staff members would suggest having selected a particular path for the course, and the other person would be more comfortable with the other life destination. As an example, Open University's website offers several different videos for several different research methods (questionnaires, interviews, experiment, etc.) to choose from, where staff members explain the pros and cons of each of these, leading the reader to choose the one most suitable for their studies.

Overall, additional research would be required to find out the real situation, based on the UK and its prospective students.

3.11 "Cool" design with no pressure for "hungry" consumers

A number of website developers were still under the impression that the customers could be confused, if something was changed on the HEIs' websites. The key audience for these providers, nonetheless, are adolescents, who are normally in the search for the data, being "hungry" for new and exciting information. It is the responsibility of the HEIs to keep up, researching and finding interesting new data, as well as presenting this information in the most attractive way. It is the key to being playful, rather than pressuring, to avoid the probable sense of the burden of continuous education, rather than suggesting a continuous experience at a different level in life, which would additionally bring financial stability and new opportunities of self-identity. The universities have to be aware of the recent trends in their subject fields, as well as the preferences of the new generations, e.g., the current preference for the personalised data by the 'Generation Z'. The technical part of the website designs is also significant, particularly for modern students, who see various designs elsewhere and require these developed designs to be on the HEI's website at least to prove that these technological advances are not only present on the home pages, but taught by experts, using available professional equipment.

3.12 More video material and gamification

There is also the need for offering much more video material relating to the information about the courses, student experiences and the university itself. Preferably, the video should not be automatically played, as it could slow down the page download (currently where those HEIs used videos played on PC, they automatically disadvantaged mobile users, who did not get the video but a banner, which replaced it), but also allowing the viewer to decide for themselves, if there was the need and desire to watch them. Moreover, other ethical institutions also provided text around these videos, explaining what was included, added subtitles and provided some more information.

The website developers should also consider gamified content, relevant to this industry, in particular to the prospective students as the key target audience (this could be identified via an additional research). The games could be, for example, preparing a student for independent living, so one of the tasks could be collecting a suitcase to take to the Halls of Residence and getting five points when collecting a pair of warm socks and ten points for packing a mug. The same could be with the preparation of the essential stationery, ideally, specified to the course requirements, as well as the protective uniform, etc., whatever is relevant. The key point here is again the regularity of the publications and the content that is not available in one go, but a game of getting the items on the regular basis, thus gaining points and eventually receiving a badge (surprisingly, individuals like collecting electronic badges and often do things to achieve as many as possible, exhibiting addictive behaviour) or whatever the research identifies as valuable for the prospective students.

3.13 The need for stories and a feeling of accomplishment

Following on, a couple of other points worth mentioning would be, firstly, the need for stories as the easiest and currently acknowledged as most acceptable form of delivering information, according to Content Marketing Institute. Secondly, the need to create a feeling of accomplishment when using a website. In the life of adolescents (or adults), it is relatively rare to achieve a long-term goal; thus, "even small wins can boost inner work life tremendously", evoking positive reactions, according to Harvard Business Review [25]. That is why, small elements of the achievement, even via the offered gamification could potentially increase the probability of the positive attitude of the students towards the HE and this HEI, as well as leading to the decision to join.

3.14 Content written "by a human being to a human being"

Despite the fact that the selected universities would not be in position to compete with the Russell Group institutions, due to a number of financial and social factors, the Post-92 institutions could gain more advantage by their attempts being different from their direct competitors, i.e., offering a non-marketing approach to the data planning and publishing. The facts highlighted on the main page – statistics, achievements and institutional awards – would deliver some positive results, as prospective students appreciate short and clear facts, expressed in awards and numbers, while the actual content is much more important.

A good quality article could not only highlight the institution from the crowd of similar institutions, but also build up these potential customer relationships, which would lead to the 'transaction' of becoming a student. The aim would be to produce articles, which are written "by a human being to a human being", not someone neutral with only marketing in mind. The articles with personalised content, relevant to the target audience at this time, would be much more successful. The emotions behind the texts could reveal a human being with doubts and sometimes not yet formed obvious and strong opinions, attitudes and beliefs. Hence, vlogs interviews could be one of the answers, e.g., where a person with no background knowledge is not afraid asking questions, which others could view as "silly".

3.15 Work together for the content

Universities might consider having difficulties in generating quality content. Having the articles for publications, however, does not have to be necessarily achieved using merely Marketing/Digital/PR/Content teams at the university.

The developed internal communications within the institutions could provide the materials prepared by various departments and, in particular, by the lecturers and actual students.

This would have not only added entertaining and developing data for the prospective students to come back to and enjoy reading, but also indicated the level of the knowledge for the university, i.e., indicating their expert position in the field, and updated views for the schools/in their students' modern and changing lives.

Having a lecturer, who is interested in the dynamic changes in their subject/field and the students, who are taught the latest technologies/tendencies, besides classic knowledge, would gain much higher competitive advantage than just a clean and attractive website design or any marketing materials.

3.16 The reasons to be back

The universities need to create the reasons for the occasional user to be interested in returning to the site and becoming a regular visitor. This approach would assist the HEI, using it, at least to achieve being in the evoked set of universities, when prospective students are thinking about higher education, and in the best-case scenario – to achieve the regular followers (or even ambassadors), who would in time become their students.

This is particularly significant, though might be challenging and requires careful consideration, following students studying remotely, as recent events of lockdown and self-isolation could become a regular experience.

Thus, having merely marketing/promotional material on the home page would not only be homogeneous, but also be seen as boring or even annoying to prospective students as the institution, which could be (i) either seen as not bothering to do anything for their potential students (sadly, they would not be in position to offer anything when they became students) or (ii) just as the HEI, which needs to get numbers, i.e., to achieve the large quantity of students, playing on marketing.

The universities, on the other hand, on a regular basis, not only had their marketing information boxes/spaces unchanged, but also the live news articles, which did not change for weeks, or even for months on some institutions' websites.

Overall, in the researchers' subjective opinions, there had been a sense of homogeneity in the information presented online for all the Post-92 institutions, such as having so called "must have" parts for the Home pages. The images/videos varied slightly, though not significantly, as there seemed no attempt by the institutions to stand out and to be different. The researchers understand that there are expected fields for the pages to contain. Despite this, Russell Group institutions had been managing to achieve the individual presentation of their HEIs, without being lost in the crowd of so many similar institutions.

Continuous effort and contribution are necessary from the universities, i.e., in time and resources, and would eventually allow them to become unique. Despite the potential expense, this approach would be more profitable in gaining students in the long-term.

3.17 Content to be

To summarise, the institutions need to, at least, consider ways of inviting the Home page visitors to enjoy thought-provoking articles and dialogues on the topics of the recent events and research within the academic subjects/fields to avoid the selling/buying attitude of education, and, possibly, offering master courses from Industry specialists. The researchers would also suggest considering the quality of the actual pieces of content and summarised the following recommendations for each piece to be successful and achieve the desired result, i.e., an action from the targeted audience (**Table 6**).

The work on the content does require significant contribution, whereas, at the same time, modern website users are accustomed to free information. These website users would most likely want to evaluate the potential value of the knowledge from HEI specialists and often wish to experience what they are buying prior to the purchase. The institutions, therefore, should still always consider, if the required resources are available to ensure successful application and to apply any effort possible producing a high level of content via the latest technology.

Table 6: Suggestions on successful content

CONTENT to be successful has to…
Be engaging with the ideas to share and discuss
Invite the call to action
Have an attractive and triggering headline
Deliver new information or a modern view of the old topic
Be written using a good language and writing style
Preferably consist of regular episodes/series/videos/publications
Hook to create the reason to return with something unrevealed/undiscovered/unclear/incomplete
Be relevant
Be timely
Aim at the target audience
Provide excellent images, not necessarily professional but relevant and engaging
Contain immaculate formatting with the consistency of the styles
Present the availability of the latest Technology
Adapt to all devices
Gamify to provide a joy of reading/viewing and/or a joy of an achievement of accomplishment
Be timely presented, updated, replaced and/or removed/archived

Conclusion and Recommendations

The researchers can conclude that, disappointingly, the homogeneity of the content in the reviewed Post-92 institutions was evidently obvious. The current content on the home pages risks neither attracting prospective students to study at their institutions, nor to higher education in general. In order to resolve the aforementioned issues and to achieve the unique position in the market, the universities should at least have a Digital Content Strategy in place, based on the Content Calendar and regular Content Audits, alongside quality inspirational and sequential articles on the home pages, with no commercial implications and free expert advice, as a bare minimum.

References

1 Razina O, Al-Husban M, Ahmad S & Ross M (2019). Making Sense of Digital Content Strategy, Higher Education and Student Recruitment. *Global Connectivity and Learning across the Generations*, 129-142

2 Baxter P & Jack S (2008). Qualitative case study methodology: Study design & implementation for novice researchers. The Qualitative Report, 13, 544-559

3 Bromley DB (1986). *The case-study method in psychology and related disciplines*. Chichester: Wiley

4 Kaarbo J & Beasley RK (1999). A practical guide to the comparative case study method in political psychology. *Political psychology*, 20(2), 369-391

5 Yin, RK (2012). A (very) brief refresher on the case study method. *Applications of case study research*, 3, 3-20

6 Munck, GL (1998). Canons of research design in qualitative analysis. *Studies in Comparative International Development*, 33(3), 18-45

7 Downe-Wamboldt B (1992). Content analysis: Method, applications and issues. *Health Care for Women International*, 13, 313-321

8 Schreier M (2012). *Qualitative content analysis in practice*. Thousand Oaks: Sage

9 Elo S & Kyngäs H (2008). The qualitative content analysis process. *Journal of Advanced Nursing*, 62, 107-115

10 Robson C (1993). Designing case studies. *Real world research. A resource for social scientists and practitioner-researchers. Oxford: Blackwell*, 146-186

11 Burnard P (1996). Teaching the analysis of textual data: an experiential approach. *Nurse Education Today*, 16, 278-281

12 Polit DF & Beck CT (2004). Nursing Research. Principles and Methods. Philadelphia: Lippincott Williams & Wilkins

13 Elo S. *et al.* (2014). Qualitative content analysis: A focus on trustworthiness. *SAGE open*, 4(1), 1-10

14 Braun V & Clarke V (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*; 3(2), 77-101

15 Vaismoradi M, Turunen H & Bondas T (2013). Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. *Nursing & Health Sciences*;15(3), 398-405

16 Miles B, Huberman A & Saldana J (2014). *Qualitative Data Analysis*. 3rd ed. Thousand Oaks: Sage Publications

17 Castleberry A. & Nolen A (2018). Thematic analysis of qualitative research data: Is it as easy as it sounds? *Currents in Pharmacy Teaching and Learning*, 10(6), 807-815

18 Delaney KJ (2015). *Quartz's Kevin Delaney: Time to kill the 800-word article*. Interview by Brian Morrissey. 1 May 2015 [retrieved 7 April 2021], from Digiday: https://digiday.com/media/wait-this-is-800-words

19 Nielsen J (2007). Long vs. Short Articles as Content Strategy. 11 November 2007 [retrieved 2 April 2021], from Nielsen Norman Group: https://www.nngroup.com/articles/content-strategy-long-vs-short

20 GLOBAL WEB INDEX (2019). Brand Discovery. Insights Report. 1 May 2019 [retrieved 27 January 2021], from Global Web Index: https://www.globalwebindex.com/reports/brand-discovery-report

21 Ferne T (2017). Beyond 800 words: new digital story formats for news. *BBC News Labs.* 26 September 2017 [retrieved 1 April 2021], from BBC News Labs: https://medium.com/bbc-news-labs/beyond-800-words-new-digital-story-formats-for-news-ab9b2a2d0e0d

22 Nachison A (2009). Keep it brief, or long; just make it great. 20 January 2009 [retrieved 3 April 2021], from WeMedia: https://wemedia.com/keep-it-brief-or-long-just-make-it-great/

23 Delaney KJ (2014). Presentation of the Quartz research on the impact of the legacy from print on the digital storytelling and the word number curve. London gathering of digital editors. 2014 [retrieved 1 April 2021], from Quartz: https://qz.com/author/kevinjdelaney/

24 Ferne T (2018). Part 2: Prototyping formats for news and Generation Z. 18 July 2018 [retrieved 1 April 2021], from BBC News Labs: https://medium.com/bbc-news-labs/beyond-800-words-prototyping-new-story-formats-for-news-e3102e783b5f

25 Amabile TM & Kramer SJ (2011). The power of small wins. *Harvard Business Review*, 89(5), 70-80

A Social Media Data Analysis Study Regarding the Effect of the COVID-19 Pandemic on Online Learning

Georgios Lampropoulos[1], Kerstin Siakas[2], Theofylaktos Anastasiadis[3]

[1, 2] Department of Information and Electronic Engineering,
International Hellenic University, Greece
Email: [1]lamprop.geo@gmail.com, [2]siaka@ihu.gr

[1] School of Humanities,
Hellenic Open University, Greece

[2] Department of Production – Industrial Management
University of Vaasa, Finland
Email: [2]ext-ksia@uwasa.fi

[3] Department of Physical Education and Sport Science,
Aristotle University of Thessaloniki, Greece
Email: [3]filias@phed.auth.gr

Abstract

Over the last year, the whole globe has been significantly affected due to the rapid and worldwide spread of the coronavirus disease (COVID-19). The COVID-19 pandemic has dramatically influenced various sections of everyday life. Drastic changes have been brought about in the educational sector with the need to rapidly switch from traditional face-to-face to online learning through virtual learning environments. In addition, educators, students and parents found themselves in the difficult position to make significant changes and find new ways to overcome the unexpected and unprecedented obstacles and to meet the new needs and requirements. Moreover, during such difficult circumstances and demanding times, it is significant for governments and involved stakeholders to comprehend the public's opinion to improve decision-making and risk communication. Social media platforms have become an indispensable part of everyday life with millions of people interacting, sharing knowledge and experiences through communicating online in real time even during global adverse events. Consequently, these platforms can be used as a means to collect diverse and multicultural viewpoints from all over the world. The aim of this study is to analyse the public's viewpoints, concerns and sentiments regarding the effect

of COVID-19 on online learning through the collection, analysis and visualisation of Twitter data. In total, 274,109 relevant tweets were retrieved from January 2020 to January 2021. Based on the results, the majority of the tweets (50.62%) were positive, 25.12% of them were neutral while 24.26% were negative. Additionally, most of the tweets expressed trust (27.47%), anticipation (20.17%) and fear (11.46%) while 24.01% of them were neutral.

Keywords: Education, Online Learning, Distance Learning, Online education, Pandemic, Covid-19, Social media, Twitter

1.0 Introduction

Over the last year, the whole world has been significantly affected due to the rapid and global spread of the coronavirus disease (COVID-19) and the severe consequences it has caused. On the 11th of March 2020, COVID-19 was declared as a pandemic by the World Health Organization (WHO) [1]. The educational sector was one of the sectors which was significantly affected by COVID-19 with schools having been suspended in 189 countries by April 2020 meaning that 89% of the overall educational community was affected [2]. The educational process had to rapidly switch from traditional face-to-face to online learning through virtual learning environments. Educators, students and parents had to drastically adapt to these changes and find ways to meet the new needs and requirements and overcome the unexpected and unprecedented difficulties.

During such demanding times, capturing and monitoring the public's opinion and information dissemination and relaying information on a timely manner while also preventing disinformation play a significant role in decision-making and risk communication [3]. Social media can be used as a means to facilitate and support these tasks.

Social media allows users to publicly share their opinions and viewpoints in real time and can be used as platforms for self-directed professional activities [4]. Therefore, social media has become a means through which people interact, communicate, share knowledge and experiences online [5]. This fact contributes greatly to the exponentially increasing volume of online data, creating thus what is called Big Data [6], which when analysed, can generate invaluable knowledge [7]. Furthermore, social media is built upon the foundations of bottom-up communities, knowledge sharing, accessibility and user generated content [8] and can be regarded as an invaluable educational tool [9]. Consequently, social media along with the tools it offers (e.g. Application Programming Interfaces - API) can be used to extract knowledge regarding the public's opinion and sentiment on specific matters.

As quarantine measures have been applied across most of the countries, people have been increasingly relying on various social media platforms to get informed, express opinions and receive news [10]. In order to comprehend the public's viewpoints regarding the effect of COVID-19 pandemic on online learning, we opted to collect open raw data from Twitter since:

- It is a popular platform for sharing knowledge and for catching up with trends and news around the world [11];
- It is considered as the go to social media platform for acquiring and sharing information and opinions during global adverse events [12];
- It is one of the predominant means of joining social conversations with an audience of potential global reach [13];
- It is used by many government officials worldwide as one of the main communication channels to regularly share news and policy updates to the general public [14].

The aim of this study is to collect Twitter data and analyse the public's opinion and sentiment regarding the effect of COVID-19 on online learning. In that view, this study is organised as follows: Section 2 presents related studies and Section 3 analyses the methodology and the analysis process used and showcases the results. In Section 4, the findings of this study are discussed and finally, Section 5 provides conclusions and directions for future research.

2.0 Related work

Xue et al. (2020) collected Twitter messages related to the COVID-19 pandemic from March 7th to April 21st 2020 [10]. The data preparation included three steps, namely sampling, data collection and pre-processing. The data analysis process which used the tweet text as the unit of analysis included i) unsupervised machine learning (for identification of patterns and probabilistic clustering based on the text data), ii) sentiment analysis and iii) qualitative method. In their study, they used a list of 25 COVID-19 related hashtags, (e.g. "#coronavirus," "#COVID-19", "#coronaoutbreak", "#quarantine"), as search terms to fetch tweets. The first search returned 35 million tweets. After having removed duplicates, retweets and non-English tweets, they still had around 4 million (n=4,196,020) tweets. In addition, they used the Python programming language to clean the raw data by removing i) the hashtag symbol, @users, and URLs from the tweets, ii) non-English characters (non-ASCII characters) as well as iii) special characters, punctuations, and stop-words. In the following step, they used Latent Dirichlet Allocation (LDA) machine learning approach to identify popular unigrams, bigrams, salient topics and themes. They identified 13 topics of discussion in total, which were classified into five different categories, namely "public health measures to slow the spread of COVID-19", "social stigma associated with COVID-19", "coronavirus news cases and deaths" "COVID-19 in the United States" and "coronavirus cases in the rest of the world". In order to relate the returned by the LDA themes to one of the 13 topics, they carried out a qualitative approach including manual coding and inductively

developing of themes based on the latent topics generated by the machine learning algorithms. They used the thematic analysis of [15] which relies on human interpretation and includes the following six steps: i) getting familiar with the keyword data, ii) generating initial codes, iii) searching for themes, iv) reviewing potential themes, v) defining themes and vi) reporting. Furthermore, they used sentiment analysis to classify the main sentiments of a certain tweet, such as fear and joy. For that reason and after removing articles, pronouns, prepositions as well as prefixes and suffixes, they used the NRC Emotion Lexicon (Mohammad and Turney, 2013) to calculate the emotion index of each eight-emotion type for each tweet. Based on their findings, the dominant sentiments regarding the spread of coronavirus were anticipation, followed by a mixed feeling of trust, anger, and fear for different topics.

Lemay and Doleck (2020) aimed to answer the research question "How did the online conversational communities evolve on Twitter during the global shutdown due to the COVID-2019 pandemic?" [13]. In that view and with the aim of comprehending the nature of the interactions in online teaching and learning using Twitter conversation, they examined follow-up and repeated interactions. More specifically, they collected tweets containing the hashtags #onlinelearning and #onlineteaching from mid-March to end of April 2020 by using the R programming language, RStudio, and the R tweet package. They created five datasets of tweets at 9-day intervals. Additionally, they used Python 3.7.6 and NetworkX 2.4 for their undirected network graphs. They used tidytext, dplyr, syuzhet, stringr, tm, and ggplot2 to analyse the tweets. Before conducting sentiment analysis, they i) removed stop-words, ii) removed urls iii) converted text in lowercase iv) removed punctuations. Based on their results, the majority of conversational groups on Twitter included two to four members and the most prevalent sentiment for both #onlinelearning and #onlineteaching was a positive sentiment. A majority of the users made spontaneous contributions to the discussion without maintaining a presence in the Twitter discourse. Moreover, their results revealed the limited efficiency of Twitter conversations as a medium for informative and communicative exchanges. As conversations do not spontaneously form and in order to increase interaction and learning as well as to facilitate discursive exchanges, the conversations need to be supported, e.g. connecting knowledge seekers and knowledge disseminators.

Ewing and Vu (2020) analysed tweets during three weeks in April 2020, when the Government policy was in the highest incongruity. They focused on public opinions about home schooling in Australia, hence they used a search query ('homeschooling' OR 'home schooling') [2]. All the returned tweets which were more than 10,000 were qualitatively analysed and classified into 9 categories. Six of them, namely positive, negative, humorous, appreciation for teachers, comments aimed at Government/ politicians and definitions, were further analysed qualitatively. The results showed that towards the end of the first three weeks, the public began to lose their sense of humour and negative tweets almost doubled.

Arambepola (2020) analysed the effectiveness of distance learning by using sentiment analysis on a dataset of 202,645 tweets which were posted between July 12th and August 14th 2020 [16]. The analysis consisted of three stages, namely i) data pre-processing to remove irrelevant tweets, ii) tweets classification into three classes (positive, negative and neutral based on their polarities) and iii) statistical data analysis for identifying any relationship between user experience on distance learning in different countries and the economic stability of those countries. Based on the results, 54% of the sentiments were positive, 30% negative and 16% neutral. Moreover, the highest number of tweets (around 6000) was posted from the United States (US), followed by the UK (around 2200), India (around 2000) and South Africa (around 1800). Their statistical analysis showed that users from developed countries where internet usage is comparatively high (e.g. 92% in USA and Canada), showed a high percentage of positive opinions regarding distance learning and users from less developed countries (e.g. 26,72% in Yemen) showed a strongly negative opinion about distance learning. However, users from South Africa, with thriving economy and advanced infrastructure [17] showed the highest percentage of positive opinions about distance learning, despite the fact that internet usage in South Africa is comparatively low. Moreover, other less developed countries, such as the Philippines and India with strong economies and relatively high internet usage showed a similar picture. According to the results, there is a relationship between user experience on distance learning in different countries, economic stability and internet usage. The limitation of the study was that developed countries were dominating the dataset, which is a general limitation, since users from countries with limited internet use are less likely to use Twitter.

In order to understand the flow of information and the development of mass sentiment in pandemic scenarios, Samuel et al. (2020) conducted a study which involved the following four critical issues: i) public sentiment associated with the progress of Coronavirus and COVID-19, ii) the use of tweets, for sentiment analysis, iii) descriptive textual analytics and textual data visualisation and iv) comparison of textual classification mechanisms used in artificial intelligence (AI) [18]. Based on their results, the accuracy of the machine learning (ML) classification methods used is higher on short tweets. In addition, through the use of Naïve Bayes, the classification accuracy of the fear sentiment classification was 91% while through the utilisation of logistic regression, the accuracy was 74%.

Gencoglu and Gruber (2020) proposed an inference approach to discover and quantify the potential relationship among Twitter activity, public sentiment and pandemic characteristics [19]. Through their approach, epidemiological domain knowledge can be acquired and variables that affect public sentiment and attention can be identified.

Al Lily et al. (2020) investigated the research question "*What are the ramifications of implementing distance education amid coronavirus?*" [20]. They targeted Arab cultures, by analysing social-media posts, online classes and interviews. Twitter was used for collecting social-media posts with relevant keywords, such as corona

education, distance education, pandemic and school closure, as well as hashtags, such as #corona_education and #corona_distance_education). They collected around 30 tweets per day over a period of two weeks excluding retweets, repeated tweets and spam messages. They retrieved data three times per day (at 11 a.m., 5 p.m. and 10 p.m.) and set the critical threshold to 50 tweets per item within each of the following items, namely: Gender (female, male), Language (Arabic), Country (UAE, Sudan, Saudi Arabia, Jordan, Egypt, Kuwait), Qualification (Bachelor, Master, PhD), Background (Urban, rural, Bedouin), Role (Parent, student, teacher, manager, decision-maker, company), Opinion (Supportive, opposing, neutral, serious, comic, extreme, negative, positive), Expression (Image, text, link, video) and Tweet Time (morning afternoon, evening). In total, 1393 posts were collected and analysed by using the mind mapping software Ayoa. Each relevant tweet was given a one-word mark that reflected its essential meaning based on which they were categorised into 'micro visions' that were later on grouped into 'meso visions' to improve clarification, vision and comprehension of data. Finally, the identified 'meso visions' were combined into an overall 'macro vision' which established a final comprehensive vision. Based on this vision, they created a crisis distance education (CDE) framework to support the unprecedented distance education needs and requirements that arose during the pandemic.

Carpenter et al. (2020) examined two popular hashtags, namely #RemoteLearning and #RemoteTeaching [21]. Initial analysis of a random sample of tweets, from mid-March to mid-April 2020 retrieved by the Twitter API (re-tweets were excluded), indicated that these two hashtags offered spaces for meeting the cognitive, social, and emotional needs of educators. Initially, 36,788 tweets were received and limited to 10,444 by selecting the tweets with the word 'teacher' in the user description. After having used the random ordering function of a MySQL query, the first 500 results were returned and analysed by the authors. They categorised the tweets, according to words used in the tweets, into knowledge sharing, asking questions, expressing gratitude, connecting with others etc. Simultaneously, they conducted sentiment analysis on the text from the dataset of 10,444 tweets by using SentiStrength [22]. SentiStrength utilises a lexicon of positive (e.g. good, happy) and negative (e.g. bad, sad) words to generate the relevant polarity scores. These two scores for each tweet were then compared to determine if the tweet was neutral, net positive or net negative. According to the results, 58% of the tweets were neutral, 36% were positive, and only 5% were negative in sentiment. Neutral tweets mainly focused on sharing information. In 55% of the tweets, educators posted resources, ideas, learning opportunities, or insights related to remote teaching, teaching with technology, or remote learning in general. 15% of the tweets focused on sharing advice or resources for using specific technology tools, such as Zoom, Microsoft Teams, Google Meet, Class Dojo, and Flipgrid. 43% of the educators tweeted words of encouragement or gratitude or shared their experiences as they navigated through the crisis. 23% of the educators wrote positive or inspiring posts, expressed thanks to the people and the digital tools which supported their remote teaching, or shared their success. Some educators (27%) tweeted about their new workplace settings or daily lives during the pandemic. 4% shared humorous photos, GIFs, and memes to lighten the mood during an intense time. 2% of the educators tweeted about missing

their classrooms, students, and school community. Furthermore, based on the findings, the following three recommendations for professional development of educators were proposed:

1. Teacher educators should aim to create learning spaces and experiences that support cognitive growth, affective well-being, and social needs.
2. Teacher educators should offer opportunities for teachers to expand their professional learning networks by using informal digital learning spaces.
3. Teacher educators, administrators, and scholars should look for patterns in the content and categories of educational tweets as a way to better understand the needs in the field.

3.0 Our study

This section presents the data analysis process of the social media data concerning the public's viewpoints and opinions regarding online learning. Particularly, data related to the effect of the COVID-19 pandemic on online learning was collected from Twitter over the period of January 2020 to January 2021. The methodology used in this study is analysed and the drawn results are presented further below.

3.1 Methodology

In order to meet the requirements and fulfill the aims of this study successfully and extract reliable information that leads to useful results, a specific methodology was developed which is described below in detail.

Data requirements: With a view to ensuring data accuracy, validity, consistency as well as high quality of data which plays a significant role in the overall analysis process and in drawing comprehensive conclusions, specific aims and requirements were set from the start regarding the retrieved data, their source as well as the methods that were used for their analysis.

Data collection: The Twitter social networking platform was used to retrieve open data about the public's opinion regarding the effect of the COVID-19 pandemic on online learning. After testing various keywords both separately and in combination and with the aim of searching for both keywords and hashtags the final search query was: *("covid" OR "covid19" OR "coronavirus" OR "lockdown" OR "pandemic" OR "corona virus" OR "covid-19" OR "covid 19" OR "covid_19" OR "corona-virus" OR "quarantine") AND ("remote learning" OR "remote education" OR "online education" OR "remote-learning" OR "distance learning" OR "online learning" OR "distance education" OR "distance-learning" OR "online-learning" OR "distancelearning" OR "onlinelearning" OR "remotelearning").* In total, 274,109 tweets were collected over the period of January 2020 to January 2021 with retweets being filtered out. Moreover, the following information was stored for each tweet: id, permalink, date, username, tweet, hashtags, mentions and urls.

Data processing, cleaning and storage: The retrieved data was pre-processed in order to create a "clean" dataset. Particularly, the text was converted into lowercase

and the punctuations, single characters, URLs and stop-words were omitted where necessary and the abbreviated words were expanded and repeated letters were normalised. The processed data was stored in both Comma-separated Values (CSV) files and in JavaScript Object Notation (JSON) format files.

Data analysis and visualisation: After creating the dataset, data analysis was conducted. It is worth noting that, lemmatisation was used for the text analysis but not for the sentiment analysis as the accuracy of the results decreases when stemming and/or lemmatisation is applied on the text [23]. In addition, in order to conduct sentiment analysis, the open-sourced library TextBlob was used for the lexicon-based polarity detection [24] while the National Research Council Canada (NRC) Word-Emotion Association Lexicon (EmoLex) [25, 26, 27] was utilised as a basis for the lexicon-based sentiment analysis for emotion detection. In order to visualise the results, figures and graphs were generated for each of the following cases: most frequently used words (excluding the keywords used) and hashtags, monthly tweet frequency as well as sentiment analysis through polarity and emotion detection.

3.2 Challenges and limitations

The main challenges and limitations in our study were i) the selection of the most effective social media platform, ii) limiting our data retrieval to tweets that were written in English, iii) determining users' country as this information, due to privacy and security manners, is regarded as private personal data in Twitter and cannot be retrieved unless the user has made it publicly available [28]. More specifically, even though we managed to retrieve the countries from some of the tweets and normalise the data, we do not believe it reflects the actual numbers and therefore, we did not include the specific results in this study.

3.3 Results

In order to better comprehend the crowd wisdom regarding the effect of COVID-19 on online learning, the above-mentioned methodology was used and a dataset containing 274,109 tweets, which were retrieved from January 2020 to January 2021, was created. More specifically, the most frequently used words (excluding the keywords used) and hashtags used within the retrieved tweets were analysed as well as the numbers of tweets made for each month. Finally, sentiment analysis through polarity and emotion detection was conducted.

The results regarding the public's opinion on the effect of the COVID-19 pandemic on online learning from January 2020 to January 2021 are presented below:

- **Word frequency analysis**: The top-20 most commonly used words excluding keywords are presented on Table 1 from which the top-5 were: "school(s)" (96,535 - 2.21%), "student(s)" (64,544 - 1.48%), "teacher(s)" (29,847 - 0.68%), "kid(s)" (21,235 - 0.49%) and "due" (19,494 - 0.45%).
- **Hashtag frequency analysis**: The top-5 most commonly used hashtags were: "#COVID19" (47,422 - 7.03%), "#onlinelearning" (27,305 - 4.05%), "#remotelearning" (2,4661 - 3.66%), "#distancelearning" (19,746 - 2.93%)

and "#coronavirus" (17,563 - 2.61%). The results of the top-20 most commonly used hashtags are displayed on Table 2.

- **Monthly tweets over the period of January 2020 to January 2021**: It is worth noting that April (44,682 tweets) and March (42,559 tweets) were the months with the highest number of tweets and the top-5 days with the highest number of tweets were: 27/04/20 (2782 tweets), 19/03/20 (2867 tweets), 18/03/20 (2807 tweets), 05/01/21 (1674 tweets) and 04/01/21 (1628 tweets). Figure 1 presents the monthly tweet frequency.
- **Sentiment analysis – polarity detection**: Based on the results, the majority of the tweets 138,759 (50.62%) were positive, 68,843 (25.12%) of them were neutral while 66,507 (24.26%) were negative.
- **Sentiment analysis – emotion detection**: The top-3 most intense emotions based on the analysis were: trust (75,304 - 27.47%), anticipation (55,284 - 20.17%) and fear (31,425 - 11.46%) while 24.01% (65,820) of the tweets were neutral. Figure 2 depicts the emotion detection results.

Table 1: The top-20 most commonly used words excluding the keywords used.

Word	Count/Percentage	Word	Count/Percentage
school(s)	96,535 (2.21%)	help	15,429 (0.35%)
student(s)	64,544 (1.48%)	time	15,228 (0.35%)
teacher(s)	29,847 (0.68%)	via	14,210 (0.33%)
kid(s)	21,235 (0.49%)	class(es)	13,656 (0.31%)
due	19,494 (0.45%)	week	13,340 (0.31%)
child(ren)	19,178 (0.44%)	support	13,198 (0.3%)
new	19,073 (0.44%)	need	12,383 (0.28%)
home	17,361 (0.40%)	access	12,336 (0.28%)
parent(s)	16,807 (0.39%)	free	12,169 (0.28%)
go	16,396 (0.39%)	resource(s)	12,153 (0.28%)

Table 2: The top-20 most commonly used hashtags.

Hashtag	Count/Percentage	Hashtag	Count/Percentage
#COVID19	47,422 (7.03%)	#lockdown	5,870 (0.87%)
#onlinelearning	27,305 (4.05%)	#elearning	5,759 (0.85%)
#remotelearning	2,4661 (3.66%)	#OnlineLearning	5,397 (0.8%)
#distancelearning	19,746 (2.93%)	#Covid_19	4,929 (0.73%)
#coronavirus	17,563 (2.61%)	#pandemic	4,505 (0.67%)
#education	12,692 (1.88%)	#learning	4,380 (0.65%)
#covid19	10,714 (1.59%)	#edchat	4,353 (0.65%)
#RemoteLearning	6,909 (1.02%)	#Covid19	4,179 (0.62%)
#edtech	6,662 (0.99%)	#Coronavirus	3,774 (0.56%)
#DistanceLearning	5,884 (0.87%)	#covid	3,445 (0.51%)

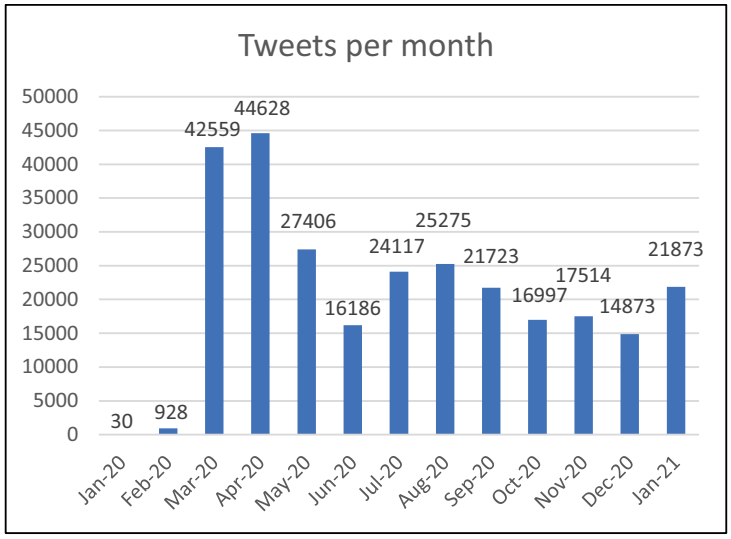


Figure 1: Number of tweets per month over the period of January 2020 to January 2021.

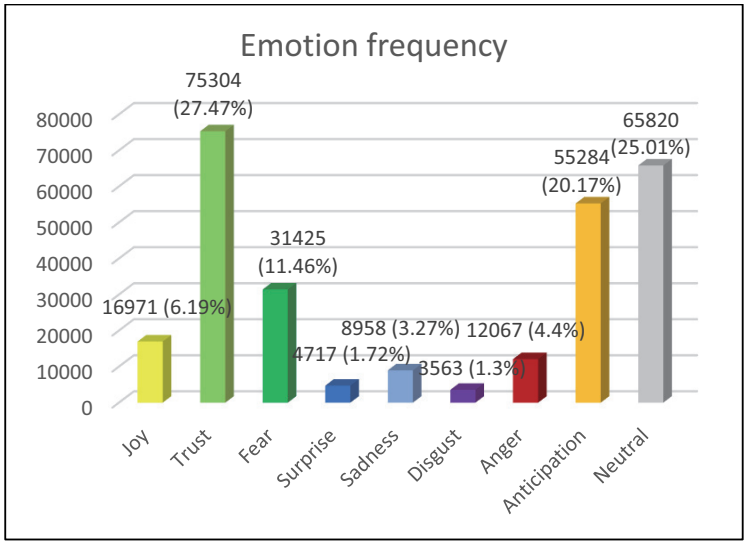


Figure 2: Frequency of emotions.

4.0 Discussion

Undoubtedly, the interest in online learning has greatly increased. Due to the COVID-19 pandemic, many people experienced online for the first time and many had to learn to teach once again but this time through a screen. This fact created many new challenges but acted as a means to solve many of the problems that arose.

Educators, students and parents had to learn new skills, make adjustments and reform their daily habits in order to engage in online learning. It is worth noting that the difficulties faced by the educational community were different for each country and for each educational stage. Nonetheless, due to all the efforts made, the fulfilment of the educational process was feasible.

Furthermore, online learning offers various advantages such as reducing the need to commute from place to place and as a result saving time and reducing greenhouse gas emissions and carbon footprint. It provides opportunities for more flexible learning and access to cutting edge digital content. Additionally, it helps the development of vital soft skills (e.g. time management) and it encourages students to take ownership of their learning, at least to some degree, and to learn in their own pace.

On the other hand, there are also disadvantages regarding online learning environments as there can be a great sense of isolation, various technological issues, deprivation of emotion sharing and self-motivation as well as direct access and interaction with peers and educators. Moreover, it was obvious that in many counties, there is a clear need for teacher training concerning online learning and virtual learning environments.

Based on the results of this study, the majority of the tweets which display the public's opinion regarding the effect of COVID-19 on online learning were positive (138,759 - 50.62%) and expressed trust (75,304 - 27.47%) but a few of them were neutral (68,843 - 25.12%) and without expressing a specific sentiment (65,820 - 24.01%). Therefore, it can be said that even though there are various drawbacks in online learning, the public still considers this learning and teaching method as a positive and viable, to some degree, supplementary method to the traditional one and not as something that could entirely replace traditional face-to-face learning.

5.0 Conclusion and Future work

The COVID-19 pandemic has dramatically affected the whole world. The educational sector as well as all the educators, students and parents had to make significant changes and find new ways to overcome the unexpected and unprecedented obstacles and to meet the new needs and requirements. It is of great significance during such difficult circumstances and demanding times to

comprehend the public's opinion to improve decision-making and risk communication. Social media platforms have become an indispensable part of everyday life with millions of people interacting, sharing knowledge and experiences and communicating online in real time even during global adverse events. Therefore, they can be used as a means to collect diverse and multicultural viewpoints from all over the world.

This study aimed at analysing the public's viewpoints, concerns and sentiments regarding the impact of COVID-19 on online learning through the collection, analysis and visualisation of Twitter data from January 2020 to January 2021. Based on the results, the majority of the tweets (50.62%) were positive, 25.12% of them were neutral while 24.26% were negative. Most of the tweets expressed trust (27.47%), anticipation (20.17%) and fear (11.46%) while 24.01% of them were neutral. Future work will focus on comparing the public's viewpoints and sentiments concerning online learning before, during and after the pandemic.

6.0 References

1. World Health Organization. (2020). WHO Director-General's opening remarks at the media briefing on COVID-19. Retrieved 10 February 2021, from: https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020
2. Ewing, L-A., Vu. H.Q. (2020). Navigating 'Home Schooling' during COVID-19: Australian public response on Twitter, *Media International Australia*, pp. 1–10.
3. Van Bavel, J. J., Baicker, K., Boggio, P. S., Capraro, V., Cichocka, A., Cikara, M., ... & Willer, R. (2020). Using social and behavioural science to support COVID-19 pandemic response. *Nature human behaviour*, *4*(5), 460-471.
4. Lampropoulos, G., & Siakas, K. (2018). Communication in Distributed Agile Software Development: Impact of Social Media–Social Networking. In *SQM* (Vol. 26, p. 43).
5. Makkonen, P., Lampropoulos, G., & Siakas, K. (2019, November). Three quality attributes-availability, performance and security-of social media services used in higher education: A cross-cultural analysis with IS/ICT students. In *E-Learn: World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education* (pp. 520-527). Association for the Advancement of Computing in Education (AACE).
6. Lampropoulos, G., Siakas, K., & Anastasiadis, T. (2018). Internet of Things (IoT) in Industry: Contemporary Application Domains, Innovative Technologies and Intelligent Manufacturing. *International Journal of Advances in Scientific Research and Engineering, 4*(10), 109-118. doi: 10.31695/IJASRE.2018.329106
7. Lampropoulos, G., Siakas, K., & Anastasiadis, T. (2019). Internet of things in the context of industry 4.0: an overview. *International Journal of Entrepreneurial Knowledge, 7*(1), 4-19.

8. Makkonen, P., Lampropoulos, G., & Siakas, K. (2019, November). Security and privacy issues and concerns about the use of social networking services. In *E-Learn: World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education* (pp. 457-466). Association for the Advancement of Computing in Education (AACE).
9. Lampropoulos, G., Siakas, K., Makkonen, P., & Siakas, E. (2021). A 10-year longitudinal study of social media use in education. *International Journal of Technology in Education (IJTE), 4*(3), 373-398. doi: 10.46328/ijte.123
10. Xue, J., Chen, J. Hu, R., Chen, C., Zheng, C., Liu, X., & Zhu, T. (2020). Twitter discussions and emotions about COVID-19 pandemic: a machine learning approach, *JMIR Publications, Advancing Digital Health & Open Science*, Vol 22, No. 11, e20550. doi: 10.2196/20550
11. Overbey, L. A., Batson, S. C., Lyle, J., Williams, C., Regal, R., & Williams, L. (2017). Linking Twitter sentiment and event data to monitor public opinion of geopolitical developments and trends. In *International Conference on Social Computing, Behavioral-Cultural Modeling and Prediction and Behavior Representation in Modeling and Simulation* (pp. 223-229). Springer, Cham.
12. Rosenberg, H., Syed, S., & Rezaie, S. (2020). The Twitter pandemic: The critical role of Twitter in the dissemination of medical information and misinformation during the COVID-19 pandemic. *Canadian journal of emergency medicine*, *22*(4), 418-421.
13. Lemay, D. J., & Doleck, T. (2020). Online Learning Communities in the COVID-19 Pandemic: Social Learning Network Analysis of Twitter during the Shutdown. *International Journal of Learning Analytics and Artificial Intelligence for Education (IJAI)*, *2*(1), 85.
14. Rufai, S. R., & Bunce, C. (2020). World leaders' usage of Twitter in response to the COVID-19 pandemic: a content analysis. *Journal of Public Health*, *42*(3), 510-516.
15. Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology*, *3*(2), 77-101.
16. Arambepola, N. (2020). Analysing the Tweets about Distance Learning during COVID-19 Pandemic using Sentiment Analysis, *Proceedings of International Conference on Advances in Computing and Technology (ICACT*), pp. 169-171.
17. Index of Economic Freedom. (2020). Retrieved 30 January 2021, from https://www.heritage.org/index/country/southafrica?version=986
18. Samuel, J., Ali, G. G., Rahman, M., Esawi, E., & Samuel, Y. (2020). Covid-19 public sentiment insights and machine learning for tweets classification. *Information*, *11*(6), 314.
19. Gencoglu, O., & Gruber, M. (2020). Causal modeling of twitter activity during covid-19. *Computation*, *8*(4), 85.
20. Al Lily, A. E., Ismail, A. F., Abunasser, F. M., & Alqahtani, R. H. A. (2020). Distance education as a response to pandemics: Coronavirus and Arab culture. *Technology in society*, *63*, 101317.
21. Carpenter, J. P., Krutka, D. G., & Kimmons, R. (2020). #RemoteTeaching & #RemoteLearning: Educator tweeting during the COVID-19 pandemic. *Journal of Technology and Teacher Education*, *28*(2), 151-159.

22. Thelwall, M., Buckley, K., Paltoglou, G., Cai, D., & Kappas, A. (2010). Sentiment strength detection in short informal text. *Journal of the American society for information science and technology*, *61*(12), 2544-2558.
23. Bao, Y., Quan, C., Wang, L., & Ren, F. (2014, August). The role of pre-processing in twitter sentiment analysis. In *International conference on intelligent computing* (pp. 615-624). Springer, Cham.
24. Loria, S., Keen, P., Honnibal, M., Yankovsky, R., Karesh, D., & Dempsey, E. (2014). Textblob: simplified text processing. *Secondary TextBlob: simplified text processing*, *3*.
25. Mohammad, S. M. (2020). *NRC Word-Emotion Association Lexicon*. Retrieved 12 February 2021, from http://saifmohammad.com/WebPages/NRC-Emotion-Lexicon.htm
26. Mohammad, S. M., & Turney, P. D. (2013). Crowdsourcing a word–emotion association lexicon. *Computational Intelligence, 29*(3), 436-465.
27. Mohammad, S., & Turney, P. (2010). Emotions evoked by common words and phrases: Using mechanical turk to create an emotion lexicon. *In Proceedings of the NAACL HLT 2010 workshop on computational approaches to analysis and generation of emotion in text* (pp. 26-34).
28. Kanakaris, V., Lampropoulos, G., & Siakas, K. (2019). A Survey and a Case-Study Regarding Social Media Security and Privacy on Greek Future IT Professionals. *International Journal of Human Capital and Information Technology Professionals (IJHCITP)*, *10*(1), 22-37.

Professionalism in Practice: The Impact of COVID-19 and Future Directions

James Uhomoibhi[1], Linda Odhiambo Hooper[2] , Soheir Ghallab[3]
Margaret Ross[4], Geoff Staples[5]

[1] Artificial Intelligence Research Group (AIRG), Faculty of Computing, Engineering and the Built Environment,
Ulster University, Northern Ireland, BT37 0QB,
j.uhomoibhi@ulster.ac.uk
[2] School of Applied and Policy Sciences , Institute of Research in Social Sciences,
Ulster University, Northern Ireland, BT37 0QB, hooper-l@ulster.ac.uk
[3] BCS Business Change SG Chair, soheirg@bcs.org.uk
[4]BCS e-Learning and Quality SGs Vice Chair, Solent University,
margaret.ross@bcs.org.uk
[5] BCS Hampshire Branch Vice Chair geoff.staples@bcs.org.uk

Abstract

The paper discusses the changes that have occurred in providing Continuous Professional Development during the pandemic of COVID-19, and the main challenges including actions to address these, as well as some advantages, moving from physical activities to remote, often using e-learning technology, provided by the BCS and other professional bodies to their members.

The paper discusses the way that these changes could affect the future of professional organisations at the grassroots level, using surveys of people organising events as well as those attending professional BCS meetings.

Future changes, once the restrictions on physical meetings are removed, are considered, such as a mixture of virtual meetings and also networking events and visits.

Keywords: CPD, BCS, professional bodies, COVID-19

1.0 Introduction

The changes since March 2020 caused by the pandemic have altered the means of providing Continuous Professional Development (CPD).
The restrictions over this time have, for some, provided the opportunity to upskill for all levels of professional from student to retired [1, 2, 3] or as cited by Eastman to " tick off items on the their perennial to-do list" [4]. The main problems being associated with the lack of suitable equipment, lack of good connections and for

certain countries the uncertainty of power supply [5, 6, 7, 8]. The wider population has also had to adapt to remote communications not only for e-shopping, the use of e-cards, business meetings, for meeting friends and families remotely. In most ways everyone everywhere has seen what is perceived at the normal way of life give way to a "new-normal" way of doing things and living life. This has meant adjusting to living life online and making technology a part and parcel of everyone's everyday life everywhere in the world This has and remains the way for the foreseeable future.

2.0 Professional Events

The professional bodies have adopted the webinar as a means of providing communications to their members. An example of this is an engineering society that has been holding regular Zoom meetings. To improve networking, some of these meetings have been followed by regular dinners with different "break-out rooms" for each course.

Some organisations, such as a science society, have changed from physical weekly meetings to a regular weekly evening Zoom meeting with a fifteen minute free chat before and an extended discussion after the presentation. This format has attracted some additional new members, Current plans to continue with a combination of physical and virtual regular events are being considered once the physical meetings are possible.

One maritime institiute, on having to move to virtual events, has found the attendance increasing to an average of over one hundred and twenty per meeting including members joining from Japan and India. Their thoughts currently are to continue with a mixture of physical and virtual events in the future.

2.1 The BCS Events

The BCS Branches and Specialist Groups have adopted webinars particularly with events that are jointly between two or more of these groups. This has the advantage of sharing the effort of organisation and providing a much wider range of webinars for the attendees whether they are BCS members or not. The geographic range of attendees is naturally much more widely spread than at conventional physical events, but the majority are from the UK. An example of this was a breakout for a Branch event during a Zoom presentation where in one virtual "room" there were four attendees that were geographically situated at Bournemouth, Bedford, London and Glasgow.

The need was felt by many BCS Specialist Groups to actively provide remote CPD for its members for all stages of their careers [1, 2]. Examples of this were the AI series provided by the BCSWomen Specialist Group, and the series of webinars by Tom Gilb HonFBCS [9] presented from Norway, organised by the BCS SPA and the BCS Quality Specialist Groups. The need to provide wider training in adapting

to virtual based learning was provided by BCS branch sessions such as by Jill Clarke [10] on the effective use of Zoom for the BCS Hampshire Branch.

3.0 Professional Conferences

The pandemic has affected both national and international conferences, regardless of size, not only the presenters, attendees and exhibitors of their products but the local economy. The cancellation of these face-to-face conferences, even the small ones, affect local economies such as hotels, restaurants and shops. An example of this is the estimated loss of more than 30 million dollars to Philadelphia of the American Chemical Society's meeting [11].

The change from physical to virtual conferences requires serious decisions concerning the digital platform [3], the use of expensive dedicated conference specialist software or the the low cost or free alternatives. Decisions need to be made whether a conference fee should be charged for non-physical events and if so, at the same rate or lower. A variety of options have been in place for professional conferences since March 2020. Many organisations use the free access to increase their awareness within the marketplace, such as the 4-day World Congress on Software Quality conference, in April 2021, attracting attendees from thirty countries, and over eighty presenters [12]. This included a virtual marketplace where organisations could have a virtual booth, to present information or talk to people. This means of providing interaction with the audiences, both in large and in small groups, within a conference need to be addressed [3] whether by using breakout rooms in Zoom or more sophisticated systems.

The International Conference on ICT for Sustainability (ICT4S) organised their virtual seven-day conference in June 2020 [13] in the same manner as their previous six physical conferences, with presentations in a virtual auditorium as well as poster areas where you could click for the appropriate poster and have a discussion with the authors. In addition there were chat areas to increase networking and to welcome and encourage new attendees.

Professional bodies also moved from physical to virtual conferences with the same fees to previous years while others provided free access, as did the Institute of Science and Technology (IST) [14] which provided free access for their 2020 conference with increased attendance numbers from 380 at the physical 2019 conference to 460 for the virtual 2020 conference, with an increase of over 20%. This also provided easy access for remote members including those from overseas. Their decision has been made for the 2021 IST conference to be held virtually in September 2021.

3.1 BCS INSPIRE Conferences

The BCS e-Learning Specialist Group [15] held their twenty four physical INSPIRE conferences before 2020 at which just a few pressenters had joined remotely. These

remote links were usually via Skype and the conference timetables were organised so that the remote presentations were usually positioned immediately after a refreshment or meal break to allow extra time for the connection to be established. In addition the remote presenters were required to send their slides in advance and if possible to add audio attached to each slide or to provide a script with each slide. This was to provide backup if there was a technical problem.This allowed the presentation to continue and if necessary for the question session to be conducted by telephone. The limited number of remote presentations were from various countries including Finland, Greece, Spain, Nepal, Nigeria and the UK.

The presenters at the BCS e-learning 25th INSPIRE 2020 conference [16] came from a range of countries including Armenia, Bosnia-Herzegovina, Cyprus, Denmark, Eire, Finland, Greece, Ireland, Kenya, Nigeria, Northern Ireland, Russian Federation, Slovak Republic, Spain, Sri Lanka, UK, and the USA. The only technical problems were experienced from London, Northern Ireland and Greece. There were problems which were addressed by changing the order with the following presentation to allow time for the issue to be fixed. Any questions relevant to a particular presentation were typed into the "chat area". In addition to the various conference session Chairs, there were also two dedicated committee members, one from the UK and the other one in the USA. These two committee members would monitor the questions and ask them at the end of the various sessions. This was very successful as relevant questions could be combined, the order of the questions could be re-arranged, and if necessary, the committee member could clarify the wording of the question with the attendee that typed it into the chat area.

In the past INSPIRE conferences, when payment was required, we expected a number of late withdrawals, but with the 2020 virtual conference, where the fee was not required, there were rather more presentations than we expected. It had been necessary to remove the planned breakout sessions. As the BCS could not allow us extra time, it was necessary to move the early evening presentations to a change to Zoom. These two points were the problems experienced with our first totally remote conference. These were the main lessons learnt and taken into account for future remote conferences.

4.0 Surveys of Attendees and Organisers of Events

Two surveys were undertaken using Google Forms [17] to identify the change of behaviour of attendees at BCS meetings and the experience of those organising professional events.

4.1 Views of Attendees of Events

An anonymous questionnaire asked attendees of BCS meetings their views on webinars compared with conventional physical meetings. These questionnaires were open to all regardless of BCS membership. Identical questions were asked about Branch events, which might have been jointly with other Specialist Groups or

Branches, and also for events organised by Specialist Groups that themselves might be jointly with other Branches or Specialist Groups.

Participants in the survey were asked to estimate the attendance since March 2020 of these BCS webinars compared with those during the previous year, when almost all the events were face-to-face. The participants were then encouraged to identify both the positive and the negative aspects of these virtual events. Information was also sought on the preferred start time for webinars. Identification of the main Branch or of the main Specialist Group were requested and an open-ended space allowed for comments, that included ideas for post virus events. Participants could request copies of the summary of the results by providing their contact details. Responses were received from attendees who all came from many different BCS Branches and a wide range of different Specialist Groups.

4.2 Results of the Attendees Survey

The results of the survey from the seventy seven respondents, from a wide variety of Branches and over thirty Specialist Groups, that attended BCS events indicated that the change to webinars might have increased the participation of members. This was shown by comparing those that did attend any Branch webinars since March 2020, which was 76.6% compared to those that did attend any of the previous physical Branch events prior to that date which was 51.9%. A similar change was shown in the Specialist Groups with an attendance of the webinars since March 2020 of 67.2% compared to those that did attend any other physical Specialist Group events at 40.3%

The survey was concerned with the number of attendances of member group activities and particularly related to webinars the attendance prior to March 2020 for both Branches webinars and Specialist Group webinars were similar. Following March 2020 all branches and specialist group activities had to be conducted by webinars the survey investigated the change of attendance of both branch and of specialist group webinars since March 2020 and compared with the Year prior to March 2020 the number of branch and specialist group events which could have been physically or combined with webinars.The results from this limited survey of responses appeared similar for both branches and specialist groups. Table 1 indicates the number of attendances of zero, one, two, three or four or more prior to or post March 2020 for Branches and for Specialist Groups.

Table 1: Attendance as a Percentage Post and Prior to March 2020

Attendance as %	Zero	One	Two	Three	Four or more
Branch after March 2020	23.4	15.6	9.1	2.6	49.3
Branch before March 2020	48.1	10.4	6.5	7.8	26.2
Specialist Group after March 2020	32.8	14.9	9.0	7.3	36.0
Specialist Group before March 2020	59.7	10.4	3.0	3.0	23.9

Participants were asked if they attended webinars prior and post March 2020 which are shown on Table 2.

Table 2: Views on attending webinars prior t0 March 2020

Attendance as %	Never	Very Rarely	Regularly
Branch	46.1	46.1	11.8
Specialist Group	44.1	41.2	14.7

The results in Table 2 are possibly attributed to the lack of webinars available to members prior to March 2020, although some physical events were also provided as an online option.

4.2.1 Advantages and Disadvantages Identified

The same positive and negative choices together with options to add additional comments were offered to both attendees of Branches and of Specialist Groups.

The positive aspects of these webinars offered were:

a. no travel time
b. no travel cost
c. no parking issues
d. refreshments of your own choice and at your own time
e. no baby or childcare arrangements
f. no other person or animal care sitters needed
g. no risk of going out late at night
h. wider range of speakers
i. joint events with other BCS Branches and/or Specialist Groups
j. more recorded events
Other:

The negative aspects of these webinars offered were:

a. no or poor networking
b. no opportunity of visiting different locations
c. already too many remote meetings through work
d. not meeting face-to-face
Other:

The results of these from the Branches were shown in Figure 1 and Figure 2 for the advantages and disadvantages of the webinars,

Additional comments with regard to those that attended Branch events, as shown in Figure 1, were as follows:

- Although there were no travel cost for me, my internet charges became too expense
- It doesn't matter where the branch is geographically, so can attend no matter where they are
- Easier to take a chance- if it is uninteresting, leaving is easy and un-embarrassing without investing travel time

- Didn't attend any BCS webinars
- Access to webinars which are held in locations which are too far away to attend under normal circumstances

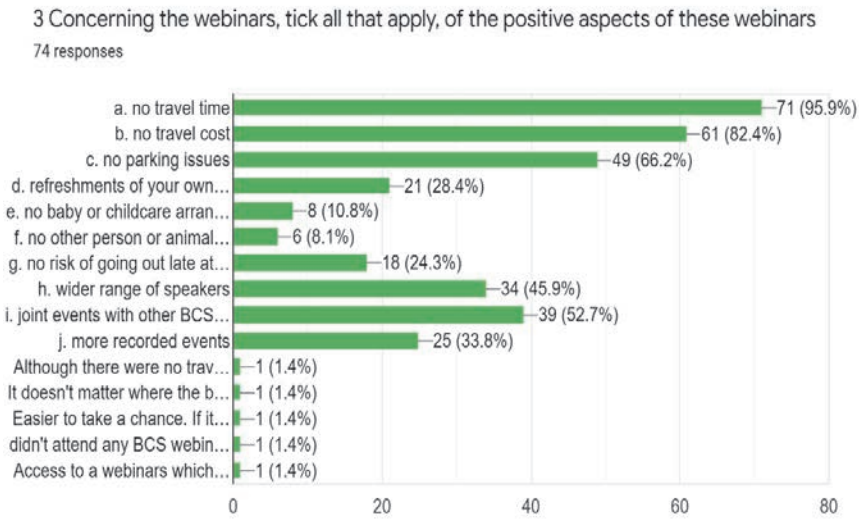


Figure 1: Positive aspects of webinars for a Branch

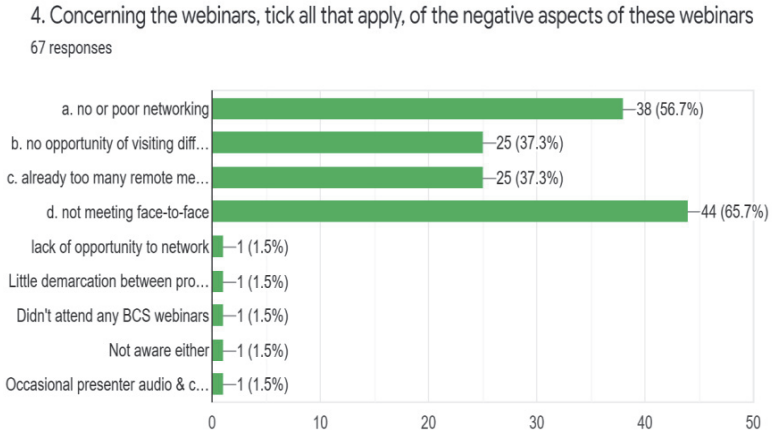


Figure 2: Negative aspects of webinars for a Branch

Additional comments with regard to those that attended Branch events, as shown in Figure 2, were as follows:

- Lack of opportunity to network
- Little demarcation between professional and home life - noise and disturbance from home life during webinars
- Didn't attend any BCS webinar
- No aware either
- Occasional presenter audio and connectivity issues

Similarly the results of these from the Specialist Groups were shown in Figure 3 and Figure 4 for the advantages and disadvantages of the webinars.
Additional comments, with regard to those that attended Specialist Group events, as shown in Figure 3, were as follows:

- Able to access meetings a long way away, so the range or meetings available to me is much larger when they are remote access
- It doesn't matter where the group is geographically, I can attend if I am free and want to
- Easier to take a chance - if uninteresting, can leave without out leave without investing travel time
- I didn't distinguish between branch and SG webinars

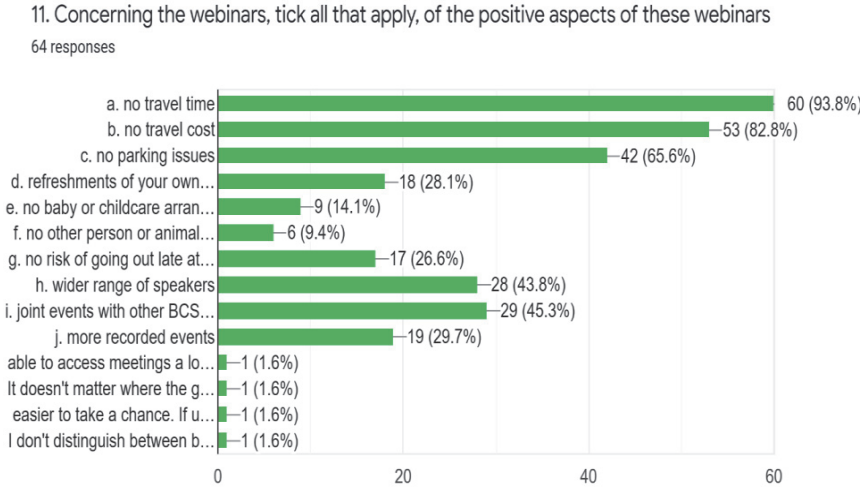


Figure 3: Positive aspects of webinars for a Specialist Group

There were no additional comments, with regard to those that attended Specialist Group events, as shownin Figure 4.

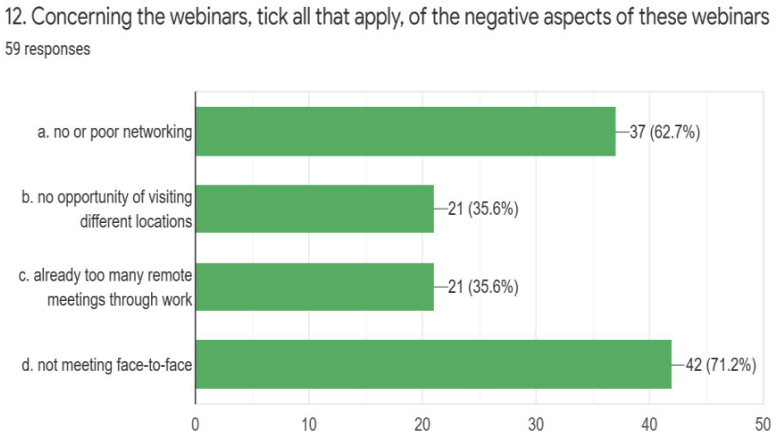


Figure 4: Negative aspects of webinars for a Specialist Group

The availability and cost of parking close to the venu can affect attendance at BCS events.

4.2.2 Additional Comments

A selection of the general comments with regard to Branches are shown, the first ones rather concerning:

- I'm new to BCS, I didn't know branches existed
- Difficult to find out what events are on, would like an email. This is the first one I've received
- Work has been very busy so I haven't been looking out for events. Emailing details of online events would be good for me
- Don't seem to get meeting notifications anymore.
- There were no webinars available. Very useful for specialist groups
- I have not historically attended branch meetings but do intend to start doing so hence answering this survey.
- I cannot recall hearing about Branch webinars, I probably did but don't remember. Part of this issue is that the BCS is no longer relevant to my day job, it does seem to be more service delivery orientated and I'm now working on land platforms in the defence environment, not "just" on computer systems. I keep my membership of the BCS because (i) my employer pays for it and (ii) through that I maintain my Engineering Council registration.

A further selection of the general comments with regard to Branches were as follows:

- I would like more physical Branch visits when possible
- The trick (and it's a difficult one) would be to offer remote access to a physical meeting when covid restrictions are lifted. Ie have simultaneously the best of both worlds.
- I would still like to see physical rather than web based presentations. There is a role for the webinar, but we loose something. I work in …., so struggle to get back in time for …….. and ……. based events, however it's important that we still have some physical meetings.
- I have attended Bournemouth meetings some times in the past. Life just seems so busy now!
- Most of my BCS activity is through …… SG, rather than the regional branch
- Would like to continue with webinars.
- Personal commitments have prevented me from attending many events in recent years, but I hope to start more-regular attendance. Zoom has been useful in this respect.
- Whilst online "meetings" are helpful, one of the main reasons for being active in the Society is networking with fellow professionals. On-line interfaces really offer very little compared with the standard face to face meetings of yesteryear
- I have only just qualified in January and become a member, which is why I have not attended any meeting during 2020
- Please continue with hybrid webinars
- Being hard of hearing I sometimes have problems with the clarity of the speech.
- Webinars tend to increase the reach , participation and contribution of diverse audiences.
- I've really enjoyed the webinars. Going online has made them a lot more accessible.
- Remote webinars have given me the opportunity to attend a much wider range of branch talks which I coudn't otherwise attend because the physical location is too far away. I will continue to attend my local branch meetings when the situation normalizes but I hope remote presentations continue. I'd go further and suggest that meetings are arranged with affliate branches and organisations in other countires

A selection of the general comments with regard to Specialist Groups follows:

- I would like more SG webinars rather than physical events
- Specialist group seminars, when face to face, tended to be several hours (& many tens of pounds) travel away in London - so I only attended if they happened to be when I needed to be there anyway.
- Would like to continue with webinars.
- I hope webinars continue.
- I hope that we decide to continue with hybrid meetings in the future

- Going forward the use of online resources and webinars has made life a bit easier albeit with increased workload for organisers. However, with continuous improvement in the processes greater and more positive impacts would be the results of current practice. Going forward would require coming up with creative and ore innovative use of technologies to bridge the digital divide as not everyone has access to or are proficient in the use of all of these technologies. This would enable as many people possible to participate in the new normal mode of living and working online.

4.3 Views of Organisers of events and Results of that Survey

An anonymous questionnaire was provided for those involved in organising BCS and other professional activities, identifying both the positive and the negative aspects of these webinars, compared to the pre COVID-19 virus activities, from the perspective of Branch and of Specialist Group activities. Responses were received from eight who all came from different BCS Branches and Specialist Groups.

There was a 100% support for that "since March 2020, the attendance at the Branch events" was on average larger than before March 2020. Whereas the attendance at the Specialist Group events was felt to be by approximately 83.3% larger and 16.7% about the same as before March 2020.

The majority 62.5% of organisers of Branch events indicated that they had held more BCS Branch events since March 2020. These might have been jointly with other Branches or Specialist Groups. Approximately 37.5% had held similar number of attended activities as before March 2020. It was interesting that no respondents had reduced the number of events attended since the start of the first lockdown in March 2020. The majority 66.7% of organisers of Specialist Group events indicated that they had held approximately the same number , whereas 33.3% felt more BCS Specialist Group events since March 2020. Again these might have been jointly with other Branches or Specialist Groups. It was interesting that no respondents had reduced the number of events attended since the start of the first lockdown in March 2020 .

These results, despite coming from a small sample of experts in organising events, indicated that members of Branches and Specialist Groups were given the same opportunity of joining events and had better turn out than prior to the pandemic.

4.3.1 Advantages and Diisadvantages Identified

The questionnaire for organisers of events contained five standard possible options with the opportunity of adding further advantages of the webinars, as shown in Figure 5 and Figure 6.

These positive options were:

a. remote located speakers more available
b. no bookings of rooms
c. no organising of refreshments
d. easier to record events
e. less cost

It was felt by the majority, ranging from 75% to 100% of those arranging Branch events that these were positive advantages; where as 100% of those organising the Specialist Group events found that they were all 100-percent positive advantages Figure 5 and Figure 6.

.

From those organising the Branch events, an additional four advantages were indicated, as shown in Figure 5, which were:

- It can be set up much faster than a physical event and less red
- Breakout rooms possible
- Easier for delegates participants to actively contribute and provide feedback
- Coincidentally new committee

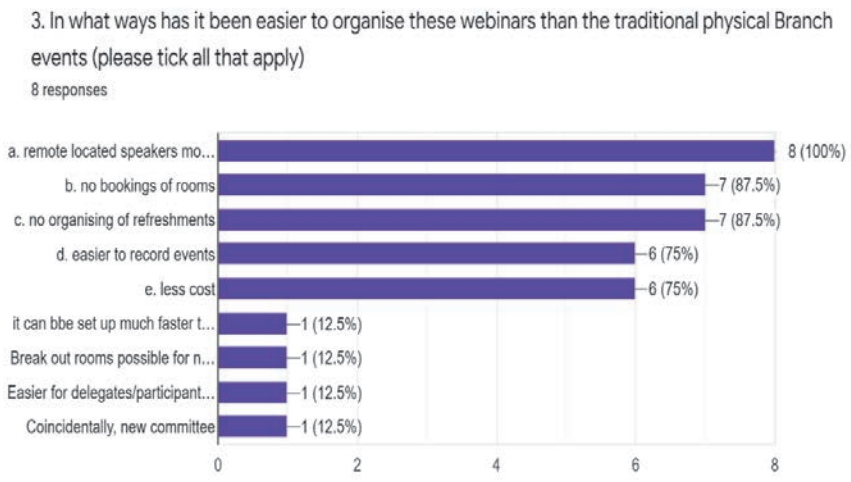


Figure 5: Positive aspects of organising Branch webinars

As with identifying the main advantages, options of potential main disadvantages were provided ,

a. no direct contact with the attendees
b. less networking
c. time zones
d. technical problems
Other:

The only additional comment on Branches was:

- Initial technical problems with the software - occasional problems with particular speakers

The only additional comment on Specialist Groups was:

- Speakers not used to some of the BCS software

The views of both those organising Branch and Specialist Group events were similar. The issue of the geographic locationof speakers, from different time zones, have caused change of starting timings from the more ususal times.

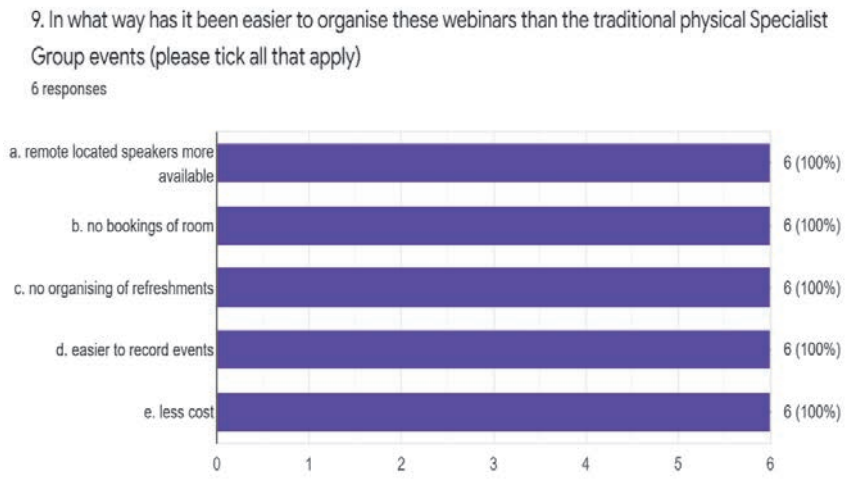


Figure 6: Positive aspects of organising Specialist Group webinars

As with identifying the main advantages, options of potential main disadvantages were provided ,

a. no direct contact with the attendees
b. less networking
c. time zones
d. technical problems
Other:

The only additional comment on Branches was:

- Initial technical problems with the software - occasional problems with particular speakers

The only additional comment on Specialist Groups was:

- Speakers not used to some of the BCS software

The views of both those organising Branch and Specialist Group events were similar. The issue of the geographic locationof speakers, from different time zones, have caused change of starting timings from the more ususal times.

The main problems resulted from problems of networking and technical issues Figure 7 and Figure 8.

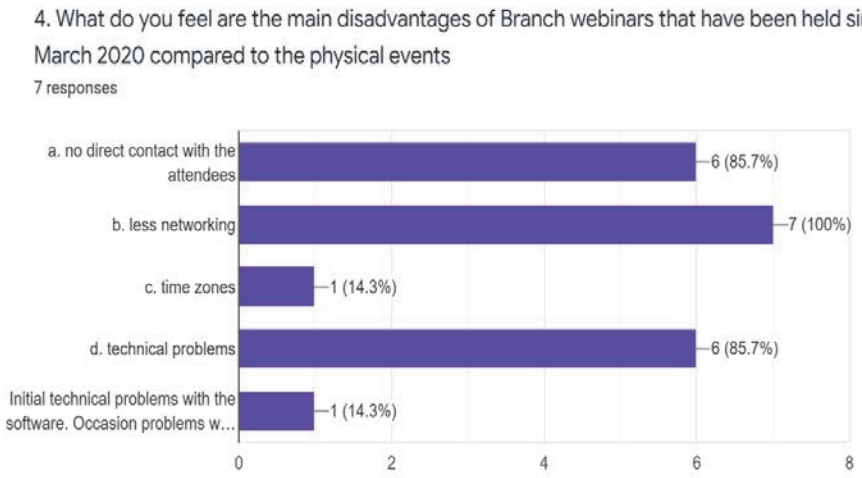


Figure 7: Negative aspects of organising Branch webinars

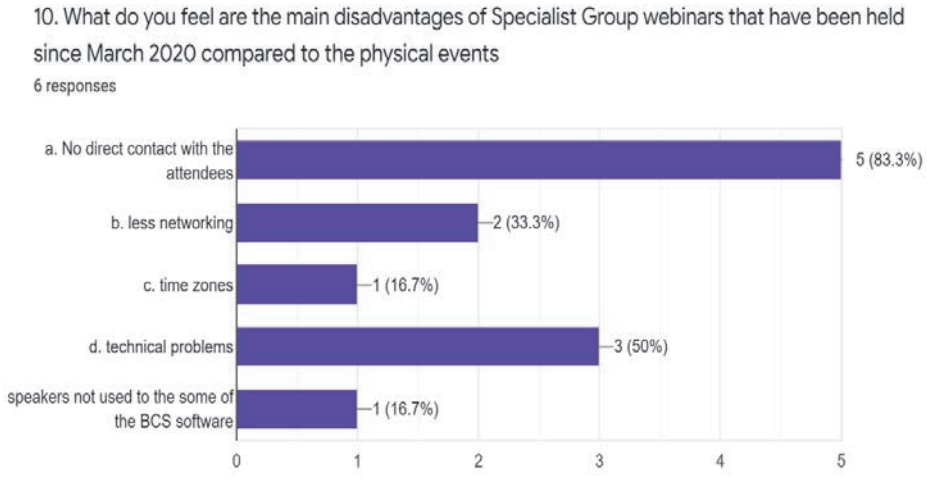


Figure 8: Negative aspects of organising Specialist Group webinars

The limited comments concerning Branches and Specialist Groups were as follows:

- I would like a future mixture of webinars and networking activities

- COVID-19 pandemic has challenged all aspects of organising and delivering events for branches and specialist groups. It has saved on amount of physical resources required to run these events but has called on the use of much time in preparation, delivery and post-event administration on the part of organisers. It has become easier to collate information but the challenges posed by GDPR and other related data privacy issues are some of the hurdles that organisers are struggling to handle well

The limited comments concerning Specialist Groups were as follows:

- I hope webinars continue
- The old comment about SGs being London centric does not apply to the webinars
- The impact of COVID-19 pandemic has been immense. The fact that everyone has recognised the need for being skilled to work online going forward is a big plus. However the challenges of digital divide that exist both here in the UK and in other places abroad need to be addressed to ensure we are achieving the goals we have set ourselves as professionals practicing what we preach and stand for and ensuring that IT is good for society.

The issue of digital divide raises a number of potential points that might have an indication of the take-up of webinars.
The digital divide also can be caused by lack of technical experience or confidence with the most widely used online communications such as Zoom. This can apply to the older population, even those whose careers had been at their most current edge of the computing industry. The digital divide could also relate to those with lower quality hardware or software, possibly in the third world countries which could also be a result of poor access to power. The lack or poor internet and mobile phone connections can happen also in many rural places in the UK which also is another aspect of the digital divide .

5.0 Future Activities

The change in delivery and receiving professional activities has provided an opportunity to rethink the way that we would proceed. Prior to the COVIC19 virus, the Hampshire Branch tried providing live streaming of some of the physical events, but that had mixed success. It did allow those that could not attend to participate, but the technical problems experienced ,had a negative effect on some of those attending. Some BCS groups had more success with combining remote and attending events. The increased number of software licences held by the BCS had improved the ease of arranging recording of webinars.

The current thoughts of some of the Branch and Specialist Group, when the face-to-face events are again normal, are that those Specialist Groups, such as BCS Business Change, that regularly used to hold their events in London, would continue when

possible, having live streaming at the same time if possible, and with the meetings being recorded automatically by the BCS. Other Branches and Specialist Groups are considering continuing with the webinars with occasional face-to-face meetings, possibly also recorded. The benefit of the recorded presentations allows those that cannot attend to achieve the event to be able to watch at the same time or at a later date if required.

The main problem with the webinars is the lack of networking which could be provided by optional "break-out" sessions of say four people during the webinars. On returning to face-to-face options local presenters could be used, which would be followed by short discussions. Networking events could be undertaken such as those that have been held face-to-face by BCSWomen Specialist Group and by the Hampshire Branch, when attendees sit in a circle, when alternate attendees move two places, to have a one-to-one short conversation of about five minutes with another attendee. The process s repeated for approximately one hour. Alternatively the attendees could be divided into groups of four to six to discuss a given topic with feedback from each group after about forty minutes.

Subject to prior agreement, a series of visits could be arranged which are normally restricted by most many organisations to about twelve to provide excellent opportunities in the past for networking.

6.0 Conclusions

The restrictions globally since early 2020 have forced a re-evaluation of all professional bodies and for their members to reconsider the effectiveness and potential different ways of communicating and undertaking CPD activities [1, 2]. The long-term effect on professional bodies could lead to an increase in membership or have the opposite effect leading to closures or amalgamation of bodies [11].

Although the research in this area is at a stage of infancy, there is a recognition of some of the implications of the "new-normal" way of life for individuals and organisations. There are many factors at play which requires resilience on both the part of everyone while recognizing the relationship betweenits implementation for both the organization [18, 19, 20, 21]. These studies have shown that individual and organisations all over the world has the capacity and ability to respond to challenges in the absence of a plan, which at times involve improvisation [22, 23, 24]. In the current era where there is encouragement and drive for innovation and creativity to be taught as part of education we see that the Covid-19 pandemic have brought with it the cultivation of improvisional competence and participation in online networked activities for everyone everywhere.

The advantages of virtual conferences particularly considering the financial issues as well as time saving need to be balanced against being able to replicate the networking opportunities of a conference. Similarly the networking features of

traditional pre virus physical professional meetings also need to be addressed if moving to virtual events. The monitoring of attendance with webinars is more difficult than actual physical events, as virtual attendance with the post event access using the recording of these events, needs also to be considered.

Maybe with more virtual events the professional membership fees would be reduced so encouraging more members, whereas other members might leave due to a decrease of face-to-face events. Also the long-term effect of the confidence post pandemic, to attend face-to-face at events might change, following the virus. As Evens [11] stated “The most Successful societies and organisations will be planning ahead not just for the next meeting, but how to adapt and evolve their meeting format over the next decades” .

7.0 References

1 Uhomoibhi. J, Ross M (2019), The Five Stage Framework for Life Long Learning in Engineering Education and Practice in *Global Connectivity and Learning across the Generations*, Proceedings of International Conference on Software Process Improvement Research, Education and Training, INSPIRE XXIV, Southampton, ISBN 978-1-9996549-3-1, pp. 143 – 153

2 Ghallab S, Odhiambo Hooper L, Ross M, Staples G, Uhomoibhi J (2020), Applying a Five Levels Framework of Lifelong Learning to e-Learning by the Wider Public , in e-Learning as a Solution during Unprecedented Times in the 21st Century, ISBN 978-1-9996549-4-8, Proceedings of INSPIRE XXV

3 Gottlieb, M, Egan D, Krzyzaniak S, Wagner J, Weizberg M, Chan T, (2020), Rethinking the Approach to Continuing Professional Development Conferences in the Era of COVID-19, Journal of Continuing Education in the Health Professions: Summer 2020 - Volume 40 - Issue 3 - p 187-191

4 Eastman, Carmen (2020), Professional Learning during the COVID-19 Pandemic, Published in Collected Magazine, no 26, 2020

5 Odero JA, Online Learning in Kenyan Public Universities: Effectiveness and Challenges in e-Learning as a Solution during Unprecedented Times in the 21st Century, ISBN 978-1-9996549-4-8, Proceedings of INSPIRE XXV

6 Hooper L, Uhomoibhi J (2019), Digital Learning Challenges and Innovations for Sustainable Education in Developing Countries: Issues of Policy and Practice, in *Global Connectivity and Learning across the Generations*, Proceedings of INSPIRE XXIV, Southampton, ISBN 978-1-9996549-3-1, pp. 103 – 116

7 Odhiambo, CA, Odhiambo Hooper, L,(2020) E-Learning in Kenya during lockdown: A Teacher/Leader's perspective. A Case Study of the Inequalities of District, Provincial and National School Experience, in e-Learning as a Solution during Unprecedented Times in the 21st Century, ISBN 978-1-9996549-4-8, Proceedings of INSPIRE XXV

8 Uhomoibhi, J. and Hooper, L., (2019) Digital Learning Challenges and Innovations for Sustainable Education in Developing Countries: Issues of Policy and Practice. In: INSPIRE XXIV, Twenty-fourth International Conference on Software Process Improvement Research, Education and Training: Global Connectivity and Learning Across the Nations.
9 Gilb, Tom HonFBCS, Managility: Management Agility: Part 2 - The technical Details,https://www.bcs.org/events/2020/november/webinar-managility-management-agility-part-2-the-technical-details/ (accessed 20/4/2021)
10 Clarke, Jill, Try Zoom's interactive capabilities, (accessed 20/4/2021) https://www.bcs.org/events/2020/november/webinar-try-zoom-s-interactive-capabilities/
11 Evens RG, The Impact of a Pandemic on Professional Meetings, (2020), Published Online: Apr 17 2020, (accessed 20/4/2021) at https://pubs.rsna.org/doi/10.1148/rycan.2020204012
12 World Congress on Software Quality conference,(April 2021) https://a4qworldcongress.com/ (accessed 20/4/2021)
13 ICT4S 2020, (June 2020), 7th International Conference on ICT for Sustainability, https://2020.ict4s.org/Program.html (accessed 20/4/2021)
14 Institute of Science and Technology, https://istonline.org.uk/ (accessed 20/4/2021)
15 BCS e-Learning Specialist Group, https://www.bcs.org/membership/member-communities/e-learning-specialist-group/ (accessed 20/4/2021)
16 INSPIRE 2020 https://www.bcs.org/media/6602/inspire-2020-proceedings.pdf (accessed 20/4/2021)
17 Google Forms, https://www.google.co.uk/intl/en-GB/forms/about/ (accessed 20/4/2021)
18 Foss, N.J., 2020. The impact of the Covid-19 pandemic on firms' organizational designs. J. Manag. Stud. 57.
19 Renjen, P., 2020. The Essence of Resilient Leadership: Business Recovery From COVID-19. Deloitte Insights. Retrieved from https://www2.deloitte.com/global/en/insights/economy/covid-19/guide-to-organizational-recovery-for-senior-executives-heart-of-resilient-leadership.html, (accessed 20/4/2021)
20 Harland, L., Harrison, W., Jones, J.R., Reiter-Palmon, R., 2005. Leadership behaviors and subordinate resilience. J. Leadership Organiz. Stud. 11, 2–14.
21 Sommer, S.A., Howell, J.M., Hadley, C.N., 2016. Keeping positive and building strength: the role of affect and team leadership in developing resilience during an organizational crisis. Group Organiz. Manage. 41, 172–202.
22 Ciuchta, M.P., O'Toole, J., Miner, A.S., 2020. The organizational improvisation landscape: taking stock and looking forward. J. Manage. 47 (1), 288–316.
23 Cunha, M.P., Cunha, J.V., Kamoche, K., 1999. Organizational improvisation: what, when, how and why. Int. J. Manag. Rev. 1, 299–341.
24 Hadida, A.L., Tarvainen, W., Rose, J., 2015. Organizational improvisation: a consolidating review and framework. Int. J. Manag. Rev. 17 (4), 437–459.

Guidelines and Multidisciplinary Knowledge Advice for Cyber Protection in e-Learning: *Hey, Teachers! Don't Leave the Kids Alone Online!*

Eleni Berki[1], Sunil Chaudhary[2], Maria Panteri[3, 4], Theodora Valkanou[5], Juri-Petri Valtanen[6], Jan Bamford[7], Yevhen Zolotavkin[8], Anna Plevraki[9], Linfeng Li[10], Mike Holcombe[11], Geoff Staples[12]

[1]University of Jyväskylä, Finland
[2]Norwegian University of Science and Technology, Norway
[3]University of Córdoba, Spain
[4]Special Unified Gymnasium and Lyceum of Iraklion, Crete, Greece
[5]University of Copenhagen, Denmark
[6]Tampere University, Finland
[7]London Metropolitan University, UK
[8]Deakin University, Australia
[9]Aristotle University of Thessaloniki, Greece
[10]Beijing Institute of Petrochemical Technology, China
[11]The University of Sheffield, UK
[12]British Computer Society, UK

Abstract

Migrating the teaching and learning activities to the Internet invites a plethora of cyber risks and security threats. As distance learning has undergone a spectacular development and use recently, especially in the Covid-19 era -when it was, once, only temporarily established-, it is considered of utmost importance to ensure the issue of *security* and guarantee *privacy* in e-learning and other online environments. The authors provide information for clarity and understanding of cyber-protection and conceptualise two approaches to it: i) a *reactive* and ii) a *proactive*. For the first, some easy-to-follow suggestions for potential measures for privacy and cybersecurity are outlined, which e-learning providers can realise in a cost-effective and efficient way. For the second, a practical and multidisciplinary knowledge framework is sketched. This is the first step of the future cyber-protection roadmap taking onboard the concepts of multidisciplinary knowledge and multiprofessionals with the means (e.g. edutainment) to realise it in curricula design and professional adult training schemes.

Keywords: Covid-19 pandemic, e-learning, cybersecurity, multidisciplinary, multiprofessional, online survey, privacy.

1.0 Introduction - Cybersecurity and Privacy

Security and privacy concerns in e-learning spaces [1] have been rising during the Covid-19 era since cyber-security incidents go on increasing at exhilarating numbers [2]. Cybersecurity is defined as the body of rules and measures adopted to protect people's fundamental human right to privacy and people's cyberspaces.

A few examples of rising cybersecurity threats and online privacy invasion mentioned last year by Anghel and Pereteanu [3] fall within the next categories:

- Data leakage, due to loss or inadequate security and encryption, unauthorised data collection, confidentiality attacks, and other.
- Problems with (user) authentication.
- Malware installation (e.g. viruses, spam, phishing, etc.).
- Use of unreliable/insecure networks, network congestion.
- Deliberate software cyber-attacks (viruses, macros, Denial-of-Service, Cross-Site Scripting, …).

As online and e- learning has undergone a spectacular development through the Internet use in recent years, especially in the COVID-19 era, it is considered of utmost importance to ensure security and privacy in e-learning spaces [1].

1.1 Cybersecurity Risks and Privacy Threats

The European Union Agency for Cybersecurity (ENISA), in its annual report for 2020, identified fifteen (15) top threats [4], as described in Figure 1. An important part of cybersecurity is the processing of the personal data of Internet users, which is regulated by the General Data Protection Regulation (GDPR) of the European Union (EU). This regulation applies to organisations in the EU, the European Economic Area (EEA), and also enterprises outside the EU and EEA areas that are processing the personal information of individuals inside the EU and the EEA. In practice, the GDPR sets out detailed requirements for companies and organisations regarding the collection, storage, and management of personal data and promotes the regulation of information confidentiality based on the following:

- consent request for data processing,
- right to access the processed data,
- right to data portability (a data subject is entitled to receive the personal data concerning them),
- right to correct or to object,
- right to delete data,
- data breach notifications with risks "for the rights and freedoms of individuals", and
- privacy by design (the inclusion of data protection from the onset of the designing of systems) [5].

Figure 1: ENISA Threat Landscape– 15 Top Threats in 2020 [4] (arrow at the top-right corner represents Assessed Trends: Up Arrow-Increasing, Horizontal Arrow-Stable, Down Arrow-Declining)

To further strengthen the privacy protection and complement the GDPR, the European Commission has recently proposed the new *e-Privacy Regulation* that will repel the existing Directive 2002/58/EC. The new regulation provides specific rules governing electronic communication even if it concerns non-personal data. The regulation suggested and aimed, among other, at:

- improving the current 'cookie law';
- including rules for new forms of electronic communications (e.g., WhatsApp, Facebook Messenger, and Skype);
- providing protection against spasm;
- guaranteeing privacy in the processing of electronic communications content and of metadata. [6].

1.2 Protecting e-Privacy - General Practices for Cybersecurity

Based on the literature there are some *best practices and recommendations* for organisations that have been identified on the need to implement cybersecurity policies.

- Educating and sensitising Internet users about potential threats and the negative impact of possible cyber-attacks.

- Authorising *the right* users, e.g., in case of schools/colleges the right users are pupils/students and faculty staff to access confidential data and provide strong passwords with mechanisms to remember them.
- Restricting access to dangerous sites and services for organisations such as schools, banks, universities, and others who keep sensitive private information.
- Using appropriate security software (e.g. anti-malware, spam filter, and anti-phishing).
- Delegating responsibilities to Information Technology (IT) staff regarding cyber protection policies; educational institutions and health organisations, in particular, need strong protection against potential threats for student/medical identity thefts.
- Operating System (OS)-Level Virtualisation (it is used to protect all information and infrastructure using system-level virtualisation) [7].

2.0 Privacy and Cybersecurity Issues in e-Learning

During the COVID-19 pandemic Formal and Non-Formal Learning Settings of state and private education were forced to migrate to virtual learning; from the in-person classroom to online person classroom settings. The main concern about this fast transition is that it happened suddenly and in an unplanned way with little time to train teachers, instructors, and students about the privacy and cybersecurity issues the e-learning activities will bring.

2.1 Virtual Tools and e-Services: Communication and Security Gaps

As many previous and most recent research studies indicate e-learning incorporates various Internet activities, such as web conferencing; file and data sharing and storage; sending and receiving emails; discussion and chatting; second life environments, and others. These activities are performed using different Information and Communication Technology (ICT) tools and services. For example, the following are three broad categories, also indicated in the answers of the participants of a recent international survey in Primary, Secondary, and Higher Education we participated.

- Online communication tools: Adobe Connect, BigBlueButton, Google Classroom, Kaltura Newrow, Labster (also include virtual lab), Microsoft Teams, Skype, Viber, WhatsApp, Cisco Webex, and Zoom.
- Learning management: Moodle, Canvas, and Blackboard.
- Email services: Gmail and Outlook.

Other Internet-based or mobile communication tools used for such purposes are, e.g. WhatsApp and Viber, which were often utilised in developing countries for distance learning.

Many of these information and communication tools and services that are currently widely used in e-learning virtual classrooms are non-educational, designed for other purposes, such as industrial teleconferencing, knowledge sharing, and the list can go on. Moreover, in order to use these online tools and e-services, users may need to register by providing their personal information. It is worth mentioning that these services store cookies and record the digital footprints of the users. In addition, there is a significant amount of the learners' personal information collected and maintained by e.g. student services and administration offices, which are being increasingly accessed through the Intranet and the Internet.

2.2 Online Threats and Compromised Privacy

Further, in order to facilitate the e-learning activities, various learners' activities and private information are recorded and digitised; this generally does not happen during in-person classroom settings. For example, recording virtual classroom discussions and tracking students' attendance online is not monitored in offline learning. These increasingly happening activities that are also related to the collection, storage, and handling of students' personal information have raised concerns for (online) citizens' privacy and cyber protection. These concerns are more alarming when considering the data breach incidents that different companies, including some companies owning the aforementioned tools and services, suffer from time to time [8].

Undeniably, migrating the teaching and learning activities to the Internet invites a plethora of cyber risks and security threats. The following two are examples of such facts:

- Distributed Denial-of-Service (DDoS) attacks affect the access of educational resources;
- phishing attacks can lead to stealing students'/teachers' login credentials and infect their devices with malware or, even worse, ransomware.

Such incidents have been significantly increased during the current Covid-19 pandemic [9]. Likewise, there are inherent security risks (see e.g. [10], [11]) connected to vulnerabilities in the Internet tools used for the same deceitful purposes. The vulnerabilities of the people who participate in e-learning are also important. For example, people may download and install malware-infected or pirated software, or equally fall for deceitful social engineering and phishing attacks online.

3.0 Data Collection and Analysis

This research study used an online survey questionnaire to collect primary data from higher education institutions worldwide, requiring responses regarding six dimensions of distance learning during the Covid-19 period.

The questionnaire was based on the design and architecture of the Google forms and Wen Juan Wang online service, translated into Chinese for students in China where Google services are inaccessible.
In addition, the online Qualtrics survey platform was utilised to submit a formal application with various documents to the Research Ethics Committee of Middlesex University in London, UK. The research study had to adhere to strict ethical rules and standards for ensuring voluntary participation, anonymity, and non-traceability, according to the ethics protocols of the participating institutions. The ethical approval letter was received in February 2021, so the data gathering process started.
All the responses were combined in an EXCEL spreadsheet which was used for the analysis of the data and their graphical representation. In total, 1005 students from 26 countries participated in the survey.
Some of the findings from the analysis of the sample data are analysed and commented next, while mainly investigating privacy and security issues in e-learning or remote/online delivery mode.

3.1 Summarised Demographics and Data Geography

The collected data showed that more participants of the sample data were female 55%, while male were 43% and other 2%. The age distribution of the sample participants ranged from 17 up to 59 years, though most of the participants were between 17 and 25 years old.
The data sample contained students' responses majoring their studies in 26 different subject areas. The main subjects of the respondents were Business (131), Computing, (129), Engineering (125) and Psychology (93).
The distribution of responses collected from various countries was wide enough to comprise a representative data sample eligible to further analysis and generalisation. The main responses were collected from the following countries listed in descending order as for the number of respondents: Greece (150), Kazakhstan (105), Egypt (98), Turkey (98), Finland (97), Slovak Republic (77), Cyprus (54), Russia (48), United States of America (43), Bosnia- Herzegovina (42), Bangladesh (35), Romania (29), Armenia (25), Kenya (19), and United Kingdom (13).

3.2 Data Analysis and Results

With the pandemic nearing no visible end, it is well understood that educational institutions will continue to be dependent on e-learning or some form of remote delivery. This also implies that their students, teachers and staff will continue being at risk of cyber-attacks and violation of privacy. More importantly, educational institutions must realise that by leaving their students, teachers, and staff vulnerable to cyber-attacks, they are exposing the university/colleges' IT infrastructure and data to cybercriminals. It is imperative to act now and implement proper privacy and cybersecurity measures to protect students, teachers, and staff.

In reality, however, educational institutions have not, yet, taken adequate precautionary actions to safeguard their teachers, students, and other staff from cyber-attacks and data breaches. Our most recent (March 2021) online

questionnaire survey for educational institutions of many countries exposed, among other, significant information about students' privacy and security, which is briefly summarised below.

In brief, forty-five percent (45%) of the respondents, that are University and College students, remained *unaware of any measures* taken by their institutions to protect their private data. Naturally, there may be a chance that some institutions have implemented privacy and security measures but have not informed their students. In that case, it is the sole responsibility of the institutions to make their students aware of the privacy and security measures they have implemented so as to build their students' confidence and trust while interacting in e-learning environments.

Figures in the Appendix A show that, apparently, a large portion of the participants had no awareness training on even basic cybersecurity issues both before and during the migration to e-learning, such as phishing attacks (before-68% | during-74%), online privacy (before-65%| during-70%), secure password (before-62% | during 71%). This implies that these students face the highest risk of cyberattacks.

Further, only a few of the participants (as shown in Appendix B) had experienced cyber-attacks or their consequences before the migration to e-learning, such as cyber threats (18%), invasions (13%), unwanted adverts (41%), phishing (29%), and identity theft (14%). These numbers show how naïve and unaware the students have been about the cyberattacks and data breaches but also about other vulnerabilities. Cybersecurity awareness training and past experiences of cyber-attacks and data breaches are two prominent ways through which students can learn and raise their awareness about potential risks and threats, but both of them are seriously missing from the participants.

To exacerbate the situation, some of the participants (shown in Appendix C) experienced cyberattacks during the migration to e-learning, such as cyber threats (16%), invasions (14%), unwanted adverts (39%), and phishing (25%).

Moreover, some participants know some of their family members (34%), fellow students (30%), friends (39%), and online friends (26%), who faced online privacy and security threats and other issues.

These numbers convey that cyber risks and threats to students are a real and legitimate problem that demands immediate attention. Some suggestions for potential measures that educational institutions can implement for i) privacy and ii) cybersecurity threats are mentioned next. These are also suitable to be considered in primary and secondary but also non-formal education (e.g. by training organisations) that utilise e-learning and virtual classrooms.

4.0 Recommendations and Potential Measures for Online Privacy and Security

Understandable and with ease-of-use cyber-protection mechanisms and public awareness are keys for citizens', teachers', and students' privacy protection from various security incidents. Usable security and people's training are concepts that go hand-in-hand in theory and practice. Sections 4.1 and 4.2, next, list two sets of our suggested measures for Privacy and Security, to be realised for cyber protection in educational institutions and other e-learning settings.

4.1 Potential Measures for Privacy Issues

Take consent from the students before collecting their data or recording classroom discussions with students. The students must be provided information about, for example, how their data will be used, for how long the data will be kept, and who else might receive it, in plain language and with clarity. For situations like this, compliance with established regulations like the GDPR, e-Privacy Regulation (still in a proposal), and national legislation can be helpful.

- Provide the students with the right to control and inspect their information. The students expect their information maintained by educational institutions to be accurate.
- Implement *data parsimony* (i.e., store as little personal data as possible) and *data partitioning* (i.e., partition data into context-specific partial identities) while storing students' data.
- Vet the IT tools and services for their privacy policies and to know, for example, the types of data they collect, how do they use the data, do they share the data with others, and their compliance with international, regional, federal, and state laws and regulations. This should be performed in advance to determine suitable tools and services that should be used by the institutes and students.
- Instruct the students to follow some etiquette rules before they enable webcam and microphone, for example:
    - Sit with a camera facing a plain wall. Items in the house or on the background wall may reveal information more than the individuals have expected.
    - Use neutral background. Background scenarios like lakes, trees, buildings, and other identifying characteristics may reveal a location of a house or building.
    - Know when to switch on/off microphone and camera.

3.2 Potential Measures for Cybersecurity Issues

- Provide training and needful resources to raise the cybersecurity awareness of the students, teachers, and staff. Make them understand the risks and threats they are vulnerable to, how to recognise warning signs of those risks and threats, and ways to stay safe online.

- Remind students and staff that the university's/college's IT staff will never ask for their login credentials via email or threaten to turn off access to accounts if they do not click on a link.
- Ask students, teachers, and staff always to download the necessary software from the university's/college's software centre where they have been vetted by the IT staff. This will protect them from using pirated and malware-infected software.
- Implement two-factor or multi-factor authentication [12] whenever possible. This will reduce the chances for data breaches.
- Encrypt the student's data during transmission and storage. This will minimise the impact if a *man-in-the-middle* attack or data breach occurs.
- Deploy technical security measures like firewall, packet inspection and filtering software, email filtering software, anti-virus software, and others. Impose specific policies for individual applications and securely enable increased network speed and throughput. Regularly update anti-virus software.
- Provide security guidelines that explain the necessary security measures [13, 14] students should implement in their personal devices in advance to attend virtual learning. Inform students, teachers, and staff to contact the university's/college's IT staff if they encounter suspicious events or activities.

5.0 The Need for Multidisciplinary Knowledge for Understanding and Applying Cyberprotection Principles

Before and during the Covid-19 crisis privacy guaranteeing [15] and other security challenges [16] in e-learning spaces along with other online activities intensified the demands for e-learners' caring and opened up new domains of rapid application development and multidisciplinary knowledge use. There are new multidisciplinary knowledge representation frameworks and application domains that guide the design of new tools and applications and call upon theoretical and practical investigations. There seems to be a need for further, multidisciplinary, and applicable knowledge and manifold thinking [17] skills. Such are, for instance, apart from digital and computing skills, thinking skills that handle and apply relevant knowledge from Information Systems Science, Philosophy-Ethics, Mathematics, Law, Sociology and the list can go on.

5.1 *Problem*: Perplex! *Problem Solving*: Via Right Question Asking! *Solution*: Multidisciplinary!

The next three subsections provide a clarified explanation of the problem and its perplexity along with the right questions and knowledge that could lead to a viable and suitable solution.

5.1.1 The Problem and its Perplexity

In every day's digital learning rooms multiple deceitful and convincing attempts with unusual trustworthy content, known as cyberattacks or social engineering techniques, can occur through various communication and dissemination means; and, most notably, in the Internet-based learning communities. Hence, thousands of e-learners can be convinced to reveal personal, vulnerable information such as social security ids, bank account numbers, home, and email addresses, passwords, and the list can go on. For instance, online identity theft, commonly known as (online) *phishing*, is an example of *social engineering* that is often associated with cyber-attacks which, in turn, obtain, abuse, and misuse personal information.

5.1.2 Problem Solving through Asking the Right Questions

The basic questions of understanding and applying cyber protection are multifaceted questions that have to be treated with caution while utilising knowledge and information from other knowledge domains. For example, phishing is a dark creativity activity online. In order to holistically understand a phisher-user interaction profile, there is a need to model their behaviours in the context of social phishing both in rich and abstract details. For that, a cyber-security expert needs to utilise *computable knowledge* from user psychology (what is the user's profile for user modelling?), Philosophy/Ethics (what is evil?) in order to create a phisher/user modelling profile able to lead to a mathematically accurate solution to scientifically compute the perplex social problem that can be of Legal (e.g. GDPR or/and Data Protection Act) or Technical (data encryption/decryption) nature and, again, apply it utilising rules from computer/cognitive science and sociology. Figure 2, from Chaudhary et al. (2017) [19], illustrates such an online user psychology-based behaviour model [18, 19].

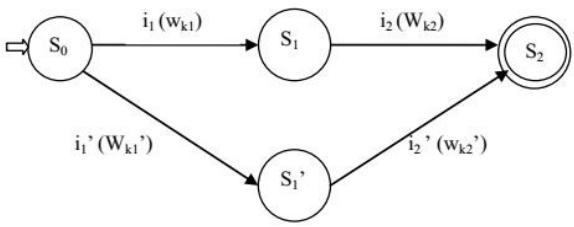


Figure 2: Conceptual computational modelling of user behaviour in the context of social phishing [19]

Social engineering online is the psychological manipulation of people in order to make them divulge their confidential information or perform activities that can be harmful to their own (online) security and privacy (see e.g. [12-16]). In fact, social engineers (e.g. phishers, cyber attackers, and others) have certain socio-

psychological knowledge, and advanced technical skills combined with ethical and/or moral motivation. They have been associated with dark creativity and deceitful information acquisition and processing and are often informed on the legal regulations for invading privacy. The so-called social engineers are various interesting types of cyber-attackers with often reasonable and justified arguments for their motivation. They also become more and more sophisticated while they are familiar with knowledge from many scientific domains.

Notably, social engineers and social engineering resembled, once, terms of positive connotations and application of interdisciplinary knowledge from socio-technical domains for societal problem solving [20, 21]. The difference to today's concept in the domain of cybersecurity is in the misuse and mistreat of such personal information but often justifying the means or/and the targets ethically, providing admirable documentation on their actions.

Notwithstanding, deceiving e-learners to reveal theirs and/or others' credentials is also considered unethical and raises multiple questions related to Law and Justice. Undoubtedly, it would be beneficial for the State, science, and society to i) know and ii) be able to timely predict the frequency of social engineering activities that compromise the e-learners and other citizens' confidentiality, privacy, and safety [13, 18, 19]. Hence, a relevant research question here could be the following: *What types of multidisciplinary knowledge and skills do cybersecurity professionals need in order to i) proactively advise e-learners and ii) predict the time and frequency of cyberattacks and other social engineering attempts that compromise privacy and safety of e-learners?* (see also [18, 19]).

5.1.3 Solution: Multi-Knowledge Models

Some of the latest ongoing and future research and development tools and applications that are of this multidisciplinary nature and borrow techniques and knowledge from a multidisciplinary arena of knowledge. Figure 3, adapted and enriched herein from Berki et al. (2018) [18], shows the multi-knowledge models associated with multidisciplinary knowledge relevant in cyber protection. *Multidisciplinary* education is sometimes used interchangeably with multi-professional education meaning *"occasions when professions learn side by side for whatever reason"* while *interprofessional* education *"occurs when students or members of two or more professions learn with, from and about each other to improve collaboration and the quality of care"* [20, p4].
Recent research [12-19] also showed that cyber activities like phishing or/and the spread of fake news become increasingly difficult to recognise, while phishers and other cyber-attackers become more sophisticated with multi-level knowledge. It seems inevitable that future cyber-attacks will utilise more (trustworthy) elements of social and personal contexts, becoming, thus, more dangerous for e-learners' communities. The (amount of) professional knowledge required to be aware of phishing/fake notifications based on fake or real news can be very demanding and combined from a number of knowledge domains.

Protecting e-learners' vulnerability and privacy in the post-coronavirus era of virtual classrooms for better readiness and preparedness is a huge challenge for cybersecurity experts. The latter are called upon to care for and realise, among other, two challenging targets in e-schooling: i) improving trust relationships and, thus, security and safety ii) securing freedom of speech and expression, which belong to the basic human rights [18, 19].

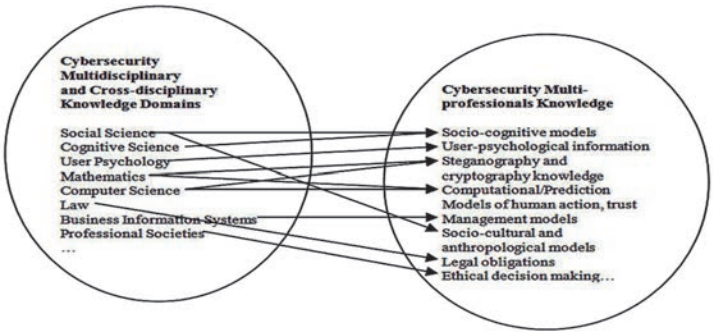


Figure 3: Cybersecurity multiprofessionals and their multidisciplinary knowledge domains

5.2 Achieving Awareness and Understanding of Cyber Protection: Future Research Directions

With fake news, social engineering, and privacy-compromising around, everyone must prioritise on achieving awareness and understanding on their own online security and make the right choices for their own cyber protection mechanisms. Understanding and acting accordingly in cyber protection is everyone's responsibility! Not just the (multi)professionals' task or duty.

5.2.1 Cybersecurity Multiprofessionals: Tasks and Responsibilities

An essential cross-disciplinary conceptualisation of knowledge for cybersecurity multiprofessionals is not a remedy-for-all solution. Scientific or ideological orientations of isolated cybersecurity research and development approaches have suffered as a result of reductionist abstractions [18, 19]. Accordingly, *"the problem of personal security (the problem of law and order) cannot be adequately explained by reducing it either to criminality (i.e. the problem between individuality and universality) or to politics (i.e. the conflict between particulars)…"* [21].

Cybersecurity professionals are IT professionals and interdisciplinary knowledge workers, who are under constant pressure to learn something new that regularly appears in cybersecurity/IT subject fields. During the Covid-19 era, the latter added to the IT professionals' stress, which also derived from many other cybersecurity incidents and work-related sources. A constant demand for continuous training can be a positive feature in knowledge work as far as it is related to interesting work tasks and autonomy and it is not under stressful work

situations or intensive work schedules [18]. The downside of the Covid-19 emphasis on multidisciplinarity, flexibility, and lifelong learning has been that work may also involve multi-level stress due to tight schedules, quick decision-making rhythms, and unrealistic expectations to keep work-related skills up-to-date (see e.g. [18, 22, 23]).

5.2.2 Educating the Reflective Learner - Edutainment for Cyberprotection

Understanding and acting accordingly in cyberprotection is everyone's business! When personal data is in danger or/and compromised timely knowledge of cyber-protection can be of absolute importance. Hence, it is crucial for parents, teachers, learners to know the basics and ABC of cyber protection principles. Everyone, for instance, should be able to make simple to remember and powerful passwords in many ways, with or without the use of technology [12, 16]. The use of professional and sophisticated techniques is also important but more critical is to be able to understand how these works and how these can be used in different cases.

Edutainment is another powerful source of awareness and understanding readiness in cyber-protection. Who and why should know about it? Edutainment (education + entertainment) is a form of (informal) learning. Learning through using cybersecurity principles and privacy regulations is a very powerful form and way of learning. This can be achieved, for instance, through customised multidisciplinary education and intercultural entertainment products [16, 17, 18, 24, 25, 26]; in this case, they could be called cyber-protection (learning) innovations. Phishers and their phishing emails can always be questioned [27] and anti-phishing design can be challenged [28] but could also be developed and taught through creative and critical learning [29] via suitable problems' choice [30, 31] in games or films or simple quizzes or through game-role playing and other edutainment approaches.

Concepts of usable security, user psychology and computational, dynamic modelling [18, 19, 32], like those depicted in Figure 2, could be taught in an interesting and innovative problem-based learning (PBL) way [30, 31] through philosophical ethics [33], utilising the e-learning concepts [34, 35] and multi-knowledge models [18, 19, 33, 36] as shown in Figure 3. After all, a cyber-security condensed and inspiring motto should be: *"Hey, teachers: don't leave the kids alone online!"* [37].

6.0 Summary, Limitations and Conclusions

In this research study the authors explored issues of e-learners' cyber protection with emphasis on cyber-security and online privacy in e-learning communities during the era of coronavirus.

In particular, the authors provide practical advice and guidelines for cyber protection in e-learning communities as part of a reactive approach to handle the current problems of security and privacy online as appeared in the educational needs created by the Covid-19 invasion in humans' lives. In addition, the authors explored the concept and application of multi-professional and multidisciplinary knowledge and its potential use as the most suitable and capable cyber-threats prevention and e-learners' protection mechanism.

Security and privacy in e-learning (or distance mode delivery) are two concepts of the same coin that raised interesting and topical points of controversy. After all, the need to consider the use of the term e-learning -as whilst the issues raised with regard to e-learners are relevant- is, arguably, redundant. This is so because currently, during Covid-19 era, in many cases students have not, freely, chosen to be e-learners and are not, sometimes, choosing to embark on a distance learning course.

It has been unofficially supported that instead of the term e-learning, the alternative "remote delivery" is the common term used in the UK as it denotes a context where the timetable and engagement expectations are the same; it is just that staff and students are not in the physical space(s). As soon as the physical spaces are open for business the expectation is that face to face teaching will return with a few variations in terms of potential hybrid delivery patterns.

The country context is also a factor that should further be considered in a more careful examination. In the UK and Greece, for instance, people and online learners have been locked down more severely than in many other countries like e.g. Finland. Hence, the impact of engaging in the cyber worlds and e-learning spaces may be more pronounced.

In addition, approaches to cyber-security and privacy appear to vary from institution to institution and from country to which country. Hence this, and perhaps other similar studies, indicate and summarise cybersecurity concerns to the best of our knowledge of the situation and the country.

A more detailed account of these and other inter-related e-learning and cybersecurity issues with more summary statistics and graph illustrations from the international student survey can be found in Georgiadou et al. [38]. The latter is a co-authored paper available in this tome of the British Computer Society INSPIRE 2021 annual international e-conference with e-proceedings online.

Regarding cyber-attacks in e-learning communities, complementary actions are also the following: i) e-learners could and should, eventually, acquire useful socio-technical skills and digital competencies, and ii) the Law and Justice could be able to utilise predictive practical information, like for example the General Data Protection Regulation GDPR body of knowledge issued by the European Commission and utilised in many countries worldwide.

Learners' awareness can act as a protection mechanism in the e-learning and social context of information and knowledge society. Cyber-security protection guidelines, multidisciplinary adult education and multi-level training programmes, as well as simple trust management strategies can equip e-learners with proper knowledge and skills for their online interaction.

Cyber protection-aware e-learners appreciate freedom of expression, privacy, confidentiality, and other human rights. Empowered and knowledgeable e-learners, in turn, can collaborate better with cyber-security professionals in supporting safe social interaction and stability.

Timely awareness and multi-level knowledge can lead to secure and active participation online as well as better readiness and preparedness. These are the first steps towards consciousness and caring, which lead to reflective and critical thinking [17, 29, 37] that are necessary skills for one's cyber protection from e.g. phishing emails and fake news.

Combining and advancing multiprofessional knowledge and awareness can result in *better* and *timely* protection of online learners' vulnerabilities and privacy. A trustworthy and multidisciplinary approach to cybersecurity along with multilevel knowledge for problem solving could encourage learners' active participation in a safer e-society and could, eventually, have a long-term social impact. Such a policy shaping approach could further prove to be the most cost-effective option for the education organisation, the State as knowledge and e-learning provider, and the cyber protection professionals.

7.0 References

1 Bandara I, Ioras F, Maher K, Cyber security concerns in e-Learning education, proceedings of ICERI2014 Conference, pp 0728-0734, Seville, Spain, 17th-19th November 2014.

2 The Conversation (8th April 2021). The coronavirus pandemic has forced parents' hands on data collection and privacy issues. Retrieved 18th June 2021 from the Conversation: https://theconversation.com/the-coronavirus-pandemic-has-forced-parents-hands-on-data-collection-and-privacy-issues-153507.

3 Anghel M & Pereteanu GC, Cyber security approaches in e-learning, proceedings of INTED2020 Conference, pp. 4820-4825, Valencia, Spain, 2nd-4th March 2020.

4 ENISA (20th October 2020). ENISA Threat Landscape 2020: Cyber Attacks Becoming More Sophisticated, Targeted, Widespread and Undetected. Retrieved on 18th June 2021 from the European Union Agency for Cybersecurity: https://www.enisa.europa.eu/news/enisa-news/enisa-threat-landscape-2020.

5 Your Europe (2021). Data protection under GDPR. Retrieved on 18th June 2021 from Your Europe: https://europa.eu/youreurope/business/dealing-with-customers/data-protection/data-protection-gdpr/index_en.htm.

6 European Commission (2021). Proposal for an e-Privacy Regulation. Retrieved on 18th June 2021 from the European Commission: https://digital-strategy.ec.europa.eu/en/policies/eprivacy-regulation.

7 Kleinberg H, Reinicke B, Cummings J (2015). Cyber Security Best Practices: What to do? Journal of Information Systems Applied Research, 8(2), 52-59.

8 Tunggal AT (11th June 2021). The 56 biggest data breaches (Updated for 2021). Retrieved on 30th April 2021 from UpGuard: https://www.upguard.com/blog/biggest-data-breaches.

9 Kaspersky (4th September 2020). Digital education: The cyber risks of the online classroom. Retrieved on 21 April 2021 from Securelist: https://securelist.com/digital-education-the-cyberrisks-of-the-online-classroom/98380/.

10 Price D (21st November 2020). Is Zoom safe to use? 6 Privacy issues to consider. Retrieved on 21st April 2021 from: https://www.makeuseof.com/is-zoom-safe/.

11 Odusanya M (10th March 2021). Top 8 Microsoft Teams security issues. Retrieved on 21st April 2021 from INSOSEC Institute:

https://resources.infosecinstitute.com/topic/top-8-microsoft-teams-security-issues/.
12 Chaudhary S, Schafeitel-Tähtinen T, Helenius M, Berki E (2019). Usability, security, and trust in password managers: A quest for user-centric properties and features, Computer Science Review, 33, 69-90.
13 Chaudhary S, Berki E, Li L, Valtanen J (2015). Time up for phishing with effective anti-phishing research strategies, International Journal of Human Capital and Information Technology Professionals, 6(2), 49-64.
14 Li L, Berki E, Helenius M, Ovaska S (2013). Towards a contingency approach with whitelist- and blacklist-based anti-phishing applications: What do usability tests indicate? Behaviour and Information Technology, 33 (11), 1136-1147.
15 Chaudhary S, Berki E, Nykänen P, Zolotavkin Y, Helenius M, Kela J, Towards a conceptual framework for privacy protection in the use of interactive 360 degrees video surveillance, proceedings of the 22nd International Conference on Virtual Systems & Multimedia, Kuala Lumpur, Malaysia, 17-21 October 2016.
16 Mystakidis S, Berki E, Valtanen J, Toward successfully integrating mini learning games into social virtual reality environments – recommendations for improving open and distance learning (cybersecurity challenges), proceedings of the EDULEARN 2017, Barcelona, Spain, 3-5 July 2017 (open access).
17 Valtanen J, Berki E, Kampylis P, Theodorakopoulou M, Manifold thinking and distributed problem-based learning. Is there potential for ICT support? proceedings of the IADIS International Multi Conference on Computer Science and Information Systems (MCCSIS '08), pp. 145-152, Amsterdam, Netherlands, 22-26 July 2008.
18 Berki E, Valtanen J, Chaudhary S, Li L, The need for multi-disciplinary approaches and multi-level knowledge for cybersecurity professionals. In Ahuja, V. and Rathore, S. (Eds) Multidisciplinary Perspectives on Human Capital and Information Technology Professionals*,* 72-94*,* IGI Global 2018, ISBN 978-1-5225-5297-0.
19 Chaudhary S, Berki E, Li L, Valtanen J, Helenius M, A Socio-Cognitive and Computational Model for Decision Making and User Modelling in Social Phishing, proceedings of the SQM, Southampton, UK, 10-11 April 2017, pp. 105-119 (available online).
20 Barr H & Low H, Introducing interprofessional education. In: Loftus S, Gerzina T, Higgs J, Smith M, Duffy E (eds) Educating Health Professionals. Practice, Education, Work and Society, Sense Publishers, Rotterdam, 2013.
21 Berki R-N, Security and society. Reflections on law, order and politics. J. M. Dent & Sons Ltd: London, 1986.
22 Pyöriä P, Melin H, Blom R, Knowledge workers in the information society, Tampere: Tampere University Press, 2005, ISBN: 951-44-6384-6.
23 Rathore S & Ahuja V (2015), A study of role stress among the IT professionals in India: Examining the impact of demographic factors. International Journal of Human Capital and IT Professionals, 6(2), pp. 1-13.

24 Cañas-Bajo J, Cañas-Bajo T, Berki E, Valtanen J, Saariluoma P (2019), Emotional experiences of films: Are they universal or culturally mediated? Participations – Journal of Audience and Reception Studies, 16(2), pp. 3-21.
25 Cañas-Bajo J, Cañas-Bajo T, Berki E, Valtanen J, Saariluoma P (2019), Designing a new method for studying feature-length films: An empirical study and its critical analysis. Projections – The Journal for Movies and Mind, 13(3), pp 53-78.
26 Mystakidis S, Berki E, Valtanen J (2021), Deep and meaningful e-learning with social virtual reality environments in higher education: A systematic review, Applied Sciences, 11 (5) (open access).
27 Li, L., Helenius, M., Berki, E. (2011). How and Why Phishing and Spam Messages Disturb Us? *IADIS International Conference Proceeding of ICT, Society and Human Being, p. 239-244.* July 2011, Rome.
28 Chaudhary, S. and Berki, E. (2013). Challenges in Designing Usable Anti-Phishing Solutions. In the Conf. Proceedings of Barikzai, S. et al. (Eds). *21st International Conference on Software Quality Management SQM 2013. Quality Comes of Age.* London, 5th of September, 2013. pp. 189-200. British Computer Society Press. ISBN 978-0-9563140-8-6.
29 Berki, E. and Valtanen, J. (2007). Critical and Creative Mathematical Thinking with Practical Problem Solving Skills - A *New Old* Challenge. In Dranidis, D. and Sakellariou, I. (Eds). *Proceedings of the 3rd South-East European Workshop on Formal Methods (SEEFM07). Service-Oriented Computing and Formal Methods; Teaching Formal Methods.* (Satellite Workshop of the Intern. Conf. on Informatics Education Europe II). Nov-Dec. 2007, Thessaloniki. Pp. 154-170. South-East European Research Centre (SEERC).
30 Valtanen, J., Berki, E., Barlas, K. Li, L. and Merruko, M. (2013). Problem-Focused Education and Feedback Mechanisms for Re-designing a Course on Open Source and Software Quality. In the Conf. Proceedings of Barikzai, S., Georgiadou, E., Linecar, P., Uhomoibhi, J. Ross M, Staples G (Eds). *The 18th INSPIRE - INternational conference on Software Process Improvement Research, Education and Training. Education Inspires.* Pp. 23-36. Publishers Southampton Solent University ISBN 978 09563140-9-3**,** 6 Sep, London.
31 Valtanen, J., Berki, E., Georgiadou, E., Hatzipanagos, S., Ross, M., Stamelos, I. and Staples, G. (2012). Features for Suitable Problems: IT Professionals´ and IT Students´ Opinions. *International Journal of Human Capital and IT Professionals (IJHCITP), Vol 3, Issue 2 (2012), pp. 27-41.*
32 Knight, B and Petridis, M. (1992). Flowes: An intelligent computational fluid dynamics system, Engineering Applications of Artificial Intelligence, Vol 5 (1), pp 51-58, Pergamon.
33 Kotkavirta, J. and Nyssönen S. (2006). Cogito – Philosophical Ethics. WSOY. Helsinki (In Finnish: Filosofinen Etiikka).
34 Silvester, N. Berki, E. (1999). Continuous Development and Improvement of Open and Distance Learning (ODL) materials. *Training and Teaching for the Understanding of Software Quality.* The BCS INSPIRE IV International Conference, University of Crete at Herakleion, Sep. 1999. pp. 233-245.

35 Berki, E. and Valtanen, J. (2013). Informal learning: Empowerment and Support with Open Educational Resources in Higher Education – or Not? In the proceedings of Castaño-Munoz, J. & Redecker, C. (Eds). *Open Education 2030 JRC-IPTS call for vision papers. Part III: Higher Education.*
36 Eriksson I. and Törn, A. A Model for IS Quality (information systems). *Software Engineering Journal, vol (6) Issue: 4, pp. 152-158*, 1991.
37 Berki E, Reflections on e-Learning in the time of Coronavirus: The Nordic experience and Ethical considerations - Back to the future with the e-Learners manifesto, proceedings of the 25th Annual INSPIRE Conference, pp. 21–52, 2020 (available online).
38 Georgiadou E, Lampropoulos G, .Siakas E, Siakas K, Edwards E, Valtanen J-P, Berki E, Paltalidis N, Rahanu H, Knezevic R, Colic A, Tomic B, Savva A, Stylianou V, Meiramova S, Elghany M-A, Khalifa N, Gevorgyan R, Popa D, Odero J, Ali U, Panteri M, Dennis K, Stoffova V, Begum D, Chaudhary S, Plastira M, Soylu D, Ross M, Staples G, Zamaraeva G, Panov Y, Zhang X, Portides G, McGuinness C, Valkanou T, Rapid migration from traditional or hybrid to fully virtual education in the age of the coronavirus pandemic: Challenges, Experiences and Views of College and University students. Proceedings of INSPIRE 2021, e-conference 21-23.6.2021. In this tome of the INSPIRE 2021 e-conference proceedings. Ross M. et al (Eds). e-proceedings available online.

APPENDIX A

Training for Cyberprotection in e-Learning before and during Covid-19 crisis
(appearing also in the co-authored paper of reference [38])

Figure A1: Phishing training before and during migration to e-learning

Figure A2: Online privacy training before and during migration to e-learning

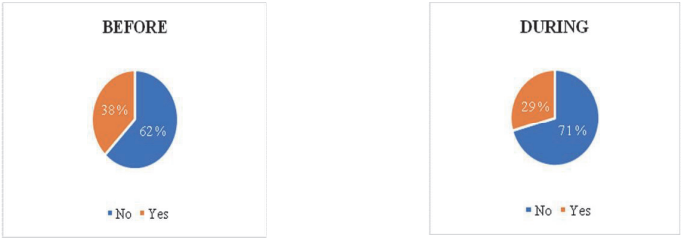
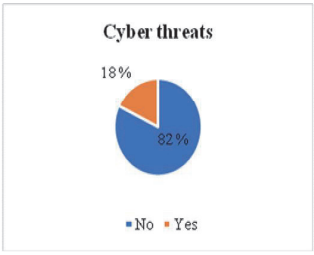
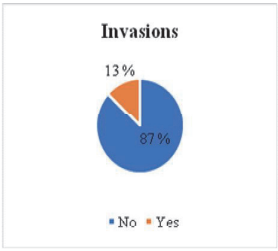


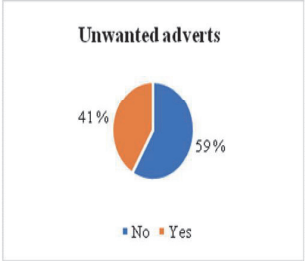
Figure A3: Secure password training before and during migration to e-learning

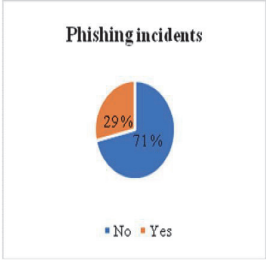
APPENDIX B –

Experienced problems caused by cybercriminals *before* migration to e-learning
(appearing also in the co-authored paper of reference [38])



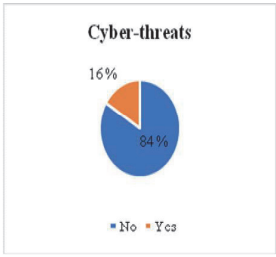


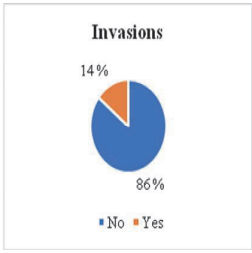


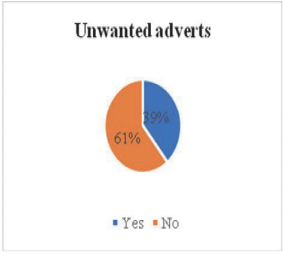


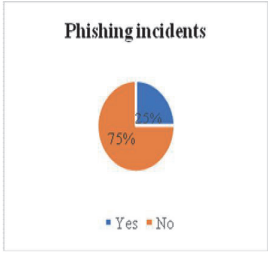
APPENDIX C

Experienced problems caused by cybercriminals *during* migration to e-learning
(appearing also in the co-authored paper of reference [38])









Challenging E-Learning Value and Application in Kenya in Conditions of Pervasive Informality

Linda Odhiambo Hooper[1], James Uhomoibhi[2]

[1] School of Applied Social and Policy Sciences
Ulster University
hooper-l@ulster.ac.uk

[2] Artificial Intelligence Research Centre, Faculty of Computing, Engineering & the Built Environment, Ulster University,
j.uhomoibhi@ulster.ac.uk

Abstract

The growing levels of informality in employment directly impact livelihood options which in turn lead to questions on the position and value of e-Learning in Kenya. This paper argues that the COVID-19 Pandemic calls for the prioritisation of eLearning as it is key to achieving education goals. Education plays a significant role in economic growth whereby the cognitive skills of the populace play a fundamental role in the drive towards realising sustainable development goals (SDGs). The pandemic exposed the limitations of implementing eLearning goals due to resource scarcity in impoverished developing countries reflected in uneven ICT development in the case for Kenya.

In Kenya, as was the case globally, schools closed to contain the virus, and learning continuity meant a move to online learning. However, although offered as the standard, in Kenya, online education was only available to the advantaged few, with over seventy per cent of disadvantaged school going students lacking access. eLearning integration efforts failed to consider these disadvantages resulting in limited impact and motivation which were further exacerbated by suspension of examinations. Private schools, however, were able to implement eLearning, highlighting the prevailing inequalities. This paper argues that the underlying reasons are two-pronged, with poor policy design and implementation playing a role alongside lack of resources, including ICT infrastructure.

This study utilises desktop studies of secondary data from journals and policy documents. The global SDGs offer a

framework for emphasising the importance of a holistic body of goals and indicators that highlights the prominent role education plays in development. It argues eLearning necessity for education as both means and ends due to technology's promise and trajectory.

Keywords: Informality, E-Learning, Development, SDGs, Education

1.0 Introduction

The COVID-19 pandemic forced countries to employ containment and mitigation measures to prevent the surge in infections that was likely to overwhelm available capacity [1, 2]. These measures failed to fully grasp the impact of these directives on the large population of informally employed citizens whose livelihoods would be affected. With this was, also to a large extent, as argued in this paper, the reason for eLearning's integration failures. The measures included travel bans intra and inter-country by enforcing curfews and quarantining measures and banning public gatherings and school closures [3]. However, the number of cases in Africa remained low mostly attributed to inadequate capacity to monitor and report. Mukherjee (2021) cites the reasons for this include inefficient health systems, low or absent testing, and insufficient medical staff. Thus, the reflection of cases is not so much the actual situation, but that the countries lack the capacity to test and trace [4]. The implications of this are that the threat of disease is present and should not be ignored, especially in Kenya, where resources to tackle such a crisis are limited.

These efforts to slow the spread of COVID-19 directly impacted informal livelihoods which constitute over three-quarters of the population [5, 6]. According to Schwettmann (2020), informal livelihoods are associated with informal housing and slums characterised by poor housing, water, and sanitation. These situations impact the containment measures; for example, handwashing, a key component additional to minimising personal contact are challenging to adhere to in these conditions. As a result, informal workers are exposed both in their homes and at work where conditions are unsafe, crowded, and unsanitary [5]. This situation becomes pertinent when working from home [7, 8], and education means eLearning from home [9, 10].

Decades of state cutback and lack of funding in healthcare means a fragile health system as is the case in Kenya [11, 12]. Furthermore, the low per capita available beds and health professional ratios, high dependency on medical imports and weak economies mean difficulties sustaining lockdown and health costs [13]. Additionally, the prevalence of disease burden in comorbidities and underlying medical conditions, including tuberculosis and HIV/AIDs is high [13]. COVID-19 thus encounters a fragile health system that has required, and was in the process of finding ways, to improve both locally and globally [14].

For example, Universal Health Coverage (UHC) is a crucial agenda for the World Health Organisation (WHO) and SDG3 as well as Kenya's Vision 2030, which calls for ensuring healthy lives and promoting wellbeing for all at all ages [13].

Informality with its links to poverty and the absence of social protection affects access to health insurance [13]. Lack of access to quality and affordable healthcare leaves many dependent on out-of-pocket payments [13]. In rural areas, this situation plays out in a similar but slightly different pattern. For example, they might be less crowded, but access to health services is on the decline due to distance and erosion of purchasing power [13]. Over 70% of the population live in slums in Nairobi, and over 70% are engaged in informal livelihoods [15]. For example, some governments, Kenya, and South Africa realised the people livelihoods, especially daily wage labourers, would be impacted by lockdowns. They anticipated a push back and deployed military and police to enforce lockdowns (stay at home) policies [14]. States may have managed to enforce lockdown rules, but the moves have economic consequences [14].

The coronavirus outbreak has resulted in a global economic downturn that is likely to have a devastating impact on the already struggling informal economy [5]. The realisation that lockdowns would impact people's livelihoods, especially daily wage labourers, is that opportunities for everyday operations shrink as they depend more on face-to-face interactions for daily earnings [15]. The resulting decline in revenues is estimated to be as high as 80% [5]. The containment measures' impact on livelihoods and the economy led the government to offer support, including fiscal stimuli, monetary interventions and central bank intervention and efforts to assist her most vulnerable [5]. These efforts are, however, inaccessible for the vast majority of informal workers, among whom are women and others experiencing intersectional inequalities [16,17, 18, 19, 20].

This paper proceeds to analyse the impact of COVID-19 on the informal economy, and the responses from the government, development partners and other stakeholders in the informal economy. It then looks at ICT policy and its knock-on effect on eLearning and education. Using SDGs as a framework, we argue that eLearning integration contributes to a key global goal. We summarise the barriers to integration and concludes by offering policy recommendations focusing on informality's growth and pervasiveness. The following section covers the development of informality in Kenya, setting the scope for the paper.

2.0 Growing Informality

According to Schwettmann (2020), in Kenya, in 2018, 762,200 jobs were created in the informal sector, ten times more than in the formal sector. In

Africa, records indicate the highest incidence of informal labour participation at 67.6 % average compared with the global 60.5% average. Non-agricultural employment in the informal economy is as high as 76.8%, and with agriculture 89.2% [5]. For women, informality is even more pervasive due to existing inequality [21, 22, 23]. The feminisation of poverty coupled with discrimination by gender, age, ethnicity or disability means that the most marginalised groups are represented more in the informal networks due to lack of choice and the need to survive [21]. In general terms, informality links poverty, low productivity, and the absence of social protection [13]. However, Arvidsson et al. (2017) claim that the notion of informality, although loosely understood as existing beyond the framework of state regulation, is a bit more nuanced. Informality does not always mean a complete separation or parallel system to formal activities [24]. Instead, they argue that the interrelationships between the formal and informal are complex and complimentary, as seen in analysis from various theoretical perspectives. These include modes of production, regulation, neoliberalism [25] [26] income generation activities [27], livelihood approaches [28] survivalist lived experiences and gender [22. [21, 23].

An overview of issues that characterise the informal sector raises challenges to eLearning integration [29, 20]. The economic context, the legal situation, levels and scope of regulations and policy frameworks align causes of informality [5]. At the micro-level, informality could result from low education levels, discrimination, poverty or gender inequality. These result in a lack of access to economic resources, property and finance, business services and markets. Furthermore, high informality results in a challenging environment to ensure human rights and decent working and living conditions [5]. It also negatively impacts enterprises' growth, control, and maintenance of public revenue, limiting the states' capacity to act. The soundness of institutions and social justice is therefore in question [5]. As much as it is difficult to homogenise the informal sectors, these are common characteristics that link these informal spaces. Statistics reveal the core role that informal employment plays in various forms within and across economies, and encompasses diverse situations and phenomena based on the country's conditions [5]. These characteristics include:

(1) Self-employment with particular vulnerabilities to health shocks and not covered by the narrow social protection systems. The workers are unrecognised as they are not registered, are unregulated, and do not fall into categories subject to labour and social protection [15].

(2) Their income is often low, and irregular characterised by small and undefined workspaces, unsafe working conditions, unhealthy working conditions, and unregulated working hours that yield low or irregular incomes ([7]. Informality is also closely linked to slums (Austrian et al., 2020).

(3) Poor representation in local and national governance structures and vulnerable results in lacking labour laws protection ([7].

(4) Finally, they also lack continuity and access to education and training, resulting in lack of access to training, markets, finance, and technology [15].

Due to COVID-19, governments established rescue packages for both citizens and business survival [30]. Formal workers were, in some cases, furloughed or allowed to work from home [18]. Still, these were less generous in low-income countries, and opportunities to work were less applicable or available [19]. Also, a large percentage of the population cannot work from home, which undermines employment and income streams with implications during and after the pandemic [8, 12]. Economic measures failed to target the informal sector despite informal employment forming the more significant part of countrywide employment and those involved being the most vulnerable [8, 12]. For example, social assistance funds designed for the vulnerable fail to meet the criteria as the age group is between 15-60 years. The bulk of informal sector workers are not considered needy, and in most cases, their businesses are not considered enterprises. Other measures such as reducing billing rates also do not impact the informally employed as they are not connected to the grid anyway [19]. Many rely on self-help mechanisms and community-based response strategies [19].

Informality is widespread in low and middle-income countries whereby in some cases, such as Mogadishu, Kinshasa, and Addis Ababa, it accounts for the bulk of economic activity where it is normal and mainstreamed and not deviant [24]. The informal is thus complex, not homogenised, leading to contestations of studies of informality association with poverty. Arfvidsson et al. (2017) argue that simplistic understanding alludes to a dichotomy that leads to misleading data, and ultimately to ill-informed policies and decision-making. The need for better policies is ever more pertinent due to this growth of informality and the implications regarding the realisation of SDGs, in this case, education goals [24]. Additionally, political representation must consider the voices and views of the growing complex network of people whose wellbeing is centred on informal livelihoods [5, 12].

The trend towards informality poses important questions as technology integration is pedagogically important to eLearning [11]. The government's failure to tailor responses challenges the capacity to educate, among other SDGs. These discrepancies have implications for ICT and eLearning, and tion in general, as explored in the next section.

3.0 ICT integration, eLearning, and SDGs

ICT development, SDGs and growing informality are parallel evolving discourses [14, 31]. For nearly three decades, authors such as Heeks and

Ospina [32] among others have documented ICT's widespread impact and solutions for developing countries. They include technology and knowledge transfer, processes and socially embedded nature of actions, and transformative interventions. These are critical areas of ICT that remain prevalent to date [33]. Included in these is democratising education, one of ICTs primary uses often as an overlapping concept with blended learning, eLearning, online courses, and online or distance education [34]. ICT integration has been sporadic and uneven. Kenya's strategic plan, Vision 2030, cites technology establishment as one of its key aims. It boasts one of Africa's fastest-growing mobile and ICT growth trajectories [35]. However, the growing inequality both globally and in Kenya [25], reflecting educational outcomes and access to digital resources, contributes to the ever-increasing digital divide [36, 37, 38, 39, 40]. The digital divide is the gap between the digitally literate and those that are unexposed or illiterate, sporadic users and non-users [36] [40]. The statistics are damning. Only an estimated 22% of Kenyans in public primary schools have access to digital learning [41]. Considerations of private schools shift the numbers to 48%, demonstrating evidence of the digital divide.

Integrating ICT falls mainly on the administration placing governments at the fore of ICT integration [42, 43]. In Kenya, the state typically executes top-down policy-making together with external influences from the mixed welfare systems where the governments and international development organisations, local NGOs and community development groups contribute to welfare [44]. The results can be problematic, including aid dependency and lack of dialogue amongst the stakeholders, resulting in low and unequal ICT integration [43]. The digital dividends – a world bank assessment of development benefits on ICT integration exemplifies this as efforts fail to meet expectations. Resources and infrastructure fail to meet the expectations of reform strategies [45]. Government efforts have shown mixed results; for example, to fulfil the Education for All (EFA) targets, the government introduced free primary school education with ICT integration in 2003 [43, 44, 46]. The results were high school enrolments but falling quality in education as the enrolment surge overwhelmed the infrastructure [47, 48]. The Kenya Education Sector Support Program (KESSP) and the National ICT Strategy for Education and Training were mandated to achieve EFA [44]. However, both bodies have failed to gain traction as ICT remains unavailable for the majority of the population, especially those in the low-income bracket [42].

Reports indicate ICTs role in enabling universal access to education, boost equity and enrich the delivery of quality learning and teaching [43]. However, the achievement of this requires mindset changes from the stakeholders, including educators, curriculum developers and administrators and policymakers. For example, a few months into the pandemic, after insisting that online learning was occurring, the Kenyan government realised that eLearning failed across the board [49]. The failure led to the cancellation of learning and exams resulting in learning loss for two-thirds of the population who frequently experience suboptimal education delivery [10, 49, 50]. Indeed,

as of 2019, a World Bank report noted the absence of standalone digital skills as a standalone compulsory subject in Kenya [51]. In terms of resources and access, some scholars cite the use of readily accessible and familiar gadgets and tools to support modes of eLearning might serve certain populations better [52]. There is an agenda on paper, but the digital learning policy is ineffective in practice, especially for the poor who need it the most [53, 54]. COVID-19 is a healthcare-based disaster that brings together the failed ICT integration agenda with growing informality which further challenges to digital integration.

Investment in ICT infrastructure, technical expertise and psychological preparedness summarise the areas that require attention [55]. ICT integration has implications for eLearning and, ultimately, education outcomes [56]. These must be core policy considerations bearing in mind the overarching growing informality. The importance of eLearning cannot be viewed in isolation, as its direct links with education are in line with the extent of cognitive skills in the achievement of sustainable development goals (SDGs) economic growth [43, 56] and better humane societies. The following section looks at SDGs goals, and their interrelationships with the lens focused on SDG4.

4.0 SDGs

The Sustainable Development Goals (SDGs) replaced The Millennium Development Goals (MDGs) [57]. MDGs focused on eliminating poverty in poorer countries, while SDGs consist of 17 goals that apply to all countries [58]. SDGs also recognise that the transition to global sustainability must consider the interconnectedness and interdependence of our world [59]. This interconnectedness requires commitments and substantive changes to the status quo, country by country, irrespective of socioeconomic position [24]. For example, SDG4 quality education focuses on exclusive, equitable, quality, and lifelong education [57]. Additionally, education plays a critical and imperative role in achieving all the other goals [60]. SDG4 plan aims to improve education outcomes, including access to early childhood development and care and pre-primary education, improve equality of access for men and women, access to quality technical, vocational, and tertiary education, the elimination of gender disparities in education and equality of access for persons with disabilities, vulnerable and indigenous groups; and the achievement of literacy and numeracy for all youth and a large proportion of adults [57]. The goal is to ensure all learners awareness, knowledge, and skills to promote sustainable development through the development of sustainable lifestyles, human rights, and equality. Additionally, it fosters a culture of peace and non-violence, global citizenship, appreciation of cultural diversity, and contribution to sustainable development [57].

Debates on how best to integrate ICT or deliver eLearning as a workable option in low- and middle-income countries, in summary, includes (1) aligning

stakeholders goals, for example, positioning goals with the delivery of SDGs, or Human Rights [61] (2)embedding human development and capability approaches [55, 62, 63, 64, 65], and considering the roles of multi and transdisciplinary collaborations SDGs requirement for realisation due to their range and scope [58, 66]

Scholars and practitioners criticise SDGs ambitious agenda [6, 11, 66, 67]. For example, developing global indicators requires developing metrics that miss many targets, especially inequality matters where substantive and not simply distributive agendas are realised [68]. Moreover, the lack of robust and reliable data hinders SDGs from becoming the envisioned powerful and effective tool that argues for a data revolution on the one hand and the strengthening of statistical systems from the local, national through to international levels, which would allow comparative analyses on the other hand [65]).

Pervasive informality meets SDGs to offer a subnational goal that focuses on undeniably important areas to the realisation of sustainable development [6, 8]. Highlighting these concerns seeks to raise awareness of informality's challenge, and to realise the complexities of finding focused strategies for building capacities for transitions towards sustainable development [24]. The barriers to ICT implementation, which this paper argues reflect barriers to eLearning, include infrastructure, technical expertise, and psychological preparedness. Lack of representation in local and national political structures have implications for education attainment and SDGs.

5.0 Summary: Barriers to eLearning

Informality is linked closely to low income and slums. School closures meant eLearning from home for all. For the vast majority of Kenyans, informality characterises this experience. Infrastructural challenges at the micro level include low or lack of access to hardware, software and the internet. Lack of computer equipment, access to electricity mains and alternatives in some cases, undefined housing and workspaces, unsafe and unhealthy working conditions, unregulated working hours mean a lack of capacity to ensure or support efforts for eLearning integration. Parents and guardians, for example, play a role through the management and direction of eLearning as they work from home during the pandemic. This opportunity to work from home does not exist for informal workers; hence, they cannot offer eLearning support to their children.

Additionally, loss of income means families struggle to get food and other basic needs. The cost of electricity and the internet become secondary to more basic requirements. At the macro level, failing state-led projects to provide ICT integration at all levels means disadvantage across most of the population. Computer literacy is low. The digital divide is evident with the wealthier, the primarily urban population having access to digital resources and the capacity

to support eLearning. At the same time, those in deprived areas lack at all levels.

Technical expertise to design and deliver eLearning exhibits shortcomings at the state level in as much as programmes were developed and delivered. There are limits to access for the vast majority who lack the resources. Those in the low-income bracket also have the added disadvantage of most probably not being computer literate and, in some cases, even lacking basic literacy. The low educational attainment characteristic of those in low-income brackets also means the more inadequate capacity to access information on training, markets, finance, and ICT technology. They cannot technically support the access and dissemination of eLearning. The shortage of teaching capacity is due to teachers not being computer literate.

Lack of psychological preparedness for the role of ICT and the role that eLearning plays in education is evident. The state has continuously failed to integrate ICT broadly and evenly, exacerbating the digital divide. The lack of interaction with ICTs for those in the low-income bracket has ill-prepared them for, at the minimum, equating eLearning with educational attainment and thus prioritising eLearning.

6.0 Conclusion

This paper noted the development of ICT development, SDGs and growing informality as parallel evolving discourses which now encounter a global pandemic. The coronavirus outbreak in 2020 has resulted in a global economic downturn that is likely to have a devastating impact on the already struggling informal economy. In Kenya, informal employment constitutes nearly three-quarters of the population, with direct implications on livelihood. The government established rescue packages for the survival of both citizens and businesses. However, the informally employed are unable to access offered assistance or any of the social assistance packages due to the informality of their enterprises and livelihoods. In addition, decades of state cutbacks and lack of funding in healthcare means a fragile health system. Access to healthcare has further implications for those in informal employment who cannot pay for or access universal health insurance and therefore have to pay out of pocket for costly medical care. Schools were closed to contain the virus and to prevent overwhelming the capacity of a struggling health system.

The only way to realise learning continuity was to move to online learning. Still, the move faces multiple challenges stemming from historical integration issues, which leads to questions of the value and position of eLearning. Beyond resources, technical expertise to design and deliver eLearning exhibits shortcomings at the state level. As much as programmes were developed and delivered, technology teaching professionals, teachers, and family support are lacking. Teachers do not need technology qualifications; therefore, they can't

provide or inspire eLearning. Lack of psychological preparedness for the role of ICT and the role that eLearning plays in education is evident both from teachers and students.

In line with Kenya's strategic plan Vision 2030, technology establishment as broadly integrated ICTs is a core goal. However, the trend towards informality poses essential questions as technology integration is pedagogically important to eLearning. Reports indicate ICTs role in enabling universal access to education, boosting equity and enriching the delivery of quality learning and teaching. A plan exists on paper, but the digital learning policy is ineffective in practice, especially for the poor who need it the most. An overview of issues that characterise the informal sector raises challenges to eLearning integration. In terms of representation, the inclusion and participation of informal sector representatives in policy design relevant policies in the emergency policy framework would realise solutions that cover the growing population.

The Sustainable Development Goals (SDGs) offer a framework for analysis of ICT, education and elearning. Within this framework, ICT integration can be part of realising SDG4: quality education focuses on exclusive, equitable, quality, and lifelong education—the alignment of stakeholder's goals, which include positioning goals with the delivery of SDGs.

Additionally, embedding human development and capability approaches that already inform SDGs and other critical development narratives serve the realisation of SDGs. And finally, it is necessary to consider the roles of multi and transdisciplinary collaborations that SDGs require for their realisation due to their range and scope while simultaneously considering scholars and practitioners' criticisms of SDGs ambitious agenda. When it comes to eLearning in particular, the matters raised in this paper are underexplored and should form the basis for future research and studies.

7.0 References

1. Guerrieri, V., Lorenzoni, G., Straub, L. and Werning, I. (2020) No title. *Macroeconomic Implications of COVID-19: Can Negative Supply Shocks Cause Demand Shortages?*
2. Barua, S. (2020) Understanding Coronanomics: The economic implications of the coronavirus (COVID-19) pandemic. *SSRN Electronic Journal* https://doi org/10/ggq92n, [05/03/2021].
3. Loembé, M.M., Tshangela, A., Salyer, S.J., Varma, J.K., Ouma, A.E.O. and Nkengasong, J.N. (2020) COVID-19 in Africa: the spread and response. *Nature medicine,* 26 (7), 999-1003.
4. Mukherjee, S. (2021) Why does the pandemic seem to be hitting some countries harder than others. *New Yorker,*
5. Schwettmann, J. (2020) COVID-19 and the informal economy. *Impact and response strategies in,*

6. Dhingra, S. (2020) Protecting informal workers in urban India: the need for a universal job guarantee. *VoxEU,*
7. Nicola, M., Alsafi, Z., Sohrabi, C., Kerwan, A., Al-Jabir, A., Iosifidis, C., Agha, M. and Agha, R. (2020) The socio-economic implications of the coronavirus and COVID-19 pandemic: a review. *International Journal of Surgery,*
8. Donovan, L. and Zhu, A. (2020) Kenya's Labor Market Wasn't Made for a Pandemic. https://foreignpolicy.com, April 10, 2021
9. Beaunoyer, E., Dupéré, S. and Guitton, M.J. (2020) COVID-19 and digital inequalities: Reciprocal impacts and mitigation strategies. *Computers in Human Behavior,* 106424.
10. Miller, N. (2020) *Virtual learning under lockdown casts doubt on Kenya as the Silicon Savannah.* Available from: https://blogs.lse.ac.uk/africaatlse/2020/08/19/virtual-learning-lockdown-casts-doubt-kenya-silicon-savannah-digital-education/ [Accessed 19.08.2020].
11. Acharya, B. and Lee, J. (2018) Users' perspective on the adoption of e-learning in developing countries: The case of Nepal with a conjoint-based discrete choice approach. *Telematics and Informatics,*
12. Dhingra, S. (2020) Protecting informal workers in urban India: the need for a universal job guarantee. *VoxEU,*
13. Were, L.P. (2018) Informality and health: universal health coverage in the era of SDGs. *The Lancet Global Health,* 6 (1), e22-e23.
14. Austrian, K., Pinchoff, J., Tidwell, J.B., White, C., Abuya, T., Kangwana, B., Ochako, R., Wanyungu, J., Muluve, E. and Mbushi, F. (2020) COVID-19 related knowledge, attitudes, practices and needs of households in informal settlements in Nairobi, Kenya.
15. Kinyanjui, N. (2020) Kenya: How the COVID-19 Pandemic Will Affect Informal Workers. Insights From Kenya. *The Conversation,*
16. World Bank (2020b) *Kenya Economic Update: COVID-19 Erodes Progress in Poverty Reduction in Kenya, Increases Number of Poor Citizens* Available from: https://www.worldbank.org/en/country/kenya/publication/kenya-economic-update-COVID-19-erodes-progress-in-poverty-reduction-in-kenya-increases-number-of-poor-citizens [Accessed 05/03/2021].
17. Fornaro, L. and Wolf, M. (2020) COVID-19 coronavirus and macroeconomic policy.
18. Gottlieb, C., Grobovšek, J. and Poschke, M. (2020) Working from home across countries. *COVID Economics,* 1 (8), 71-91.
19. Bosio, E. and Djankov, S. (2020) When economic informality is high, cash transfers may be the best COVID response. *LSE Business Review,*
20. Kiaga, A.K., Lapeyre, F. and Marcadent, P. (2020a) The impact of COVID-19 on the informal economy in Africa and the related policy responses. *International Labour Organisation, Geneva,*

21. Kabeer, N. (2014) *Gender and social protection strategies in the informal economy.* Routledge India. Available from:
22. Chant, S. and Pedwell, C. (2008) Women, gender and the informal economy: An assessment of ILO research and suggested ways forward.
23. Williams, C. and Martinez, A. (2014) Is the informal economy an incubator for new enterprise creation? A gender perspective. *International Journal of Entrepreneurial Behavior & Research,*
24. Arfvidsson, H., Simon, D., Oloko, M. and Moodley, N. (2017) Engaging with and measuring informality in the proposed Urban Sustainable Development Goal. *African Geographical Review,* 36 (1), 100-114.
25. Carmody, P. (2019) *Development theory and practice in a changing world.* Routledge.
26. Harvey, D. (2007) *A brief history of neoliberalism.* Oxford University Press, USA. Available from:
27. Muia, D., Kamau, A., Kamau, P., Baiya, H. and Ndung'u, J. (2018) Social capital as a coping mechanism for women small scale traders in the informal economy in Nairobi, Kenya.
28. Devereux, S. (2001) Livelihood insecurity and social protection: a re-emerging issue in rural development. *Development policy review,* 19 (4), 507-519.
29. World Bank (2020a) ASSESSING THE ECONOMIC IMPACT OF COVID-19 AND POLICY RESPONSES IN SUB-SAHARAN AFRICA.
30. Brand, S.P., Aziza, R., Kombe, I.K., Agoti, C.N., Hilton, J., Rock, K.S., Parisi, A., Nokes, D.J., Keeling, M. and Barasa, E. (2020) Forecasting the scale of the COVID-19 epidemic in Kenya. *MedRxiv,*
31. Jokiaho, A., May, B., Specht, M. and Stoyanov, S., (2018) Obstacles to Using ELearning in an Advanced Way. *In: The International Conference on E-Learning in the Workplace.*
32. Heeks, R. and Ospina, A.V. (2018) Conceptualising the link between information systems and resilience: A developing country field study. *Information Systems Journal,*
33. Gallivan, M. and Tao, Y.Y. (2013) A Longitudinal Scientometric Analysis of Research Published in IFIP 9.4 (2002-2013). *GlobDev 2013,*
34. Cunningham, M., (2015) Factors impacting on adoption of Technology-enhanced Learning techniques by universities in Nairobi, Kenya. *In: 2015 IEEE International Symposium on Technology and Society (ISTAS).* IEEE, 1-7.
35. Vision, 2. (2007) Vision 2030 . *A globally competitive and prosperous Kenya*: https://www.opendatagoke/download/jih3-amby/application/pdf,
36. Antonio, A. and Tuffley, D. (2014a) The gender digital divide in developing countries. *Future Internet,* 6 (4), 673-687.

37. Pick, J. and Sarkar, A., (2016) Theories of the digital divide: Critical comparison. *In: 2016 49th Hawaii International Conference on System Sciences (HICSS).* IEEE, 3888-3897.
38. Goncalves, G., Oliveira, T. and Cruz-Jesus, F. (2018) Understanding individual-level digital divide: Evidence of an African country. *Computers in Human Behavior,* 87 276-291.
39. Okunola, O.M., Rowley, J. and Johnson, F. (2017) The multi-dimensional digital divide: Perspectives from an e-government portal in Nigeria. *Government Information Quarterly,* 34 (2), 329-339.
40. Brandtzæg, P.B., Heim, J. and Karahasanović, A. (2011a) Understanding the new digital divide—A typology of Internet users in Europe. *International journal of human-computer studies,* 69 (3), 123-138.
41. Uwezo (2020) *Are Our Children Learning? The Status of Remote-learning among School-going Children in Kenya during the COVID-19 Crisis.* Nairobi: Uwezo Kenya. Available from: https://docs.opendeved.net/lib/LRBK4LWS [Accessed 12.08.2020].
42. Wiseman, A.W. and Anderson, E. (2012) ICT-integrated education and national innovation systems in the Gulf Cooperation Council (GCC) countries. *Computers & Education,* 59 (2), 607-618.
43. Tabira, Y. and Otieno, F.X. (2017) Integration and implementation of sustainable ICT-based education in developing countries: low-cost, en masse methodology in Kenya. *Sustainability Science,* 12 (2), 221-234.
44. Ngavana, M.M., Mutua, F. and Koech, P.K. (2018) The Extent of School Management Support of ICT Tools Integration in Teaching and Learning of Kiswahili Language in Public Secondary Schools in Kenya.
45. World Bank (2019b) *World Development Report 2016: Digital Dividends.* New York: World Bank. Available from: http://www.worldbank.org/en/publication/wdr2016 [Accessed 05/03/2019].
46. Zuilkowski, S.S., Piper, B., Ong'ele, S. and Kiminza, O. (2018) Parents, quality, and school choice: why parents in Nairobi choose low-cost private schools over public schools in Kenya's free primary education era. *Oxford Review of Education,* 44 (2), 258-274.
47. Unterhalter, E. (1)&Brighouse, H. (2) (2007) *Distribution of what for social justice in education? The case of education for all by 2015.* Palgrave Macmillan. Available from: http://search.ebscohost.com/login.aspx?direct=true&db=edselc&AN=edselc.2-52.0-85014182376&site=eds-live [Accessed 05/03/2021].
48. Walker, M. (1,2) (2007) *Selecting capabilities for gender equality in education.* Palgrave Macmillan.Available from: http://search.ebscohost.com/login.aspx?direct=true&db=edselc&AN=edselc.2-52.0-85014158967&site=eds-live [Accessed 05/03/2021].

49. Parsitau, S. and Jepkemei, E. (2020) *How school closures during COVID-19 further marginalizeVulnerabel children in Kenya* . Available from: https://www.brookings.edu/blog/education-plus-development/2020/05/06/how-school-closures-during-COVID-19-further-marginalize-vulnerable-children-in-kenya/ [Accessed 20.07.2020].
50. Dahir, A.L. (2020) Kenya's Unusual Solution to the School Problem: Cancel the Year and Start Over. *International New York times,* Aug 7,
51. World Bank (2019a) Kenya: Kenya Economic Update - Accelerating Kenya's Digital Economy. https://www.worldbank.org, October 30, 2020
52. Asanov, I., Flores, F., Mckenzie, D.J., Mensmann, M. and Schulte, M. (2020) Remote-learning, Time-Use, and Mental Health of Ecuadorian High-School Students during the COVID-19 Quarantine. *World Bank Policy Research Working Paper,* (9252),
53. Harris, R.W. (2016) How ICT4D research fails the poor. *Information Technology for Development,* 22 (1), 177-192.
54. Ochieng, O. and Ogejo, W. (2020) Glaring inequalities in our education system exposed . *Standardmedia,* June 7th,
55. Uhomoibhi, J. and Hooper, L., (2019) Digital Learning Challenges and Innovations for Sustainable Education in Developing Countries: Issues of Policy and Practice. *In: INSPIRE XXIV, Twenty-fourth International Conference on Software Process Improvement Research, Education and Training: Global Connectivity and Learning Across the Nations.*
56. Hooper, L.O. and Uhomoibhi, J. (2020) COVID-19: Impact on E-Learning, Capabilities for Development and Digital Citizenship in Emerging Economies. *INSPIRE XXV,* 239.
57. United Nations (2015) Transforming our world: the 2030 Agenda for Sustainable Development. *United Nations: New York, NY, USA,*
58. Kumar, S., Kumar, N. and Vivekadhish, S. (2016) Millennium development goals (MDGS) to sustainable development goals (SDGS): Addressing unfinished agenda and strengthening sustainable development and partnership. *Indian journal of community medicine: official publication of Indian Association of Preventive & Social Medicine,* 41 (1), 1.
59. Fukuda-Parr, S. (2016) From the Millennium Development Goals to the Sustainable Development Goals: shifts in purpose, concept, and politics of global goal setting for development. *Gender & Development,* 24 (1), 43-52.
60. Ferguson, T. and Roofe, C.G. (2020) SDG 4 in higher education: Challenges and opportunities. *International Journal of Sustainability in Higher Education,*

61. Robeyns, I. (2006) Three Models of Education: Rights, Capabilities and Human Capital. *Theory and Research in Education,* 4 (1), 69-84.
62. Alkire, S. and Deneulin, S. (2009) Introducing the human development and capability approach. *An introduction to the human development and capability approach.London: Earthscan,*
63. Nussbaum, M. (2000) *Women and human development: the capabilities approach.* Cambridge: Cambridge University Press.
64. Robeyns, I. (2016) Capabilitarianism. *Journal of Human Development and Capabilities,* 17 (3), 397-414.
65. Odhiambo, C.A. and Hooper, L. eLearning in Kenya during Lockdown: Case Study Comparing District, National and Private School Experience. *INSPIRE XXV,* 231.
66. Fukuda-Parr, S. and McNeill, D. (2019) Knowledge and Politics in Setting and Measuring the SDG s: Introduction to Special Issue. *Global Policy,* 10 5-15.
67. Chabbott, C. and Sinclair, M. (2020) SDG 4 and the COVID-19 emergency: Textbooks, tutoring, and teachers. *Prospects,* 49 (1), 51-57.
68. Unterhalter, E. (2019) The many meanings of quality education: Politics of targets and indicators in SDG 4. *Global Policy,* 10 39-51.

Student Attitude towards E-learning Adoption: A Case Study of Masinde Muliro University of Science and Technology, Kenya

Dr Jackline Akoth Odero[1] and Dr Umulkher Ali Abdillahi[2]

[1]Department of Business Administration and Management Science
[1]Masinde Muliro University of Science and Technology, Kakamega, Kenya
jacklineodero@gmail.com

[2]Department of Economics
Masinde Muliro University of Science and Technology, Kakamega, Kenya
aumulkher@mmust.ac.ke

Abstract

Emergence of COVID 19 pandemic has dramatically changed the higher education landscape. Universities around the world have been forced to embrace e-learning as a measure to contain the spread of the virus. As much as there is expansive literature on the potential benefits of e-learning, there is still a need to understand the user acceptance process as the students have not fully embraced e-learning. Students are expected to have the right attitude and perceive e-learning positively for it to be effective, otherwise they may be reluctant to adopt it. Student attitude plays a critical role in ensuring smooth adoption of e-learning. This paper focused on assessing the determinants of student attitude towards e-learning adoption. Specifically the paper examined the effect of perceived usefulness, perceived ease of use and challenges to adoption of E-learning. The study was anchored on the Technology Acceptance Model (TAM) which explained and predicted user behavior in regards to information technology. Survey research methodology was used. An online survey was conducted using Google forms to elicit the required information. The study adopted a convenience sampling technique to select a sample of 236 undergraduate students undertaking Bachelor of Commerce, Bachelor of Science in Economics and Bachelor of Science in Economics and Statistics from the School of Business and Economics. Recommendations were drawn from the findings. The study findings provide greater insight into the determinants of student

attitude and provide valuable insights for policy makers, practitioners, developers and designers in successful implementation of e-learning systems. The research will contribute to the improvement of student attitude towards adoption of E-learning.

Keywords: Adoption**.** E-learning, Perceived ease of use, Perceived usefulness, Student attitude

1.0 Introduction

There has been a substantial growth in the utilization of E-learning platforms around the world in higher education [1] Tremendous growth has been reported in several countries such as Korea [2], Denmark[3], United States[4] and South Africa [56. E-learning refers to instruction delivered through all electronic media in particular the internet, extranets, intranets, audio/video tape, satellite broadcasts and CD-Rom and interactive TV [6]. According to Abbad, Morris and De Nahlik [7], e-learning is any learning that has been enabled electronically.

E-learning has come to be more and more important in institutions of higher education. Decman, [8] and Glenn [9] pointed out that higher learning institutions throughout the world have adopted e-learning to support and also enhance their learning as well as teaching activities. Wagner, Hassanein and Head [10] emphasized that e-learning availed extra prospects for interactivity during content delivery between students and teachers. Amongst the many advantages of e-learning are that it is self-paced, less expensive in terms of delivery, provides consistent content, it is fast and can be used anywhere and anytime for the learners [11]. Moreover, in the wake of COVID-19 e-learning has gained much prominence.

According to Aiken [12] attitude is a 'learned predisposition that is learned so as to respond either positively or negatively in regards to a particular object, institution or even a person'. A student's attitude may be affected in several ways and this depends on the teaching method employed. Bertea [13] contends that attitude depicted the possibility of adoption of certain behaviours. In regards to e-learning students' favourable and positive attitude suggests a greater probability that they will accept it. Grunwald [14] reported that the potential adopters 'beliefs and attitudes, perceived usefulness and ease of use influenced technology adoption. Similarly Yang and Lin [15] reiterated that the learner's attitude towards the internet was a determinant of their motivation, interest and also performance in the online learning environment. According to Lim, Hong and Tan [16] and Selim [17], students' positive attitudes and behaviors towards e-learning are crucial for their e-learning readiness and acceptance. Moreover, Ho and Kuo [18] argued that learner's computer attitudes played a critical role in regards to online learning usability. Thus the students' attitudes, beliefs and satisfaction with the technology are imperative for the future success of e-learning initiatives.

In Kenya, public universities have mostly blended learning where online learning and face to face learning are integrated though they have lagged behind in implementing it fully [19]. Masinde Muliro University of Science and Technology is a public university located in Kakamega County, Kenya. The University operates in an environment experiencing rapid technological changes and amongst the key changes include; internet, information sharing, e-learning modes of study and digital technologies [20]. As much as the university has embraced e-learning, its effective implementation is yet to see fruition.

1.1 Statement of the Problem

Literature has consistently suggested e-learning to be the best alternative to managing constraints to accessing education [21]. Currently, COVID-19 has posed a challenge with regards to access to education thus necessitating the adoption of e-learning. However, successful implementation of e-learning in education relies much on students ' attitudes towards it as such studies have pointed out poor student attitude as being a limiting factor in the adoption of e-learning in public universities [22, 23]. Further previous studies have postulated that student attitude is a determinant of e-learning adoption [16, 24, 17]. Students' perceptions as well as aspirations should be taken into consideration as it directly affected their learning space including learning style [25, 26, 27, 28]. It had been argued that the implementation of e-learning depended on having a positive attitude and it did not matter how advanced or even how capable the technology used was [29].This paper therefore intended to assess the determinants of student attitude towards e-learning adoption at Masinde Muliro University of Science and Technology.

1.2 Research Objectives

This research paper sought to address the following three main research problems:

i)To assess the levels of perceived usefulness, towards e-learning adoption at Masinde Muliro University of Science and Technology

ii)To determine the levels of perceived ease of use towards E-learning adoption at Masinde Muliro University of Science and Technology

iii)To ascertain the challenges towards E-learning adoption at Masinde Muliro University of Science and Technology

2.0 Literature Review

2.1 Theoretical Framework

Davis [30] developed the technology acceptance model (TAM) which points out perceived usefulness and ease of use as being determinants for developing a particular attitude towards technology acceptance. The model demonstrates that

technology adoption by students based on information technology can be explained by perceived ease of use as well as the perceived usefulness. According to Park [31], TAM is a well-known model linked to technology acceptance and use and it is also used to explain and predict user behaviour with regards to information technology. TAM explores the acceptance of information technology [30]. On the same vein Al- Adwan, Al- Adwan and Smedley [32] alluded that the model measured acceptance, usefulness and also use of technology. Perceived ease of use is the extent to which a person believes that the technology can be used without difficulty and perceived usefulness refers to the degree to which a person believes the technology would enhance his job performance [30]. Ease of use results in better performance and even greater perception of usefulness.

2.2 Empirical Literature Review

Parker [33] posited that learners who were comfortable in using technology and had a positive attitude towards it were more likely to be successful within an e-learning environment. Andersson [34] carried out a study on challenges for e-learning courses in developing countries with specific focus in Sri Lanka. She found support, flexibility, teaching activities, learning activities, academic confidence, access, localization and attitudes as the major challenges. Masrom [35] found that perceived usefulness has a significantly influenced attitude of students and their intention to use the e-learning system. He explained that students may be willing to use e-learning applications that were beneficial, thus suggesting that students tended to dwell on the technology's usefulness. He further suggested that e-learning training as well as information sessions should emphasize on ways in which technology could enhance productivity, effectiveness and efficiency of the students' learning process.

Qteishat, Alshibly, Alqatawna and Al-Ma'aitah [36] conducted a study in Jordan's higher education institutions and they examined the factors that contributed to student attitudes towards e-learning. The research utilized the Technology Acceptance Model and established that perceived usefulness and ease of use of the technology, extent of technological support and previous technological experience influenced student attitudes towards their willingness to adopt E-Learning. Almarabeh [37] conducted a study on Students' Perceptions of e-learning at the University of Jordan and established that the students were not only well acquainted with the e-learning system but also had sufficient knowledge of its benefits.

Adewole-Odeshi [38] carried out a study in selected South West universities in Nigeria on how student attitude influenced e-learning. The study used the Technology Acceptance Model (TAM). Questionnaires were used to collect data and for data analysis both descriptive and inferential statistics were employed. Findings revealed that students perceived the system as being easy to use and also useful and as such they had a positive attitude towards e-learning. Pilli, Fanaeian and Al-Momani [39] investigated students' attitude towards using E-learning system. The study established that technological factors, student factors, perceived usefulness

and ease of use influenced attitude towards use of e-learning. The technological factors included the quality of the system, service quality and quality of information. Student factors included technological experience and keenness and satisfaction levels. Odero [23] established that public universities in Kenya experienced certain challenges such as poor lecturer attitude, poor student attitude and perceptions, increased workload, inadequate finances, poor infrastructure, inadequate technical skills and insufficient internet connectivity. However, the study utilized a desktop approach.

3.0 Research Methodology

This research used survey methodology. Data was collected from undergraduate learners by administering a structured questionnaire. This was done while adhering to the objectives of the study. Given that COVID-19 pandemic spread globally and for the purpose of safety, the researcher conducted an online survey using the structured questionnaire developed.

3.1 Respondents

The study was conducted at Masinde Muliro university of Science and Technology, Kenya. The study targeted 250 students. The respondents were a sample of 26 undergraduate students at the School of Business and Economics undertaking Bachelor of Commerce, Bachelor of Science in Economics and Bachelor of Science in Economics and Statistics and Bachelor of Science in Accounting.

3.2 Data Collection and Analysis

The researcher collected data using a Google form. This was chosen because it was easy to create using the current Gmail account and its efficiency in collecting data. The undergraduate students were also able to easily navigate the interface as they have had several recent online surveys since the pandemic broke out. In addition, feedback received was stored for analysis. Finally, it allowed for unlimited questions and answers without minimal cost, compared to other survey tools requiring a payment based on the number of questions and recipients.

Non-probability convenience sampling [40,41] was used in this study. Data was collected using both structured and unstructured questionnaires. The structured questionnaire used a 3-point Likert scale (Where 1 = Not at all; 2 = Small extent 3 = Great extent) to measure students' response. The research instrument for this study contained items constructed by adapting items generated from the extant literature which were previously validated tools that were used to investigate the perceived usefulness ,ease of use and challenges of adoption to e-learning. The survey items were spread across three sections: Section A contained 4 items that capture demographic data of the respondents including: gender, age range, course undertaken, year of study and self-reported previous use of e-learning systems

(computers, e-mails, Web 2.0 tools, etc.). Section B had 30 items on perceived usefulness and ease of use and Section C had items on challenges of adoption of e-learning.

The students were asked to elaborate on what they would recommend to enable them to have a positive attitude towards e learning and to comment on why or why not they felt the course was well organized. Data was analysed using descriptive statistics and content analysis. Results were presented in figures and tables.

4.0 Results and Discussion

4.1 Response Rate

The response rate was 94 % as 236 students responded out of the targeted 250. This response rate is adequate as proposed by Kothari [42] who considered responses above 70% as being excellent.

4.2 Validity and Reliability

Validity and reliability of the instrument was face-validated by the research supervisor and also by a measurement and evaluation (test) expert in one of the universities within the locality. This validation procedure was aimed at checking the content and overall format of the research instrument, including individual items, the wordings and statements used.

4.3 Demographic Characteristics of Respondents

Descriptive statistics was obtained on the respondents' demographic details.

4.3.1 Gender of Respondents

According to figure I, out of the 236 respondents, 158 were male (66.95 per cent) and 78 were female (33.05 per cent).

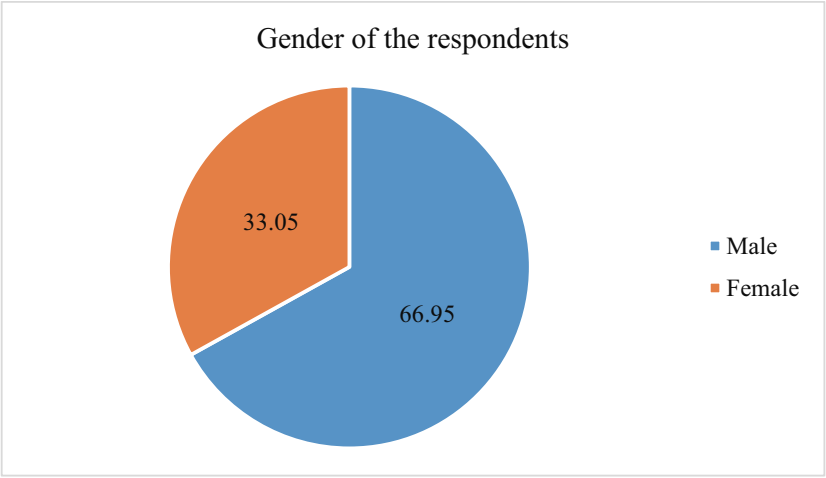


Figure 1: Gender of respondents

4.3.2 Age of Respondents

As indicated in figure 2, 38.08% were less than 20 years, 60.67% were between 21-25 years and finally 1.26% were above 25 years.

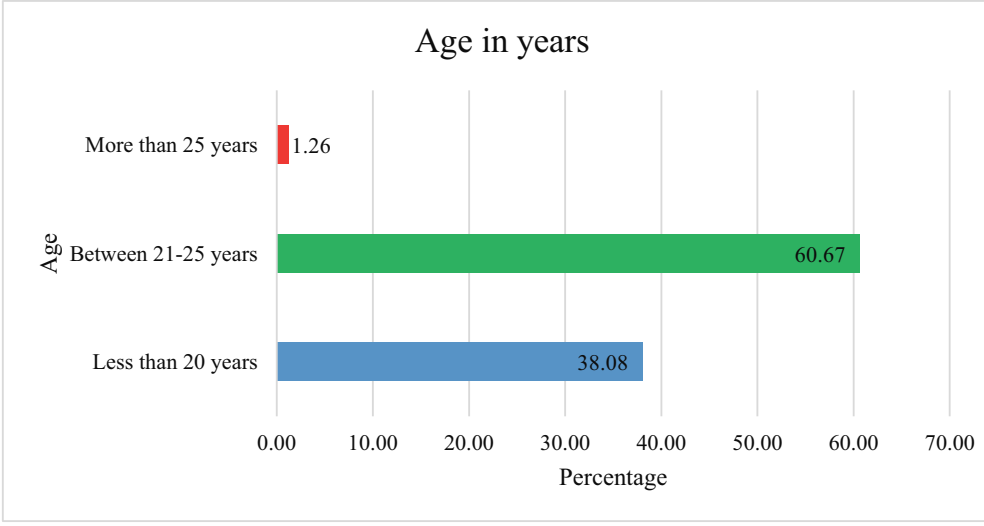


Figure 2: Age of respondents

4.3.3 Course Undertaken

The respondents were drawn from undergraduate programs in the School of Business and Economics, whereby 40.25 % of the respondents are currently undertaking Bachelor of Science in Economics,35.59% Bachelor of Commerce,18.64% Bachelor of Science in Economics and Statistics, while 5.51% representing students undertaking Bachelor of Accounting as shown in figure 3.

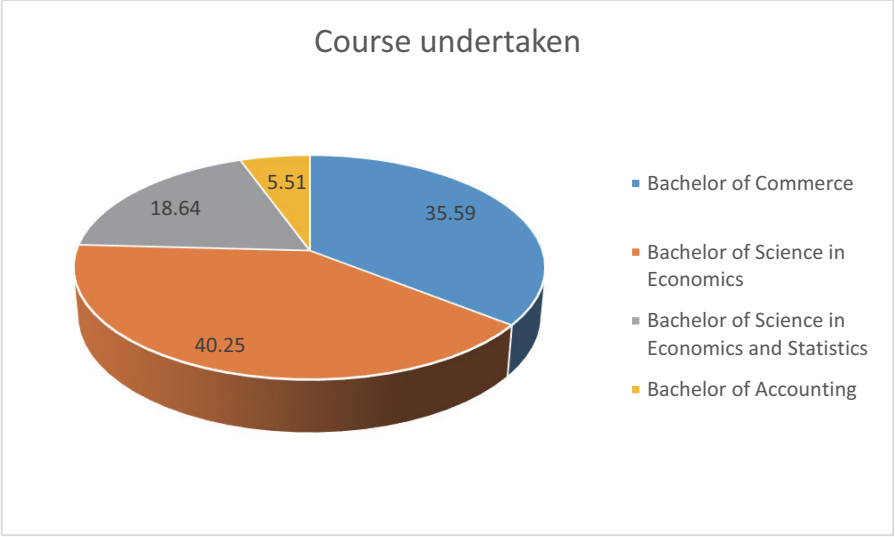


Figure 3: Course undertaken

4.3.4. Year of Study

Majority of the respondents are students in their first year (67.36%), followed by second years at 16.74%, third and fourth years at 9.21% and 6.69% respectively as depicted in figure 4.

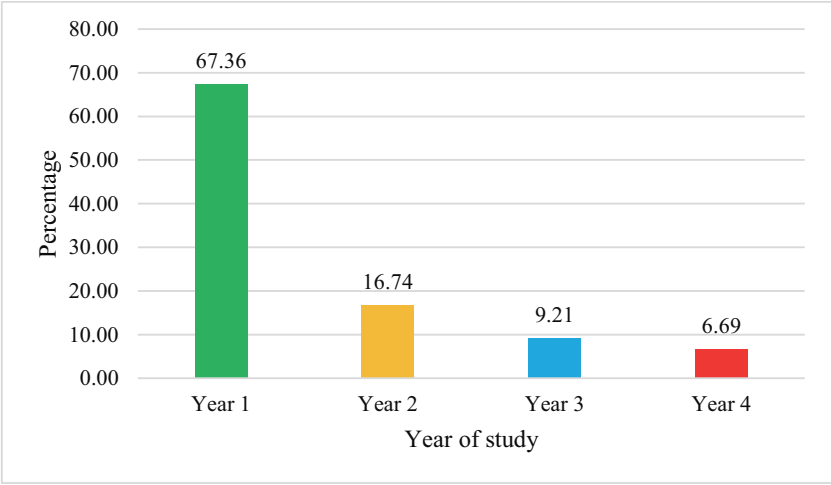


Figure 4: Year of study

4.3.5 Use of E-tools

The study established that 57.20% of the students seldom e-tools while those who use them use virtual classroom is most preferred by 29.23%. Majority of the population, 86.44% use their phone as the gargets to access e-learning and this was equally evident because of mobile phone penetration in the country.

Table 1: Use of e-tools

		n	**%**
How often the respondents use e-tools	Always	74	31.36
	Seldom	135	57.20
	Never	27	11.44
E-tools often used	Emails	44	18.65
	Video conferencing	44	18.65
	Virtual classrooms	69	29.23
	Search engines	34	14.40
	Web based search course materials	45	19.07
Gadgets used	Laptop	27	11.44
	Phone	204	86.44
	Ipad/Tablet	5	2.12

4.4 Influence of perceived Usefulness Towards E-Learning Adoption

Majority of the students agreed to a great extent that e- learning was a useful learning method (59.4%), that they believed e- learning facilitated their learning (47.9%), that they believed e-learning enhanced their learning experience (60.9%),that it gave them more time to explore a variety of learning sources (66.9%), that it makes learning more interesting and enjoyable(51.7 %),that it had improved their motivation to learn (53.5%), that it improved self confidence in expressing ideas and opinions (57.9%), that it had helped them learn under minimal supervision (65.1%), it had improved their self-discipline (54.9%). Majority agreed to a great extent that feedback was prompt in comparison to traditional learning (56.8%), that a variety of learning methods are employed by the lecturers (60.9 %), that it provides flexibility in time (64.7 %), it provides flexibility and convenience in space since I do not have to come (69.0%), feedback on assignments was timely (58.3%) and that learning services such as electronic library services and technical support were available (57.3%). The findings reveal that the majority of students agreed to a great extent to the statements on perceived usefulness of e-learning. The findings are in line with those of Almarabeh [37] and Adewole-Odeshi [38] who found that the students had sufficient knowledge of its benefits and perceived the system as being useful. The findings have been corroborated by Buabeng-Andoh and Yidana [43] and Earle [44] who reiterated that students looked forward to online learning since it enabled them to use the internet as well as participate in lessons while they were in their homes. Unwin [45] pointed out the usefulness of e learning was useful as it enabled timely and consistent content delivery, increased access to learning, supported student centred learning and learning could go on in any place. Meissonier, Houzé, Benbya and Belbaly [46] were assertive that students' motivation, self-discipline and satisfaction enhanced e-learning outcomes. Previous studies confirmed that perceived usefulness influenced student attitude towards e-learning use [30. 35, 39] . According to Khirwadkar, Hewit and Chaudhari [47] e-learning can provide learners with an exceptionally rich learning experience.

Table 2: Descriptive results for statements on perceived usefulness

Statements on perceived usefulness		Not at all	Small Extent	Great extent	Total
I believe that e-learning is very useful learning method	n	26	68	136	230
	%	11.3	29.6	59.4	100.0
I believe that e-learning has facilitated my learning	n	41	79	110	230
	%	17.8	34.3	47.9	100.0

Statements on perceived usefulness		Not at all	Small Extent	Great extent	Total
I believe that e-learning enhances my learning experience	n	23	67	140	230
	%	10.0	29.1	60.9	100.0
E-learning gives me more time to explore a variety of learning sources.	n	23	53	154	230
	%	10.0	23.0	66.9	100.0
E-learning makes learning more interesting and enjoyable	n	52	59	119	230
	%	22.6	25.7	51.7	100.0
E-learning has improved my motivation to learn.	n	55	52	123	230
	%	23.9	22.6	53.5	100.0
E-learning improves my self-confidence in expressing ideas and opinions	n	40	57	133	230
	%	17.4	24.8	57.9	100.0
E-learning has helped me to learn under minimal supervision	n	19	62	151	232
	%	8.2	26.7	65.1	100.0
On-line assignments has improved my self-discipline.	n	44	59	125	228
	%	19.3	25.9	54.9	100.0
Feedback is prompt than the traditional learning	n	38	60	129	227
	%	16.7	26.4	56.8	100.0

Statements on perceived usefulness		Not at all	Small Extent	Great extent	Total
A variety of learning methods are employed by the lecturers	n	26	64	140	230
	%	11.3	27.8	60.9	100.0
It provides flexibility in time	n	22	58	147	227
	%	9.7	25.6	64.7	100.0
It provides flexibility and convenience in space since I do not have to come	n	18	52	156	226
	%	8.0	23.0	69.0	100.0
Feedback on assignments is timely	n	23	64	140	227
	%	9.6	26.7	58.3	94.6
Availability of learning services such as electronic library services, technical support	n	45	50	128	223
	%	20.2	22.4	57.3	100.0

4.5 Influence of Perceived Ease of Use towards E-Learning Adoption

Majority agreed to a great extent that they possessed an email address which they used in the learning context (49.8%),that they had high expertise in using computers for learning (46.2%),that they possessed expertise in general web surfing (43.9%), that they had high expertise in using Internet for learning(61.1%),that the learning process at the e-learning platform was clear and structured (50.5%), that they believed convenience was an important feature of e-learning (62.5%), that they used appropriate technology for e-learning (60.5 %), that the university provides timely and adequately data bundles for use (47.9 %), that the language of delivery of e-learning is easy to understand (61.5%), that online instructions by lecturer's was easy to understand (51.0 %), that the online discussion forums eased their interactions with lecturers and classmates (50.2%) and that they were able to navigate the LMS (learning management system) with ease and do their tasks (45.1%).

The findings reveal that the majority of the students are well versed with the e-learning method. Thus the findings are in agreement with those of Almarabeh [37] who found that the students were well acquainted with the e-learning system. Similar sentiments are shared by Adewole-Odeshi [38] who revealed that students perceived the system as being easy to use. Parker [33] alluded that learners who were comfortable in using technology and had a positive attitude towards it were more likely to be successful within an e-learning environment. Findings are consistent with those of Al- Adwan, Al- Adwan and Smedley [32] and Davis [30] who indicated that perceived ease of use significantly influenced attitudes towards using E-learning. According to Selim [17], users who had the skills for using mobile devices and computers and were familiar with web technology developed positive attitudes. On the contrary (Felton, [48], Pelgrum, [49] and Ola-toye [50], posited that computer experience did not reduce computer anxiety or aid in enhancing a positive attitude. Lee, Hsiao and Ho [51] asserted that using ICT tools could enhance students' understanding of the instructional materials.

Table 3 : Descriptive results for statements on perceived ease of use

Statements on perceived ease of use		**Not at all**	**Small Extent**	**Great extent**	**Total**
I possess an email address and I use it in the learning context	n	46	66	111	223
	%	20.6	29.6	49.8	100.0
I have a high expertise in using computers for learning.	n	50	70	103	223
	%	22.4	31.4	46.2	100.0
I possess expertise in general web surfing	n	57	67	97	221
	%	25.8	30.3	43.9	100.0
I have a high expertise in using the Internet for learning.	n	33	53	135	221
	%	14.9	24.0	61.1	100.0
The learning process at the e-learning platform is clear and structured	n	34	76	102	222
	%	15.3	34.2	50.5	100.0
I believe that convenience is an important feature of e-learning	n	23	61	140	224
	%	10.3	27.2	62.5	100.0

Statements on perceived ease of use		Not at all	Small Extent	Great extent	Total
I use appropriate technology for e-learning	n	30	57	133	220
	%	13.6	25.9	60.5	100.0
The university provides timely and adequate data bundles for use	n	55	60	106	221
	%	24.9	27.1	47.9	100.0
The language of delivery of e-learning is easy to understand	n	22	63	136	221
	%	10.0	28.5	61.5	100.0
Online instructions by lecturer's is easy to understand	n	39	70	113	222
	%	17.6	31.5	51.0	100.0
The online discussion forums ease my interactions with lecturers and classmates	n	34	76	111	221
	%	15.4	34.4	50.2	100.0
I am able to navigate the LMS (learning management system) with ease and do my task	n	46	76	100	222
	%	20.7	34.2	45.1	100.0

The students were asked what they would recommend to enable them to have a positive attitude towards e learning. They suggested that the university should provide them with e-learning bundles, that the timetable be strictly adhered to by the lecturers, that the student email be activated and that to avoid disturbance during e learning classes, the lecturers should keep on reminding students to mute their microphones unless they want to comment or raise questions. Some students mentioned that they would work on improving their self-confidence and also focus their attention on learning more about the e-learning system. Some indicated that lecturers should be audible throughout the lessons, the link to join online classes should be sent early, e learning should be accompanied by handouts on topics covered/study materials, students should be able to be let in on time for the classes, more data bundles be issued for them to be able to access more study materials and that feedback on assignments should be timely.

Further the students were asked to comment on why or why not they felt the course was well organized. Some students mentioned that it was well organized since they had good lecturers, the learning activities went on smoothly, lessons were well organized and that the e-learning system was user friendly. The course was completed in time giving them adequate time to prepare for exams, lecturers were well prepared and the course content was well delivered, lecturers arranged their work systematically and it was easy to follow throughout the lesson, the lecturers were audible, study materials were availed, lecturers explained course content with clarity and provided suitable examples, topic and subtopics were structured well. Rohleder, Bozalek, Carolissen, Leibowitz and Swartz [52] posited that e-learning was friendly, provided good communication and was useful in accessing information and materials.

While other students were of the opinion that the course was not well organized since there were interferences during lessons by some students who did not mute their microphones and also due to network fluctuations, some lecturers changed class timings at the last minute, for quantitative courses e learning was complicated as it involves calculations, some lecturers gave students a short notice of class hence some missed the lessons or joined late and some students either failed to attend or attended classes late due to lack of data bundles or when there was a delay in getting the bundles on time. A few students mentioned that the lecturers were not audible enough. Some students missed classes since the platform being used had reached its maximum capacity hence they could not be let in and others indicated that some things being displayed on the screen by the lecturer were not clear.

4.6 Challenges towards E-Learning Adoption

The challenges facing institutions of higher learning are leading most of them to establish and implement strategies towards e-learning adoption. Many studies have established that most higher education institutions in developing countries had already established e-learning systems pre-COVID-19 pandemic period. They have not been successful because of some challenges [53, 22]. .This current study investigated and identified the important factors that impede the acceptance of e-learning in higher educational institutions, at Masinde Muliro University and Science and Technology. Understanding of these challenges would hopefully provide a basis for university stakeholders to allocate the funds adequately to areas of shortages identified.

Challenges for using e-learning were related to ICT infrastructure barrier, e-learning user interface being not user-friendly, slow internet, lack technical support, limited time, lack of awareness, lack of electricity, poor internet connectivity, lack of technical support, limitations faced by the course lecture and lack of human contact. Tarus, Gichoya and Muumbo [54] established that that the implementation challenges faced by universities in Kenya have had continued negative impact on its effective utilization e-learning resources.

Table 4: Descriptive results for statements on challenges towards E- learning

Statements on challenges towards E- learning		Not at all	Small Extent	Great extent	Total
Access to computers/laptops on campus and at home is limited	N	46	50	125	221
	%	20.81	22.62	56.56	100.00
Inadequately equipped computer laboratories	N	32	57	132	221
	%	14.48	25.79	59.72	100.00
Access to internet	N	25	58	141	224
	%	11.16	25.89	62.94	100.00
Lack of awareness to e-learning	N	43	62	115	220
	%	19.55	28.18	52.28	100.00
Slow internet connectivity	N	35	54	138	227
	%	15.42	23.79	60.08	100.00
Inadequate training on e-learning	N	38	58	128	224
	%	16.96	25.89	57.14	100.00
Lack of time	N	63	76	84	223
	%	28.25	34.08	37.67	100.00
Lack of electricity	N	51	62	111	224
	%	22.77	27.68	49.55	100.00
Lack of ICT skills by students	N	38	58	126	222
	%	17.12	26.13	56.75	100.00
Inadequate knowledge by the course lecturer in using e-learning resources	N	72	68	83	223
	%	32.29	30.49	37.23	100.00

Statements on challenges towards E- learning adoption		Not at all	Small Extent	Great extent	Total
technical problems using the LMS(learning management system)and any other virtual environment	N	34	58	131	223
	%	15.25	26.01	58.75	100.00
Inconsistent use of different platforms is confusing and less motivating	N	68	41	114	223
	%	30.49	18.39	51.13	100.00
Lack of human contact affects the learning mood	N	58	49	116	223
	%	26.01	21.97	52.03	100.00
Inadequate support by the technical team	N	56	52	111	219
	%	25.57	23.74	50.69	100.00

Universally, the influence of information and communication technologies (ICTs) has continually transformed the traditional framework in education and they have continued to provide significant tools to support educational processes [55]. Access to computers/laptops on campus and home was reported by 56.4% of the students to affect learning while there are students who had no limitations of access to computers nor laptops (20.8%). A study by Ruxwana,Msibi and Mahlangu [56], assessed the readiness status of South African universities to adopt bring your own device (BYOD) for education purposes, using a conceptualized BYOD readiness assessment framework. They found out that even though most higher education institutions in developed countries have adopted and implemented this strategy in order to support students' engagement and potentially enhance students' learning experience, the rate of BYOD adoption is slow. Barriers to its adoption include lack of comprehensive policies by institutions, lack of inclusive infrastructure readiness, and limited top management support.

Indeed computer labs would also play a vital role in bridging the gap to access to appropriate gadgets to facilitate e-learning. A well-equipped lab will go a long way towards supporting learners' ease of e-learning. Inadequately equipped laboratories is a challenge to a majority of the student (59.72%).In the same vein the study established that 62.94% of the learners had no access to internet. Only 1.6% of the students were not affected. In addition 60.8% of the students mentioned slow internet connectivity to be a major problem.

A majority of the students (51.85,%) cited lack of awareness to e-learning, in line with this finding, inadequate training on e-learning was also observed as a limitation (57.14%). According to Bubou and job [57] explored the role individual innovativeness along with e-learning self-efficacy play in predicting the e-learning readiness in an African context. They established that e-learning readiness enhances the ability of learners to persevere and complete their studies. Hence, to harness the full potential of e-learning as an educational strategy to increase broader access to tertiary education to augment classroom instruction and eventually intensify students' learning outcomes in distance learning institutions, the authors emphasized that it is imperative that we investigate the factors students perceive as significant in their adoption of electronic learning systems, as this helps in predicting the sustainability of e-learning programmes. The current study examined the knowledge by the course lecturer in using e-learning resources and this was not reported as limitation by a majority of the students(62.78%).Despite this finding further regular training is needed by members of faculty to improve on their content delivery.

Lack of time was not seen to be a limitation by a majority of the students(56.85%).This findings are consistent with [58,59],who established that to most learners, online instruction offers the flexibility and convenience to complete learning units when and where a learner desires, as the issues of location and time are no longer limitations to study.

49.55% of the students reported lack of electricity to be a limitation to e-learning, while 56.75 % mentioned that they lacked ICT skills. According to Sawyerr [60] higher education systems in Africa in the 1980s were complicated by the diversification of categories of student, types of institutions, and the kinds of knowledge demanded. Africa's universities were compelled to develop strategies for coping and innovation. The result has been a halt in the decline in many instances, and revival and growth in several others.

A majority of the students (58.75%) highlighted that technical problems using the LMS (learning management system) and any other virtual environment affected their attitude towards e-learning. Inconsistent use of different platforms is cited by students to be confusing and less motivating (51.13%). Jayasena and Song [61], conducted an interesting study on private cloud, e-learning system, that can be easily installed by using standard local computing resources, without the need of different hardware or external resources. The study framework solves the various challenges faced by e-learning, and increases the availability, reliability and scalability of cloud-based e-learning systems. This study demonstrated the framework of Virtual Private Network (VPN), private cloud integration and resource sharing in the university environment. The study further made us understand that the e-learning platform was also scalable and capable to interconnect other multi-platforms that were developed in different locations across the globe.

Lack of human contact affects the learning mood was equally reported to be limitation to e-learning by 52.03% of the students. Zhang et al. [59] reported that there is a feeling of neglect from the lack of immediate feedback in asynchronous e-learning which may result in higher attrition rates, as established by [62],that learner frustration, anxiety and confusion explains why learners drop out. In agreement with these authors Arkorful and Abaidoo [63] in their study reported that students may experience a sense of learner isolation or tendency to feel more disconnected than professors perceive. [64]. Inadequate support by the technical team was observed by a majority of the students (50.69%).

5.0 Conclusions and Recommendations

The paper investigated the determinants of student attitude towards adoption of e-learning at Masinde Muliro University of Science and Technology. It has emerged that perceived usefulness and perceived ease of use influence students' adoption of e-learning. Further the study highlighted certain challenges such as limited access to computers/laptops on campus and at home, Inadequately equipped computer laboratories, limited access to internet, lack of awareness on e-learning, slow internet connectivity, Inadequate training on e-learning, lack of time, lack of electricity, lack of ICT skills by students, Inadequate knowledge by the course lecturer in using e-learning resources, technical problems while using the LMS (learning management system) and any other virtual environment, Inconsistent use of different platforms is confusing and less motivating, lack of human contact which affected the learning mood and Inadequate support by the technical team.

Based on the findings the paper recommends that;

- Students should be enlightened on the usefulness of e-learning
- The university should engage the students more on e-learning by introducing a curricula making it compulsory to study e learning courses
- The university should make it compulsory for students to acquire laptops when joining the university
- The university should equip its computer labs adequately and invest in IT infrastructure to enhance smooth implementation of e-learning.
- There is need to provide appropriate training to students as well as lecturers on e-learning
- It is imperative for the technical team to provide assistance to the students at all times. Bentley, Parkin and Selassie, [65] also pointed out student support as an area requiring improvement.

6.0 Suggestions for Further Research

A similar study should be replicated on a larger sample. A comparative study on student attitude and e learning adoptions between public and private universities

should be done. A study should be conducted on other factors influencing e learning adoption such as organizational resources and lecturer attitude.

7.0 References

1. 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(1), 222-229. http://dx.doi.org/10.1016/j.compedu.2009.08.005
2. Park, K. A. (2012). E-*Learning System in STI, Statistics Korea*: Statistical Training Institute, Statistics Korea. Workshop on Human Resources Management and Training in Statistical Offices, United Nations Economic Commission for Europe, 05 - 07 September 2012. Retrieved 22nd March, 2020, http://www.unece.org/fileadmin/DAM/stats/documents/ece/ces/ge.54/2012/UNECE2012Korea.pdf
3. Rytkønen, M., & Rasmussen, P. (2010). *E-learning capacity at the East African STRAPA universities*. Copenhagen: University of Copenhagen / Faculty of Life Sciences (UC/LIFE), Denmark
4 Edelson, P.J., & Pittman, V.V. (2001). *E-Learning in the United States*: *New Directions and Opportunities for University Continuing Education*. State University of New York, Stony Brook. Retrieved 21st October, 2019, from http://www.stonybrook.edu/spd/dean_papers/newdelhi.pdf
5. Ravjee, N. (2007). The politics of e-learning in South African higher education. *International Journal of Education and Development using Information and Communication Technology*, (3)4:27-41.
6. Frimpon, M.F. (2012). A restructuring of the critical success factors for E-Learning Deployment. *American International Journal of Contemporary Research*, *2* (3), 115-127.
7. Abbad, M. M., Morris, D., & De Nahlik, C. (2009). Looking under the Bonnet: Factors Affecting Student Adoption of E-Learning Systems in Jordan. *The International Review of Research in Open and Distance Learning*
8. Decman, M. (2015). Modeling the acceptance of e-learning in mandatory environments of higher education: The influence of previous education and gender. *Computers in Human Behavior, 49, 272-281.*
9. Glenn, M. (2008). The future of higher education: How technology will shape learning. *A report from the Economist Intelligence Unit Sponsored by the New Media Consortium*. London: The Economist Intelligence Unit. Retrieved from https://library.educause.edu/resources/2008/10/the-future-of-higher-education-how-technology-will-shape-learning
10 Wagner, N., Hassanein, K. & Head, M. (2008). Who is responsible for E-learning in Higher Education? A Stakeholders' Analysis. *Educational Technology & Society*, 11 (3), 26-36.
11 Uhomoibhi, J. O. (2006). Implementing e-learning in Northern Ireland: prospects and challenges *Campus-Wide Information Systems*, *23* (1), 4-14.
12. Aiken, R. L. (2000). Psychological Testing and Assessment, (10th ed.). Boston: Allyn and Bacon.

13. Bertia, P. (2009). Measuring students' attitude towards e-learning; A case study. *Proceedings of the 5th standing conference on e-learning and software for development* held in Bucharest from 09-10 April 2009 Bucharist Romania 1-8
14. Grunwald, H. (2002). *Factors Affecting Faculty Adoption and Sustained Use of Instructional Technology in Traditional Classrooms*. Comprehensive Qualifying Exam, Center for the Study of Higher and Postsecondary Education, University of Michigan
15. Yang, Y. & Lin, N.C. (2010). Internet perceptions, online participation and language learning in Moodle forums: A case study on nursing students in Taiwan. *Procedia Social and Behavioral Sciences,* 2
16. Lim, B., Hong, K. S., & Tan, K.W. (2008). Acceptance of e-learning among distance learners: A Malaysian perspective. In *Hello! Where are you in the landscape of educational technology? Proceedings ascilite Melbourne 2008.* Retrieved March 4, 2021 from http://www.ascilite.org.au/conferences/melbourne08/procs/lim.pdf
17. Selim, H. M. (2007). Critical success factors for e-learning acceptance: Confirmatory factor models. *Computers and Education, 49*(2007) 396–413. Retrieved March 15, 2021, from http://www.qou.edu/arabic/researchProgram/eLearningResearchs/criticalSuccess.pdf
18. Ho, L.A. & Kuo, T.H. (2010). How can one amplify the effect of e-learning? An examination of high-tech employees‟ computer attitude and flow experience. *Computers in Human Behavior,* 26.
19. Tarus, J. (2011). Adoption of E-learning to Support Teaching and Learning in Moi University, MPhil Thesis (Information Technology), Moi University, Kenya.
20. MMUST (2019). Strategic Plan http://www.mmust.ac.ke/mmust/images/ALMANAC/MMUST%20Strategic%20Plan%20Final.pd Retrieved 24th February 2021.
21. Clarke, A. (2008). *E-learning skills*. 2nd Ed. England: Palgrave Macmillan.
22 Mutisya, D. N. & Makokha, G. L. (2016). Challenges affecting adoption of e-learning in public universities in Kenya. E-Learning and Digital Media 2016, Vol. 13(3–4) 140–157
23, Odero, J. A. (2020). Online Learning in Kenyan Public Universities: Effectiveness and Challenges. E proceedings for *INSPIRE X*XV International conference on e-Learning as a Solution during Unprecedented Times in the 21st Century. July 2020. pp 215-230 London.
24. Omidinia, S., Masrom, M., & Selamat, H. (2011). Review of e-learning and ICT infrastructure in develop-ing countries (Case study of Iran). *American Journal of Economics and Business Administration*, *3*(1), 120-125. Retrieved 20th December, 2020 from http://thescipub.com/pdf/10.3844/ajebasp.2011.120.125
25 Buabeng-Andoh, C., & Totimeh, F. (2012). Teachers' innovative use of computer technologies in classroom: A case of selected Ghanaian schools. *International Journal of Education and Development using Information and Communication Technology, 8*(3), 22-34

26. Fu, J. S. (2013). ICT in Education: A Critical Literature Review and Its Implications. *International Journal of Education and Development using Information and Communication Technology, 9*(1), 112-125.
27. Jung, I. (2005). ICT-Pedagogy Integration in Teacher Training: Application Cases Worldwide. *Journal of Educational Technology & Society, 8*(2).
28. Mirzajani, H., Mahmud, R., Fauzi Mohd Ayub, A., & Wong, S. L. (2016). Teachers' acceptance of ICT and its integration in the classroom. *Quality Assurance in Education, 24*(1), 26-40. https://doi.org/10.1108/QAE-06-2014-0025
29. Liaw, S-S., Huang, H-M., & Chen, G-D. (2007). Surveying instructor and learner attitudes toward e-learning. *Computers and Education, 49,* 1066–1080
30. Davis,F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *Management Information Systems Quarterly*, 13(3), pp318---339.
31. Park, S. (2009). "An Analysis of the Technology Acceptance Model in Understanding University Students' Behavioural Intention to Use e-Learning". *Education Technology & Society*, 12(3), pp.150-162.
32. Al- Adwan, A., Al- Adwan, A., & Smedley, J. (2013). Exploring student's acceptance of e-learning using Technology Acceptance Model in Jordanian universities. *International Journal of Education and Development using Information and Communication Technology, 9*(2), 4-18.
33. Parker, M. (2003). Technology-enhanced e-Learning: Perceptions of First Year Information Systems Students at the Cape Technicon. *Proceedings of SAICSIT 2003*, 316-319.
34. Andersson, A. (2008). Seven major challenges for e-learning in developing countries: Case study eBIT, Sri Lanka. *International Journal of Education and Development using Information and Communication Technology*, *4* (3), 45-62.
35. Masrom,M. (2007).Technology Acceptance model and E-learning. *Proceedings on the 12th standing conference on Education, Sultan Hassanal Bolkiah institute of education held in university Brunei Darussalem from 21-24 May, 2007, pp 1-10*
36. Qteishat,,M., Alshibly, H., Alqatawna, J. & Al-Ma'aitah, M. (2013). Factors Influencing the Adoption of E-Learning in Jordan: an Extended TAM Model European Journal of Business and Management Vol.5, No.18, 2013 pp84-100 www.iiste.org
37. Almarabeh,T .(2014). Students' Perceptions of E Learning at the University of Jordan. iJET – Volume 9, Issue 3, 2014 pp31-35 http://dx.doi.org/10.3991/ijet.v9i3.3347
38. Adewole-Odeshi, E. (2014). "Attitude of Students Towards E-learning in South-West Nigerian Universities: An Application of Technology Acceptance Model". Library Philosophy and Practice (e-journal). 1035.https://digitalcommons.unl.edu/libphilprac/1035
39. Pilli,O., Fanaeian,y., and Al-Momani,M.M. 2014 Investigating the Students' Attitude Toward the use of E-Learning in Girne American University *International Journal of Business and Social Science Vol. 5, No. 5; PP169-175*
40. Yin, R.K. (1984). Case Study Research: Design and Methods; Sage: London, UK.

41. Etikan, I., Musa, S.A., Alkassim, & R.S. (2016) Comparison of convenience sampling and purposive sampling. Am. J.Theor. Appl. Stat., 5, 1–4.
42. Kothari, C. R., (2011). Research Methodology; Methods and Techniques. New Delhi: New Age International Publishers.
43. Buabeng-Andoh, C., & Yidana, I. (2014). An investigation of secondary school students' attitudes toward pedagogical use of ICT in learning in Ghana. *Interactive Technology and Smart Education, 11*(4), 302-314. https://doi.org/10.1108/ITSE-10-2013-0024
44. Earle, R. S. (2002). The Integration of Instructional Technology into Public Education: Promises and Challenges. *Educational Technology & Society, 42*(1), 5-13.
45. Unwin, T. (2008). Survey of e-Learning in Africa. Based on a Questionnaire Survey of People on the e-Learning Africa Database in 2007.
46. Meissonier, R., Houzé, E., Benbya, H., & Belbaly, N. (2006). Performance factors of a "full distance learning": the case of undergraduate students in academic exchange. *Communications Of The Association For Information Systems*, *18*2-33.
47. Khirwadkar, A., Hewit, J., & Chaudhari, P. (2013). Exploring pepper to introduce e-learning for pre-service teacher education programme at the m. S. University of baroda. *Indian Streams Research Journal*, *3*(2), 1-15.
48. Felton, F. S. (2006). *The use of computers by primary school principals*. PhD Thesis, Virginia Polytechnic Institute and State University, Blacksburg, Virginia. Retrieved March 10, 2021 from http://scholar.lib.vt.edu/theses/available/etd-04242006 144854/unrestricted/FFelton04202006.pdf
49. Pelgrum, W. J. (1993). Attitudes of school principals and teachers towards computers: Does it matter what they think? Studies in Educational Evaluation, 19(2), 199-212
50. Olatoye, R. A. (2009). Influence of computer anxiety and knowledge on computer utilization of senior sec-ondary school students. *Electronic Journal of Research in Education Psychology, 7*(3), 1269-1288. Re-trieved August 1, 2020 from http://www.investigacion-psicopedagogica.com/revista/articulos/19/english/Art_19_360.pdf
51. Lee, Y., Hsiao, C., & Ho, C. H. (2014). The effects of various multimedia instructional materials on students' learning responses and outcomes: A comparative experimental study. *Computers in Human Behavior, 40*, 119-132. https://doi.org/10.1016/j.chb.2014.07.04
52. Rohleder, P., Bozalek, V., Carolissen, R., Leibowitz, B., & Swartz, L. (2008). Students' evaluations of the use of elearning in a collaborative project between two South African universities. *Higher Education*, *56*(1), 95-107. doi:10.1007/s10734-007-9091-3
53 Al-Azawei, A., Parslow, P., & Lundqvist, K. (2016). Barriers and opportunities of e-learning implementation in Iraq: A case of public universities. *The International Review of Research in Open and Distributed Learning*, *17*(5).
54. Tarus, J. K., Gichoya, D., & Muumbo, A. (2015). Challenges of implementing e-learning in Kenya: A caseof Kenyan public universities. *The International Review of Research in Open and DistributedLearning*,16(1).

55. Seliaman, M., & M. Al-Turki. (2012). “Mobile Learning Adoption in Saudi Arabia.” International Journal of Computer, Electronical, Automation, Control and Information Engineering 6 (9): 1129–31.
56. Ruxwana,N,Msibi,M & Mahlangu,T. (2018). Bring Your Own Device Adoption Readiness in a South African University South African Review of Sociology 49(3):78-95 DOI:10.1080/21528586.2019.1580218
57. Bubou, G.M. & Job, G.C. (2020), "Individual innovativeness, self-efficacy and e-learning readiness of students of Yenagoa study centre, National Open University of Nigeria", *Journal of Research in Innovative Teaching & Learning.*
58. Yoo, S. J., Huang, W.-H., & Lee, D. Y. (2012). The impact of employee’s perception of organizational climate on their technology acceptance toward e-learning in South Korea. Knowledge Management & E-Learning: An International Journal, 4(3), 359–378.
59. Zhang, D., Zhao, J. L., Zhou, L., & Nunamaker, J. (2004). Can e-learning replace traditional classroom learning—Evidence and implication of the evolving e-learning technology. Communications of the ACM, 47(5), 75–79.
60. Sawyerr, A. (2004). Challenges Facing African Universities: Selected Issues. *African Studies Review, 47*(1), 1-59. Retrieved May 1, 2021, from http://eresources.mku.ac.ke:2055/stable/1514797
61. Jayasena K., Song H. (2017) Private Cloud with e-Learning for Resources Sharing in University Environment. In: Vincenti G., Bucciero A., Helfert M., Glowatz M. (eds) E-Learning, E-Education, and Online Training. Lecture Notes of the Institute for Computer Sciences, Social Informatics and Telecommunications Engineering, vol 180. Springer, Cham. https://doi.org/10.1007/978-3-319-49625-2_21
62. Frankola, K. (2001). Why online learners drop out. Workforce, 10, 52–60.
63. Arkorful, V., & Abaidoo, N. (2015). The Role of E-learning, Advantages, and Disadvantages of its Adoption in Higher Education. International Journal of Instructional Technology and Distance Learning, 12(1), 29-42
64. Otter, R. R., Seipel, S., Graeff, T., Alexander, B., Boraiko, C., Gray, J.,Sadler, K. (2013). Comparing student and faculty perceptions of online and traditional courses. The Internet and Higher Education, 19, 27–35.
65. Bentley, Y., Parkin, E., & Selassie, H. (2012). Evaluation of an International Postgraduate eLearning Programme. *Proceedings of the International Conference on Information Management & Evaluation*, 27-36.

Inequality in e-Learning in Kenya: Looking Beyond the COVID-19 Pandemic

Linda Odhiambo Hooper[1] Caroline Akinyi Odhiambo[2], James Uhomoibhi[3]

[1]University of Ulster: School of Applied and Policy Sciences,
University of Ulster
Hooper-L@ulster.ac.uk

[2]Kapkoi Girls Secondary School: Headmistress
panache68@yahoo.co.uk

[3]Artificial Intelligence Research Centre,
Faculty of Computing,
Engineering & the Built Environment,
Ulster University, BT37 0QB, Northern Ireland, UK
j.uhomoibhi@ulster.ac.uk

Abstract

COVID-19 has had a massive impact on education in Kenya, particularly in low-income rural and urban areas where schools typically experience more significant disadvantages due to poverty and inequality. This paper bases its analysis on a case study of eLearning in a rural Kenyan secondary school. Over 40% of Kenyans live in absolute poverty. The pandemic's impact means a sizeable portion of the population now risks re-entry into poverty. Most of those living in these areas rely on informal means for their livelihood without recourse to any form of social security.

Despite Kenya's development plans strongly converging on education and ICT integration, successes in both areas are small, sporadic, and lacking in equity. Students, teachers, and administrators feel this impact strongly in the education sector in low-income areas with little or no online resources and adequate systems in place for use.

This study outlines the case of Kapkoi Girls delving into the education policy direction and the links between ICTs development and eLearning. Using SDGs 4 as a framework, the authors analyse motivations, outline direction, and conclude with suggested areas for future research. The paper utilises secondary data to critically evaluate state policies and actions before and during the 2020 academic year. Finally, it maps the continuing challenges; lessons learned and concludes by suggesting possible solutions and areas for future study.

Keywords: eLearning, Inequality, COVID-19, education policy

1.0 Introduction

In Kenya, the impacts of COVID-19 on education requires an emergency move to online learning, which is challenging [1, 2, 3, 4]. This paper claims that this is mainly due to a lack of ICT infrastructure, technical expertise, and psychological preparedness. It will use a case study to highlight these factors.

Information and Communication Technology (ICT) refers to the electronic means of capturing, processing, disseminating, and storing information [5]. The critical role ICT plays in well-being and development is documented by several authors [6,7, 8, 9]. It is, therefore, imperative that ICT development is in line with a country's socio-economic development [10].

Due to the underlying unpreparedness and lack of development in ICTs, school closures conducted globally to control the spread of the virus and mitigate the pandemic's impact has impacted and will continue impacting learning continuity in Kenya [1,11,12]. In addition, COVID-19's anticipated consequence global economic impact that will massively affect people's livelihoods in low- and middle-income countries [13,14,15,16]. The COVID-19 impact will reveal pre-existing inequalities, including income, digital, and gender inequalities, to impact developing countries and low-income sectors more [17,18,19,20].

As was the case globally, school closures in Kenya were necessary to stop the spread of the virus, which meant the move to online learning [21]. However, poverty levels and lack of preparedness in Kenya resulted in school closures leading to loss of learning increased dropout rates, and to even higher inequality [15]. Even before the pandemic, the world was in a learning crisis, with children and youth out of school and experiencing low schooling quality [15]. Inequality exacerbates these concerns further; the most disadvantaged have the worst access to schooling, highest dropout rates, and most significant learning deficits meaning a world that is off-track to meet SDG4 [15] [22].

This study begins with a detailed profile of the case of Kapkoi Girls by outlining the current situation regarding COVID-19 and eLearning. Then, to fully understand the limitations of Kapkoi Girls' capacity to integrate eLearning, an overview of the countries socio-economic status sets out a basis for the impact that school closures are having and will have on education attainment. It then delves into the education policy direction and investment in ICT infrastructure, technical expertise, and psychological preparedness as critical factors at the core of ICTs development and eLearning. Finally, using SDGs as a framework, the authors analyse global and local policy direction, resources, motivations, outline direction, and conclude with suggested areas for future research.

2.0 Case Study: Kapkoi Girls

Kapkoi Central Girls is a public all-girls district secondary school situated in rural western Kenya. Operating as both a day and boarding school, its students mainly come from low-income backgrounds. Often, they lack basic needs and are hardly able to afford two meals a day. Characterised by such disadvantages and nestled in a farming area, some students are forced to work as casual farm labourers to add to their families' income even during term time.

Before the pandemic and nationwide lockdowns, pedagogically, traditional methods were being used to teach, including lectures, demonstrations, explanations, etc. The school possesses only one computer for the whole of the 350+ students. Also, all the teachers have limited interaction with ICT. ICT integration is, therefore, at best minimal but mostly non-existent. One teacher uses the camera projection for maths and chemistry demonstrations to display experiments onto whiteboards installed in all the classrooms, reducing overcrowding around the demonstrations. These whiteboards are a novelty among schools, and the students find these sessions both exciting and stimulating. These experiences are, however, rare as not all teachers possess computer literacy. Other subject teachers mostly neither have the capacity nor are interested in the utilisation of eLearning. The most important use for the computer is for the analysis of exam results.

There is hardly any e-Learning taking place during the lockdown, a common situation with most schools in the district experience. In Kapkoi Girls school, the earlier weeks had one of the teachers teach maths and business studies through eLearning. This quickly revealed limitations as only two students responded as most learners were unable to access smartphones. For the few with access to smartphones, data bundles are expensive and therefore prohibitive. Additionally, most homes also lack access to electricity, which renders other media like radio and television also inaccessible.

Due to exams playing a pivotal role in the annual school calendar, the educational material offered for eLearning is limited to basic revision material that required further simplicity to be delivered through WhatsApp as this was necessary for the pending exams. After insisting that exams would proceed as scheduled in the first weeks of the lockdown, the government made an about-turn, perhaps realising the impossibility of a countrywide engagement with eLearning. The U-turn from the government to scrap exams considering the obstacles accessing online learning meant that any motivation to teach and learn all but died.

Delayed entry into schooling for children means that most learners start school older than the typical six years or below. Some start school as late as when they are ten years old. By the time they reach high school, they are in their twenties. This fact is relevant as it explains the lack of interest in education and, therefore, also in eLearning. For there to be an understanding of the underlying issues that hinder ICT

integration, the following section outlines the prevailing socio-economic conditions, and the impact COVID-19 has on ICT integration and on eLearning.

3.0 Socio-Economic Underpinnings

Economic shock though not ideal, remains an anticipated consequence of the pandemic [16]. Before the pandemic, poverty and inequality were contentious areas contributing to disadvantage and marginalisation [23, 24, 25, 26]. The IMF predicts a more significant drop in the global economy than that of the 2008/9 financial crisis, with impacts expected to reverberate from the government to the homes [15]. A large and growing population engaged in informal means of livelihoods as poverty and inequality continue to grow [27, 28, 29, 14]. The proportion of those engaged in informal livelihoods is as high as 70% of the population in Kenya [14].

The mixed economy of welfare leaves pockets of marginalisation without welfare, necessitating informal livelihoods [14]. In a country already struggling with a high level of poverty, COVID-19 will lower living standards; in some cases, the projected figures of loss of income are over 80% [15]. Characteristics of informal livelihoods include poverty, low productivity, and the absence of social protection, low income, poor housing, and lack of access to governance structures or social security [14]. Informality has implications for eLearning as the well-being of those engaged for their livelihoods disadvantage generally experienced hinder their capacities to invest in ICT infrastructure, technical expertise, and psychological preparedness [19].

However, the socio-economic impact will reveal uneven distribution as Kenya is also a highly unequal country [30]. Inequality reflects in various ways, including differences in income levels [31, 32], location-based inequalities [33, 34, 35], gender-based inequalities [36, 37, 38, 39], and relevant to this study is the digital divide particularly the gender digital divide [40, 41, 42, 43]. The digital divide refers to the gap between the digitally literate and the exposed or illiterate [44]. Several scholars have contributed to studies on the digital divide [40] [45] [43] mainly citing the importance of closing the gap in the interest of optimising the effectiveness of national innovation systems [46].

Despite the government's effort to integrate eLearning, prevailing inequalities plague the process. For example, having shown limitations, free primary education has led to the proliferation of private schools that offer better services, including access to eLearning but at a cost. eLearning is not absent countrywide; it is inaccessible to public schools reflecting prevailing inequalities and digital divides [33,34].

Gender inequality in education is also prevalent, which means poor girls' outcomes, especially those with low income or marginalised areas [15, 47]. Poor attendance, higher school dropout, likelihood, and expectation to provide labour culminating in poor academic outcomes, dropping out, or early marriage. School dropouts are likely to increase significantly among the most disadvantaged with a gender bias towards girls. These also manifest in child labour and early marriage for children and youth

[48, 49]. For example, the unfortunate reports of many schoolgirl pregnancies during the lockdown concerns global to national and community levels [49]. Deprivation manifests in a lack of access to menstruation materials, sexual and mental health support [15]. Getting a handle on poverty is problematic, especially as most low-income areas engage in various forms of informal livelihoods for their well-being.

Schools offer education but are also responsible for student welfare and security [11]. School closures mean removing this level of security, exposing many school-going students to various forms of vulnerability [34, 49] such as homelessness, food insecurity, lack of healthcare and welfare services for persons with disabilities [11]. Boarding schools are popular among Kenyans. All aspects of student well-being are the responsibility of the school, from food, healthcare, and overall safety [34] [49]. The economic pressures render households unlikely to value education cost books, private lessons, and eLearning [19].

The following section is an overview of education policy illustrating a disconnect where policy that broadly encompasses ICT integration does not translate in practice.

4.0 Education Policy and ICT

The Kenyan government recognises the importance of ICT in development and the role education plays in realising that goal [15, 50]. The plan to make Kenya a middle-level economy is to invest in ICTs, countrywide infrastructure, and school integration [50]. Free primary education introduced in 2003 was to fulfil the Education For All (EFA), the then global agenda [51, 52]. EFA resulted in large enrolments, as had happened in previous moves since post-colonial times [53]. However, the available structures could not sustain the large enrolments resulting in overcrowding, lower education quality, and waning teacher motivation [53]. The enrolment versus quality situation issues has remained unresolved, resulting in private schools' growth [53]. The ministry of education in 2006 developed its sector policy on ICTs in education, aiming to make "ICTs a universal education and training tool." The realisation of the plan was through the facilitation of ICT in schools, colleges, universities, and other educational institutions [54, 55]. The strategies target education institutions, teachers, learners, and communities and ensure their equipment of appropriate ICT infrastructure and skills for use [55, 54]. The realisation of these plans faces a range of challenges, including lack of resources, and the lack of modernisation of teaching pedagogies and psychological barriers [5].

Lack of resources in institutions, lack of administrative support, and an overall negative attitude towards ICT integration among teachers and school administration trickled down to students' perspectives. Sections of the country, especially the high-income urban areas benefit from better ICT infrastructure, but rural areas suffer a lack of infrastructure and more severe levels of poverty and deprivation [4]. The lack of resources is evident, especially prior to the elections, the current president promised all primary school children would possess a laptop. This promise was never delivered [4].

The modernisation of teaching pedagogies is necessary to enable ICTs as transformational for teaching and learning. Teacher training in ICTs increases their confidence, motivation, and commitment [5]. However, studies of ICT teaching in Kenya first cite the lack of ICT training or requirement in teacher training institutions [54]. The lack of training limits the capacities of teachers to learn how to use technologies in lessons planning and delivery. They, therefore, were ill-prepared for the emergency move to online learning due to the pandemic [54].

ICT in integration in education, therefore, remains low or non-existent. Therefore, a change of attitudes is evidently a requirement for all stakeholders, including educators, curriculum developers, administrators, and policymakers who must deal with attitudes and how best to deliver ICTs by Investment in ICT infrastructure, technical expertise, and psychological preparedness [56]. In addition, much more input is necessary to integrate ICTs globally to the household level [19].

SDGs offer a framework that can push for state-wide ICT integration bearing in mind a country prevailing socio-economic condition. The following sections explore SDG4 – quality education as a goal and what this means for universal education and eLearning.

5.0 SDG4

Under the previous Millennium Development goals (MDGs), Education for all (EFA) – the Dakar Platform for Action. Education was considered a narrow focus on universal primary education [58]. SDGs go beyond this, whereby SDG4 mentions expanding education access at all levels and encompasses literacy and numeracy to include more comprehensive learning, including global citizenship, sustainability, and gender equality. The SDGs, as SDG4, offer a vision of quality education that is free, inclusive, and oriented towards reducing equalities – to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all [15] [58].

Education impacts other SDGs directly and is key to realising all the other SDGs [57]. For example, SDG3 good health and well-being, SDG5 gender equality and women's empowerment, and SDG8 decent work directly impact education SDG4 [59]. Quality and equality form the basis of targets for SDG4 linking access throughout the learning period, skill training, literacy and numeracy, and the content which must include knowledge and skills that promote sustainable development, gender equality, human rights, and promotion of cultures of peace and non-violence (Unterhalter, 2019).

6.0 Policies and Practice

The case of Kapkoi Girls School exhibits the disconnect between rhetoric and practice. This case harnesses the global nature of SDGs and pushes for countries' goals to align and to realise ICT and eLearning goals. Quality education that is

exclusive, equitable, and lifelong are SDG4 education targets [60]. For schools like Kapkoi Girls already experiencing socio-economic disadvantages and challenges stemming from poverty and lack of basic needs. These factors drive the student into late entry into school, the need to undertake paid manual labour during school time, and lack of access to ICT resources both at the household level and in this case at the institution level. Possessing a single computer for a whole school exhibits strongly the lack of policy preparedness to avail ICTs broadly.

The COVID-19 impact on the economy will result in even less government spending on education, reducing resources available to teachers and students. These cuts will negatively impact teaching quality. The learning loss and long gap in teaching also mean that teachers work harder to catch the student up with the national curriculum. The historical deficit in learning, together with the current pandemic-led low education attainment, will mean further learning poverty means that a whole generation fails to have the opportunity to realise their potential, have low lifetime productivity and earnings [15].

The target to eliminate gender disparities also manifests itself in that academic attainment is less valuable for girls. In addition, the older school entry age means that these already marginalised students are less likely to be attached to schooling, resulting in higher dropout rates. Overall, there are chances of an increase in criminal activity and risky behaviours among children and the youth.

The Kapkoi Girls case reflects the lack of technical expertise from household to institution level. The teachers do not possess ICT training, lack access to ICT resources as well as motivation. eLearning due to the pandemic meant learning from home with the help and supervision of parents and guardians. However, in the case of Kapkoi girls, the socio-economic arrangements mean they do not have the material resources and the technical guidance necessary to support this. Often, they do not even have access to electricity.

eLearning integration at the national level exhibits a lack of capacity and flexibility in changing the education model attributed to underlying resource and infrastructure-related disadvantages resulting in the absence of teacher training and student engagement. However, disadvantage and inequality are not registered broadly. For example, for the wealthier across the country, schooling proceeds seamlessly to online learning, setting the stage for further inequality. Remedying this situation must be prioritised. There is no more significant argument for prioritising education beyond education playing a critical and imperative role in achieving all the other SDGs goals, either directly or indirectly [57].

7.0 Conclusion

The continuing challenges to ICT integration and consequently eLearning are due to a lack of ICT infrastructure, technical expertise, and psychological preparedness.

The Kapkoi Girls case highlights COVID-19 impacts and the challenges on education in Kenya of the emergency move to online learning ICTs. Education plays a critical role in development.

These reflect in global ideas of development and country-level strategic plans, as is the case in Kenya. It is, therefore, imperative that ICT development is in line with a country's socio-economic development, but in the case of Kenya, ICT development is sporadic and unequally distributed. Furthermore, the lack of capacity for most schools to move to online learning is due to the pandemic and reflects not only resource scarcity but a lack of concrete plans for ICT integration.

School closures necessary to control the spread and mitigate the effects of the pandemic resulted in the loss of learning. For example, in Kenya, as reflected in Kapkoi Girls, due to the underlying unpreparedness in ICT coupled with poverty and disadvantage now heightened by the pandemic, both the institution and individuals cannot participate in online learning at any level. However, this impact will exhibit pre-existing inequalities, including income, digital, and gender inequalities, to impact developing countries and low-income sectors more.

The policies outlined both as national education strategies and those from SDG4 on education offer objective realisable goals within which possible solutions lie. Revisiting these offers the country a starting point that must move beyond metre rhetoric to application. Application of policy prescription as well as learning from other regions will form the basis for suture research.

The learning crisis and deficit recorded before the pandemic will exacerbate pre-existing inequalities. The most disadvantaged have the worst access to schooling, the highest dropout rates, and the most significant learning deficits meaning a world that is off-track to meet SDG4. Thus, the Kenyan education development goal fails to meet a country's educational needs, affecting human capital accumulation and overall development prospects.

Suggested areas of future study, the authors offer this case study as a starting point for more detailed analysis of ICT integration in Kenya especially in low-income areas. A larger analysis study or survey would offer more insights and areas for comparison. Additionally, interdisciplinary studies that consider all aspects of livelihoods such as human development approaches will highlight how best to realise outcomes that support education and eLearning more broadly by firstly ensuring sustainable livelihoods. SDGs offer a global platform for comparisons and learning therefore studies from other countries can illuminate policies across borders.

8.0 References

1. Kinyanjui, N. (2020) Kenya: How the COVID-19 Pandemic Will Affect Informal Workers. Insights From Kenya. The Conversation,

2. Mbogo, R.W. (2020) LEADERSHIP ROLES IN MANAGING EDUCATION IN CRISES: THE CASE OF KENYA DURING COVID-19 PANDEMIC. European Journal of Education Studies, 7 (9),
3. Donovan, L. and Zhu, A. (2020) Kenya's Labor Market Wasn't Made for a Pandemic. https://foreignpolicy.com, April 10,
4. Uwezo (2020) Are Our Children Learning? The Status of Remote-learning among
School-going Children in Kenya during the Covid-19 Crisis. Nairobi: Uwezo Kenya. Available from: https://docs.opendeved.net/lib/LRBK4LWS [Accessed 12.08.2020].
5. Tabira, Y. and Otieno, F.X. (2017) Integration and implementation of sustainable ICT-based education in developing countries: low-cost, en masse methodology in Kenya. Sustainability Science, 12 (2), 221-234.
6. Avgerou, C. and Walsham, G. (2017) Information Technology in Context: Studies from the Perspective of Developing Countries: Studies from the Perspective of Developing Countries. Routledge.
7. Heeks, R. and Ospina, A.V. (2018) Conceptualising the link between information systems and resilience: A developing country field study. Information Systems Journal,
8. Heeks, R. and Bhatnagar, S. (1999) Understanding success and failure in information age reform. Reinventing government in the information age: International practice in IT-enabled public sector reform, 1 49-74.
9. Boateng, R., Heeks, R., Molla, A. and Hinson, R. (2008) E-commerce and socio-economic development: conceptualizing the link. Internet Research, 18 (5), 562-594.
10. Heeks, R. (2010) Do information and communication technologies (ICTs) contribute to development? Journal of International Development, 22 (5), 625-640.
11. Parsitau, S. and Jepkemei, E. (2020) How school closures during COVID-19 further marginalizeVulnerabel children in Kenya
. Available from: https://www.brookings.edu/blog/education-plus-development/2020/05/06/how-school-closures-during-covid-19-further-marginalize-vulnerable-children-in-kenya/ [Accessed 20.07.2020].
12. McBurnie, C. and Haßler, B. (2020) Is there learning continuity during the COVID-19 pandemic? Six lessons. Is there learning continuity during the COVID-19 pandemic? Six lessons,
13. World Bank (2020c) Kenya Economic Update: COVID-19 Erodes Progress in Poverty Reduction in Kenya, Increases Number of Poor Citizens Available from: https://www.worldbank.org/en/country/kenya/publication/kenya-economic-update-covid-19-erodes-progress-in-poverty-reduction-in-kenya-increases-number-of-poor-citizens [Accessed 05/03/2021].
14. Schwettmann, J. (2020) Covid-19 and the informal economy. Impact and response strategies in,
15. World Bank (2020a) ASSESSING THE ECONOMIC IMPACT OF COVID-19 AND POLICY RESPONSES IN SUB-SAHARAN AFRICA.

16. Barua, S. (2020) Understanding Coronanomics: The economic implications of the coronavirus (COVID-19) pandemic. SSRN Electronic Journal https://doi org/10/ggq92n,
17. HRW.ORG (2020) Impact of Covid-19 On Children's Education in Africa
. HRW, , Aug 26,
18. World Bank (2020b) The COVID-19 pandemic: Shocks to education and policy responses.
19. Hooper, L.O. and Uhomoibhi, J. (2020) COVID-19: Impact on E-Learning, Capabilities for Development and Digital Citizenship in Emerging Economies. INSPIRE XXV, 239.
20. Beaunoyer, E., Dupéré, S. and Guitton, M.J. (2020) COVID-19 and digital inequalities: Reciprocal impacts and mitigation strategies. Computers in Human Behavior, 106424.
21. Ghallab, S., Hooper, L.O., Ross, M., Staples, G. and Uhomoibhi, J.Applying a Five Levels Framework of Lifelong Learning to e-Learning by the Wider Public. INSPIRE XXV, 203.
22. UN (2015) Sustainable Development Goals kick off with start of new year. Available from: https://www.un.org/sustainabledevelopment/blog/2015/12/sustainable-development-goals-kick-off-with-start-of-new-year/ [Accessed 29/07/2021].
23. Hulme, D. (2015) Global poverty: global governance and poor people in the post-2015 era. Routledge. Available from:
24. Beall, J. and Kanji, N. (1999) Households, livelihoods and urban poverty. University of Birmingham, International Development Department. Available from:
25. WORLD BANK (2001) World development report 2000/2001 : attacking poverty UN: UNDP. Available from: http://documents.worldbank.org/curated/en/230351468332946759/World-development-report-2000-2001-attacking-poverty [Accessed 15/06/2018].
26. Desai, M. (1992) Population and poverty in Africa. African Development Review = Revue Africaine De Developpement, 4 (2), 63-78.
27. Were, L.P. (2018) Informality and health: universal health coverage in the era of SDGs. The Lancet Global Health, 6 (1), e22-e23.
28. Arfvidsson, H., Simon, D., Oloko, M. and Moodley, N. (2017) Engaging with and measuring informality in the proposed Urban Sustainable Development Goal. African Geographical Review, 36 (1), 100-114.
29. Bosio, E. and Djankov, S. (2020) When economic informality is high, cash transfers may be the best Covid response. LSE Business Review,
30. Oxfam (2021) Kenya: extreme inequality in numbers. Available from: https://www.oxfam.org/en/kenya-extreme-inequality-numbers [Accessed 05/03/2020].
31. Berdiev, A.N., Goel, R.K. and Saunoris, J.W. (2020) The path from ethnic inequality to development: The intermediary role of institutional quality. World Development, 130 104925.
32. Aaberge, R. and Brandolini, A. (2015) Multidimensional poverty and inequality. In: Anon.Handbook of income distribution. Elsevier, 141-216.

33. Ricart-Huguet, J. (2020) Colonial Education, Political Elites, and Regional Political Inequality in Africa. Comparative Political Studies, 0010414021997176.
34. Berry, M.E., Bouka, Y. and Kamuru, M.M. (2020) Implementing Inclusion: Gender Quotas, Inequality, and Backlash in Kenya. Politics & Gender, 1-25.
35. Barford, A. (2020) Challenging inequality in Kenya, Mexico and the UK.
36. Muhibbu-Din, M.O. (2017) Gender Justice and Women Empowerment in Africa: A Critical Perspective of Post MDGs. Journal of Gender, Information & Development in Africa, 6 (1/2), 95-116.
37. Bank and Asante, E. (2002) Engendering Development: Through Gender Equality in Rights, Resources and Voice. Canadian Journal of Sociology, 27 (2), 291-294.
38. Unterhalter, E. (2005) Global Inequality, Capabilities, Social Justice: The Millennium Development Goal for Gender Equality in Education. International Journal of Educational Development, 25 (2), 111-122.
39. Razavi, S. (2016) The 2030 Agenda: challenges of implementation to attain gender equality and women's rights. Gender & Development, 24 (1), 25-41.
40. Antonio, A. and Tuffley, D. (2014) The gender digital divide in developing countries. Future Internet, 6 (4), 673-687.
41. Van Dijk, J.A. (2006) Digital divide research, achievements and shortcomings. Poetics, 34 (4-5), 221-235.
42. Okunola, O.M., Rowley, J. and Johnson, F. (2017) The multi-dimensional digital divide: Perspectives from an e-government portal in Nigeria. Government Information Quarterly, 34 (2), 329-339.
43. Hilbert, M., (2011) Digital gender divide or technologically empowered women in developing countries? A typical case of lies, damned lies, and statistics. In: Women's Studies International Forum. Elsevier, 479-489.
44. Brandtzæg, P.B., Heim, J. and Karahasanović, A. (2011) Understanding the new digital divide—A typology of Internet users in Europe. International journal of human-computer studies, 69 (3), 123-138.
45. Brännström, I. (2012) Gender and digital divide 2000–2008 in two low-income economies in Sub-Saharan Africa: Kenya and Somalia in official statistics. Government Information Quarterly, 29 (1), 60-67.
46. Wiseman, A.W. and Anderson, E. (2012) ICT-integrated education and national innovation systems in the Gulf Cooperation Council (GCC) countries. Computers & Education, 59 (2), 607-618.
47. Loembé, M.M., Tshangela, A., Salyer, S.J., Varma, J.K., Ouma, A.E.O. and Nkengasong, J.N. (2020) COVID-19 in Africa: the spread and response. Nature medicine, 26 (7), 999-1003.
48. Bewa, J.M. (2021) School closures and teenage pregnancy. Bull World Health Organ, 99 6-7.
49. Stevens, L.M., Rockey, J.C., Rockowitz, S.R., Kanja, W., Colloff, M.F. and Flowe, H.D. (2021) Children's vulnerability to sexual violence during COVID-19 in Kenya: recommendations for the future. Frontiers in Global Women's Health, 2 7.

50. Vision, 2. (2007) Vision 2030
. A globally competitive and prosperous Kenya: https://www.opendatagoke/download/jih3-amby/application/pdf,
51. Murnane, R.J., Sawhill, I. and Snow, C. (2012) Literacy Challenges for the Twenty-First Century: Introducing the Issue. The Future of Children, 22 (2), n/a.
52. Unterhalter, E. (1)&Brighouse, H. (2) (2007) Distribution of what for social justice in education? The case of education for all by 2015. Palgrave Macmillan.Available from: http://search.ebscohost.com/login.aspx?direct=true&db=edselc&AN=edselc.2-52.0-85014182376&site=eds-live
53. Oketch, M. and Ngware, M. (2010) Free primary education still excludes the poorest of the poor in urban Kenya. Development in Practice, 20 (4-5), 603-610.
54. Anyonyi, K.E. (2020) FACTORS LIMITING THE USE OF ICT IN TEACHING MATHEMATICS AT SECONDARY LEVEL IN NAIROBI COUNTY, KENYA. International Engineering Journal For Research & Development, 5 (ICIPPS), 12.
55. Orodho, J.A. (2014) Policies on free primary and secondary education in East Africa: Are Kenya and Tanzania on course to attain Education for All (EFA) Goals by 2015. International Organization of Scientific Research (IOSR) Journal of Humanities and Social Sciences (IOSR-JHSS), 19 (1), 11-20.
56. Uhomoibhi, J. and Hooper, L., (2019) Digital Learning Challenges and Innovations for Sustainable Education in Developing Countries: Issues of Policy and Practice. In: INSPIRE XXIV, Twenty-fourth International Conference on Software Process Improvement Research, Education and Training: Global Connectivity and Learning Across the Nations.
57. Unterhalter, E. (2019) The many meanings of quality education: Politics of targets and indicators in SDG 4. Global Policy, 10 39-51.
58. Fukuda-Parr, S. and McNeill, D. (2015) Post 2015: a new era of accountability? Journal of Global Ethics, 11 (1), 10-17.
59. UNESCO (2018) Rethinking education: towards a global common good? New York: UNESCO. Available from: https://unesdoc.unesco.org/ark:/48223/pf0000232555 [Accessed 5/03/2019].
60. United Nations (2015) GLOBAL SUSTAINABLE DEVELOPMENT REPORT. United Nations.

Teaching and Learning Strategies and Actions at the Armenian State Pedagogical University during Coronavirus

Rita Gevorgyan
Economics and Management division
Armenian State Pedagogical University after Kh. Abovyan (ASPU)
17 Tigran Mets Ave., Yerevan, 3750010 RA
gevorgyanrita32@aspu.am

Abstract

Digitalization has been a priority for education in Armenia, and since 2009 digital skills were integrated into teaching and learning activities at the Armenian Educational Institutions. In the following years, the government strategy was directed towards development of the online learning culture in the education field.

The Covid-19 crises immensely affected the quality of learning. Generally, further developments indicate that the influence of technology on the teaching process is apparent and that universities need to transfer their potentials to create an appropriate environment to use the online platforms.

This paper reports the findings of a survey that sought the opinions and feelings of the students and presents the strategies at ASPU used to address the crisis generated by the COVID-19 pandemic.

Keywords: quality of teaching and learning, students' opinions, COVID-19 crisis, soft skills, digital learning modes, strategy.

1.0 Introduction

The COVID-19 pandemic had a real psychological impact on both students and teachers. While some believe that the rapid move to online learning will result in a poor user experience, others believe that a new hybrid education model will emerge, with significant benefits [1].

There have already been successful transitions amongst many universities. However, there are universities where students are faced with challenges to participate in digital learning. For example, in Switzerland, Norway, and Austria, 95% of students have a computer to use for their schoolwork, while in Indonesia, only 34% have such opportunity [2].

Due to the Coronavirus-2019 pandemic extensive impact on the global higher education sector scholars questioned if higher education was ready for the forthcoming digital era of learning [3]. University staff and educators had to meet new online education challenges demonstrating pedagogical skills in an online classroom, addressing their managerial role, establishing relationships with students, and providing technical support [4].

Online learning can be effective if there are several conditions: trained specialists, lecturers, and technicians, appropriate logistical base, interactive methods in teaching, development of technological infrastructure, availability of quality digital libraries. Some control mechanisms are also needed to ensure a proper level of education.

When the lesson shifted from the physical to a technological mode, it did not mean that universities had online teaching and learning experience. We can state that Moodle, Google Classroom, Blackboard are learning management systems that help document, administer, track the learning process. Zoom, Skype, Viber, Microsoft Teams, Google Hangouts are communication tools. Teaching through Google Classroom with Google Meet tool when pedagogy is not integrated into online teaching means that universities simply convey the physical lesson to a student through technology.

Online education should ensure technological, pedagogic-educational, and socio-economic aspects. Universities should create a sustainable system that will gradually empower teachers and students with software, hardware, network, and pedagogical capacity to utilize those meaningfully. That system needs to be incorporated into every teacher's and student's common practice.

Many universities initially focused on transitioning of the content to an online environment, and not necessarily on online pedagogy [5]. Others faced with problems related to socially disadvantaged learners. Limited access to technology and internet impacted the students' ability to be engaged in an online environment [6].

In South Korea, Iran, and Italy the pandemic situation in the higher education sector brought changes which made them focus on their own operations [7]. Australian higher education has responded to COVID-19 with varied effectiveness. The majority of universities progressed to alternative forms of learning. Some had a temporary halt to learning to design online learning (e.g., Macquarie University, 2020; Monash University, 2020; Victoria University, 2020) and others made rapid progressions towards online learning without suspending offerings (e.g., Australian National University, 2020; University of Tasmania, 2020) [8].

With the transition to online system China turned attention to the quality of the learning experience [9]. Some issues occurred in implementing online learning by major state universities of Egypt, e.g., in Cairo University, related to the availability

of the right hardware and software, networks, and storage capacity. Other universities such as Alexandria University opted for live and recorded sessions [10].

During the COVID-19 crisis, Jordan universities were required to provide the Ministry of Higher Education and Research with the number of courses converted to online learning platforms [11]. University College Dublin (UCD), like many other higher educational institutions on the island of Ireland, implemented dedicated teaching continuity measures for academic staff and students [12]. Romania suspended classes at the beginning of March 2020 and started online teaching on specific educational platforms and implemented video conferencing tools. All above mentioned shifts together with the need for fast adaptation determined serious gaps and improvised teaching methods [13].

The Government of Armenia initiated several activities to ensure online courses and distance learning. Therefore, the Education, Science, Culture, and Sports Ministry (ESCS Ministry) of Armenia directed efforts to find various solutions to get through the situation.

After evaluation of the results of numerous studies, the Armenian State Pedagogical University (ASPU) administration decided to implement Google Classroom as an e-platform for learning and teaching, which was introduced to students and academic staff.

The Google Classroom learning platform of the ASPU was implemented in 2016. During those years, it has been updated to enhance the quality of teaching and learning, and to improve the technical aspects. New tools for online lectures and their recording have been integrated into the remote platform.

At ASPU, the Google Classroom platform is used not only to exchange the materials but also courses are created according to a certain structure. These include video lectures, special assignments, tests, surveys, projects, electronic participation books, various literature resources, and distribution materials, which allow the students to master the theoretical material and perform assignments gradually.

In this paper among internal and external stakeholders we covered only the student's opinion. In further research the teachers', employers', institutional finance providers' opinions will be analysed.

2.0 The Survey

2.1 Methodology of the Survey

Following the previous study that reported the strategy and actions taken by institutions and staff during the rapid transition from a traditional model of education to a fully online mode, this case study paper reports the findings of a survey that sought the opinions and feelings of the students [14].

The respondents are the students from the Educational Management Master's Degree Programme of ASPU. The programme was launched within the framework of the international project in 2014, aiming at preparation of management specialists in the education field. The annual planned number of full-time students approved by the ESCS Ministry of Armenia should not exceed 15 students.

The important data related to the survey:

- Data collection: February 23- March 9, 2021
- Respondents: students
- Sample size: 25 respondents from first and second-year students
- Data collection method: online questionnaire
- The mode of study: full time
- The duration of the course: 2 years
- The gender: female
- The age of students: 23-40 years old

2.2 Results of the Survey

The majority of respondents (64%) evaluated their technical skills at the start of pandemic as high (see Figure 1).

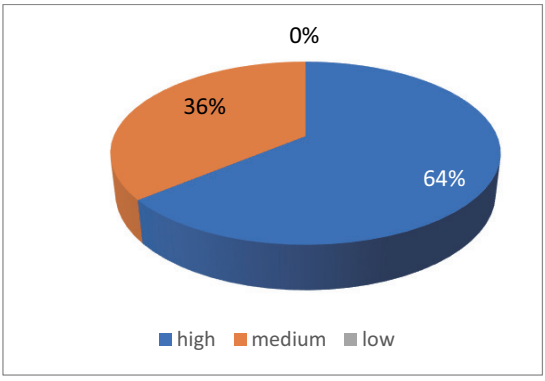


Figure 1: How would you evaluate your technical skills at the start of the pandemic?

About 84% mentioned the high-level experience related to online learning environment at the beginning of the pandemic (see Figure 2).

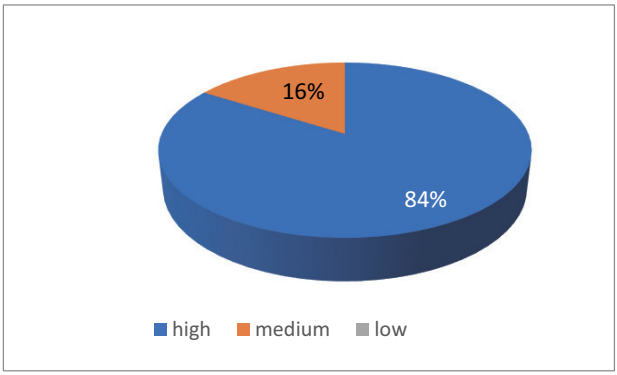


Figure 2: How would you evaluate your experience at the start of the pandemic in online learning environments

According to the survey results, all students stated that they had internet access at home when the pandemic broke out. Moreover, it was mentioned that they had access to any of the following equipment before the pandemic: Desktop, Laptop, Tablet, Smart mobile. Most of them upgraded their equipment, - 56 % themselves, 28% by the help of university (see Figure 3).

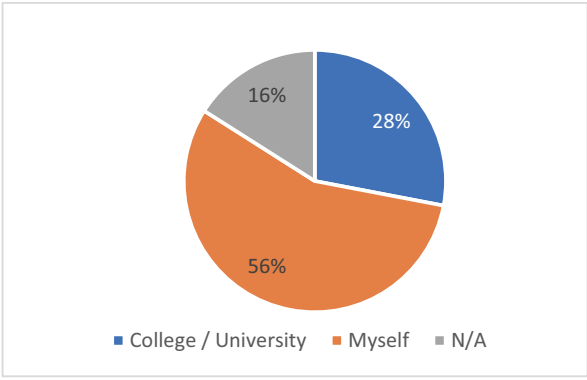


Figure 3: In case you acquired or upgraded any equipment, please tick below to show who provided the equipment

The average number of students sharing the equipment with their family members varied from 2-3 persons. The overwhelming majority of respondents (68%) said that they got monthly technical support from the university during the pandemic (see Figure 4).

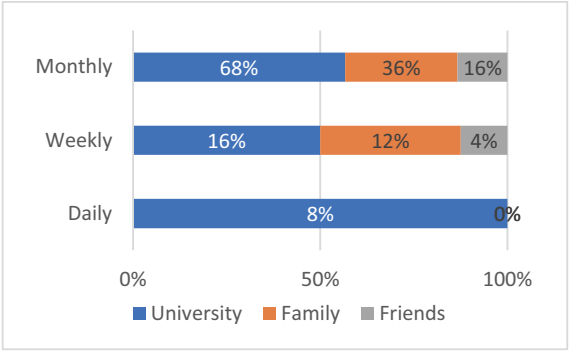


Figure 4: How frequently (Daily, Weekly, Monthly, Never) did you have technical support and by whom during the pandemic?

The below stated results indicate the most used platforms by students since the outbreak of the pandemic: Zoom, WhatsApp, Viber, and Skype - 96%, Google classroom - 100%, Webex- 40%, Moodle- 32%, Microsoft Teams - 24%, Adobe Connect - 4% (see Figure 5).

.

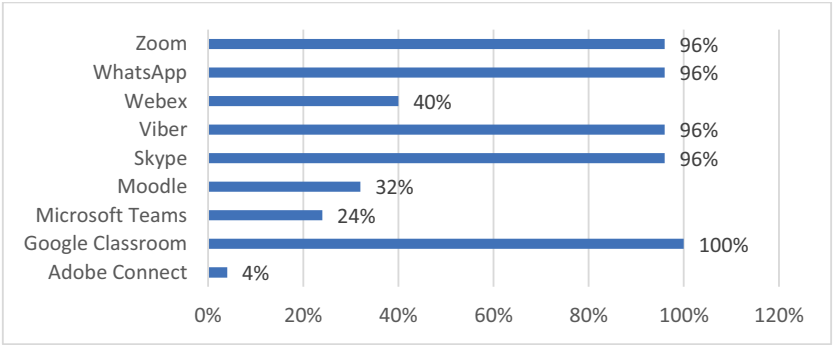


Figure 5: What learning and communication platform(s) have you been using?

Survey results indicate that during the pandemic Self-study was used by 60% of students mainly in weekly degree, 84% of students used Self prior study primarily in weekly degree, 48% of the students used recorded broadcast equally in weekly and daily degree and 88% of the students used live class learning methods primarily in daily degree (see Figure 6).

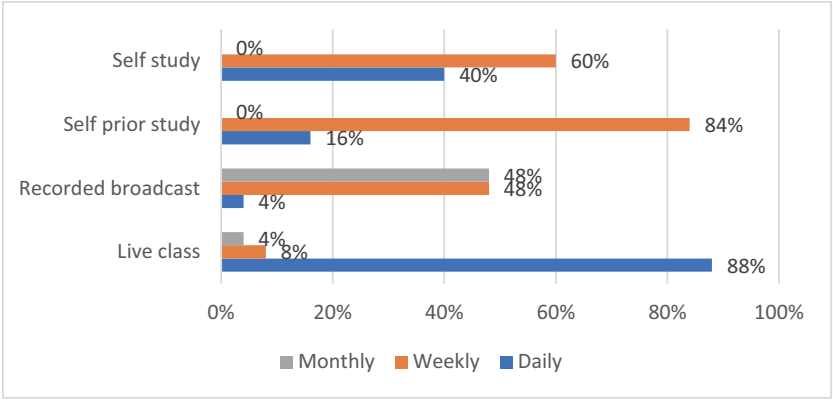


Figure 6: What learning methods, and to what degree, did you use during the pandemic?

As a result of the survey, 92% of students mentioned that they spent more time on learning during the lockdown than before it.
During the pandemic, 52% of students mentioned that the learning attitude to studies became very serious than before the pandemic (see Figure 7).

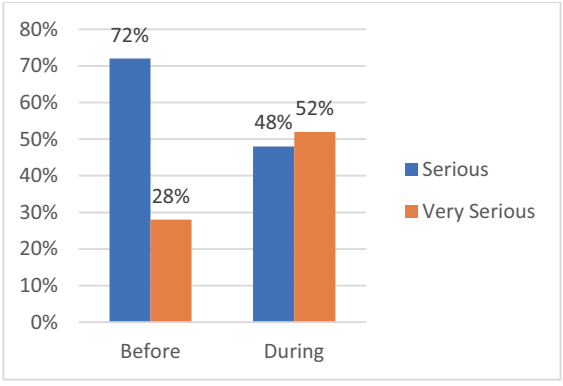


Figure 7: What do you think of your learning attitude to your studies before the pandemic? What do you think of your learning attitude to your studies during the pandemic?

Considering students' opinions, the practical subjects (72%) and internships (28%) more severely affected by the pandemic, and 100 % of the students mentioned that theoretical subjects were less affected by the pandemic (see Figure 8).

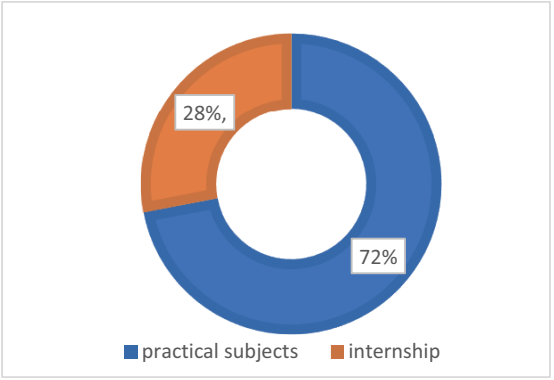


Figure 8: Which subject(s) was / were most severely affected by the pandemic?

Students are generally satisfied (good and very good) by their interaction with the lecturers before and during the lockdown(see Figure 9).

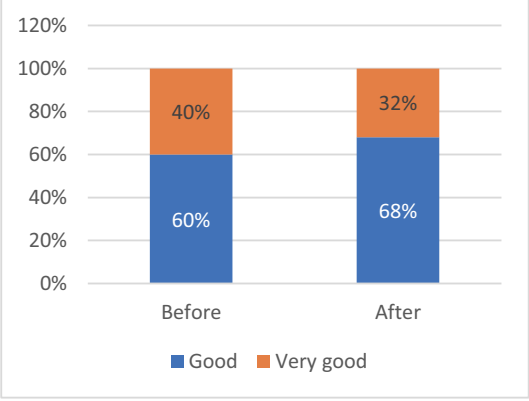


Figure 9: How would you describe your interaction with your lecturers before the lockdown?. How would you describe your interaction with your lecturers the lockdown?

All students mentioned that the University provided the appropriate guidance regarding the protection of private data, and 84% of respondents stated that participated in training about cybercrime during the migration to online learning.

Survey results indicated that 36% of students preferred to study online, 16 % face-to-face, and 48% in hybrid modes (see Figure 10).

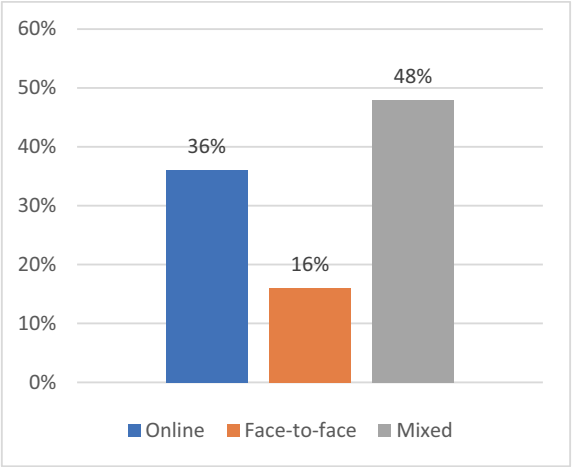


Figure 10: Having experienced online learning, do you prefer online, face-to-face or mixed mode?

According to the survey results, lectures were best delivered in live online, seminars (40%) in mixed mode, labs (72%) in the face-to-face mode, workshops (48%) in recording (see Figure 11).

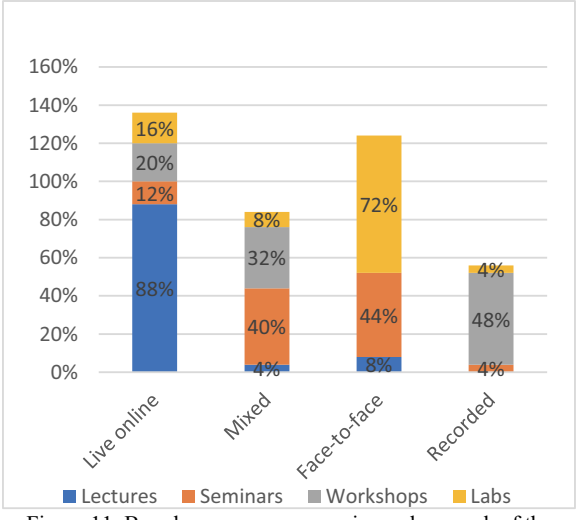


Figure 11: Based on your own experience, how each of the following teaching methods were best delivered?

The development of online courses requires certain knowledge allowing the lecturers to create interactive lessons aiming to meet modern requirements. Students are sure that online education is the education of the future. The sooner universities will

develop this field by using appropriate tools, and the more competitive they will be in the future. At the same time the survey results show that students also value the nature of the integrated relationships, the interaction between students and lecturers. They prefer face-to-face mode for labs and internships. In general, according to findings the majority of students preferred to study in hybrid mode.

3.0 Conclusion and Further Actions

Ensuring the quality of online teaching and learning tools and caring about sustainable systems, it is necessary gradually to empower teachers and students with software, hardware, network, and pedagogical capacity to utilize them meaningfully. Therefore, a significant investment in online education is required.

Learners have alternative opportunities to gain knowledge through digital technologies, which forces them to reconsider teachers' roles. The teacher's role in the context of 21st-century education can't be only knowledge-oriented; it should be aiming to provide future life skills. In an ever-changing integrated environment, students should be very flexible and adaptive. Besides the digital skills, in the job market required skills are creativity, communication, collaboration, compassion, emotional intelligence, and teamwork. Above mentioned skills students can gain only during the face-to-face mode. Therefore, to enhance students' digital and soft skills in parallel with professional skills, university is paying attention to hybrid mode advantages.

In general, the crisis may be an opportunity to explore alternative education organization approaches that foster the autonomy of students to manage their learning and provide additional support [15,16].

In the long run, the following strategies are suggested at ASPU:

- Develop a vision that acknowledges the university's commitment to key educational principles: equity, quality, wellbeing, and safety.
- Choose the hybrid model of education delivery based on the assessment of resources and stakeholders' feedback.
- Provide professional development for teachers and course leaders and administrative staff.
- Enhance students' digital and soft skills in parallel with professional skills.
- Implement actions directed to achieving strategies by bringing together tools, and available resources.
- Develop tools to monitor implemented actions and understand progress.
- Establish a communication strategy by engaging stakeholders and considering available human and technological resources.

Further monitoring of the external and internal stakeholders' perceptions of the institutional responses is needed to identify the most critical areas of concern as the pandemic continues to affect teaching and learning quality.

4.0 References

1. The COVID-19 pandemic has changed education forever. This is how. World Economic Forum. https://www.weforum.org/agenda/2020/04/coronavirus-education-global-covid19-online-digital-learning/ (accessed on 7 February 2021).
2. Global perspectives on education and skills https://oecdedutoday.com/coronavirus/
3. Houlden, S., & Veletsianos, G. (2020). Coronavirus pushes universities to switch to online classes – but are they ready?. The Conversation. (accessed on 7 February 2021). https://theconversation.com/coronaviruspushes-universities-to-switch-to-online-classes-but-arethey-ready-132728 (accessed on 7 February 2021).
4. Fatani, T.H. Student satisfaction with videoconferencing teaching quality during the COVID-19 pandemic. BMC Med. Educ. 2020, 20, in press. [CrossRef]
5. Wu, Z. (2020). How a top Chinese university is responding to coronavirus. https://www.weforum.org/agenda/2020/03/ coronavirus-china-the-challenges-of-online-learning-foruniversities/ (accessed on 7 February 2021).
6. Zhong, R. (2020, March 17). The coronavirus exposes education's digital divide. The New York Times. https:// www.nytimes.com/2020/03/17/technology/china-schoolscoronavirus.html(accessed on 7 February 2021).
7. UNESCO. (2020). COVID-19 Educational disruption and response. https://en.unesco.org/themes/educationemergencies/coronavirus-school-closures
8. Australian National University. (2020). Information for students – 17 March 2020. https://www.anu.edu.au/news/ all-news/information-for-students-0
9. Qu, L. (2020). Online learning: When class is just a click away. Duke Kunshan University. https://www.scmp.com/tech/ enterprises/article/3048891/chinas-traditional-schoolsembrace-online-learning-coronaviru (accessed on 7 February 2021).
10. Alexandria University. (2002). Live Broadcast of Student Classes Start. https://www.alexu.edu.eg/index.php/ar/2018- 04-02-10-35-29/5684 (7 March 2021).
11. Crawford, J.; Butler-Henderson, K.; Rudolph, J.; Malkawi, B.; Glowatz, M.; Burton, R.; Magni, P.; Lam, S. COVID_19: 20 countries' higher education intra-period digital pedagogy responses. J. Appl. Learn. Teach. 2020, 3, 9–28.
12. University College Dublin. (2020). COVID-19: Special arrangements. http://www.ucd.ie/COVID-19 (accessed on 7 February 2021).
13. Potra, S.A.; Pugna, A.P.; Pop, M.-D.; Dungan, L. Romanian University Hybrid Educational System: A Grounded Theory Approach of 1st Year Students Experience. Available online: https://iated.org/inted/ (accessed on 7 February 2021).
14. Rita Gevorgyan Enhancing the Quality of the Teaching and Learning Process Though the Implementation of E-Learning Tools (Armenian State Pedagogical University Kh. Abovyan, Armenia) . e-Learning as a solution during unprecedented times in the 21st century (INSPIRE 2020 Proceedings). In: Twenty Fifth International Conference on Software Process Improvement Research, Education and Training (INSPIRE XXV), 16 Jul 2020, Online. e-ISBN 9781999654948 (accessed on 7 February 2021).. https://www.researchgate.net/publication/348169750_Challenges_of_Rapid_Migration_to_Fully_Virtual_Education_in_the_Age_of_the_Corona_Virus_Pandemic_Experiences_from_Across_the_World (accessed Apr 06 2021).
15. Education responses to COVID-19: an implementation strategy toolkit https://www.oecd-ilibrary.org/ (accessed on 7 February 2021).
16. Viennet, R. and B. Pont (2017), "Education policy implementation: A literature review and proposed framework", OECD Education Working Papers, No. 162, OECD Publishing, Paris, https://dx.doi.org/10.1787/fc467a64-en (accessed 7 February 2021)..

Study Habits, Communication Levels, and Teaching Modality Preferences Before and During Coronavirus Pandemic – A Comparative Analysis of United States and Russian University Students

Galina Zamaraeva[1], Karen K. Dennis[2]

[1]Vladimir State University,
Vladimir, Russia
galyonka@mail.ru

[2]Illinois State University,
Normal, Illinois, USA
kkdenni@ilstu.edu

Abstract

It is difficult to imagine universities, schools and other educational institutions having the ability to overcome pandemic challenges and continue providing education for all students in the 1990s – early 2000s. Realistically, because of lack of access to the Internet and necessary equipment twenty years ago, it would have been impossible to arrange virtual live and interactive classes. Fortunately for students and educators today, technology has advanced to such a high level that the educational process could continue. To mitigate the spread of the pandemic virus, universities and colleges would shift all of their face-to-face and hybrid classes to fully online. Professors, who had no or little experience designing or teaching in the online environment, and/or didn't consider online teaching as a complete equivalent to replace face-to-face classes, were challenged to design and implement instruction for online delivery with little to no warning, all in the midst of a pandemic with its own fears and unknowns. We have also to take into account that the student population had little to no idea what to expect with online learning. **PURPOSE:** The purpose of this study was to gain a better understanding of and to compare Russian and United States college and university students' challenges, experiences, and views of their educational experiences after the rapid migration from traditional or hybrid learning to fully virtual education as a result of the

coronavirus pandemic, with particular attention to study habits, communication levels, and teaching modality preference before and during the pandemic. **METHODS:** 91 subjects (48 Russian students; 43 United States students) completed an anonymous and non-traceable Google Forms survey. Institutional Review Board (IRB) approval was obtained prior to dissemination of the survey form weblink. Subjects were enrolled in classes at the universities where authors teach. The questionnaire was designed to ascertain subjects' demographics, facilities, learning, communication, privacy and security, and a section that allowed students to provide open comments. **RESULTS:** Data from this study show that just over half of both US and Russian students indicated that they did not spend more time studying during the lockdown than before. Both US and Russian students were either casual or serious about their learning attitude before the pandemic, and during the pandemic, students from both countries' attitudes fell to a more casual to indifferent attitude. Regarding communication with lecturers, prior to the lockdown, the majority of US students interacted with their teachers weekly, whereas the majority of Russian students reported daily interactions. During the lockdown, the majority of respondents indicated they still maintained weekly interactions with teachers, however, the percentage decreased significantly, and lower levels of communication increased. While the daily interactions with teachers with Russian students decreased, the frequency of interactions with teachers predominantly remained at higher levels, although there was a slight increase in the lower levels of communication. Having experienced online learning, 35% of both US and Russian students indicated they preferred a mixture of both face-to-face and online format. Interestingly, while only 9% of US students preferred online, 23% of Russian students preferred online only. **CONCLUSIONS:** The comparison of study habits and communication levels with teachers shows that US and Russian students were fairly similar in their response's pre-pandemic. Russian students reported more overall communication with their teachers during the pandemic than US students. Interestingly, a higher percentage of Russian students reported preferring online format than US students, which may be connected to their more frequent communication with their teachers.

Keywords: online learning, study habits, communication, pandemic

1.0 Introduction

1.1 Shift to Fully Online Learning as a Result of Pandemic

It is difficult to imagine universities, schools and other educational institutions having the ability to overcome pandemic challenges and continue providing education for all students in the 1990s – early 2000s. Realistically, because of lack

of access to the Internet and necessary equipment twenty years ago, it would have been impossible to arrange virtual live and interactive classes. Fortunately for students and educators today, technology has advanced to such a high level that the educational process could continue. On March 11, 2020, the World Health Organization (WHO) declared the COVID-19 virus a worldwide pandemic [1]. The result of this declaration was that, in an effort to mitigate the spread, universities and colleges would shift all of their face-to-face and hybrid classes to fully online. Professors were challenged to design and implement instruction for online delivery with little to no warning. According to a report by Celia Miller, [2] in the United States (US) only 46% of faculty members stated they had taught an online course prior to the transition to online due to COVID policies. Furthermore, 43% of college/university students enrolled in traditional face-to-face classes had not taken online classes prior to the transition to online. Given that, consider that about half of the student population had little to no idea what to expect for online learning, while only about half of the faculty had any experience designing or teaching in the online environment, all in the midst of a pandemic with its own fears and unknowns. According to the analytical report *Lessons of Stress-Test* by the Ministry of Science and Higher Education [3], in Russia 60% of university lecturers seldom or never taught their courses or delivered their lectures online before the COVID-19 pandemic. They graded their technical skills (ability to use cloud technologies) as 3.5 of 5. They didn't consider online teaching as a complete equivalent to replace face-to-face classes. At the same time 34% of students considered on-line learning to be as effective as off-line classes, though 40% of them stated increase of academic load. Thus, we can see contradictory information.

1.2 Background

The analysis was carried out based on the responses of the survey distributed to students at Illinois State University and Vladimir State University. The survey was also distributed to other higher educational institutions in 19 different countries as part of a larger study. As there was a similar participation response from Illinois State and Vladimir State universities, it is interesting to analyze the data related to these universities. We begin by describing the universities and the cities they are located in.

As of fall 2019, Illinois State University had 20,878 students. The number of students at Vladimir State University was about 20,000 students as of October 1, 2020. Illinois State rates 333rd among 2528 US universities [4] while the latter is 90th among 467 Russian universities [5].

Illinois State University is located in Normal, Illinois, USA, which is part of the larger community of Bloomington-Normal, a twin-cities community. As for the population of the cities where the universities are located, it is 54,800 (Normal, IL, United States) [6] and 78,330 (Bloomington, IL, United States) [7]. Even combined, their population is less than that of Vladimir – 348,256 (Vladimir, Russian Federation) [8]. We suppose that the population of the university community could have impact on the intensity of communication of students with their professors during lockdown.

Both universities had to transition to fully online learning with very little notice. The pandemic made the shift toward complete online learning urgent. It is important to next describe institutional involvement during this transition, along with the arrangement of educational processes and the provision of trainings for the faculty.

University administration at Vladimir State had to re-design existing institutional and departmental structures and processes to support online learning, to consider available technologies, as well as to provide staff training and to support the urgency and requirements for online-based learning platforms. There were a series of orders at Vladimir State University on different issues, from life and health safety measures, to access to educational resources. Like most of the universities around the world, Vladimir State University shut down in an attempt to slow the spread of novel coronavirus. From March 16, 2020 all traditional face-to-face activities, including classes, social events, meetings, etc. were cancelled to shift to online teaching-learning and communicating. The rector of the university addressed the staff and students to declare that classes would be held online for some period, and all university-related trips, both international and domestic, would be suspended. Later it was stated that online classes were prolonged till the end of the academic year. One of the first orders signed by the rector declared establishment of psychological support service, which provided advice or consultation with psychologists on any issue related to virtual life during lockdown.

Staff training was arranged by some professors. Some other professors, those in their 60's and 70's canceled their classes, as they had technical difficulties or simply panicked over the necessity to teach their classes in a completely new mode using special educational online platforms. They were not accustomed to using technologies for blended or entirely online teaching. Thus, some curricula were disrupted. Some professors had difficulties managing a classroom via a screen, a camera and a microphone. Some students also needed support. That is why webinars were arranged to teach those who were not skilled enough to use online platforms.

The situation was similar at Illinois State University. All faculty and staff were sent several emails by the University Provost and President, first asking them to prepare for the potential quarantine/isolation of students and faculty, and possible closure of the campus, then a few days later informing them that the campus indeed would close. Professors were instructed to prepare to transition to fully online teaching. Faculty were given recommendations for what to do, and several links were provided for further information, and for learning and acquiring new skills. The "Center for Teaching and Learning Technology," a faculty development center at Illinois State University, worked feverishly to develop the "Redbirds Keep Teaching" website for faculty to learn what resources were available to help them transition to an online class, while also developing a student-focused website called "Redbirds Keep Learning." The Provost wrote in an email sent to the faculty and staff on March 10, 2020, "While we know that a quick transition to online

education is not ideal and will most likely result in a less than desirable situation for our students and faculty, we must continue to move forward while keeping our campus safe in an emergency situation". All of this took place during the week of spring break at the university. University administration announced that spring break would extend an additional week to allow the faculty to make the adjustment to alternative instruction (similar step was taken at Vladimir State University later). These emails were supportive, thus, very important in such challenging situation.

It should be mentioned that all of the institutional actions made were based on the governmental and ministerial regulations in the COVID-19 pandemic.

Another point to consider is the stress and adaptation to online learning and teaching. Given remote learning due to the pandemic lasted for a long time, experts say the mental, emotional and academic impacts of that shift are likely to be challenging. A technical report by the Joint Research Centre (JRC), the European Commission's Science and Knowledge Service, put several arguments forward to explain this. "First, there is evidence showing that quarantined students tend to spend less time in learning compared to when schools are open. Second, many students confined at home due to COVID-19 may feel stressed and anxious, and this may negatively affect their ability to concentrate on schoolwork. Third, physical school closure and the lack of in-person contact may make students less externally motivated to engage in learning activities". [9]

1.3 Purpose of this Study

The purpose of this study was to gain a better understanding of and to compare Russian and United States college and university students' challenges, experiences, and views of their educational experiences after the rapid migration from traditional or hybrid learning to fully virtual education as a result of the coronavirus pandemic, with particular attention to study habits, communication levels, and teaching modality preference before and during the pandemic.

2.0 Methods

91 subjects (48 Russian students; 43 United States students) completed an anonymous and non-traceable Google Forms survey. Institutional Review Board (IRB) approval was obtained prior to dissemination of the survey form weblink. Subjects were enrolled in classes at the universities where authors teach. The questionnaire was designed to ascertain subjects' demographics, facilities, learning, communication, privacy and security, and a section that allowed students to provide open comments.

3.0 Results

3.1 Demographic Results

Basic descriptive statistics were completed to describe the subject population. The 48 Russian student subject population consisted of 66.7% females (n=32) and 27.1% males (n=13), with one subject reporting "other" and two students reporting "Prefer not to say." The 43 United States student population consisted of 41.9% females (n=18) and 55.8% males (n=24), with one student reporting "Prefer not to say." All of the subjects from the United States reported being "full-time" students, while two Russian students reported being "part-time" with the remaining 46 Russian students reporting "full-time" student status. The age of the subject population varied by country. Most Russian subject participants were between the ages of 18 and 20, with only two participants reporting the age of 17 and two participants reporting the age of 21 (mean age was 18.96 years). Most United States participants were between the ages of 20 and 22, with only one participant reporting the age of 18, four reporting the age of 19, and a total of nine participants reporting ages between 23 and 28 (mean age 21.54). See Table 1 for age of subjects by country.

Table 1: Subject Age by Country

Age	17	18	19	20	21	22	23	24	25	28	Total
Russia	2	20	12	10	2	0	2	0	0	0	48
United States	0	1	4	7	13	9	3	4	1	1	43

3.2 Comparison Results

Comparative analysis of Russian and United States students' study habits, communication levels, and teaching modality preference before and during the pandemic was completed using IBM SPSS Statistics 26 software. Basic descriptive statistics and the chi-square test for independence were employed.

3.2.1 Study Habits

The study survey asked participants to answer the questions "Did you spend more time studying during the lockdown than BEFORE the lockdown?" (response options were "yes" or "no"). Results show that about half of the students in both Russia and the United States reported studying more and half reported studying less during the pandemic. See Table 2 for response breakdown.

Table 2: Subject Report of Study Habits During Lockdown

"Did you spend more time studying during the lockdown than BEFORE the lockdown?"	**Yes**	**No**	**No response**
Russia	45.8% n=22	50% n=22	4.2% n=2
United States	48.8% n=21	51.2% n=22	0

Participants were also asked in the survey to respond to two questions pertaining to their learning attitude. The questions were "What do you think of your learning attitude to your studies BEFORE the pandemic?" and "What do you think of your learning attitude to your studies DURING the pandemic?" (response options were "casual," "serious," "very serious," or "indifferent"). Both Russian and United States participants reported that they were "serious" about their learning before the pandemic. See Table 3 for response breakdown.

Table 3: Learning Attitude BEFORE Pandemic

Learning Attitude BEFORE Pandemic	**Casual**	**Serious**	**Very Serious**	**Indifferent**	**No Response**
Russia	18.8% n=2	43.8% n=21	14.6% n=7	18.8% n=9	4.2% n=2
United States	23.3% n=10	41.9% n=18	34.9% n=15	0	0

Subjects' attitudes during the pandemic decreased from the pre-pandemic level of "serious". Table 4 displays the response breakdown.

Table 4: Learning Attitude DURING Pandemic

Learning attitude DURING pandemic	**Casual**	**Serious**	**Very Serious**	**Indifferent**	**No Response**
Russia	20.8% N=10	39.6% N=19	4.2% N=2	31.3% N=15	4.2% N=2
United States	39.5% N=17	37.2% N=16	16.3% N=7	7.0% N=3	0

Further analysis of the data revealed a statistically significant correlation between study habits during pandemic and learning attitude during pandemic for Russian students, but not for United States students. See Table 5 for chi-squared test results and Figures 1 and 2 for graphical representation of study habits and learning attitude.

Table 5: Chi-Squared Test Results for Study Habits and Learning Attitude During Pandemic

Country		Value	df	Sign. (2-sided)
Russia	Pearson Chi-Square	52.656	8	.000
	Likelihood Ratio	21.891	8	.005
	N of Valid Cases	48		
United States of America	Pearson Chi-Square	7.611	3	.055
	Likelihood Ratio	9.168	3	.027
	N of Valid Cases	43		
Total	Pearson Chi-Square	100.176	8	.000
	Likelihood Ratio	29.072	8	.000
	N of Valid Cases	91		

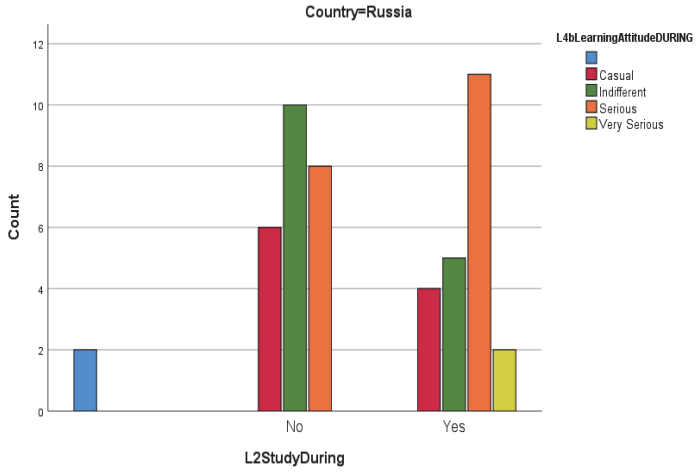


Figure 1: Study Habits and Learning Attitude During Pandemic – Russia

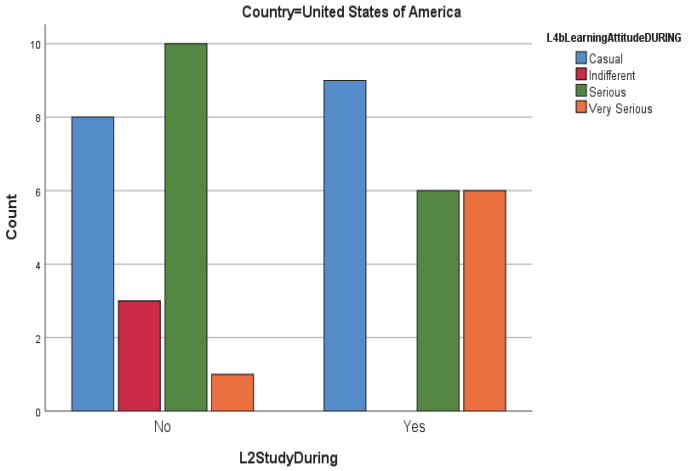


Figure 2: Study Habits and Learning Attitude during Pandemic – United States

3.2.2 Communication Levels

The study survey asked respondents to answer the questions "How frequently did you personally interact with your lecturers BEFORE the lockdown?" and "How frequently did you personally interact with your lecturers DURING the lockdown?" Survey response options were "daily," "weekly," "every two weeks," "monthly," and "not at all." Results show that prior to the lockdown, the majority of US students interacted with their teachers weekly, whereas the majority of Russian students reported daily interactions. During the lockdown, the majority of respondents indicated they still maintained weekly interactions with teachers, however, the percentage decreased significantly, and lower levels of communication increased. While the daily interactions with teachers by Russian students decreased, the frequency of interactions with teachers predominantly remained at higher levels, although there was a slight increase in the lower levels of communication.

Results of the frequency distribution can be found in Tables 6 and 7.

Table 6: Communication with Lecturers BEFORE Lockdown

Frequency of Communi-cation	Daily	Weekly	Every Two Weeks	Monthly	Not at All	No Response
Russia	37.5% n=18	29.2% n=14	4.2% n=2	12.5% n=6	10.4% n=5	6.3% n=3
United States	14.0% n=6	53.5% n=23	9.3% n=4	18.6% n=8	4.7% n=2	0

Table 7: Communication with Lecturers DURING Lockdown

Frequency of Communi-cation	Daily	Weekly	Every Two Weeks	Monthly	Not at All	No Response
Russia	27.1% n=13	27.1% n=13	8.3% n=4	12.5% n=6	18.8% n=9	6.3% n=3
United States	2.3% n=1	37.2% n=16	18.6% n=8	20.9% n=9	18.6% n=8	0

To evaluate if there was any association between communication with lecturers BEFORE and DURING the lockdown, a chi-squared test was conducted. Results show a statistically significant relationship between BEFORE and AFTER communication with lecturers for Russian subjects, but not for United States subjects. See Table 8 for chi-squared test results.

Table 8: Chi-Squared Test Results for Communication with Lecturers BEFORE and DURING Lockdown

Country		Value	df	Sign. (2-sided)
Russia	Pearson Chi-Square	92.308	25	.000
	Likelihood Ratio	66.504	25	.000
	N of Valid Cases	48		
United States of America	Pearson Chi-Square	10.277	16	.852
	Likelihood Ratio	12.454	16	.712
	N of Valid Cases	43		
Total	Pearson Chi-Square	121.726	25	.000
	Likelihood Ratio	58.895	25	.000
	N of Valid Cases	91		

3.2.3 Teaching Modality Preference

Study participants were asked to respond to the following question "Having experienced online learning, do you prefer online, face-to-face, or mixed mode?" Both Russian and United States students preferred the face-to-face modality over mixed/hybrid or fully online modalities. Table 9 provides descriptive statistics of teaching modality preference by country. Figure 3 displays the countries and their student's teaching modality preferences.

Table 9: Teaching Modality Preference

Teaching Modality Preference	Face-to-Face	Mixed	Online	No Response
Russia	39.6% N=19	33.3% N=16	20.8% N=10	6.3% N=3
United States	55.8% N=24	34.9% N=15	9.3% N=4	0

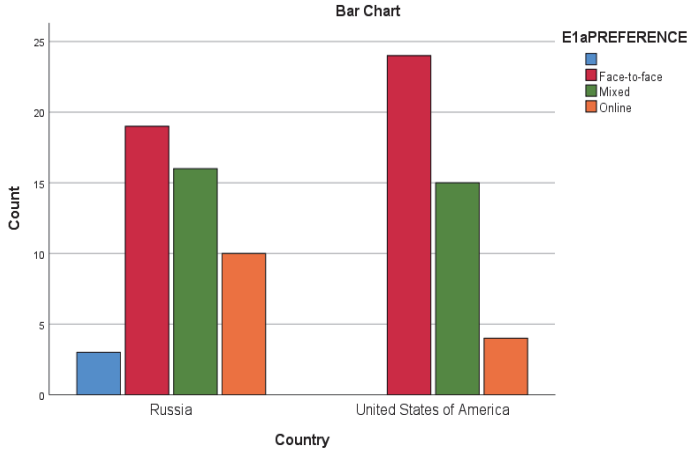


Figure 3: Teaching Modality Preference

Chi-squared tests for independence were conducted to assess if communication frequency, technical skill, experience levels, gender and age were correlated with teaching modality preference. Results show a statistically significant correlation with communication frequency during the pandemic and teaching modality preference for Russian students (see Table 10 and Figures 4 and 5); a statistically significant correlation with technical skill and teaching modality preference for Russian students See Table 11 and Figures 6 and 7); a statistically significant correlation with online learning experience at the start of the pandemic and teaching modality preference for Russian students (See Table 12 and Figures 8 and 9); and statistically significant correlations ($p < .05$) for age and teaching modality preference for both Russian and the United States students (See Table 13 and Figures 10 and 11). There were no statistically significant correlations between gender and teaching modality preference (Table 14).

Table 10: Communication Frequency and Teaching Modality Preference

Country		Value	df	Sign. (2-sided)
Russia	Pearson Chi-Square	66.193	15	.000
	Likelihood Ratio	43.057	15	.000
	N of Valid Cases	48		
United States of America	Pearson Chi-Square	8.652	8	.372
	Likelihood Ratio	10.481	8	.233
	N of Valid Cases	43		
Total	Pearson Chi-Square	105.380	15	.000
	Likelihood Ratio	41.213	15	.000
	N of Valid Cases	91		

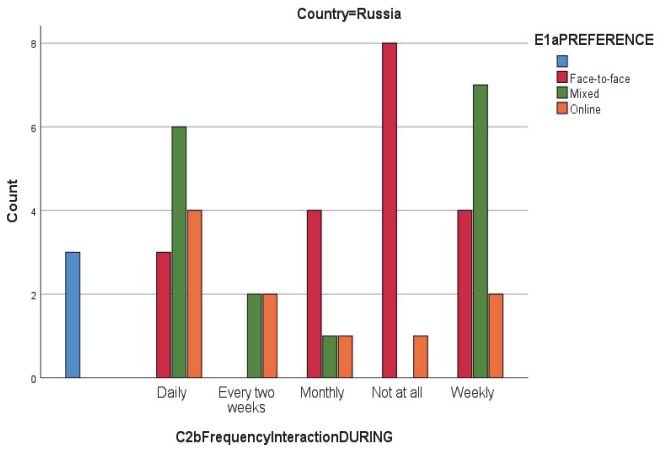


Figure 4: Communication Frequency and Teaching Modality Preference - Russia

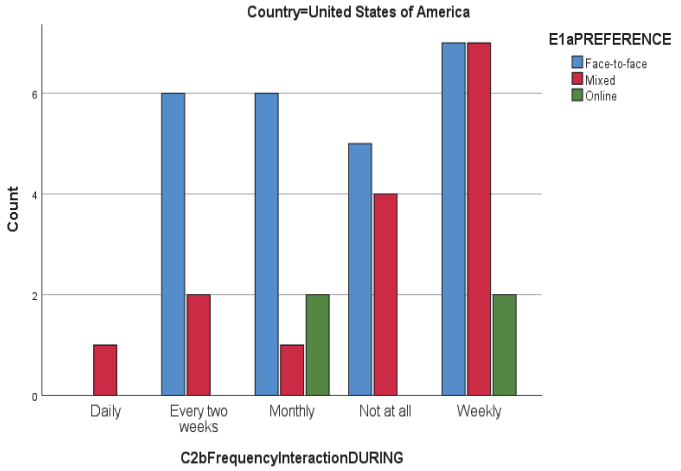


Figure 5: Communication Frequency and Teaching Modality Preference - United States

Table 11: Technical Skill and Teaching Modality Preference

Country		Value	df	Sign. (2-sided)
Russia	Pearson Chi-Square	27.165[b]	9	.001
	Likelihood Ratio	32.760	9	.000
	N of Valid Cases	48		
United States of America	Pearson Chi-Square	5.583[c]	4	.233
	Likelihood Ratio	7.487	4	.112
	N of Valid Cases	43		
Total	Pearson Chi-Square	22.845[a]	9	.007
	Likelihood Ratio	25.812	9	.002
	N of Valid Cases	91		

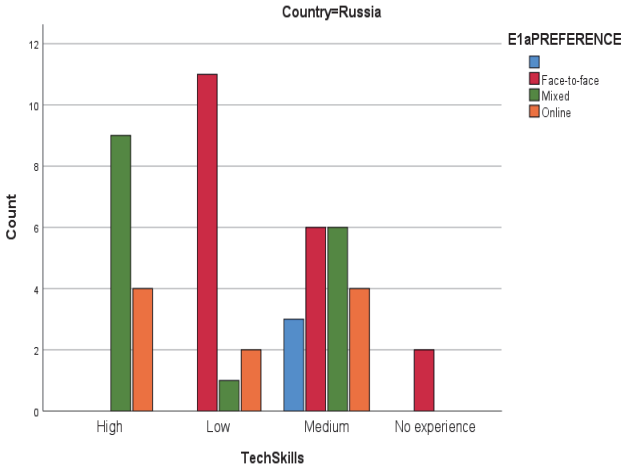


Figure 6: Technical Skill and Teaching Modality Preference - Russia

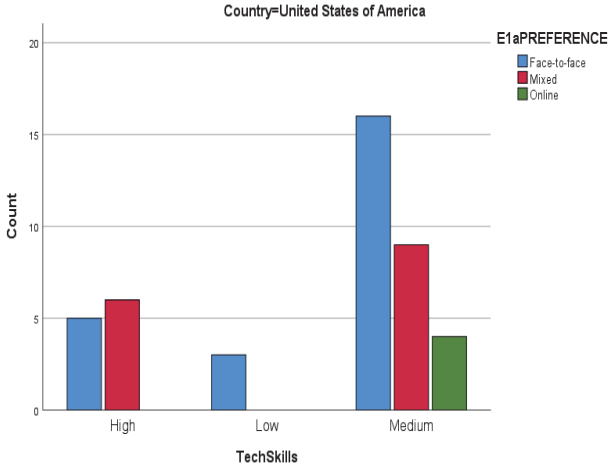


Figure 7: Technical Skill and Teaching Modality Preference - United States

Table 12: Online Learning Experience (at Start of Pandemic) and Teaching Modality Preference

Country		Value	df	Sign. (2-sided)
Russia	Pearson Chi-Square	19.458	9	.022
	Likelihood Ratio	23.585	9	.005
	N of Valid Cases	48		
United States of America	Pearson Chi-Square	11.275	6	.080
	Likelihood Ratio	12.524	6	.051
	N of Valid Cases	43		
Total	Pearson Chi-Square	18.380	9	.031
	Likelihood Ratio	20.312	9	.016
	N of Valid Cases	91		

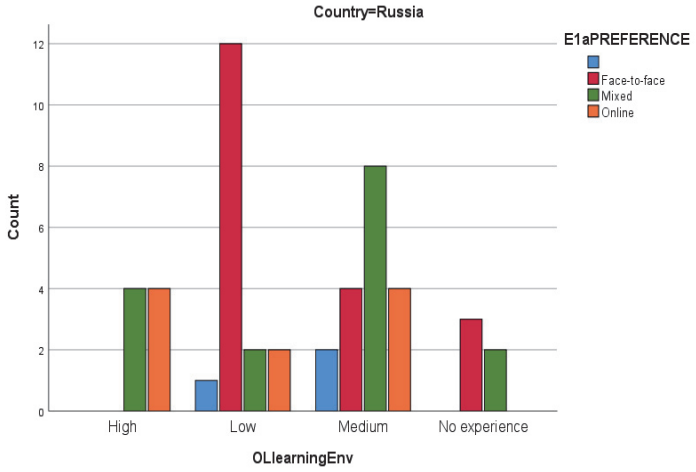


Figure 8: Online Learning Experience (at Start of Pandemic) and Teaching Modality Preference - Russia

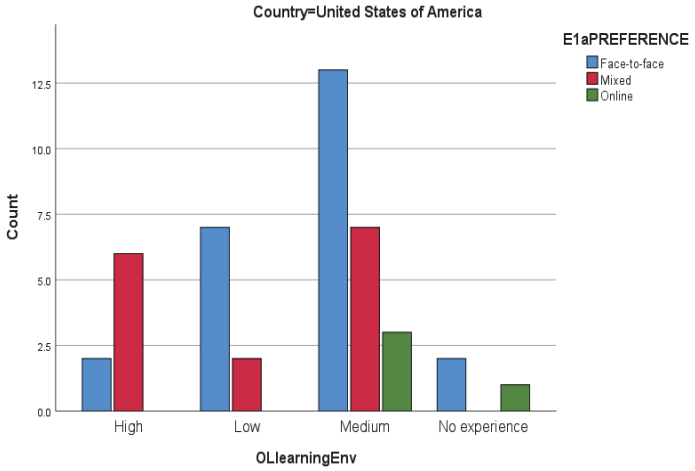


Figure 9: Online Learning Experience (at Start of Pandemic) and Teaching Modality Preference - United States

Table 13: Age and Teaching Modality Preference

Country		Value	df	Sign. (2-sided)
Russia	Pearson Chi-Square	25.467	15	.044
	Likelihood Ratio	22.145	15	.104
	N of Valid Cases	48		
United States of America	Pearson Chi-Square	26.869	16	.043
	Likelihood Ratio	24.655	16	.076
	N of Valid Cases	43		
Total	Pearson Chi-Square	51.316	27	.003
	Likelihood Ratio	43.856	27	.021
	N of Valid Cases	91		

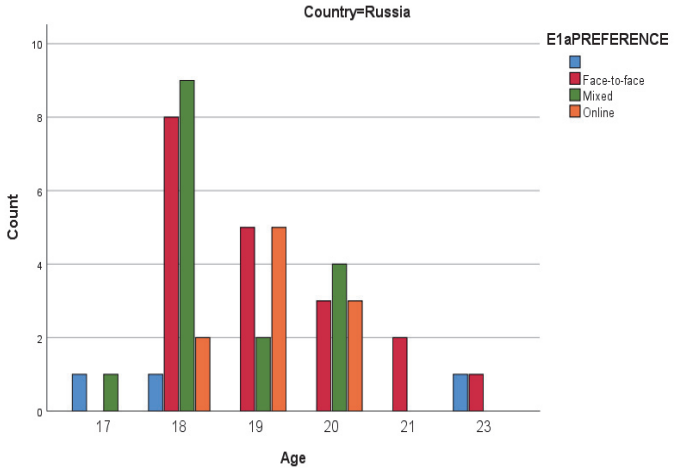


Figure 10: Age and Teaching Modality Preference - Russia

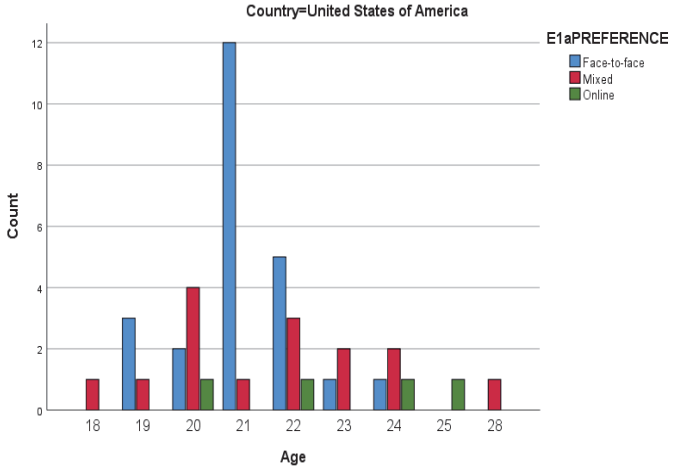


Figure 11: Age and Teaching Modality Preference - United States

Table 14: Gender and Teaching Modality Preference

Country		Value	df	Sign. (2-sided)
Russia	Pearson Chi-Square	7.301	9	.606
	Likelihood Ratio	8.636	9	.472
	N of Valid Cases	48		
United States of America	Pearson Chi-Square	1.692	4	.792
	Likelihood Ratio	2.068	4	.723
	N of Valid Cases	43		
Total	Pearson Chi-Square	5.388	9	.799
	Likelihood Ratio	6.687	9	.670
	N of Valid Cases	91		

4.0 Conclusions

As reported in the results section, the Russian student participants were slightly younger than the United States student participants. Most Russian participants were between the ages of 18 and 19, while most United States participants were between the ages of 20-22. We found this to be interesting as we examined the results of the study.

When the coronavirus reached pandemic level during the spring 2020 semester, the decision was made at both of our universities to send students home for a period of at least two weeks, and then at that point, reevaluate the situation to determine if in-person classes would resume. As it turned out, classes remained fully online for the remainder of the spring semester. At Illinois State University in the United States, classes remained predominantly online for the entire 2020-2021 academic year, while at Vladimir State University in Russia, classes returned to predominantly face-to-face (September 1 – November 19, February 1 – till now). This is an important consideration as we examine the results of this study. Students in the United States have been online since March of 2020, so their responses were current, while Russian participants were responding to survey questions through recall of experience.

As we consider participants reported study habits during the pandemic, it is interesting to note that just under half of the participants in both countries reported that they did not spend more time studying during the lockdown than before. Additionally, their attitude towards learning became more casual during the pandemic than it was pre-pandemic. Although this study did not investigate the impact of having to leave the university campus and return home on participants'

learning attitude, we find it interesting that most participants reported a more casual or indifferent learning attitude while being off campus. This result, however, does align with the report by the Joint Research Centre (JRC) [9], mentioned above, in that quarantined students tend to spend less time in learning compared to when schools are open and that physical school closure and the lack of in-person contact may make students less motivated to engage in learning activities. It is not surprising, however, that participants that had a more serious learning attitude studied more during the pandemic. This correlation was statistically significant for Russian participants, but not for United States participants.

Both Russian and United States participants preferred traditional face-to-face learning, however, more Russian participants indicated a preference for online modality than United States participants did. There were some statistically significant correlations between learning modality preference and other variables for Russian participants (not for United States participants) that we found interesting and will discuss.

Communication levels with lecturers during the pandemic decreased in both countries, however, Russian participants maintained a greater percentage of daily interaction with teachers than United States participants did. For Russian participants, communication levels were significantly correlated with preference for online learning, meaning the more frequent the communication with the teacher, the greater preference the participant had for fully online or mixed modality (hybrid) learning. There was not a statistically significant correlation with communication frequency with the teacher and modality preference for United States participants. It is important to consider communication frequency with students when implementing an online course. As indicated by the Russian participants, the more frequent the communication, the greater the preference for online learning modalities.

Participants' perception of their technical skills at the start of the pandemic also had a statistically significant correlation for Russian participants. The higher the perceived technical skill, the greater the preference for online or mixed (hybrid) learning modality. Russian participants previous experience with online learning was also statistically significant for correlation with learning modality preference. As with communication levels with students, it is important to consider technical ability and previous experience with online learning when designing and implementing online or hybrid courses. It is interesting that neither technical skill nor previous online learning experience was statistically significant for correlation with United States participants. It may be that participants from the United States, having had only online classes for more than a year, were simply tired of the online modality wanted to return to the classroom in person.

Another interesting result in this study was age and teaching modality preference. Both Russia and United States had statistically significant correlations for age and

teaching modality. What is interesting to find, however, is that while the Russian participant group was younger overall, more of the younger students preferred fully online (18-20 years old), while for United States participants, older students preferred fully online (20-25 years old).

While not all of the variables were statistically significant for correlations for students from the United States, it is still important to remember and consider the variables discussed above when designing and implementing an online course both in Russia and in the United States. The results of this study indicate that for Russian students, factors that are correlated to preference for online learning include younger age (18-20 years old), daily or weekly communication with lecturer, technical ability, and previous online learning experience. For United States students, older age (20-25 years old) was correlated with preference to online learning. Providing teachers with training to equip them with instructional design principles for the online modality would provide a solid foundation for which to build upon with course implementation procedures. Course implementation procedures found to be correlated with Russian students preferring online learning in this study include daily or weekly communication, having technical ability, and previous online experience. When designing an online course, teachers should ensure that technical requirements for the course are appropriate. Provision of or referral to technical support for students that are less confident in their technical skills may provide the student with greater confidence and success. Lastly, keeping check of students' learning attitudes during the course and working to maintain high levels of engagement through regular communication and positive interactions, may also increase students' preference for the online learning modality.

5.0 References

1 World Health Organization. (2021). Timeline: WHO's COVID-19 Response. Retrieved 28th April 2021, from https://www.who.int/emergencies/diseases/novel-coronavirus-2019/interactive-timeline#!

2 Miller C (2021, March 14). Online Education Statistics. Retrieved 28th April 2021from https://educationdata.org/online-education-statistics

3 Ministry of Science and Higher Education. (2 June 2020). Lessons of the Stress-Test: Higher Educational Institutions in the Pandemic and after it. Analytical Report. Moscow. Retrieved 28th April 2021, from https://drive.google.com/file/d/1GMcBIoP8ITzE_WDVh4nFksX6lceotZY3/view

4 EduRank (2021). Illinois State University Rankings. Retrieved May 13, 2021 from https://edurank.org/uni/illinois-state-university/

5 Vladimir State University (2021). VlSU - Vladimir State University named after Alexander Grigorievich and Nikolai Grigorievich Stoletovs (117 specialties). Retrieved May 13, 2021 from https://vuzoteka.ru/%D0%B2%D1%83%D0%B7%D1%8B/%D0%92%D0%BB%D0%93%D0%A3

6 DataUSA (nd). Normal, IL. Retrieved May 13, 2021 from https://datausa.io/profile/geo/normal-il/
7 Data USA (nd). Bloomington, IL. Retrieved May 13, 2021 from https://datausa.io/profile/geo/bloomington-il/
8 Population Hub (2021). Population of Vladimir. Retrieved May 13, 2021 from https://population-hub.com/ru/ru/population-of-vladimir-2282.html
9 Pietro G, Biagi F, Costa P, Karpiński Z, Mazza J, The likely impact of COVID-19 on education: Reflections based on the existing literature and international datasets, EU R 30275EN, Publications Office of the European Union, Luxembourg, 2020

A Case Study of two Pre-primary Schools regarding the Implementation of Distance Mode Online Education.

Georgia Plastira[1], Paschalia Sarmi[2] , Dimitra Vraka[3]

[1] **76th pre-primary school of Thessaloniki,**

plastirageorgia@gmail.com

[2] **Neochorouda's pre-primary school**

pokelina@yahoo.com

[3]**76th pre-primary school of Thessaloniki,**

dvraka@gmail.com

Abstract

The sudden onslaught of the COVID-19 pandemic, in the early months of 2020, created a new situation regarding education at all levels. In order to deal with the abrupt distancing of pupils from the face-to-face educational process, it was necessary to ensure the continuation of the pedagogic and educational process. Thus, the whole body of educators were called to offer emergency distance mode synchronous and asynchronous education. All educators were faced with challenges and difficulties. The kindergarten teachers faced more severe problems, because they were not sure whether the new model could be implemented for such young children.
In this paper, the authors report the results of a study that was carried out at the 76th State Pre-primary School of Thessaloniki and Neochorouda's State Pre-primary School, Greece in order to identify the potential and the restrictions involved in the implementation of distance mode online education. The main purpose was to carry out a self-assessment which could lead to quality improvement of the work carried out.
Reflections and Lessons learned from this self-assessment study are already used for quality improvement.

Keywords: emergency distance mode education, pre-primary school pupils', self-assessment, quality improvement, parents.

1.0 Introduction

The study used on the survey method with using a questionnaire an instrument for capturing responses from the pupils addressed to the parents of the pupils, as an instrument for data capture. The questionnaire was constructed around four axes namely communication, exchange of information, co-operation, and mutual respect. Nearly 90% of the parents responded to the questionnaire with primarily positive comments. The close collaboration between the teachers and the parents enabled to children to continue their learning. The study revealed the anxieties and

problems such as issues of well-being of pupils, participation and cyber-security but, also, the solutions reached as a result of the close and fruitful collaboration between the pre-primary school and the parents.

1.1 Literature Review

The pandemic created new conditions in education. Under the new and unprecedented situation, governments and Ministries of Education internationally struggled to continue the school process by providing distance education for all, as reported by UNESCO in 2020 [1]. However, the sudden transition, from lifelong to distance learning, inevitably, caused great unrest throughout the educational community. Thus, teachers on one hand, acting as transmitters, were called upon to adopt and offer (although most did not have the prerequisite knowledge and familiarity) distance learning in both synchronous and asynchronous form, while students and their families, from on the other, the active recipients of distance / online learning had to be made immediately.

Distance learning, proposed as a solution after school closure, is not a completely new practice, as it has been widely used by many educational systems around the world since Beck et al, in 2014 [2]. The term is used to describe the educational activity in which the learner has a physical distance from the trainer and in order to achieve communication and access to educational material some form of technology must be used, as reported by Schlosser & Simonson in 2002[3]. However, the dissemination and implementation of online learning is directly related to the possibility of access to the Internet, educational infrastructure and individual technological resources. If these factors are absent, families find it difficult to participate in online educational opportunities according to Rideout & Katz, 2016 [4].

A special role in the educational process during distance learning was assigned to the parents, as on the one hand they had to provide the appropriate financial-technological resources for their children and on the other hand they were in charge of the daily participation and supervision of their educational activities.

Various studies confirm the important role of parents and families in the development and education of children such as by Durisic & Bunijevac in 2017 [5], and find that parents' overall satisfaction with their children's learning is influenced by a variety of factors, including parental education levels, marital status and socioeconomic characteristics as reported in 2017 by Jónsdóttir, Björnsdóttir, & Bæck [[6].

The new challenges, and difficulties brought about by the closure of schools in educational systems, opened a new field of research. The literature review showed that since April 2020, much research has been conducted internationally aimed at exploring aspects of this new reality. One of the issues that seems to concern researchers is to explore the views and experiences of parents regarding distance learning. This is evidenced by the qualitative research of Bhamani, Makhdoom, Bharuchi, Ali, Kaleem, & Ahmed, in 2020 [7] and Lase, Zaluchu, Daeli, & Ndraha in 2020 [8] who explored the experiences of parents from Pakistan and Indonesia respectively on the pandemic learning process and its management at home.

Four quantitative surveys had the same purpose. The first was conducted in Hong Kong by Lau & Lee in 2020 [9] that aimed to explore parents' views on the experience and support of distance education for kindergarten and elementary school students, as well as the time children spend on the screen at home during the suspension of lifelong teaching. The second was held in Kazakhstan by Bokayev et al, in 2021 [10] and investigated the involvement of parents in distance learning and their degree of satisfaction. A third, by Bonal & González, in 2020 [11], addressed the issue of assessment and the impact of school exclusion on the learning gap between children from different social backgrounds in Catalonia. Finally, a different dimension is given by the research of Mangiavacchi et al in 2020 [12] that attempted to explore the role of the father and the redistribution of responsibilities and roles within the household during the lock down and how these aspects have affected the use of time, the emotional state of children and learning at home.

All the above research converges to very important conclusions. They link the socio-economic level of families with the quality of distance learning. Indicatively, they point out that middle-class families can maintain higher quality standards of education, while children from socially disadvantaged families have few learning opportunities both in terms of time and learning experiences [10, 11] add to the family socio-economic characteristics and the number of children in the family (which in itself is closely related to the family socio-economic situation) as a factor of parental satisfaction. Parents in Pakistan seem to be concerned alo the same direction, pointing out technical issues (availability of computers and internet at specific / exact times) that may affect the learning of children in families with more children [7]. Also interesting is the aspect highlighted in the research of Lase et al. in 2020 [8] where the psychological problems as a consequence of the sudden adoption of distance are also addressed: parents experience depression, anxiety and frustration due to the increasing cost of educating their children.

The role of parents in distance learning is not limited to securing the required technological resources, but also to the daily supervision and participation, especially of parents with children in kindergarten and primary school. Bhamani et al. in 2020) [9] reported that the role of parents is responsible, because they often have to explain the tasks to the children and answer any questions that were not solved in the lesson, while Lau & Lee in 2020 [9] reported that parental stress can to be reduced, when they are better supported by the school, to guide their children's learning. What is certain about this aspect of parental involvement is that, not only during school

closures, the cultural and educational capital of families and everyday informal practices have an impact on children's learning experiences and opportunities [11].

Research shows parents' concerns about the learning outcomes of distance learning and their children's socio-emotional development. The majority of parents in Indonesia are concerned about the negative effects of the pandemic on children's education according to Lase et al [8], while research by Bhamani et al.[7] states that parents were concerned about the abrupt transition from physical classes to online, because the vast majority of children in Pakistan were not accustomed to this kind of teaching. The results of Bokayev et al. [10] reported that home education in combination with social isolation has a strong effect on children's learning motivation.

Many parents worry that the pandemic has affected their children's social development. Especially in the case of younger children, the loss of interaction with peers and their normal environment has affected the development of their social and emotional skills [7], while the absence of schooling offsets the benefits of socialization provided by preschool. education for the most vulnerable children [11].

A very interesting dimension to the role of parents in distance learning is given by the results of the research of by Mangiavacchi et al.[12] where it appears that forced stay at home has caused changes in the domestic distribution of household chores and child care of families. Thus, the role of the father, who in many families before the pandemic was helpful, was upgraded to a major and this had a positive effect on the mental well-being of the children. However, the results of research by Lase et al. [8] indicate that distance education could incite violence against children at home.

The literature review did not lead us to published research on the subject in Greece. This is the reason why our research interest turned in this direction in order to fill the gap by exploring the views of Greek parents about distance learning and degree of satisfaction with it. The authors believe that the results of such research can enlighten and help teachers in their work and act as a starting point for knowledge and reflection of the rulers, based on domestic data, in order to lead to the best decisions.

2.0 Aim of the Research

The aim of this study, which was conducted on parents of students of two pre-primary schools in the Prefecture of Thessaloniki, Greece, was, on one hand to evaluate the synchronous distance learning provided in the midst of covid-19 pandemic, on the other hand to trigger a global study, for distance education imposed worldwide due to the covid-19 pandemic.

2.1 Research Questions

Taking into account the above, in the present research an attempt was made to answer the following research questions:

1. What problems do the parents of the students of the two pre-primary schools of Thessaloniki face during the synchronous distance learning?
2. To what extent does the involvement of the parents of the students of the two pre-primary schools of Thessaloniki extend during the synchronous distance learning?
3. To what extent do the parents of the students of the two pre-primary schools of Thessaloniki consider that the cooperation of the children with the teachers is sufficient during the synchronous distance learning?
4. To what extent do the parents of the students of the two pre-primary schools of Thessaloniki trust the teachers during the synchronous distance learning?

2.2 Research

The present research was prepared by two (2) Pre-primary schools of Thessaloniki, one in an urban area and one in a semi-urban area, during the period 2020-21, in which Greece was in compulsory lockdown, due to the COVID-19 pandemic. Schools during this time period were required to distance teaching and learning using the WEBEX software. Pre-primary schools were assigned with three (3) hours of 30 minutes distance teaching (teleducation). The children, with the help of their parents, attended classes by whatever means they had at home (laptop, mobile phone, tablet). Attendance, based on Greek legislation was mandatory, as is attending to Pre-primary schools (Αριθμ. 100872/Δ1 – ΦΕΚ Τεύχος Β’ 2569/27.06.2019).

The necessity of the present research arose when the teachers wanted to investigate the convenience and difficulties that parents encounter during the distance teaching of their children and to make their educational work meaningful.

3.0 Quantitative Experimental Research

3.1 Sample

The sample consisted from parents of the children who attend the 76th Pre-primary school of Thessaloniki and the Pre-primary school of Neochorouda. 67 students are enrolled in the 76th Pre-primary school of Thessaloniki. Of these, 63 have Greek citizenship, 3 Albanian, and 1 Georgian. 35 students are 5 years old and 32 are 4 years old.

There are 40 students enrolled in the Pre-primary school of Neochorouda, of which 31 are of Greek nationality, 1 of Albanian nationality, 4 Syrian refugees and 4 Afghan refugees. 24 students are 5 years old and 16 students are 4 years old.

The questionnaire was sent to all parents electronically, through a social network group. It was sent to the refugees' parents electronically and translated into English.

3.2 Participants

3.2.1 Individual Data of Subjects

Of the parents who completed the questionnaire, 17% were men and 83% were women.

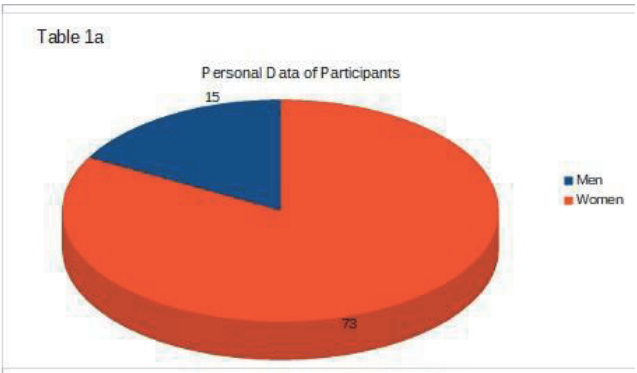


Table 1a: Personal Data of Participants

Completed by 88/107 parents, 82.2% of the total group of parents of students of the two schools. Of the parents who did not respond, eight (8) parents are the parents of refugee students attending the Pre-primary school of Neochorouda.

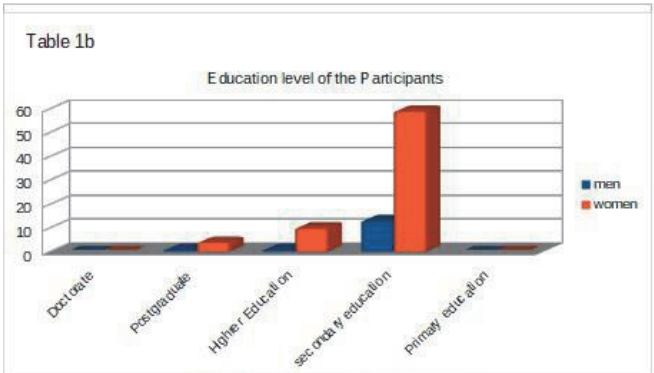


Table 1b: Education Level of Participants

According to Table 1b, the educational level of parents is wide, with a large percentage being secondary graduates 81%, 12.5% of parents are graduates of higher education and 4.5% of parents have a master's degree.

3.3 Questionnaire

The questionnaire has 15 statements, which refer to the views of parents, divided into four (5) main axes.

Table 1: Grouped questionnaire answers

	Questions	Analytical Description
1	Communication (3 statements)	Refers to Communication issues during distance learning.
2	Parent's involvement (3 statements)	Refers to the presence of the parents during the distance learning, to their weekly information by the teachers and to the daily information of the teachers by the parents in case of absence.
3	Cooperation (3 statements)	It refers to the collaborative solution of problems in computer use and problems that students encounter during distance learning.
4	Mutual trust (2 statements)	It refers to Trust in the teacher's face, to interpersonal relationships with the teacher.
5	Evaluation (3 statements)	It refers to the evaluation by the parents of the provided curriculum, the effectiveness in the children and the acceptance by the children.

This questionnaire used the Likert rating scale with a rating from 1 to 4, where 1 Agree and 4 Disagree.

3.4 Methodology

The questionnaire was piloted with 10 parents and after the first pilot survey, it was sent electronically to all parents of both schools, via the google forms. Finally, it was translated into English and sent to the parents of refugee students who do not speak Greek. Within a month all the answers were received and the statistical processing of the data started.

3.5 Data analysis

For each of the research questions there is a comparative table, with the results of the two schools that help readers better understand the results, while reading a short commentary.

1st Research Case

How many times does your child participate in distance learning?

As shown in Table 2, the largest percentage of children attend class daily. A small percentage watch 2/3 times and a small percentage never watch or rarely.

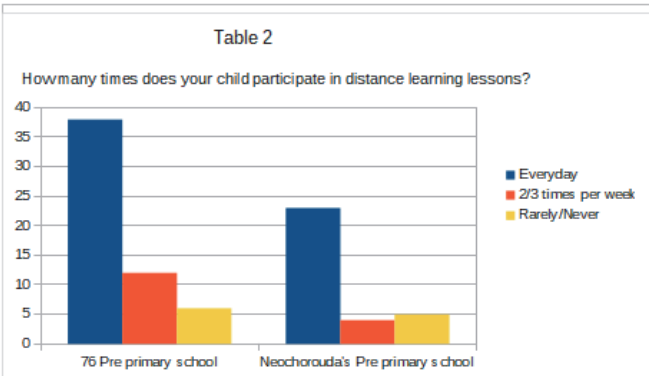


Table 2: How many times does your child participate in distance learning?

The reasons for not attending classes, as shown in the parents' commentary, can be summarized as follows:

- Inappropriate time. (3 answers). The lessons were set at 2.10 to 16.20 which for many children is nap time. Therefore, many children are extremely tired of attending class or prefer sleeping to class.
- Difficulty monitoring from mobile (2 answers). 2 parents stated that they only had mobile phones for distance learning, which makes attending classes extremely difficult.
- Lack of electronic media (3 answers). 3 families stated that they do not have electronic means, as the existing ones are used by the other members of the family (older children or parents).
- Disagreement with the use of electronic media (2 answers). 2 parents stated that their children do not want to have contact with electronic media.
- Inability to attend the lesson (3 answers) 3 parents stated that their children do not like to attend the lesson or cannot sit in front of the computer for so long.
- Parents' work (3 answers). 3 parents stated that they work during the distance learning and cannot support their children's participation.

2nd Research Case

Are you able to communicate with the school, both in scheduled online meetings, and in other cases, when you have problems with connection, audio, video?

As shown in Table 3, the parents of both schools in their majority, completely agree that the school teachers are available in communication and help in any audio and video problems.
Only a small percentage of 6% (3 parents) consider that they do not have the desired communication or assistance from teachers when there are problems with connection, audio and video during distance learning.

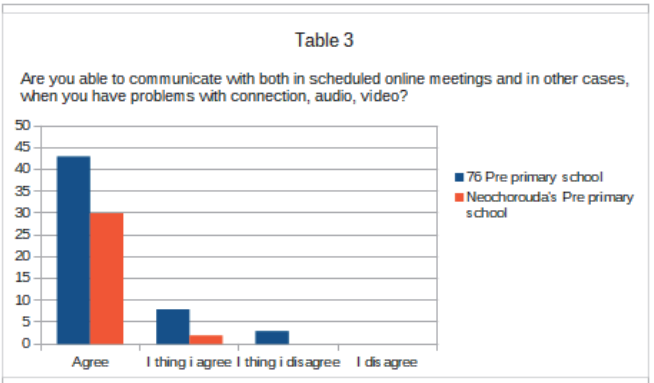


Table 3: Are you able to communicate with the school, both in scheduled online meetings, and in other cases, when you have problems with connection, audio, video?

3rd Research Case

Did this year's effort of your Pre-primary school teachers during distance education exceed your expectations?

According to Table 4, the parents of both schools' state that they are completely or rather satisfied with the teachers' efforts in evaluating their educational work. No parent evaluates teachers' efforts negatively or rather negatively.

Table 4

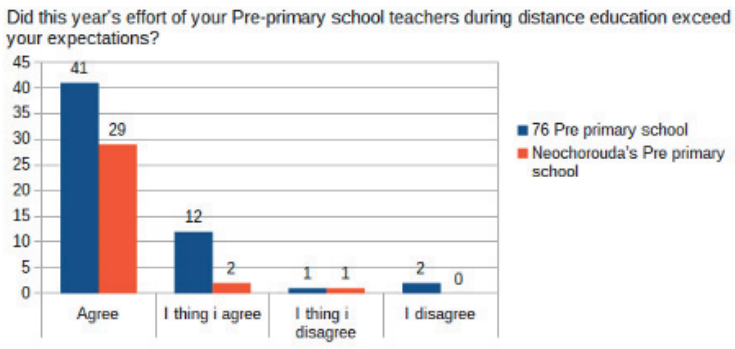


Table 4: Did this year's effort of your Pre-primary school teachers during distance education exceed your expectations?

4th Research Case

I find my child happy to participate in the online lessons?

According to Table 5, a high percentage evaluate positively or rather positively the psychology of their children during their participation in the online lesson. Of interest is the percentage of parents who evaluate negatively or rather negatively their children's participation in the online lesson.

Table 5

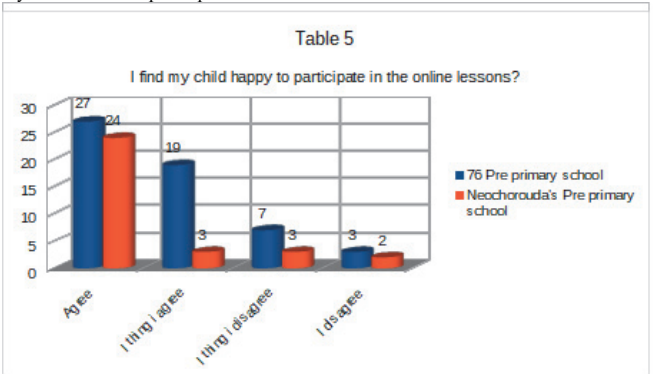


Table 5: I find my child happy to participate in the online lesson?

Parents' comments on the negative or rather negative assessment of their children's psychology can be summarized as follows:

- "*Lack of practical interest.*"
- *"The lesson is not very interesting".*
- *"Fatigue due to inappropriate time."*

- *"There is a phenomenon of lack of interest during the lesson, due to fatigue, which comes more from my completely inappropriate, personal point of view, lunch time and less from the distance learning process. "Lifelong learning is not replaced even at a basic level and in addition the parents are responsible for the important and at the same time sensitive role of the teacher who unfortunately often do not carry it out".*
- *"Practical procedural problems that cause frustration in children."*
- *"He does not like to sit in front of the computer.*
- *"When given the opportunity to answer a question, she often does not hear the answer from the hustle and bustle and is frustrated when the pre-primary school teachers do not hear it and do not reward her for the correct answer."*

5th Research Case

Am I present during the distance learning, keeping track of the quality of my child work, his / her development and progress, helping when needed?

According to Table 6, 92% of parents (72 answers) fully agree or agree that they are by their children's side, monitoring the quality of their work, progress and progress and helping when needed. And only 8% (7 answers) of parents leave their children unattended during distance learning.

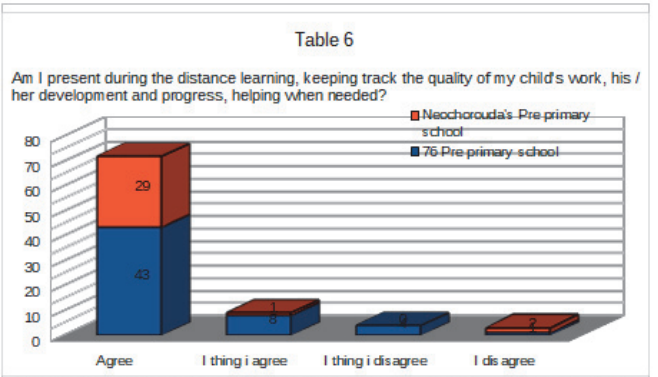


Table 6: Am I present during the distance learning, keeping track the quality of my child's work, his / her development and progress, helping when needed?

6th Research Case

Am I informed about my child weekly education program, as well as any other individual and group support provided in synchronous distance education by pre-primary school teachers?

As shown in Table 7, the vast majority of parents of the 76th Pre-primary school of Thessaloniki at 100% state that they are informed by the teachers of the Pre-primary school on a weekly basis both about the weekly program and that they receive individual or group support on a weekly basis. In the case of Neohorouda pre-primary school, 88% of the parents consider that they are informed by the teachers on a weekly basis and 12% consider that they are not informed on a weekly basis about their children's program or do not receive individual or group support from the Pre-primary school teachers.

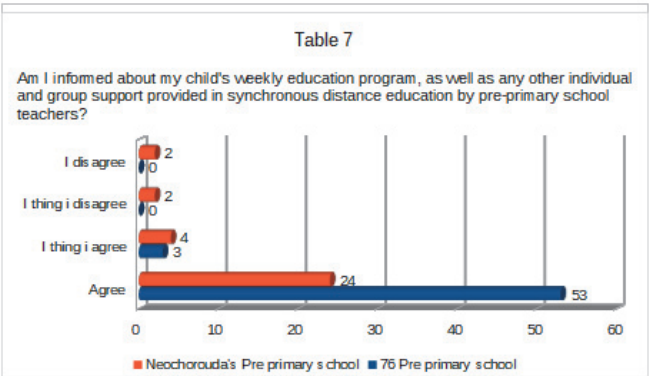


Table 7: Am I informed about my child's weekly education program, as well as any other individual and group support provided in synchronous distance education by pre-primary school teachers?

7th Research Case

Do I inform the pre-primary school in cases of events at home that may affect my child presence in the online classroom?

According to Table 8, 88% (77 answers) of the parents of both schools agree or strongly agree that they inform the school about anything that may affect the presence of their children in online education. A percentage of 12% (11 answers) state that they do not inform the school about changes that may affect their child's presence in the classroom.

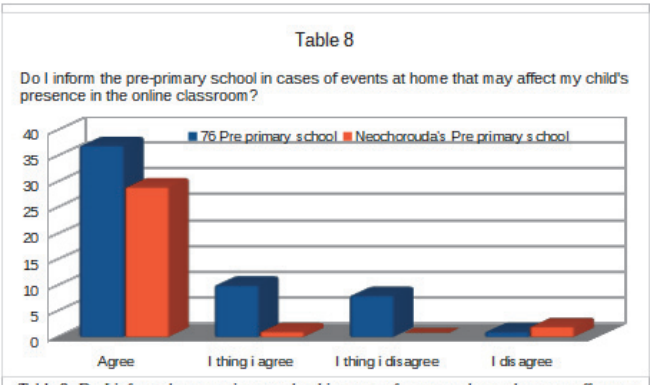


Table 8: Do I inform the pre-primary school in cases of events at home that may affect my child's presence in the online classroom?

8th Research Case

Does my child understand the instructions of the pre-primary school teachers during the distance learning?

As shown in Table 9, 79 parents (90%) agree or rather agree that their child understands the instructions of teachers in modern distance education.

9 parents (10%) consider that their child does not understand or rather does not understand the instructions of teachers during modern distance education.

It would be interesting if there were answers for the reason for not understanding the instructions or suggestions for how the teachers' instructions could be understood.

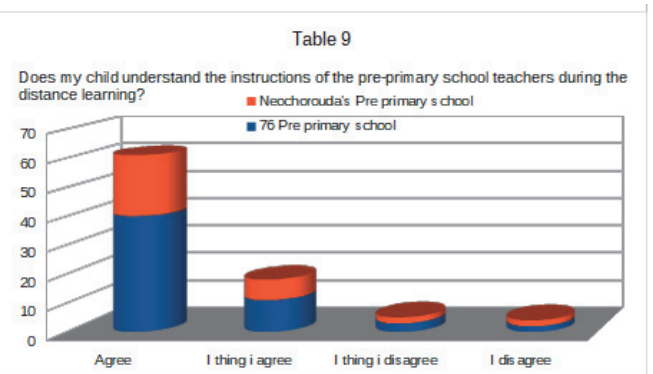


Table 9: Does my child understand the instructions of the pre-primary school teachers during the distance learning?

9th Research Case

Does the Pre-primary School help me acquire skills or information related to the using skills 'and using the webex online platform?

According to Table 10, 83% (73 responses) of parents respond positively or rather positively to the help they receive from the Pre-primary school regarding the use of the webex platform and in general the skills of the parents using the internet.

A percentage of 17% of parents (15 answers) answer negatively or rather negatively, considering that they do not receive help regarding the use of the webex platform and more generally about their skills using the internet. All the negative or rather negative answers concern the 76th Pre-primary school of Thessaloniki, as the parents of Neochorouda's Pre-primary school answer positively or rather positively in a percentage of 100%.

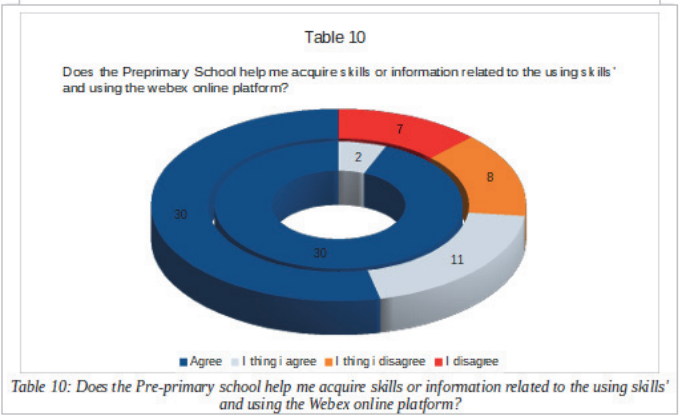


Table 10: Does the Pre-primary school help me acquire skills or information related to the using skills' and using the Webex online platform?

It would be really interesting for parents to have added information in the comments to get more accurate information about using the webex platform, so that in the future more accurate information can be provided, if needed.

10th Research Case

Do the distance learning Pre-primary School teachers 'courses meet my child individual needs?

According to Table 11, 84% of parents agree or rather agree that distance education courses meet their children's individual needs. It is interesting that while in their previous answers "I totally agree" prevails, in this Table, "I probably agree" has received a percentage of 34%, stating a small challenge.

The remaining 16% of parents believe that the courses offered in distance education do not meet the individual needs of their children.

Table 11

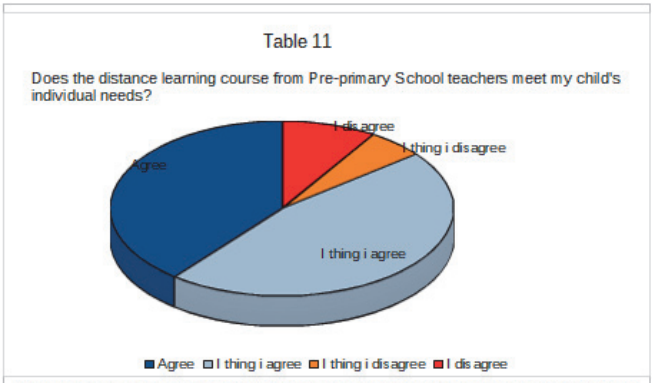


Table 11: Does the distance learning Pre-primary school teachers' courses meet my child's individual needs?

Their answers to the reasons that make them evaluate negatively the courses offered by Pre-primary school during distance education is summarized as follows:

- Inadequate distance learning schedule.
- The inappropriateness of the lessons for the age of the children.
- The inadequacy of writing for playful activities.
- The lack of contact with nature.
- Lack of contact with other children.

➢ "*I believe that a child 4+ cannot gather between the hours of 14.00-16.00 to do a lesson because these are the hours when he traditionally rests. And because his fatigue grows as time goes by, he is unable to attend activities such as work or reading a fairy tale rather than being consumed in the presentation and the date. Finally, I strongly disagree with the fact that children at 4 must know how to write the date. This learning must be done through play (as they did the plasticine job with the first letter of their name). I fully understand that the program and planning start from the Ministry of Education but there must be flexibility and adaptability based on the children and their needs. Thank you very much".*

➢ *"The role of the Pre-primary school is for the children to have contact with nature and to develop friendships. It's definitely not about having kids stuck on a computer. "*

11th Research Case

Does the daily distance learning lesson from the pre-primary school teachers meet the special educational needs of my child? (This question addressed to parents with a child in the integration department or in parallel support).

Of the 5 children belonging to this category of students, 4 parents evaluate positively the quality of the courses provided regarding the special needs of their children and only 1 parent evaluates the lesson related to the special category of their child rather negatively.

It would be interesting if there were answers about the reason for the negative evaluation or suggestions for improving the educational project.

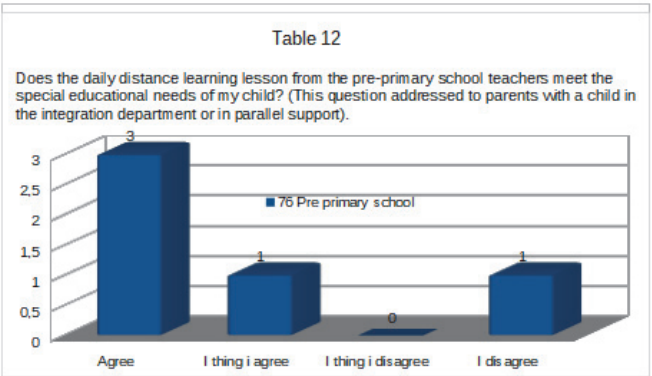


Table 12: Does the daily distance learning lesson from the pre-primary school teachers meet the special educational needs of my child? (This question addressed to parents with a child in the integration department or in parallel support).

(The Pre-primary school of Neochorouda does not have an integration department or parallel support and the above question was not answered by any parent. Thus, the results of the above question concern only the 76th Kindergarten of Thessaloniki).

12th Research Case

Does the Pre-primary school make every effort to support synchronous distance education by providing the necessary printed material for daily activities?

The vast majority of parents 100% agrees that teachers have supported modern distance education with printed material, with every possible effort.

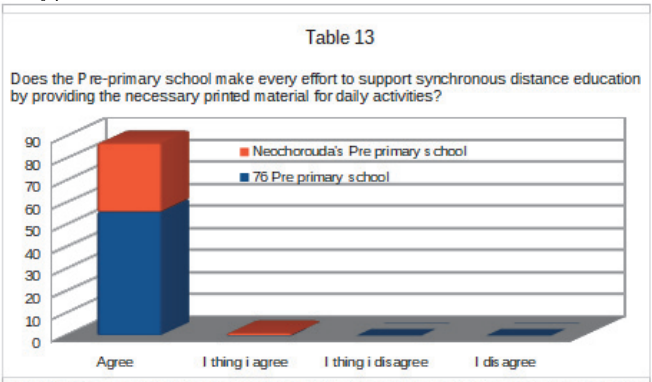


Table 13: Does the Pre-primary school make every day effort to support synchronous distance education by providing the necessary printed material for daily activities?

13th Research Case

Do I feel friendly and comfortable with the pre-primary school teachers, if I need to intervene during the teleducation?

According to Table 14, the vast majority of parents, 98.8% agree or rather agree that they feel comfortable intervening in any need during distance learning.

Only 1.2% of parents do not feel comfortable intervening during distance learning. (The parents of the 76th Kindergarten of Thessaloniki have no negative answers.)

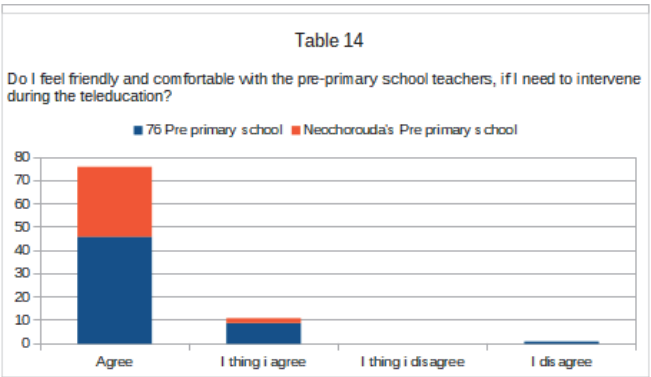


Table 14: Do I feel friendly and comfortable with the pre-primary school teachers, if i need to intervene during the teleducation?

14th Research Case

Is the daily program of interest to my child?

As shown in Table 15, all parents of both pre-primary schools agree or rather agree that the daily program is of interest to their child at a rate of 89.7%. There is a portion of parents who assess that the lesson is not or probably not interesting for their child, and this constitutes 10.3% of the answers.

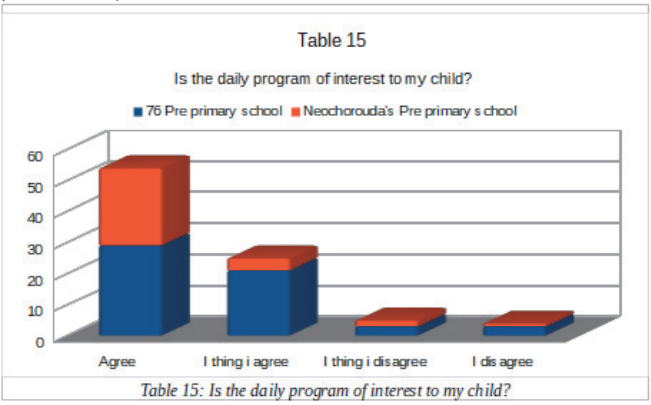


Table 15: Is the daily program of interest to my child?

15th Research Case

Are Pre-primary school teachers 'people I can trust and rely on?

According to Table 16, 96.5% of parents say they trust or rather trust their children's school teachers and only 3.5% probably do not trust their children's school teachers.

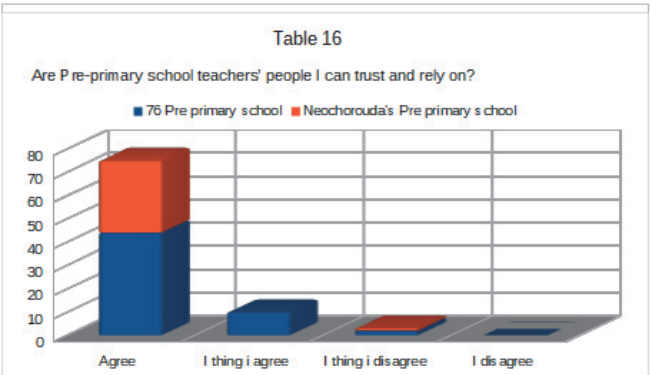


Table 16: Are P re-primary school teachers' people i can trust and rely on?

4.0 Conclusion and Discussion

The research presented aimed to investigate the views and the degree of satisfaction of parents in relation to distance learning, in an effort to evaluate and improve the educational work of the two kindergartens in Thessaloniki.

The data that emerged from this research effort led to important findings, which stem from the point of view of parents, i.e. how they themselves experience working with the pre-primary school in order to better implement distance education, but also demonstrates the importance of preparation, support and training of teachers for the methodology of EXAE, according to Dempsey & Burke [13], Reimers & Schleicher [14] and by UNESCO [1].

Indeed, the parents in both schools were given the special role during the distance learning to ensure in the educational process the appropriate financial-technological resources for their children and on the other hand they were responsible for the daily participation and supervision of their educational activities.

From the small percentage of parents whose children did not attend distance education, (because unfortunately we did not receive answers from parents who did not participate in distance learning at all) it appears that the time of the lessons, in relation to the lack of interest is from them key factors of non-participation in the distance learning course.

In substantiating the answers, we focused on the statements of negative or low participation. According to the answers, the children who did not participate in the distance education were both 5-year-olds and 4-year-olds. One would expect 4-year-olds to be more distant, as they are younger and will repeat their studies. On the contrary, 5-year-olds, as they walk to primary school, one would expect to participate uninterruptedly. Perhaps the role of the Pre-primary school for some parents is to take care of their children and not the educational experience offered by preschool education.

Our research also confirms the important role of parents and families in the development and education of children [5] and finds that the general satisfaction of parents with their children's learning is influenced by various factors, including levels parental education, marital status and socioeconomic characteristics [6]. More specifically, the parents of the children who did not participate or participated a little in the modern online education, in the majority were graduates of higher education. Some of them did not want their children to participate in e-learning for ideological reasons (contact with technological means), some of them did not have the technological means to support their children's e-learning, because they and other members of their family worked at the same time. Finally, some of them stated that their child did not like distance education or that their children were sleeping at that time. Higher education parents seem to want different things for their children than distance education offers or set different priorities.

On the contrary, the parents who were secondary school graduates, it seems that as a whole their children were constantly present in the distance education classes and were always by their side.

It is a great lack of non-response from immigrant parents of children attending kindergarten. Nevertheless, the total absence of these students from modern distance education confirms the extensive reports of social inequalities that children from vulnerable groups, low socio-economic status, low performance, etc. face with home learning, as reported by Masters et al [15] and by UNESCO, [1].

Also, through this research the role of teachers in relation to the parents of the student children is highlighted. According to the research, parents who feel safe and trust their children's teachers say that they participate in the

lesson every day, while parents who do not trust teachers or do not feel safe, say that their children participate little or not at all.

In conclusion, in the Pre-primary school, due to the young age of the students, the teachers have to build relationships with the parents of their students and not only with the students.

The answers we received to all the questions related to the areas explored Communication, Information Exchange, Cooperation, Mutual Trust, Evaluation.

The training program implemented in the two pre-primary schools was done in accordance with some of the priorities proposed by UNESCO [1] for education in pandemic conditions: the immediate emotional / psychological support of all involved, the choice of more or less technological solutions according to accessibility and digital capabilities, upgrading digital infrastructure, creating / delivering open educational content, ensuring equal opportunities, protecting privacy and personal data, accelerating teacher training and support for the design / creation of student-centered learning activities; and selection of the appropriate type of EXAE provision (online, Educational TV, Radio, printed educational material), the participation of parents / guardians to support home learning, the duration of lessons based on the self-regulatory abilities of students / three, the use configure evaluation, providing feedback and designing long-term training goals in the new regularity.

Certainly, the results of the research are one aspect of reality, certainly not the only one, and cannot lead to generalizations about the design, planning and implementation of an action plan to improve e-learning. This is not only because of the limited number of subjects and case studies, but mainly because there are no data on all the variables related to school becoming. However, as case studies, they can be the reason for their conclusions to lead to further research.

5.0 References

1. UNESCO. (2020). UNESCO's support: Educational response to COVID 19. UNESCO. https://ru.unesco.org/covid19/ educationresponse (Retrieved 03/02/2021).
2. Beck, D. E., Maranto, R., & Lo, W. J. (2014). Determinants of student and parent satisfaction at a cyber charter school. Journal of Educational Research, 107(3), 209–216. https://doi.org/10.1080/00220671.2013.807494 , (retrieved 28/01/2021).
3. Schlosser, L. A., & Simonson, M. (2002). Distance Education: Definition and Glossary of Terms By Distance Education, 5(3), 211– 213. http://search.ebscohost.com/login.aspx?direct=true&db=ehh&AN=16304241&site=ehost-live (Retrieved 03/02/2021).
4. Rideout, V. J., & Katz, V. S. (2016). Opportunity for all? Technology and learning in lower-income families. A report of the families and media project. The Joan Ganz Cooney Center at Sesame Workshop, (retrieved 08/02/2021).
5. Durisic, M., & Bunijevac, M. (2017). Parential inolvement as an important factor for successful education. CEPS Journal, 7(3), 137–153.
6. Jónsdóttir, K., Björnsdóttir, A., & Bæck, U. D. K. (2017). Influential factors behind parents' general satisfaction with compulsory schools in Iceland. Nordic Journal of Studies in Educational Policy, 3(2), 155–164. https://doi.org/10.1080/20020317.2017.1347012 (Retrieved 03/02/2021).
7. Bhamani, S., Makhdoom, A. Z., Bharuchi, V., Ali, N., Kaleem, S., & Ahmed, D. (2020). Home Learning in Times of COVID: Experiences of Parents. Journal of Education and Educational Development, 7(1), 9. https://doi.org/10.22555/joeed.v7i1.3260 (retrieved 28/01/2021).
8. Lase, D., Zaluchu, S. E., Daeli, D. O., & Ndraha, A. (2020). Parents' Perceptions of Distance Learning during Covid-19 Pandemic in Rural Indonesia, https://doi.org/10.35542/osf.io/hfza7 ,(retrieved 03/02/2021).
9. 9. Lau, E. Y. H., & Lee, K. (2020). Parents' Views on Young Children's Distance Learning and Screen Time During COVID-19 Class Suspension in Hong Kong. Early Education and Development. https://doi.org/10.1080/10409289.2020.1843925 (Retrieved 28/01/2021).
10. Bokayev, B., Torebekova, Z., Davletbayeva, Z., & Zhakypova, F. (2021). Distance learning in Kazakhstan: estimating parents' satisfaction of educational quality during the coronavirus. Technology, Pedagogy and Education, 00(00), 1–13. https://doi.org/10.1080/1475939X.2020.1865192 , (retrieved 03/02/2021).
11. Bonal, X., & González, S. (2020). The impact of lockdown on the learning gap: family and school divisions in times of crisis. International Review of Education, 66(5–6), 635–655. https://doi.org/10.1007/s11159-020-09860-z (retrieved 04/01/2021).
12. Mangiavacchi, L., Piccoli, L., & Pieroni, L. (2020). Fathers Matter: Intra-Household Responsibilities and Children's Wellbeing during the COVID-19 Lockdown in Italy. IZA Discussion Paper, 13519.
13. Dempsey, M., & Burke, J. (2020). *Covid-19 Practice in Primary Schools in Ireland Report: A Two month Follow-up*. *May*, 1–98. https://doi.org/10.13140/RG.2.2.14091.03369 (retrieved 28/01/2021).

14. Reimers, F. M., & Andreas, S. (2020). A framework to guide an education response to the COVID - 19 pandemic of 2020. *OECD,* 1–40
15. Masters, N. B., Shih, S. F., Bukoff, A., Akel, K. B., Kobayashi, L. C., Miller, A. L., ... & Wagner, A. L. (2020). Social distancing in response to the novel coronavirus (COVID-19) in the United States. *PloS one*, *15*(9), e0239025.

Impact of the *COVID*-19 Pandemic on Education: Experiences and Feelings Reported by Primary School Pupils from Greece and Turkey

[1]Demet Soylu, [2,3]Georgios Lampropoulos, [4]Errikos Siakas, [5]Maria Panteri, [6]Juri Petri Valtanen, [7]Eleni Berki, [2,8]Kerstin Siakas,[9]Tunç D. Medeni, [10]Adam Edwards, [10]Elli Georgiadou

[1] Hacettepe University, Turkey, bunchnoble@gmail.com

[2] International Hellenic University, Greece,lamprop.geo@gmail.com,ksiakas@gmail.com

[3] Hellenic Open University, Greece,lamprop.geo@gmail.com

[4] Aristotle University of Thessaloniki, Greece,esiakas@gmail.com

[5] Iraklion Special Needs Secondary School, Greece,mar_krhth@yahoo.gr

[6] Tampere University, Finland, valtanenjuripetri@gmail.com

[7] Jyväskylä University, Finland, eleniberki1@gmail.com

[8] University of Vaasa, Finland,ksiakas@gmail.com

[9] Ankara Yıldırım Beyazıt University, Turkey,tmedeni@gmail.com

[10] Middlesex University, United Kingdom, a.edwards@mdx.ac.uk, e.georgiadou@mdx.ac.uk

Abstract

COVID-19 pandemic had a huge impact upon life and the educational experience of students. One of the groups mostly affected from this global pandemic is the primary school children. The sudden transition to distance education from traditional face-to-face education undoubtedly changed the implementation methods of the teaching programmes in schools. The research study reported in this paper was carried out in Greece and Turkey. Responses were collected from primary school pupils who voluntarily and anonymously completed an online questionnaire with multiple choice questions. The latter were carefully worded in an appropriate

and understandable way, using language suitable for primary school age children. Comparisons between the responses from the two countries revealed similarities and differences. Through a comparative approach the research results are particularly scrutinised through the lenses of equal opportunities and social inclusion policies along with a cross-cultural perspective, which is expected to have a useful impact during the post-pandemic era. By sharing the collective knowledge and experience gained, we aspire to propose educational strategies for well-being and recovery, and overall educational process improvement.

Keywords: *COVID-19* pandemic primary education, socio-digital inclusion, online questionnaire, online learning, cross-cultural study

1. Introduction - Primary Education and *COVID* -19 Across the World

The sudden and quick outbreak of the Coronavirus (*COVID*-19) pandemic resulted in unprecedented loss of life and in major disruption of all aspects of human activity. The thread to life and livelihood continues to challenge humanity. Education was no exception. The rapid transition from traditional face-to-face learning to remote (online, by post, and other) learning was proved to be a great challenge for schools, school teachers, pupils and their families. It also directly challenges, above all, the educational, socio-technical and knowledge infrastructures which, in turn, influence the well-being of the individuals in the information society. A whole year has already gone by and still a large number of schools across the world remain closed or are closing intermittently. According to data released by UNESCO in 2020, over 800 million pupils, a percentage which corresponds to half of the world's pupil population, continue to face major disruption in their education and lives [1].

A number of researchers carried out country or sector specific studies and it has been reported that pre-existing inequalities, such as the digital divide, were exacerbated and continue so at the present rate [2, 3] . Lack of or poor preparedness coupled with the required speed of implementing the transition are the two factors responsible for the varying degrees of success. Vulnerable and disadvantaged communities suffered more severe problems both in terms of disproportionate high loss of life and loss of learning opportunities [4]. Additionally, many of the published research papers refer to actions and opinions of senior decision makers, ignoring the voices of other interested groups and learners of primary education in particular.

The study reported in this paper was initially carried out in Greece, Cyprus and Turkey. Responses were collected from primary school pupils who voluntarily and anonymously completed an online questionnaire with multiple choice questions. The questions were carefully worded in an appropriate and understandable way using language suitable for the primary school age children, thus customised to the socio-cognitive and socio-technical skills and learning needs of children at the age of 6-12. The pupils were invited to describe the problems related to their studying and learning, their communication with their fellow pupils, and with their teachers. They were also asked to express their feelings, experiences and opinions. Through this part of the questionnaire, the state of the pupils' well-being could be ascertained. Finally, the answers from the four (4) Cypriot participants were not included in the sample examined herein because the disparity in numbers of responses would render any comparison unrealistic and statistically inaccurate.

We particularly aimed at identifying educational practices and prevailing pedagogic and socio-technical problems in order to draw comparisons among the participating countries, genders and socio-economic strata including pupils' digital literacy, and the availability and secure access of digital technologies. Attention was paid to parent/guardian employment status before and during the pandemic, and to parents'/guardians' ability (e.g. financial, educational, socio-digital and other) to support and safely guide their children while on remote and/or online learning. Further, the research study, based on pupils' experiences, aimed at exposing the advantages and disadvantages and security dangers of online learning [4, 5]. Comparisons between the two countries revealed commonalities and differences that are discussed in a later section.

Based on the comparative analysis of the results, the authors discuss equal opportunities and social inclusion policies. By sharing the collective knowledge and experience gained, we aspire to propose strategies for recovery that can benefit the overall educational process improvement efforts.

The rest of the paper presents a brief literature review (section 2), followed by section 3 which discusses the socio-economic and digital inequalities in general, and their impact on primary education in particular at these challenging times of the pandemic. The research questions and the questionnaire structure are shown in Section 4. The results and their interpretation follow in Section 5. Section 6 presents the identified similarities and differences, and section 7 contains suggestions for recovery and overall learning and teaching process improvement.

2. Related research

2.1 Education of primary school teachers in Greece.

The education of primary school teachers in Greece, focuses on familiarizing future primary school teachers with skills related to Information and

Communication Technologies (ICTs), digital technologies and applications they can use in teaching and learning according to Tzifopoulos [7-8].

2.1.1 University pedagogic departments of Primary Education

Tzifopoulos [7] investigated the curricula of the nine pedagogic departments at Greek universities that prepare teachers (preschool teachers, primary school teachers and philologists) in Greece, and described the modules offered and related to Information and Communication Technologies (ICTs) and digital tools. Seven of the nine university pedagogic departments that offer primary school education in Greece offer from 4 to 10 ICT modules to primary school teacher candidates. In total, of the 84 modules offered, concerning computers and ICTs, twelve (16.7%) are compulsory and 8 modules combine theoretical and laboratory approaches. Two are totally theoretical modules and one module has a laboratory character. Teacher candidates can acquire more specialised knowledge and enhance their technical and pedagogical skills with the contribution of digital technology, such as Programming Languages, WebQuests, Digital Games, Digital Comics, Virtual Learning Environments, Wikis, Blogs, Websites, STEM Applications, Video Editing, Google Apps and other [7-8].

2.1.2 University Schools of preschool teachers, primary school teachers and philologists

Tzifopoulos investigated the curricula of other University Schools that prepare teachers (preschool teachers, primary school teachers and philologists) in Greece, and described the modules offered and related to Information ICTs and digital tools [7-8]. He identified both theoretical and practical modules, as well as modules related to distance education contact (Tzifopoulos & Bikos, 2016). However, of the 44 modules devoted to ICTs only one third of them are compulsory. Seven of the compulsory modules (half of them) are Computer Science modules. Three (3) modules were identified to include theoretical orientation for technology (theories for educational technology and ICT learning). The other modules (4) identified were laboratory modules linking theory to practice. The remaining 30 optional modules, included four in Computer Science, seven (7) related to theoretical issues for technology and the remaining 19 modules were characterised as "*application modules*". Also, two modules compatible with teaching with modern educational platforms entitled "*Design, implementation and evaluation of actions and materials of modern and asynchronous distance learning*", "*Online tools*" were identified.

Tertiary education institutions preparing teachers for primary education: A small number of compulsory ICT modules (12) and a disproportionately larger number of elective specialised modules (72) were identified. The elective modules aim to help deepen concepts and applications, useful for the educational process.

Learners, in general, seem to be quite familiar with the use of ICTs and technology, but they are integrated into their own everyday practices, such as entertainment (YouTube), communication (social networking, such as by the use of Instagram,

Facebook, Messenger) digital games (such as Roblox). Parents consider this activity to be natural, but not so natural in the school environment [10, 11, 12] .

Attempts are also made by the government to support e-learning in the pandemic by providing (a) synchronous form of learning, with digital libraries and websites, such as Photodentro (http://photodentro.edu.gr/lor/), digital school (https://dschool.edu.gr/), digital platform "e-me" (https://auth.e-me.edu.gr/), platform "Aesop" (http://aesop.iep.edu.gr/), video lessons from the Hellenic Radio Television (ERT) (https://webtv.ert.gr/category/mathainoume-sto-spiti/), involving pupils in this process and with adequate preparation of teachers to "upload" material to the platforms and accept the assignments of their learners [8].

Also a form of flipped classroom, where learners read, research, and consult digital material through platforms outside the school context and as assignment discuss the relevant theory and what they undertook at home in order to develop it and reflect further slowly also starts to be used. This is achieved through strategies for problem-solving, collaboration and interaction among learners and between learners with their teacher.

Tzifopoulos [8] asserts that the more positive the epistemological assumptions of the teacher about the modern form of learning are, the more receptive they seem to be to harnessing technology with didactic and pedagogical targeting.

2.2 Support by the Hellenic Ministry to teachers and learners during the pandemic

Attempts were made by the Hellenic Ministry immediately establishing a help desk for advice, support and solving problems. The lack of digital equipment was addressed at a later stage with donation of equipment, such as tablets and laptops, that reached schools across Greece to enable the distant learning process. The telecommunication services provided free of charge access to national platforms and software used for teaching and accessibility to all learners and teachers [13]. Furthermore, the Ministry set up a website (https://mathainoumestospiti.gov.gr/) to provide the teaching and learning community with useful and innovative distance learning tools and ideas.

In the framework of Action [13]: Staying at home with eTwinning the Hellenic National, the Support Service (EYY) of eTwinning created three online seminars and webinars:

1. Distant learning – Communication tools – Cooperation tools – Advice https://seminars.etwinning.gr/course/view.php?id=4221,
2. Educational Communities & Blogs in the Panhellenic School Network (blogs.sch.gr) https://seminars.etwinning.gr/course/view.php?id=4222,
3. Electronic school class PSN (eclass.sch.gr) https://seminars.etwinning.gr/course/view.php?id=4223.

The eTwinning also promoted a webinar on “Practical tools for developing well-being and cohesion in classroom groups during *COVID*-19 time” and approved

twelve new works on *COVID*-19 for the implementation of which, 372 teachers of primary and secondary education collaborated from all around Europe. In total 382 new teachers and 214 new school units registered on the platform of eTwinning from March 2020. It also created ten semi-yearly webinars (of 120 hours each) https://seminars.etwinning.gr. On an international level the Hellenic eTwinning Support Service (EYY) participates and organizes the following actions:

1. In- school eTwinning collaborative projects through TwinSpace platform and other digital tools shared by the pupils and teachers participating in the projects
2. New Groups "eTwinning at Home, eTwinning in times of school closure"
3. Monthly learning events and webinars, such as:
    - Learning Event 2020: How to launch an eTwinning VET project from zero?
    - How to implement projects into lessons, and lessons into project,
    - The School Education Gateway School Education Gateway.

The Ministry of Education is planning to develop a crash-course training programme (15 hours) for all teachers of the public sector in digital skills and distance learning.

3.Education of Primary School Teachers in Turkey

Training teachers is one of the key topics in the Turkish Educational System. Education has three significant pillars, namely student, teacher and programme. Integrity and success of an educational system is based upon this. Teachers in education goes in parallel with the political, socio-economic and cultural developments. During the process of transition to the Turkish Republic Period, education of teachers was a central issue, as well. In 1923, there were 10102 primary school teachers, 1081 of them female and 9021 of them male. Also, 378 of the teachers who had vocational education were female and 2356 of them were male. Out of the remaining 7368 teachers 1357 had secondary school education, 152 of them did not have regular education [14]. Turkey underwent different teacher training programmes. In the Republic Period, legal efforts were made to enable the teaching activity as a legal occupation. The educational period of teachers studies were extended to six years in 1932-1933. It was composed of two sections. The first three years was called as the first educational period, and the following three years were called the second educational period. After a period of time, this implementation was removed. Training village teachers came to the fore in 1937. Two educational institution, one in Eskişehir and the other one in İzmir, were opened. This implementation began to be the starting period of the publication of Law 4274 regarding the village institutes (a kind of teaching institution for training teachers) and enactment of 3238 named "Village educational courses" and "Village Teacher School". Between 1924-1938 professional courses for teaching were prioritised. In different parts of the country, till 1948, 21 village institutes were established and high village institute, providing three-year higher education was established. Till 1953, the policy of training two types of primary school teachers was sustained. After this, with law 6234,

institutions training teachers were combined under the title of " Primary School Teacher ". In 1974, two year education institutes started to be opened. In 1976, 30 of the 50 institutions were closed. Since the 20th of July 1982, they were turned into vocational high schools and were included within the frame of universities [15]. As of 1989, teaching period of high schools were prolonged to 4 years and they got transformed into educational faculties. Today in universities, in educational faculties, teachers were trained in the four-year departments. They study subjects such as Educational philosophy, Information Technologies, Fundamentals of Early Childhood, Child Health and First Aid Kit, Early Childhood Program, Teaching Technologies, Performance Measurement and Evaluation, ICT Technologies, Teaching Design, Games in Early School Development Period, Turkish Educational System and School Management, Art Education in Early Childhood, Training of Social Values.

3.1.Distance Education in Turkey During *COVID* 19

Primary education was both provided in distance education teaching platforms and TRT EBA TV channel. The courses were repeated three times. In EBA there exist approximately 40,000 rich, reliable and interactive content. There are videos, interactive content, summaries, infographics, project documents, contents special for teachers. Also there were books (more than 5000) and there were questions more than 240,000 [16]. Besides this, students joined the courses offered by their schools. For some children who have limited access to the Internet and laptops, smart phones, support was provided by the state. In some classes, online exams were made. In other classes, assignments were given to the students.

4.Socio-economic and Digital Literacy Inequalities

4.1 The Pre-existing Digital Divide

Learners from different cultural and economic backgrounds have given rise to digital inequalities related to the level of availability of digital infrastructure at home and the education levels of their parents, who may lack digital skills themselves [17] This concerns the different degree of familiarity and engagement with the digital tools of learners of the same age group. Digital divide also refers to the gap between demographics and regions that have access to Information and Communication Technologies (ICTs). The digital divide is heavily interwoven with the issue of education and poverty [18].

Long before the pandemic ICT literacy has been viewed as a set of user skills that enable active participation in a society where services and cultural offerings are computer-supported and distributed on the Internet. Technological literacy (formerly referred to as computer literacy) entails a deeper understanding of digital technology and comprises both user and technical computing skills. At the same time a growing gap between certain countries and sections of society even within advanced economies considerable levels of illiteracy as well as digital literacy kept

growing [19, 20]. Karpati [21] identified (i) effective selection and application of ICT systems and devices, (ii) utilisation of common generic software tools in private life, (ii) use of specialised tools for work; and (iv) flexible adaptation to changes in infrastructure and applications, as core skills in order to become ICT user literate.

In addition to pre-existing efforts towards bridging the digital divide, the crisis caused by the *COVID*-19 pandemic meant that teachers and parents had to switch to Emergency Remote Teaching [22].The lack of preparedness by governments has its root in political and economic ideologies and policies which result in an increase in inequalities in advance economies but primarily in countries struggling under immense national debt.

In the UK, one of the seven richest economies in the world, many primary school children from deprived backgrounds found themselves lagging behind due to cramped living conditions, with limited facilities they had to share with siblings, often with parents out of work. They had to be supplied with digital equipment by the school, the municipality, or by charities. Andrew et al. [23] in their extensive study found that *"there is a real risk that time spent learning at home since schools closed in March 2020 has widened educational inequalities between poorer and richer students, especially among primary school students. If the pandemic forces schools to close again, it will continue particularly to deprive poorer students of the protective and (at least partly) equalising role that time in school can play for their learning and development".*

As Tumwesige [24] emphasises *"the digital divide in Uganda highlights the enormous inequality gap The difficulty of accessing learning technologies and level of digital literacy skills between privileged and the deprived groups continues to widen the education gap. For the vast majority of learners living in rural Uganda, online learning is but a dream within a dream."*

UNICEF Office of Research – Innocenti [25] reported in March 2021that *"COVID-19 has negatively affected social spending in indebted countries, in sectors including education, child protection, nutrition, and water, sanitation and hygiene……this identifies priority countries with high levels of child poverty, where budget expenditure on key social sectors may be threatened if debt levels continue to rise".*

Countries that are plagued by poverty and deprivation spent a higher proportion of total government expenditure on debt service in 2019 than they did on education, health and social protection combined. The socio-digital divide is a consequence of the socioeconomic divide and anti-social policies of the local governments and international bodies and organisations.

Azubuike et al. [3], for example, studied remote learning in Nigeria during the COVID-19 pandemic by using a quantitative study including 557 pupils and 626

parents living in Nigeria. The results showed significant differences in access to remote learning opportunities during the pandemic by pupils. They also found significant differences in access to digital tools between pupils in government schools and private schools as well as a statistically significant relationship between parental level of education and the ability to support learners in their remote learning during the pandemic.

4.2 Rapid Digital Skills Acquisition by Teachers. The Role of Parents

Rapid digitalization, over the past decades, has transformed many aspects of work and daily life. The education and training system is increasingly part of the digital transformation and can take advantage of its benefits and opportunities. However, it must also effectively manage the risks, including the risk of the urban / rural digital divide where some people can benefit more than others. This transformation in education during the COVID-19 era is influenced by advances in connectivity, the widespread use of devices and digital applications, the need for individual flexibility and the growing demand for digital skills. The COVID-19 crisis has significantly accelerated this change [26].

The question that arises is what the role of teachers and parents is in this new online learning experience. Undoubtedly, the COVID-19 crisis has for the first time put teachers, students and parents in a situation where there were not many options but to use digital technologies to provide education and training. Many educators and students faced a steep learning curve as their digital skills had to be updated at a rapid pace. In this unprecedented use of technology for learning, teachers had to organize their teaching differently and interact with students on a more personalized basis, focusing on their specific needs.

Based on this knowledge, efforts should be made by governments and school principals to support teachers to effectively integrate online tools into their teaching practices, e.g. encouraging the pedagogies of teachers that aim to provide guidance and motivation to students for active learning [27]. In addition, it should be ensured that the use of digital technologies and online tools corresponds to the needs of students, their previous skills and their digital education. In fact, it is argued that the role of the teacher in the integration of digital technology in education is crucial, as when it is done skillfully, equitably and effectively by teachers, it can fully support the agenda of high quality and inclusive education and training for all students. It can also facilitate more personalized, flexible and student-centered learning, in all phases and stages of education, as technology can be a powerful and engaging tool for collaborative and creative learning [28].

The role of parents in the online learning experience is also emphasised, especially in the development of strong attitudes towards learning that can help students overcome some of the potential challenges posed by online learning, such as staying focused during online lessons or maintain adequate motivation. These data suggest that parents can play a critical role in homeschooling, such as ensuring that their children follow the curriculum and supporting their children emotionally to maintain their motivation and ambitious goals in a situation where they can easily

be discouraged. However, many obstacles can hinder effective parental engagement; for example, they may find it difficult to engage their children in school work while combining work or other family responsibilities. The feeling also that they themselves are not able to support their children due to lack of digital skills or familiarity with the content of school work can make it difficult for them to be actively involved [29].

4.3 The Effects of the Environment at all Layers on the Children

The many layers of the child's world (as shown in Figure 1) exert an influence and provide opportunities or the lack of opportunity to the child.

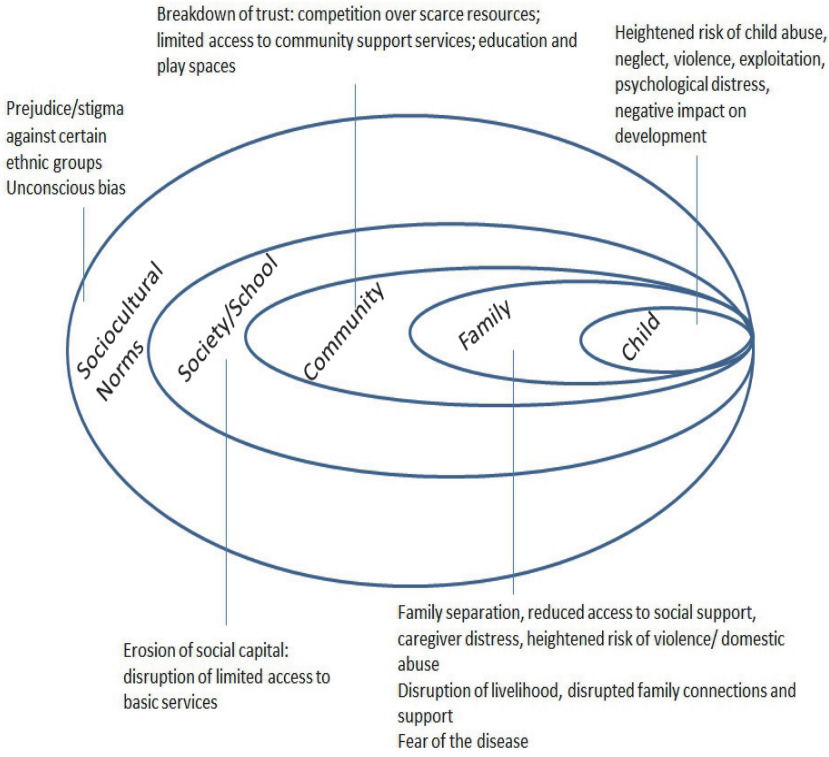


Figure 1**:** Socio-ecological impact of COVID-19 (adapted from Putri et al [30]).

Figure 1 depicts the relations between the family, the community, the society/school and the sociocultural norms. The sociocultural norms are the cornerstones for values, which are learnt implicitly since childhood and remain unconscious to those who hold them. Psychologists believe that most children have their basic value system in place by the age of 10 [6]. Values are qualities, principles or behaviours that generate tendencies to prefer certain states of affairs over others [5, 31]. The societal norms influence the whole society and how the education system works. Hence, it influences the community, the family and the child, its opportunities or lack of opportunities.

5. Research Design

The context of the research is the global crisis created by the COVID-19 pandemic and the effects on primary education, the learning and well-being of primary school pupils, teachers and their families.

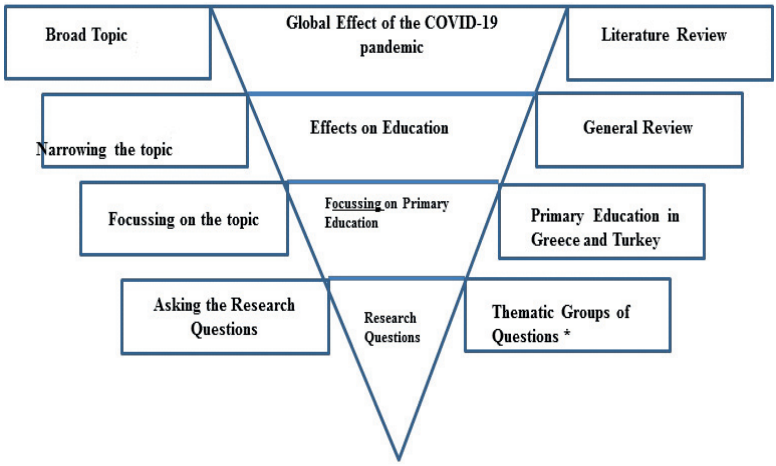


Figure 2 – Research Context and Stages

This qualitative research was based on the ethical principles of voluntariness, anonymity, and non-traceability. It consisted of a review of relevant literature, initially providing a global perspective, and subsequently focusing on the effects of the pandemic on education in general and on primary education in particular. Initially several countries were involved, however due to lack of response the research concentrated on responses from Greece and Turkey.

The survey method was selected for capturing primary data from various countries using the instrument of an online questionnaire, which primary school children were invited by their teachers, their parents and other members of their family to complete. There was an inherent risk to receiving low responses as children were already adjusting to studying from home. The imposition of having to complete the questionnaire might have proved difficult.

The Research Questions were worded in a terminology which is understandable to children of 6-12 years of age covered 6 areas:

- Demographics: age, gender, country, year/grade at school, employment category and status of parents/guardians before and during the pandemic.
    - Availability and access to facilities (internet, desktops, laptops, smart phones)
    - Ability of parents to support home learning
    - Learning – communication with teachers, friends/classmates , support, concentration
    - What they liked best about online learning#
    - What they hated the most about online learning.

6.Research Results and Interpretation

6.1 Demographics

6.1.1 Gender

In total 34 pupils from Greece and 30 pupils from Turkey answered the questionnaire. The gender distribution included 15 girls and 15 boys from Turkey, as well as 16 boys and 18 girls from Greece.

6.1.2 Age

According to the collected data from Greece, there are 16 pupils at the age of 7 and 17 pupils at the age of 8 as the highest age. There is only 1 pupil at the age of 5 and only 1 pupil at the age of 12 as the lowest numbers. As for Turkey, there are 2 pupils at the age of 7, 11 pupils at the age of 8, 4 pupils at the age of 9 and 13 pupils are at the age of 10.

6.1.3. Distribution of the pupils - Pupil according to the study year

A total of 34 Greek pupils responded: 17 pupils were in the 1st class, 22 pupils were in the 2nd class and 19 pupils were in the 4th class. Only 1 pupil is in the 6th, 9th and 12th year of study..

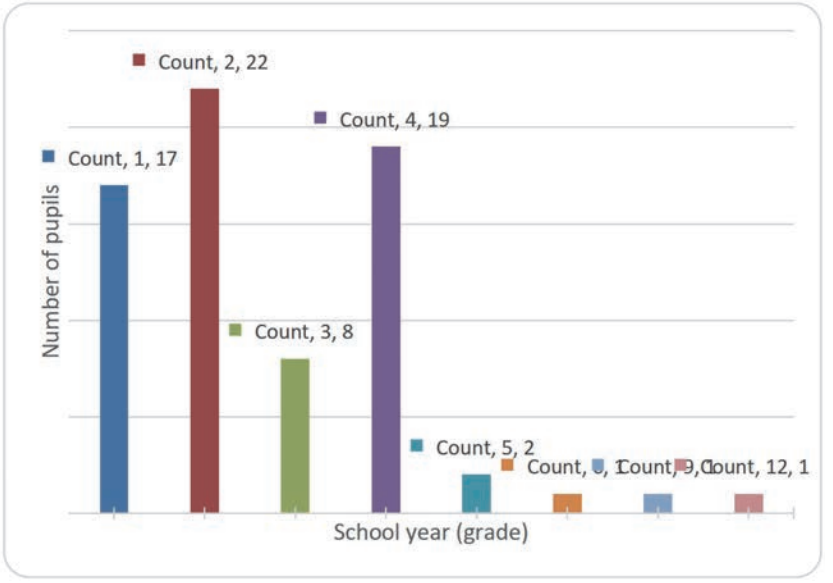


Figure 3: Distribution of the Greek pupils according to the study year

In the Turkish group (30 pupils), there were 13 pupils in the 4th class, followed by the 11 in the 2nd class, 4 pupils in the 3rd class and 2 pupils in the 1st class.

Figure 4: Distribution of the Turkish pupils according to the study year

6.1.4 Employment Status of the Parents/Guardians before the Pandemic

The pupils were asked if any of their parents/guardians were unemployed before the pandemic or not. 3 of the total number of pupils in Greece said that both of their parents are not employed during the pandemic. These results give an idea about the economic conditions of the pupils' families, and generally it seems their families were employed and had certain economic means to support their educational activities. Twenty nine (29) of the Turkish participants reported that their parents, including both mother and father, were employed before the pandemic.

6.1.5 Employment Status of the Parents/Guardians during the Pandemic

In Greece, all respondents confirmed that none of their parents/guardians became unemployed DURING the pandemic for Parent/Guardian 2, and, except for 1, for Parent/Guardian 1. These results confirm that the employment status of pupils' families did not change much during the pandemic, resulting in stable economic conditions. In Turkey, all respondents said no for Parent /Guardian 2. Whereas 3 of respondents stated that their parents did not get unemployed during the pandemic. The respondents of the survey from Ankara, which indicated the stable economic conditions in Ankara, as well. Comparing and contrasting both countries's data, one can see that the situation from Ankara and Thessaloniki seemed almost the same during the pandemic.

6.1.6 Working from home during the lockdown

One of the Parent/Guardian of totally 16 pupils and the other Parent/Guardian of 19 pupils in Greece, were working from home DURING the lockdown. These results generally match with the pandemic conditions that result in more intensive experience of work from home, distance work and distance education have become the inevitable reality of the lock down (See Figure 5 and Figure 6)

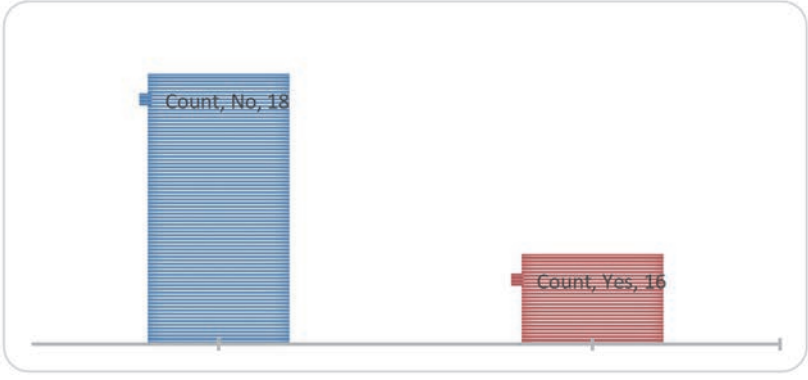


Figure 5: Distribution of the first parent/guardian who worked from home during the pandemic in Greece.

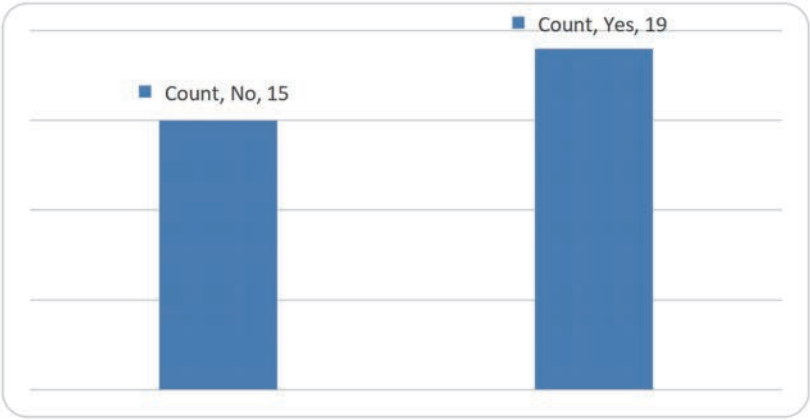


Figure 6: Distribution of the second parent/guardian who worked from home during the pandemic in Greece.

When the situation in Turkey was examined for the distribution of the parent/guardian one, 23 pupils reported that their parent/guardian one was working from distance during the pandemic (see Figure 7) and 24 respondents also provided the same information for the second parent/guardian. When compared to Greece, the number of parents who were working from home during lock down was considerably lower in Turkey as we can see from figures 5, 6, 7 and 8.

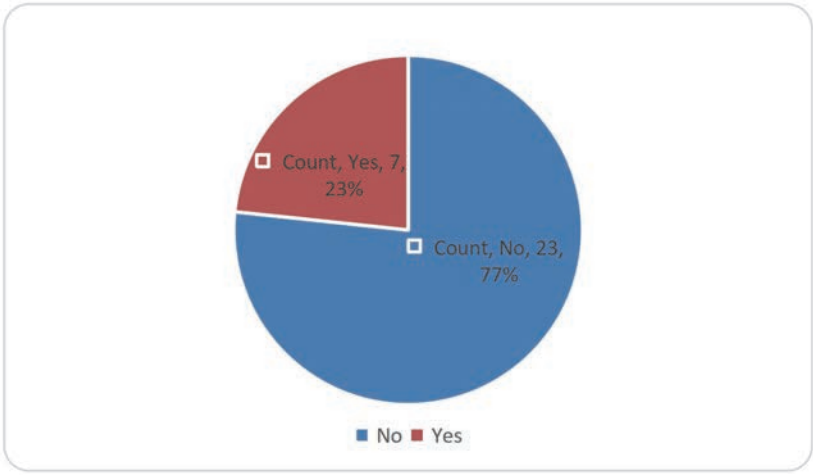


Figure 7: Distribution of the parent/guardian one who worked from home during the pandemic in Turkey.

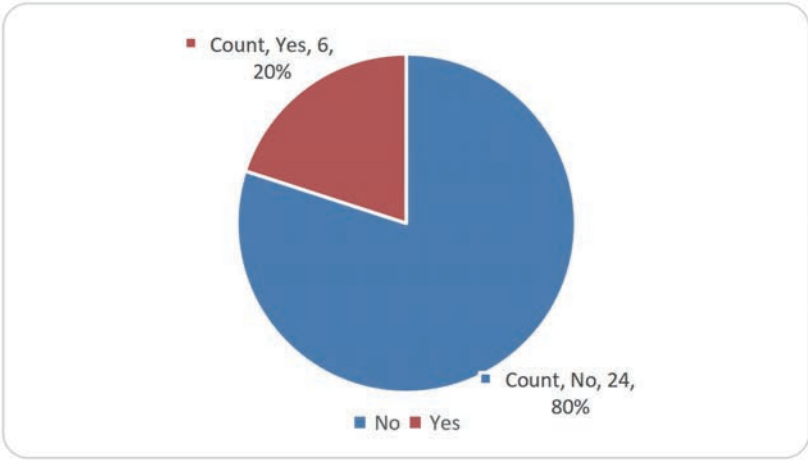


Figure 8: Distribution of the parent /guardian two who worked from home during the pandemic in Turkey.

6.1.7 Number of Siblings in Greece

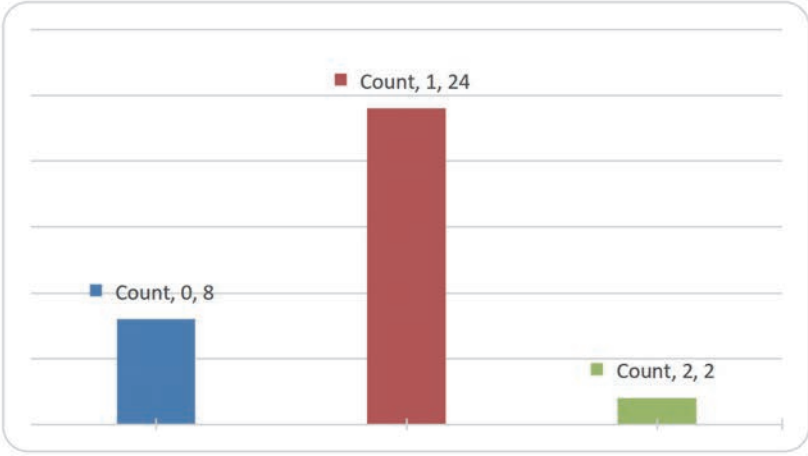


Figure 9**:** Number of Siblings in Greece

In Greece, 8 pupils have none, 24 pupils have one, and 2 pupils have two siblings. No answers were recorded for siblings equal to or more than 3.

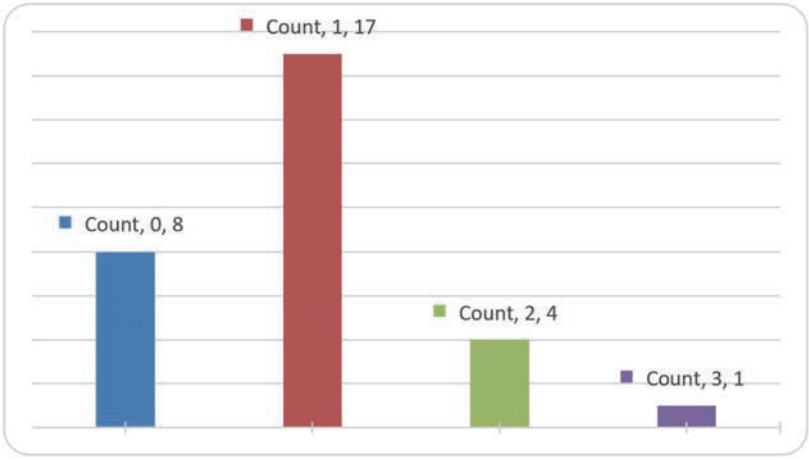


Figure 10: Number of Siblings in Turkey

When analysing the number of the siblings of the respondents from Turkey, it is seen that 8 of the pupils have no siblings. The majority (17) of the pupils reported to have one sibling; where as 4 pupils reported to have two siblings. This is followed by the number of participants (n=1) who stated to have three siblings. In Greece and Turkey, the majority of the pupils have one sibling, which indicate that respondents are not coming from crowded families and may not need to share the equipment with their siblings.

6.1.8 Internet status at home before the pandemic

All of the pupils from Greece have Internet access before the pandemic. This is an important data in terms of satisfying the minimum requirements of accessing to distance education. However the situation in Turkey is a bit different. Only 18 of the respondents reported to have access to Internet before the pandemic. Greece is seen to be in better position in terms of Internet access before the pandemic.

6.1.9 Tools Used for Online Classes

For online classes Microsoft Teams and Webex were equally used in Greece (16 pupils each). Zoom was used by 2 pupils. Google Classroom, or other tools w not used by any of the Greek pupils according to the results (See Figure 10.)

Figure 11: Tools reported to be used by the Greek Respondents

In Turkey, Zoom was the most used platform. Only 1 pupil reported that Google Classroom was used and 8 pupils responded for the other option.

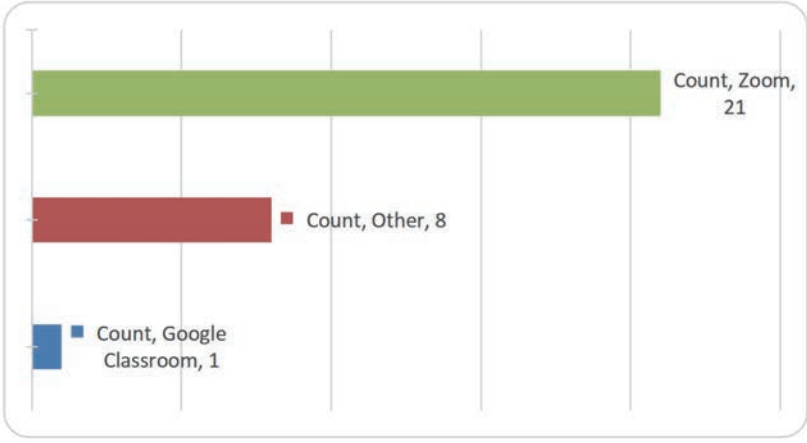


Figure 12: Tools reported to be used by the Turkish Respondents

6.1.10 Access to any of the following equipment BEFORE the pandemic

7 pupils have access to all of the equipments such as desktop, laptop, tablet and mobile phone in Turkey.

In addition, one pupil had access to smart TV (instead of desktop). Five pupils had access to none of these equipment. The others had access to at least one of these equipment.

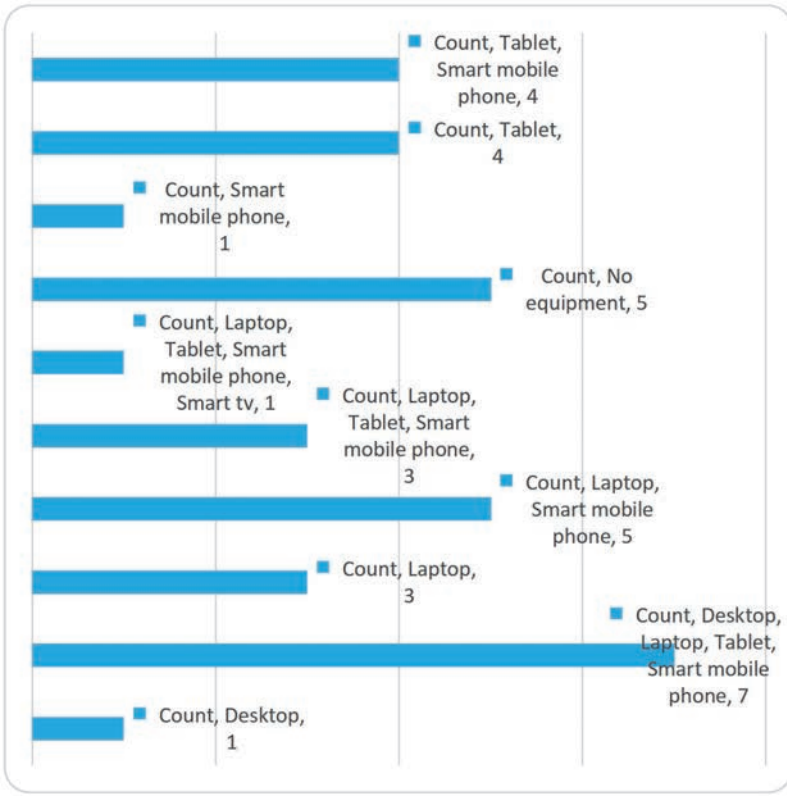


Figure 13: Access to digital equipment in Turkey before the pandemic

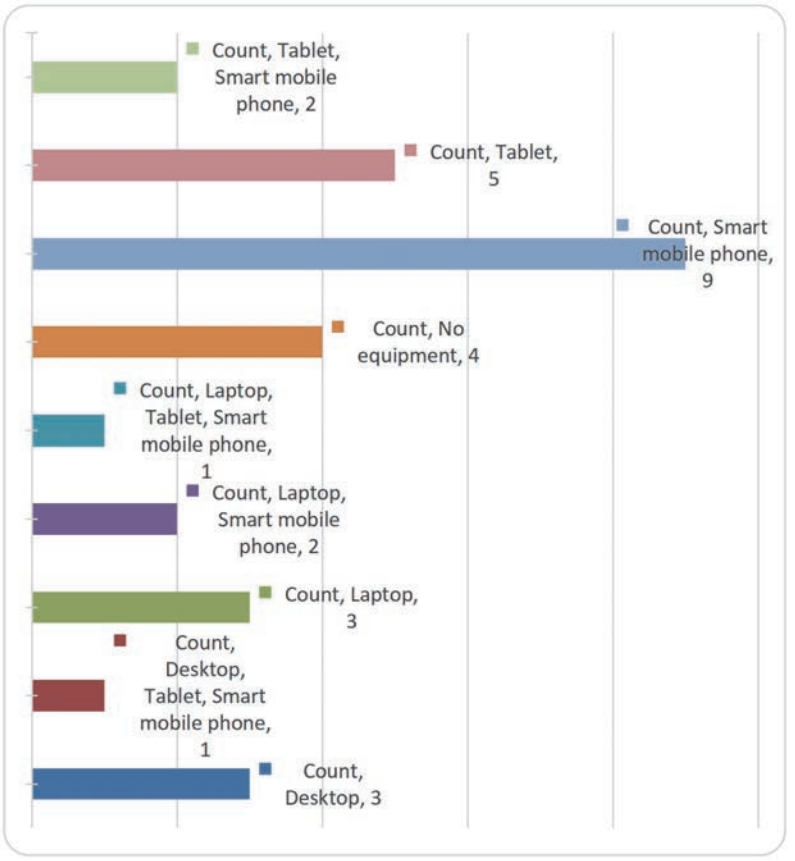


Figure 14: Access to digital equipment in Greece before the pandemic

While in Greece the number of pupils who had access to desktops/laptops is considerable; in Turkey, this is valid for the pupils who had access to a smart mobile phone. Five pupils reported to have access to a tablet. The number of pupils who had no access to equipment at all are almost the same in both countries.

6.1.11 Upgrade of any equipment later on DURING the pandemic

In Greece, 13 pupils acquired new equipment, while 7 pupils updated their existing equipment, the remaining 14 pupils noted no change.

These results are in line with an expected need of additional technical capacities and capabilities in order to address the requirements of online communication and education (See Figure 15).

Figure 15: Situation of respondents from Greece who acquired or upgraded on later on during the pandemic.

In Turkey, 16 of the pupils acquired new equipment. The number of the pupils who reported to have no change was 10. The number of pupils who upgraded existing equipment is lower when compared with Greece.

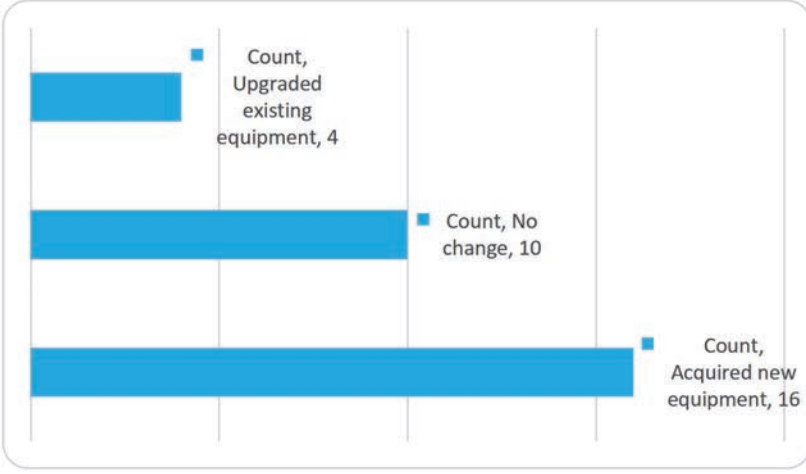


Figure 16: Situation of respondents from Turkey who acquired or upgraded on later on during the pandemic.

6.1.12 In case of need for upgrade who provided the equipment:

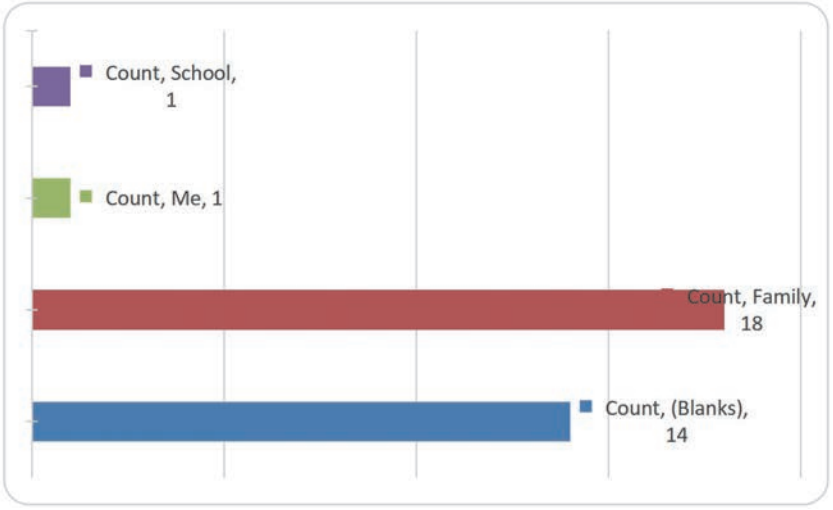


Figure 17: Who provided support for upgrades in Greece.

The newly acquired or updated equipments were mostly provided by the pupils' family (18 responses among the given 20 respondents) responses. This could be expected from the previous findings, which confirm that the families have stable economic conditions. In Greece, mainly parents seem to support the pupils to buy or update any equipment, which is in parallel with the results in Turkey (See Figure 18). In both countries, the number of pupils who were supported from school is only 1. While in Greece no pupil seemed to get support from local authority, in Turkey 7 pupils upgraded or acquired equipment with the local support, which demonstrated the role of government in supporting pupils.

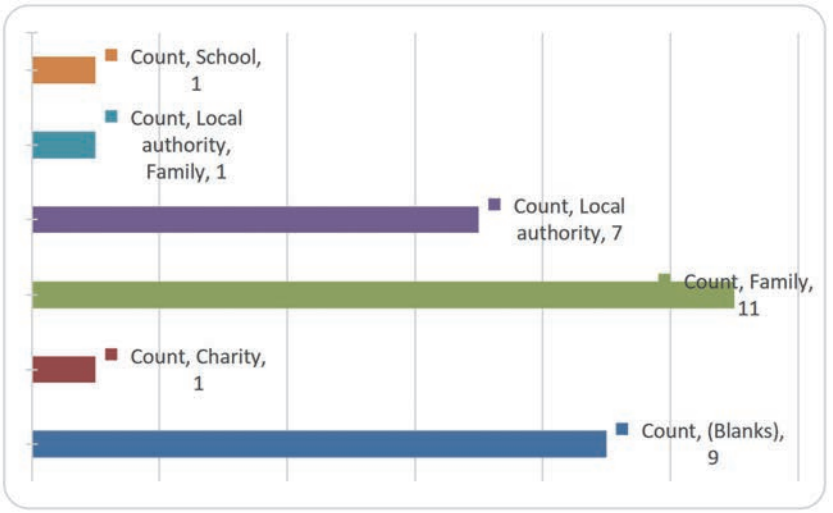


Figure 18: Who provided support for upgrades in Turkey.

6.1.13 Other methods of communication and learning

If you had NO equipment and DID NOT acquire any equipment before or during the pandemic, what other methods of communication and learning did you have to use?

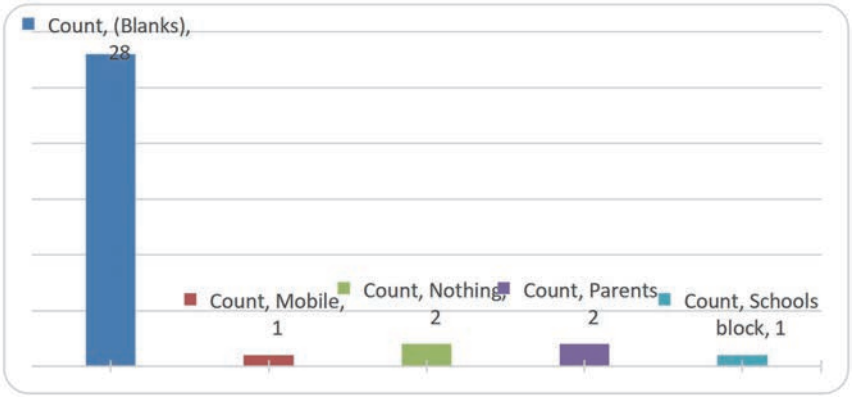


Figure 19: Other methods of communication and learning in Greece

Among the five pupils who had access to no equipment before (F3) or during the pandemic, three reported other methods for communication and learning.

Two pupils answered “nothing”, as an indication of troublesome conditions against distance education. 28 pupils did not respond this question (Figure 17). Similarly in Turkey, 27 pupils did not respond to this question (See Figure 18.)

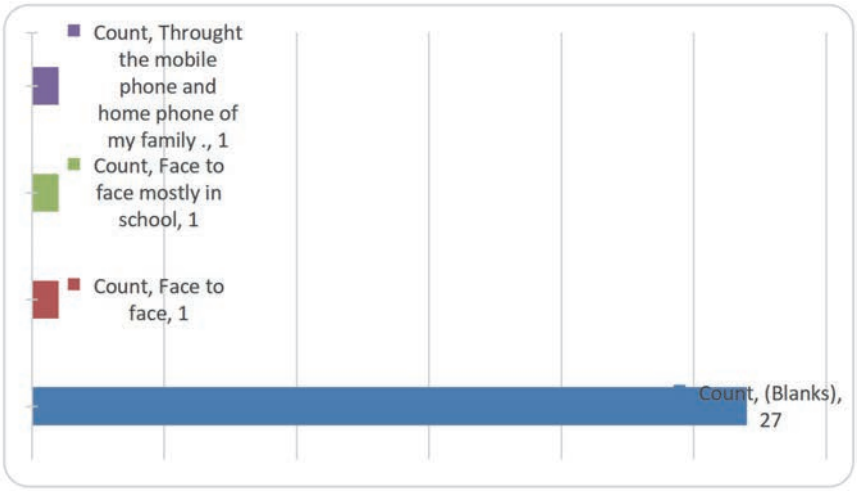


Figure 20: Distribution of participants from Turkey

6.1.14. Members of family that shared the same equipment

F5. Please select with how many members of your family (e.g. your brothers / sisters / parents / carers) you had to share the equipment with?

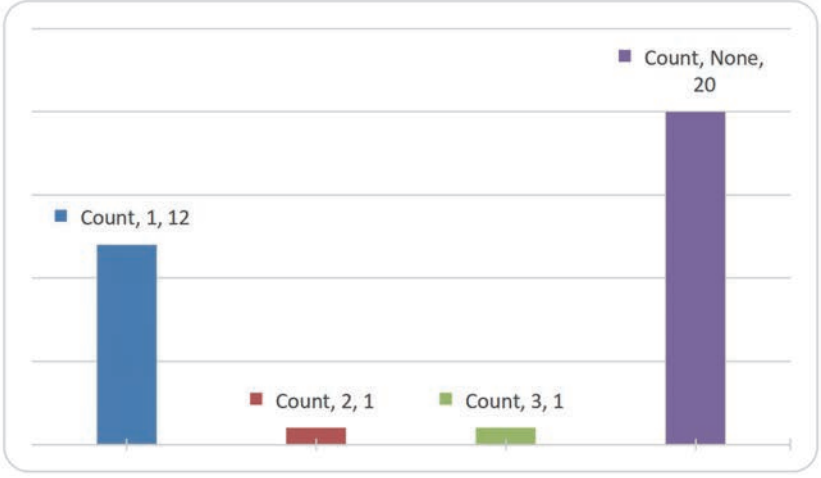


Figure 21: Number of the pupils who reported to share their equipment with other members of the family (brothers/sisters/parents/carers) in Greece.

In Greece, 20 pupils did not have to share their equipment with others, while 12 of them had to share with one other, and 2 with more than one other. It is expected that those being shared to be pupils' siblings, based on previous findings on the related question.

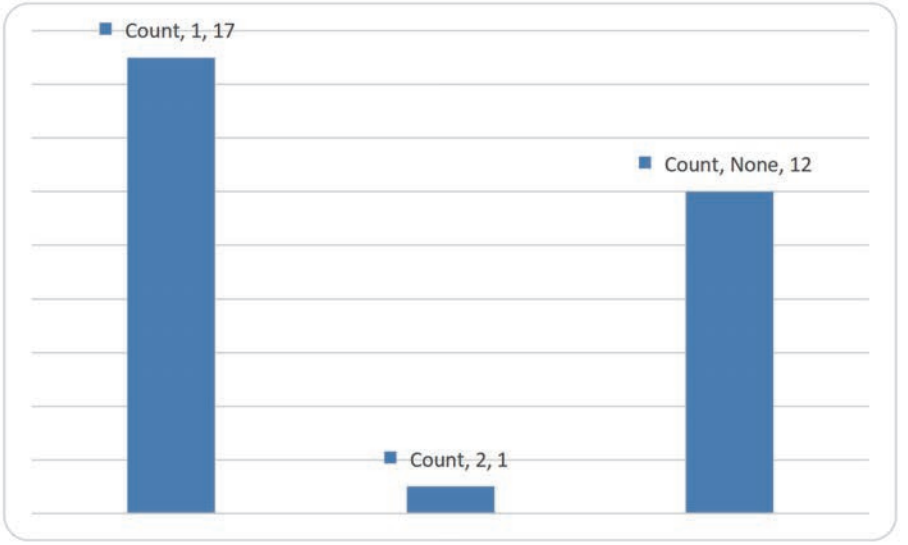


Figure 22: Number of the pupils who reported to share their equipment with other members of family (brothers/sisters/parents/carers) in Turkey.

In Turkey, the number of the pupils who did have to share their equipment is lower when compared with Greece. The ones who shared with at least one member of family were more than the number of participants in Greece.

6.1.15 Degree of help with equipment from family

To what degree was your family able to help you overcome difficulties in using the equipment?

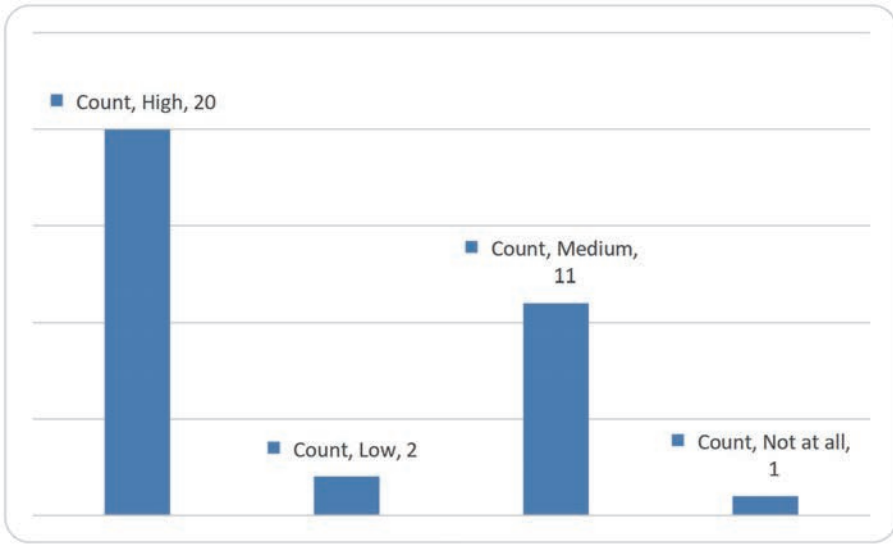


Figure 23: Degree of help with equipment from family in Greece

In total 20 of the Greek pupils confirm that they received high degree of help from their parents to overcome the difficulties in using the equipment. 10 pupils also confirm medium degree and 2 pupils low degree of help respectively. Only 1 pupil acknowledged no help. It seems that learning from home comes up with its own specific challenges, which are addressed by support from home. (See Figure 21).

The results seem to be the similar for the Turkish respondents. In both countries, it is seen that pupils get and feel the family support.

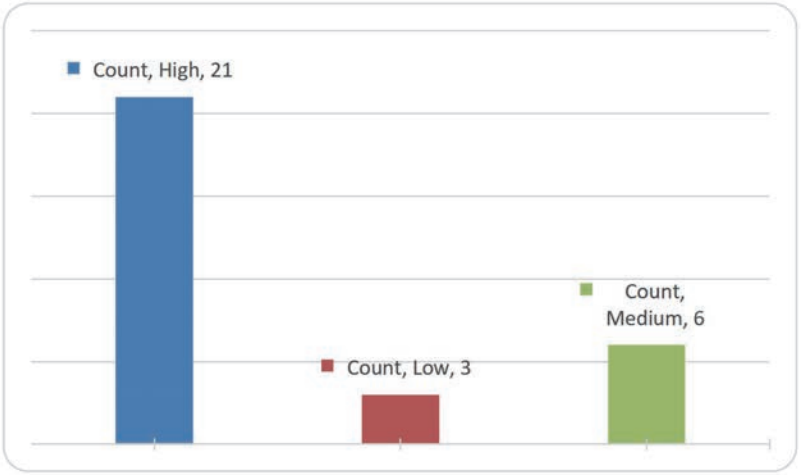


Figure 24: Degree of help with equipment from family in Turkey

6.1.16. Use of web-camera

How often did you use your web camera (video) during your online lessons?

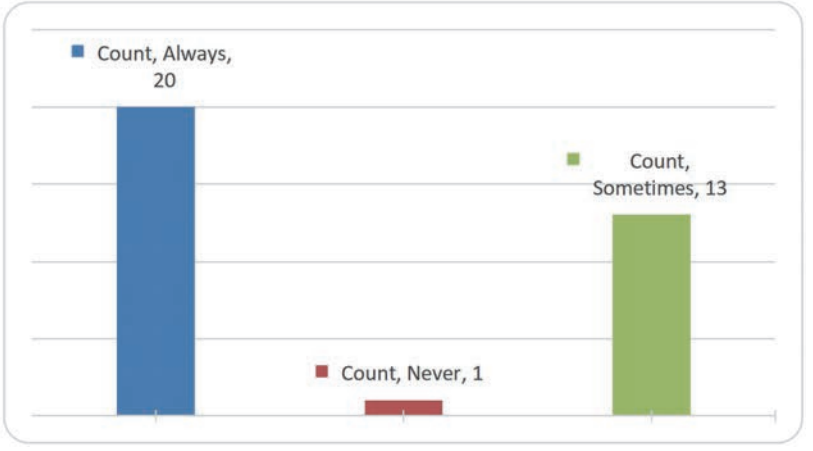


Figure 25: Greek respondents' use of web camera during online lessons.

20 pupils always used their web camera (video) during their online lessons. 13 s sometimes used their web camera (video) during their online lessons. Only 1 pupil did not use web camera at all. The common use of web camera is important as it could support a better environment for two-way communication and interaction between pupils and teachers.

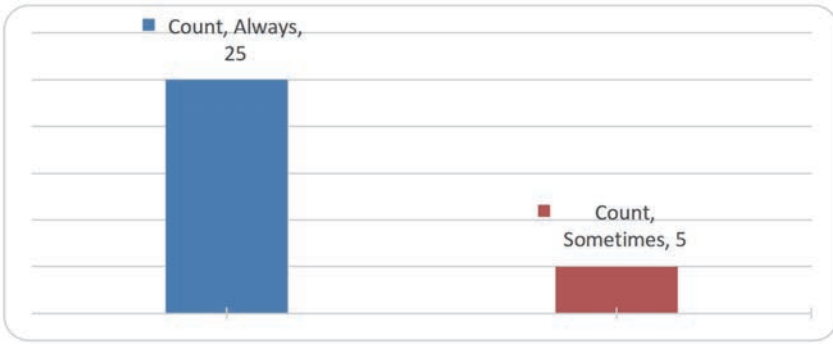


Figure 26: Turkish respondents' use of web camera during online lessons

25 pupils from Turkey reported to use their camera all the time. The number of pupils who sometimes used it is lower than those in Greece. Differences might be caused by the different implementations of the courses or expectations of the class teachers in each country.

6.1.17 Notes and exercises sent to pupils.

Did the teachers send you notes and exercises at home?

All the pupils from Greece confirm that their teachers sent them notes and exercises at home. It is understood that home works are common as part of distance education, supported by additional materials that complement online teaching sessions. As for Turkey, 21 of the respondents reported that their teachers sent notes and exercises at home. 9 of the pupils said no for this question. Some teachers might be implementing the exercises online during the class. The difference might have been caused by this.

6..1.18. Most difficult subjects to follow by distance learning

Which classes were the most difficult to follow from home DURING the pandemic?

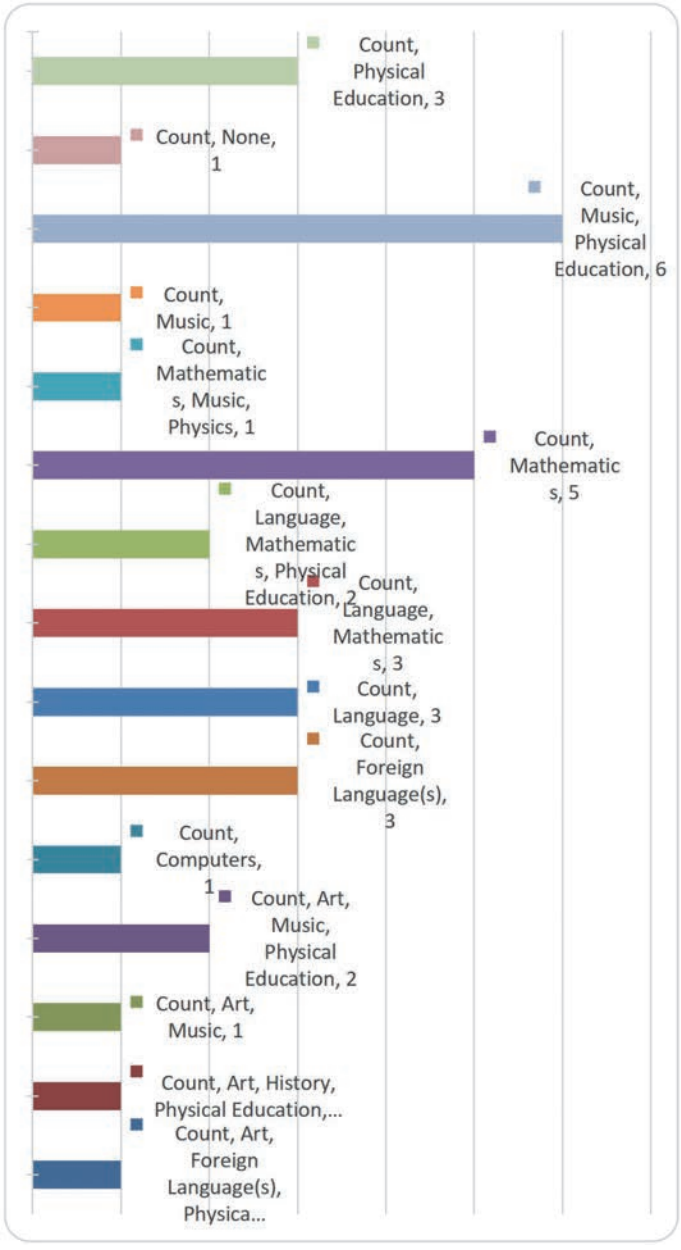


Figure 27: Subjects reported to be the most difficult to follow from home in Greece during the pandemic.

For 15 pupils physical education, for 11 pupils music, and for 11 pupils mathematics were chosen (separately or together with others) to be the most difficult classes to follow from home. While other classes were also reported to have moderate (for example art) or low (for example computers) difficulty, only 1 pupil reported difficulty from any class at all.

In Turkey, 16 pupils reported the highest challenge for language course. This is followed by 15 pupils who have chosen the Mathematics as the most difficult course during the pandemic. 5 pupils reported difficulty for physical education course. Among the least challenging courses, art is rated whereas history can be said to be in moderate level of difficulty for pupils.

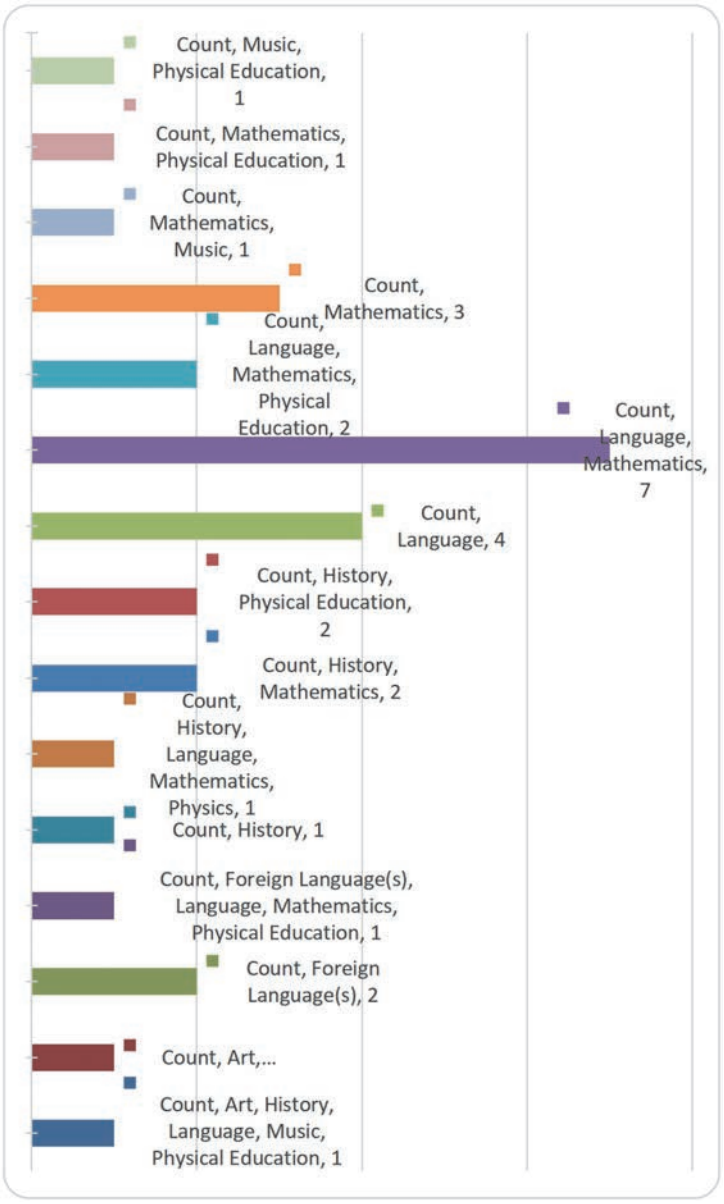


Figure 28: Classes Reported to be the Most Difficult to Follow from home in Turkey during the pandemic.

Who helped you the most when you had queries?

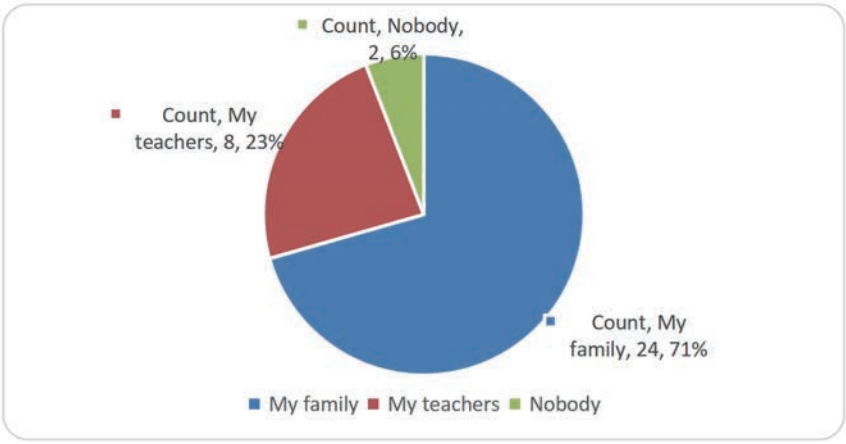


Figure 29: Who helped the respondents most when they have queries in Greece.

In Greece, 24 pupils acknowledged that their families and 8 pupils acknowledged that their teachers helped with their queries, while two pupils acknowledged help from nobody. It is also note-worthy that no help from friends were reported. These results are to be expected from a study environment at home distant from school. In Turkey, teacher and family support are very close to each other. Less pupils reported to get support from their friends.

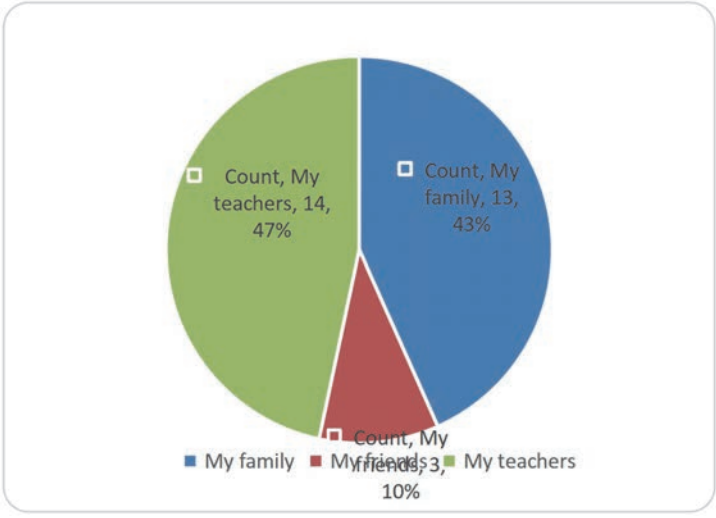


Figure 30: Who helped the respondents most when they have queries in Turkey.

6.1.19. Level of enjoyment of distance learning

Did you enjoy learning from home?

17 pupils answered that they did not enjoy the learning from home, while 11 acknowledged that it was OK for them. Three pupils answered that they hated it and enjoyed it very much as the most extreme answers on both sides. These common and extreme comments seem to be in accordance with the remaining part of the findings.

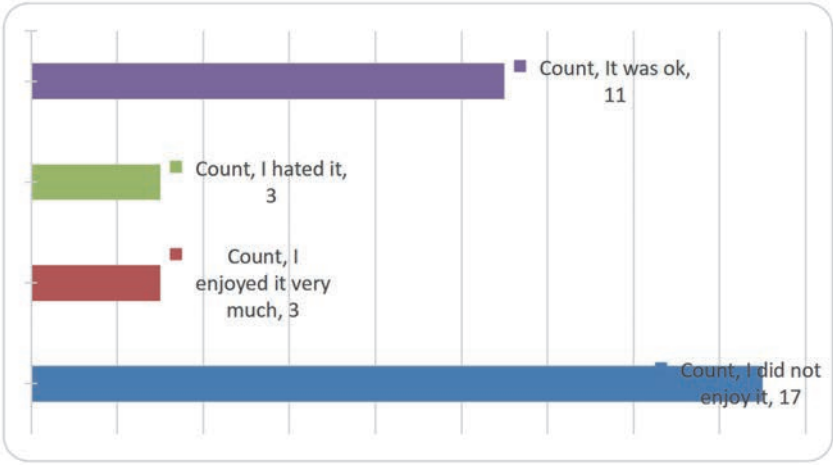


Figure 31: Enjoyment levels of the pupils during remote courses in Greece

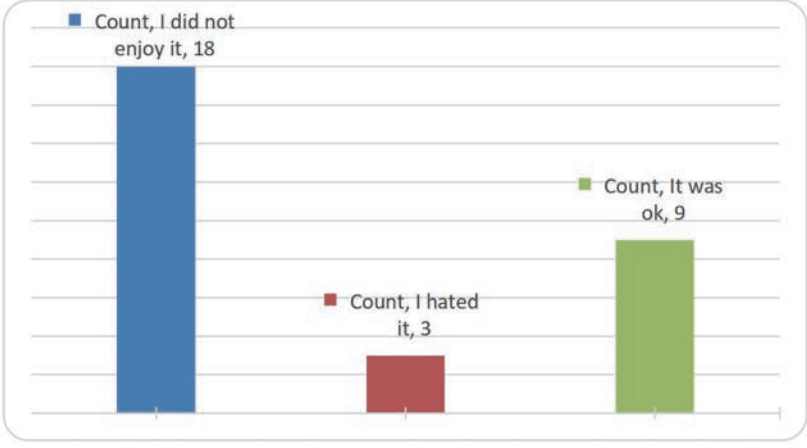


Figure 32: Enjoyment levels of the pupils during remote courses in Turkey

Likewise, the majority of the respondents from Turkey did not enjoy distance education and three of them said that they hated it. The results seemed to be similar in both Greece and Turkey.

6.1.20. Missing friends during pandemic.

How much did you miss you friends?

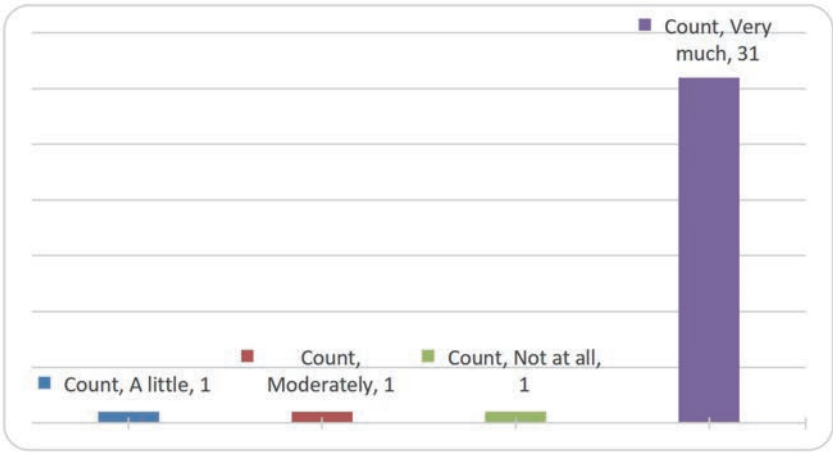


Figure 33: How much students missed their friends during the lockdown in Greece

31 of 34 pupils confirmed that they missed their friends very much. Only one missed his/her friends a little, one moderately one not at all respectively.

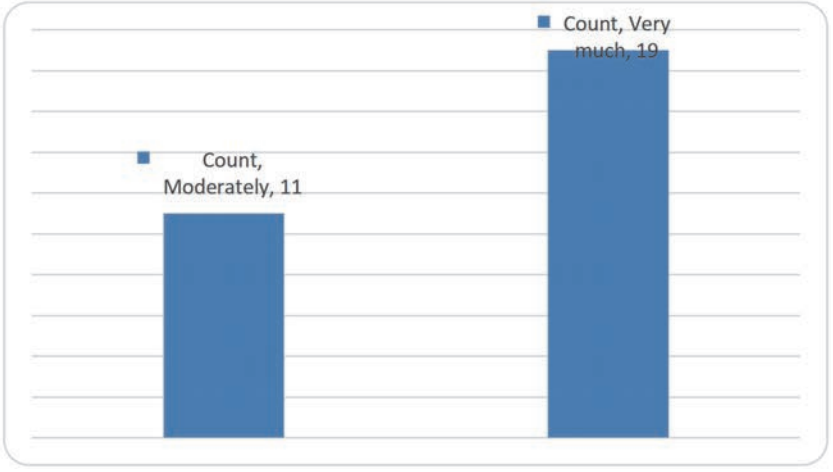


Figure 34: How much students missed their friends during the lockdown in in Turkey

In total 19 of 30 pupils missed their friends very much; however the remaining 11 stated that they moderately miss their friends.

6.1 21. Radio or TV lessons

Did you attend any lessons on TV or Radio?

Among Greek respondents, no lessons on radio were reported. It seems radio was not used as a means for education during pandemic. Totally six respondents reported that they attended lessons on TV. It can be inferred from these results that while there were certain educational opportunities available on TV, they were not commonly used by the responding Greek pupils. Among the Turkish respondents, no lessons were followed through the channel of radio.The result is the same as that of Greece. In Turkey more pupils (n=25) followed courses on TV. Education Information Network (EBA) channel was daily used by children in Turkey during the pandemic. The teachers played an important role to encourage children to watch the EBA channel, which was considered as complementary support to the pupils.5.11.21 Frequency of connection to school friends during the pandemic

How frequently did you keep in touch with any of your school friends DURING the pandemic?

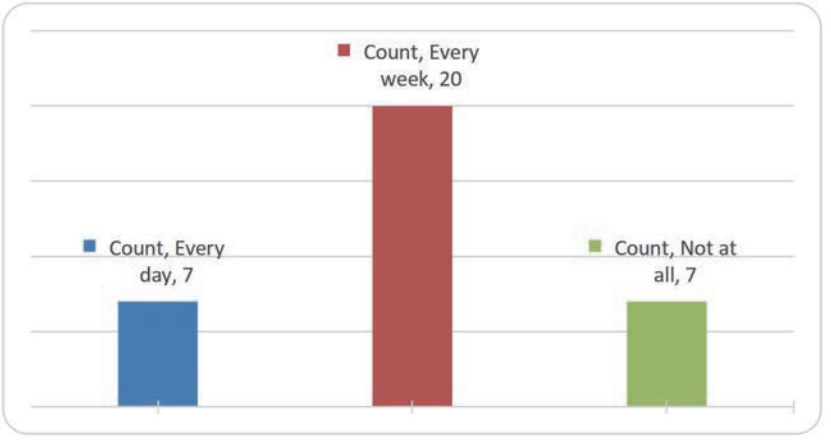


Figure 35:. Greek Pupils' frequency of keeping in touch with their school friends.

During the pandemic, 20 pupils weekly kept in touch with their school friends, while 7 pupils daily did so. 7 pupils did not keep at all contact with their school friends..

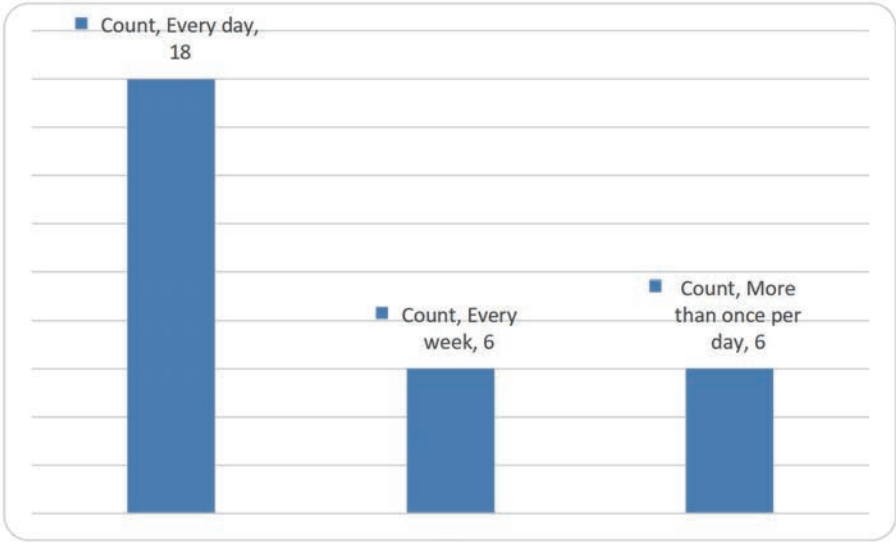


Figure 36: Turkish pupils' frequency of keeping in touch with their school friends.

Among Turkish pupils during the pandemic, 24 pupils reported to contact their friends more often. There was no respondent who claimed to have no contact with their school friends. The results indicate that the pupils need social dialogue and they want to keep in touch with their classmates to get socialized and relieve pandemic-related stress.

6.1.22 Looking forward to school opening

How much are you looking forward to your school opening after the pandemic?

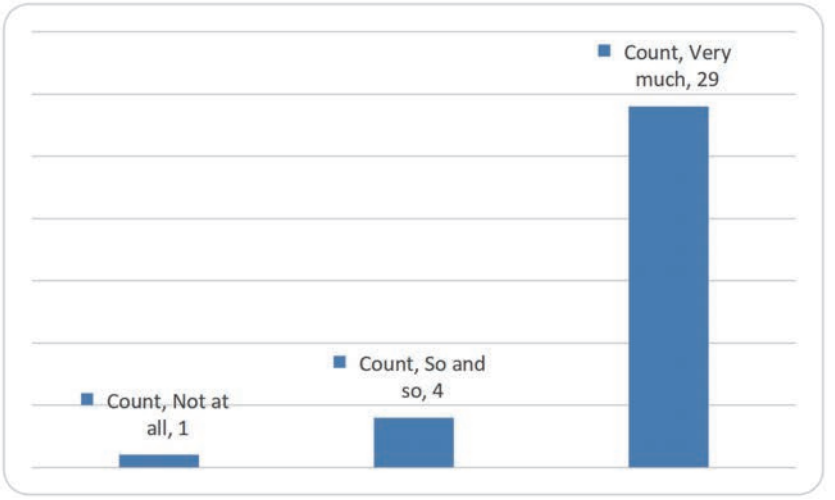


Figure 37: Distributions of the participants who are looking forward to opening of the school after the pandemic in Greece.

In total 29 of 34 pupils very much looked forward to their school opening after the pandemic. These results confirm that distance education is seen as temporarily and the pupils prefer studying at school to studying at home.There seem to be, however, one outlier who enjoys distance education more than anything else, and do not want schools to reopen.

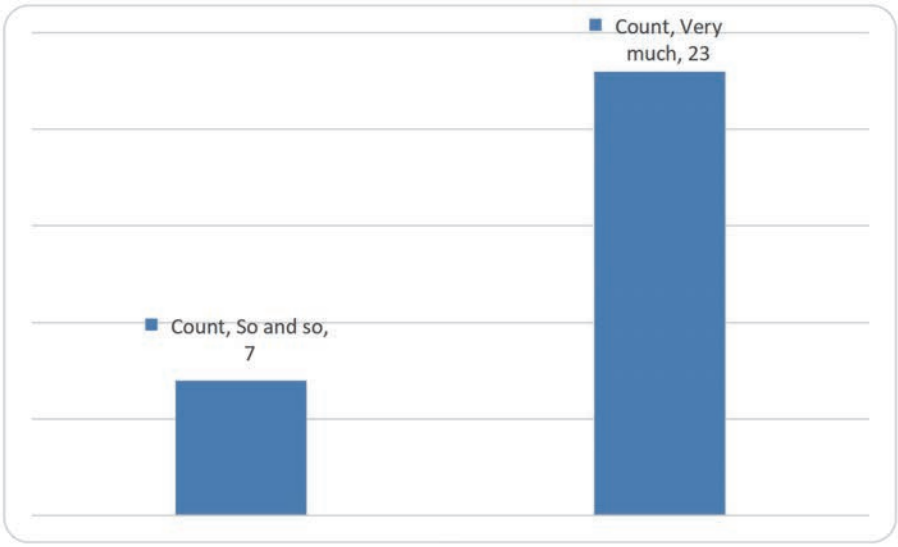


Figure 38: Distributions of the pupils who are looking forward to opening of the school after the pandemic in Turkey.

In Turkey in the majority of pupils look very much forward to the opening of schools (23/30), while seven pupils do not really mind.

6.1.23 How students learn best

How much do you agree with the following statements?

Among 34 pupils from Greece, 32 of the pupils and among 30 pupils from Turkey, 26 of them disagreed with the fact that they learnt better home. They did not find studying at home efficient and appropriate for their learning process. This might be caused by the lack of effective communication with their teachers or friends. Also lack of physical contact or eye contact was lost in distance education. The challenges of distance education might have affected the psychology of children in a negative way in both countries.

I learnt better from/at home

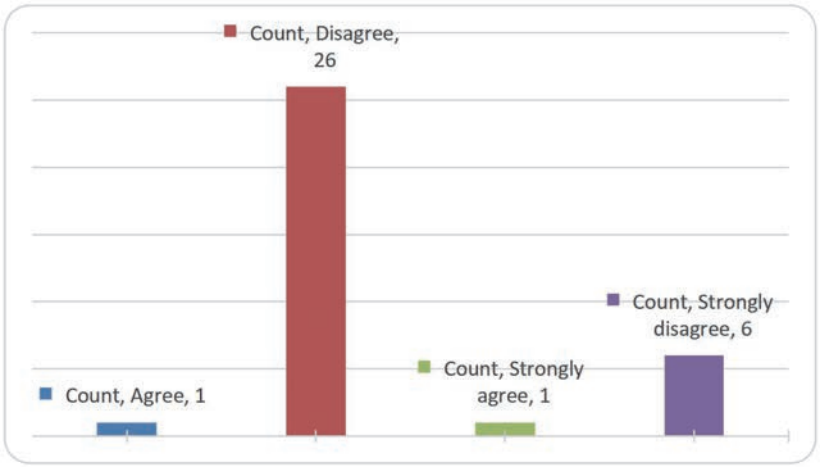


Figure 39: Learning better from home in Greece

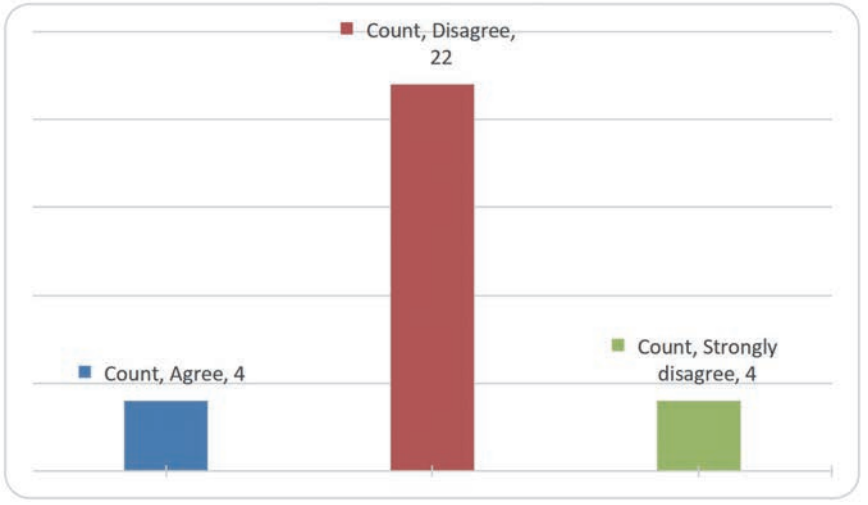


Figure 40: Learning better from home in Turkey

6.1.24 Difficulty in following online classes It was difficult for me to follow online classes

It has been observed that the majority of the Greek and the Turkish pupils found it difficulty to follow online courses. This data harmonise with the responses of the previous statement, which are both complementary to each other. It can be inferred that pupils do not find distance education process fruitful and efficient. Their learning process and progress might have been slowed down.

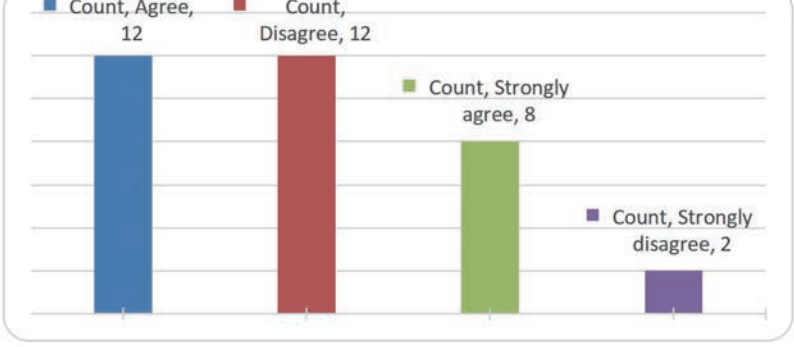


Figure 41: It was difficult to follow online classes in Greece

Due to this reason, their manner towards distance education was found out to be quite negative (See Figure 41 and 42).

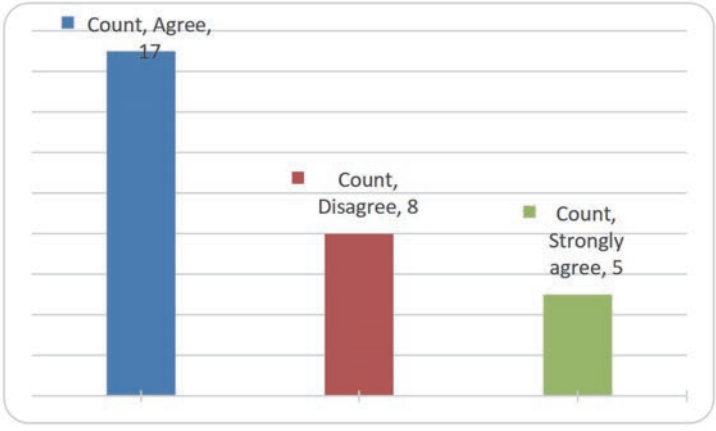


Figure 42: It was difficult to follow online classes in Turkey.

In total 15 of the Greek pupils reported that science and mathematics classes should not be taught online. However, when figure 43 was examined, it was seen that more than half of the Greek pupils found online Mathematics courses efficient. In Turkey, the results are quite different. Except 2 pupils, the other pupils do not prefer to be taught science and mathematics online.

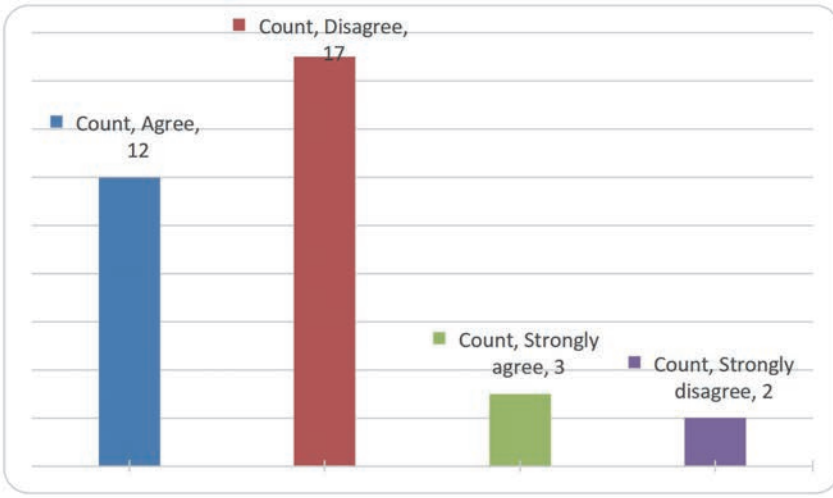


Figure 43:Should Science and Mathematical subjects be taught online in Greece

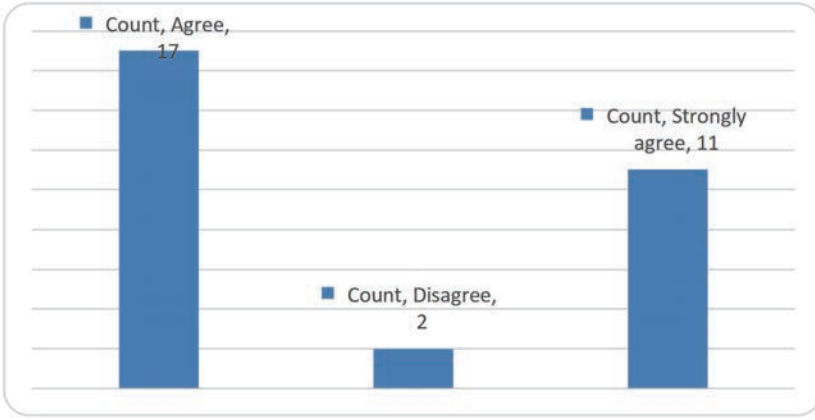


Figure 44: Should Science and Mathematical subjects be taught online in Turkey

6.1.25 .Better learning in school atmosphere

I learn better in the school atmosphere

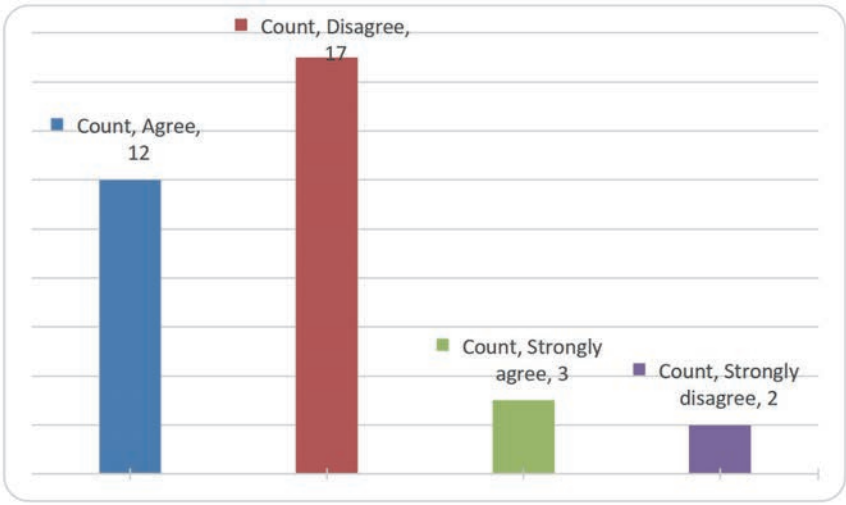


Figure 45**:** I learn better in the school atmosphere in Greece

Fifteen (15) of the pupils from Greece state that they learn better in the school atmosphere. According to the other findings of the study, more pupils were expected to agree with the statement.

Figure 46: I learn better in the school atmosphere in Turkey

According to Figure 44, among 30, 22 of the pupils agreed with the given statement. There are still some pupils who think that they learn better in the distance education courses.

6.1.26 Difficulty of asking questions in online classes. Is it more difficult to ask questions in online classes?

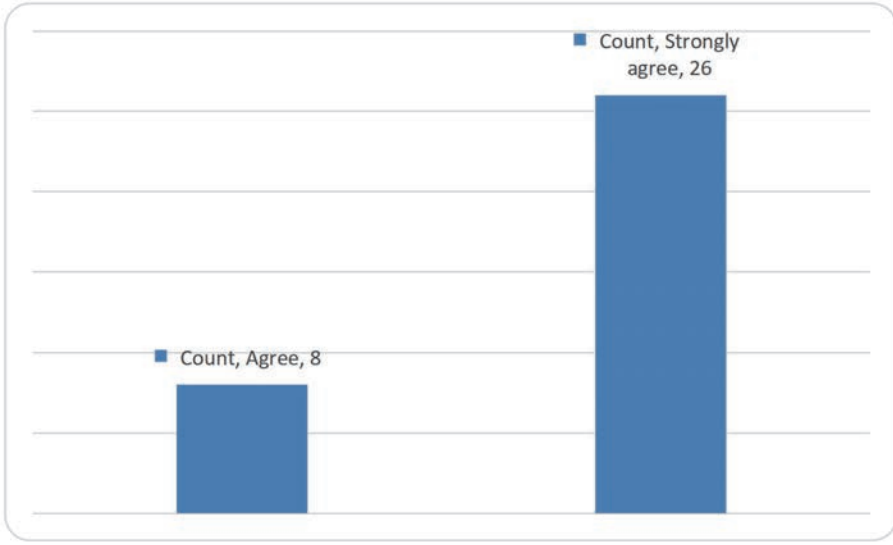


Figure 47: More difficult to ask questions online in Greece

26 pupils from Greece and 17 pupils from Turkey found it extremely difficult to ask questions online. Findings from Turkish respondents are similar, with the difference that instead of strongly agreeing they mainly agree. It is surprising that even though the rate of Greek pupils who think that learning in school environment is better is lower than in Turkey, the majority of the Greek respondents (when compared with Turkey) find it particularly difficult to ask questions in online classes.

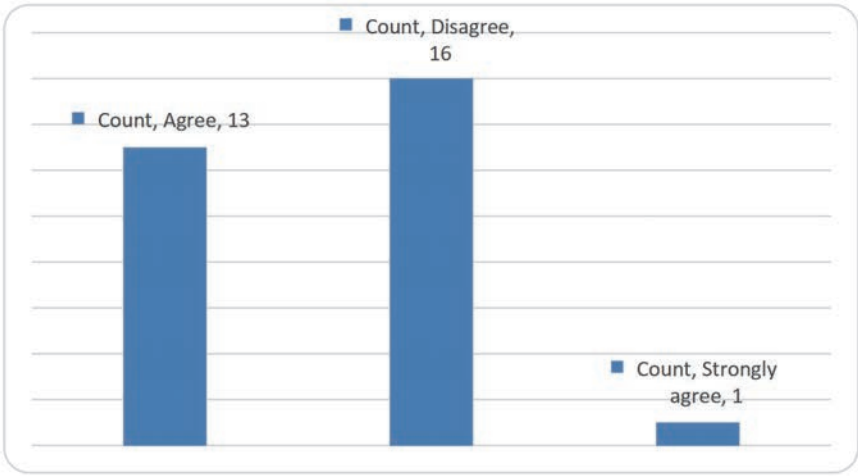


Figure 48: More difficult to ask questions online in Turkey

6.1.27 Difficulty in following homework announcements

Is it difficult to follow the announcements about homework

While 20 pupils from Greece found it difficult to follow the announcements about homework, 14 pupils from Turkey found it difficult. It is surprising result that 16 Turkish Respondents did not find it difficult.

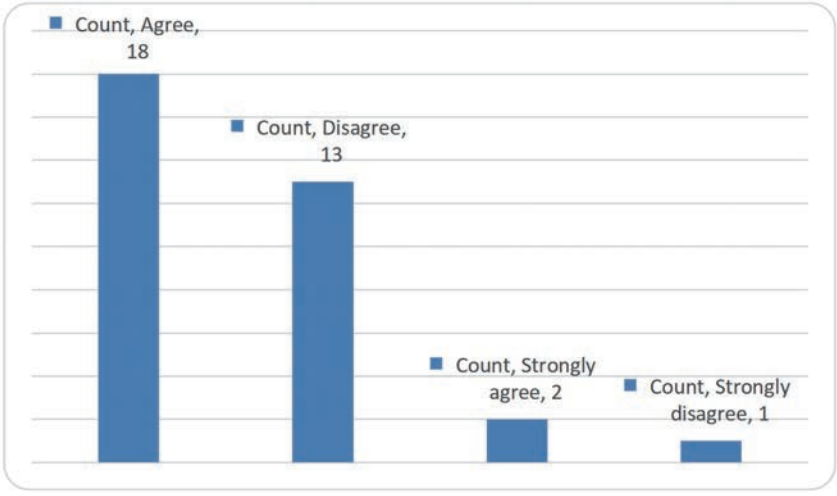


Figure 49: Difficulty in following homework announcements in Greece

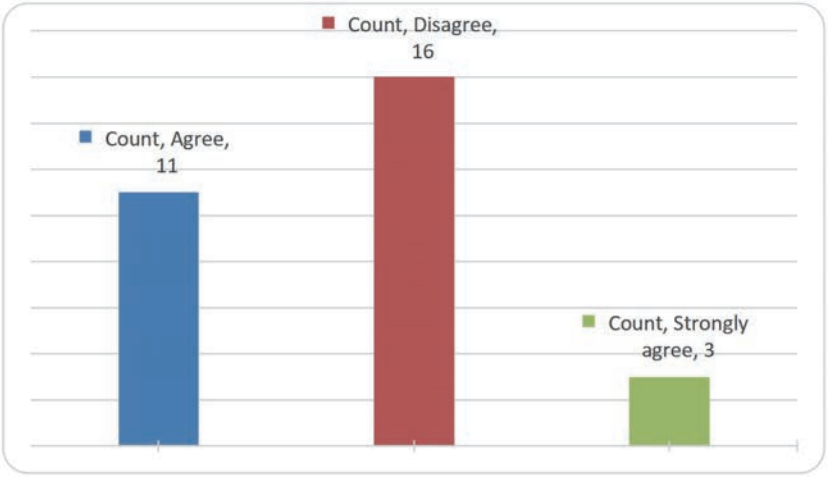


Figure 50: Difficulty in following homework announcements in Turkey

6.1.28 Like most about online learning during the pandemic

What did you LIKE the most about online learning DURING the pandemic.

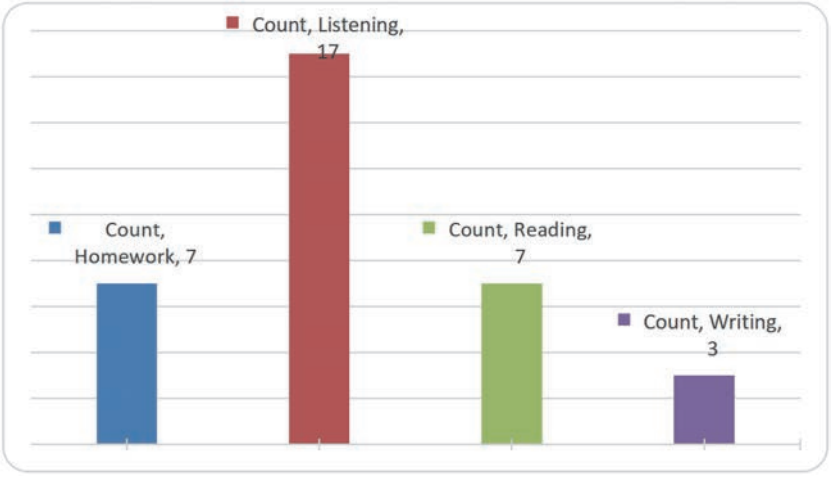


Figure 51: What pupils liked most about distance courses during pandemic in Greece

In Greece the majority of the pupils liked listening most. This is followed by reading and homework. Among Turkish respondents, listening is in the top rank, as well. However, it is quite strange that pupils did not vote for homework.

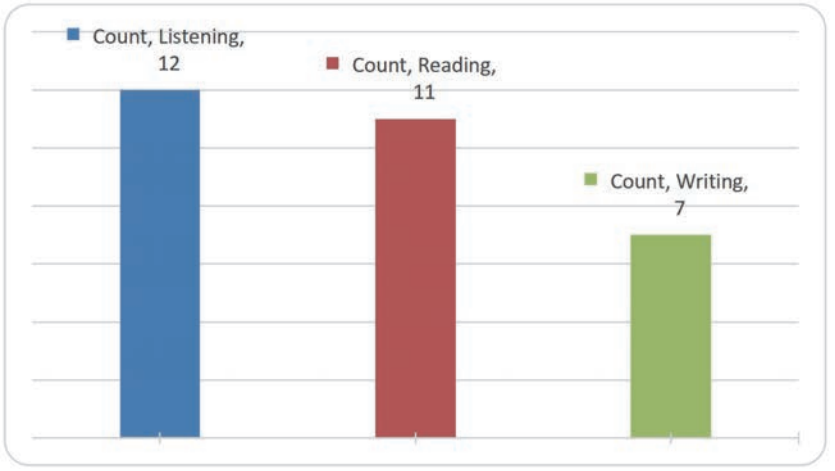


Figure 52: What pupils liked most about distance courses during pandemic in Turkey

6.1.29 Hate most about online learning during the pandemic.

What did you HATE the most about online learning DURING the pandemic.

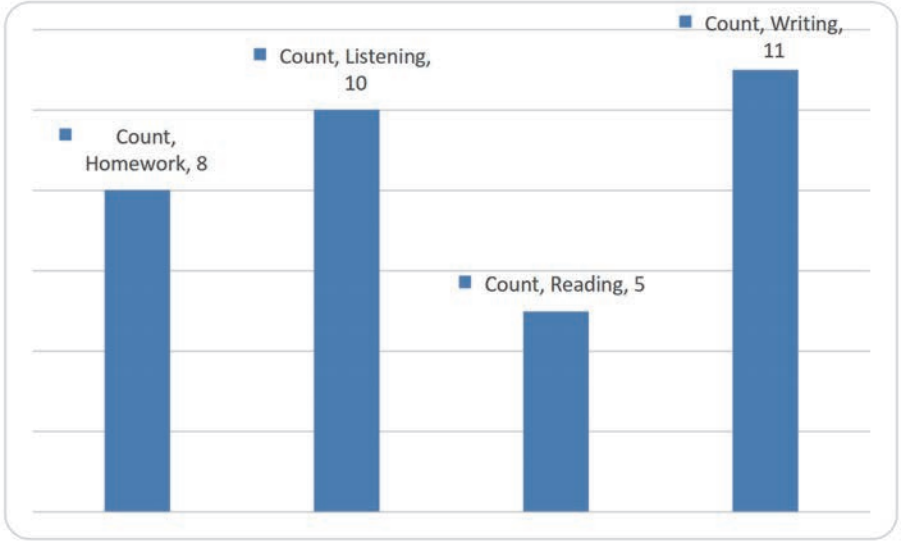


Figure 53: HATE the most about online learning DURING the pandemic in Greece

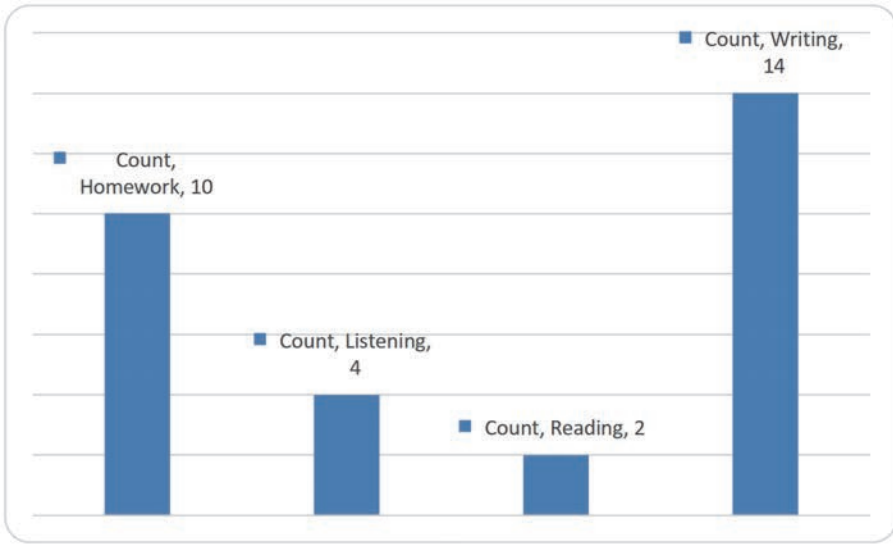


Figure 54: HATE the most about online learning DURING the pandemic Turkey

7. Greece and Turkey: Comparing and Contrasting Primary Education Outcomes

The results of this study revealed some clear similarities and some differences between the Greek and the Turkish (mostly 7-8 years old) pupils' experiences on studying and learning on online distance mode.

7.1. Key Differences

The main key differences between the Greek pupils and the Turkish pupils found from their answers to the following issues: *Equipment(s) and tool(s) for online learning, difficulties in online learning*, and *support for online learning*.

The Greek pupils seem to have a higher level of equipment, readiness for online studying and learning than the Turkish pupils. That is, before the pandemic, all Greek pupils had access to the Internet at home while that was not the case for many Turkish pupils. Also, some Greek pupils had access to all types of equipment (desktop, laptop, tablet, and smart phone) but that option was very rare for the Turkish pupils. However, the majority of both the Greek and the Turkish pupils had access at least for one equipment, yet, the Greek pupils had access mostly to tablet while the Turkish pupils had access to smart phones. An explanation for that

might be that the tablet had been thought to be more suitable for 7-8 years old pupils in Greece. It is possible that online studying and learning could be more fun and with more pleasure when the person does not have to share the equipment with other family members. That is, when a person feels a need to study and learn, she/he does not have to think about, for example, when the equipment is available and/or for how long can I use it now. From this perspective, the Greek pupils were in a better position than the Turkish pupils. That is, the majority of the Greek pupils do not have to share the equipment with other family members, while more than half of the Turkish pupils had to share the equipment. This might create the need to build a timetable and schedule for the usage of the available equipment.

In order to manage to participate in online studying and learning, many Greek and Turkish families needed to upgrade the existing equipment. Half of them purchased/got new equipment and a few of them updated the existing one. However, half of the Greek pupils' families did not make any changes regarding their equipment upgrades, while one third of the Turkish pupils' families proceeded to no changes at all for the already existing equipment.

Yet, when the equipment's upgrading was needed, there was a difference found among the two countries in regard with whose responsibility this was. More specifically, the particular upgrade was mostly under the families' responsibility in Greece, but in Turkey the authorities also participated in upgrading the equipment for pupils. Notably, the new or/and updated equipment was difficult to be used by both the Greek pupils and the Turkish pupils. Apparently, for this reason, in Greece and in Turkey their families helped the pupils a lot in order to overcome the usage challenges.

Table 1: Access to Internet and relevant equipment before *COVID-19*

Internet at home before	All (34) have access	18 out of 30 have access
Access to equipment before	To all equipments 7	To all equipments 1
	To none equipments 5	To none equipments 4
	To at least one equipment 22	To at least one equipment 25
	Mostly tablet (4)	Mostly smart phone (9)

Table 2: Status of sharing same equipment with family members

Sharing same equipment with family members	With nobody 20	With nobody 12
	With one 12	With one 17
	With two 1	With two 1
	With three 1	

Table 3: The source of the provided and upgraded equipment

Who provided and upgraded equipment	Family 18	Family 11
	School 1	Authority 7
	Oneself 1	School 1
		Charity 1(2)

Table 4: Upgrading equipment during pandemic

There were significant differences between the Greek pupils and the Turkish pupils concerning the actual online learning and studying classes.

From the tools perspective, the Greek pupils used mainly Microsoft Teams and WebEx, while the Turkish pupils used mainly Zoom.

In addition, the Turkish pupils used more actively the web camera during the online lessons than the Greek pupils. This might have been encouraged or even demanded by the teachers in Turkey. In one sense, the use of web camera creates a feeling of belonging. That is, a person sees other people's faces. On the other sense, the use of web camera is a convenient way to monitor that all the pupils are really participating or, at least, are present.

The radio as a learning and studying tool was not used in either the Greek pupils or the Turkish pupils. In Turkey, there were no offered courses on Radio. However, attending TV lessons were very common among the Turkish pupils and it was encouraged by the teachers. This was not the case in Greece, since only a few Greek pupils attended TV lessons. In Turkey, there might be a long tradition for sending learning material by TV for pupils.

Table 5: Tools used in distance education process

Tools used for online classes	Microsoft teams 16	Zoom 21
	Web ex 16	Other 8
	Zoom 2	Google classroom 1

Table 6: Status of using web camera

Use of web camera (how often use video during online lessons)	Always 20	Always 25
	Sometimes 13	Sometimes 5
	Never 1	

Table 7: Attendance to Radio or TV Lessons

Radio or TV lessons (attend)	No radio 34	No radio 30
	Yes TV 6	Yes TV 25
		(Education Information Network (EBA) channel)

Online learning and studying may have specific challenges and difficulties. In terms of the difficulties found in online taught subjects, the Greek pupils had most difficulties in physical education, music and mathematics, while the Turkish pupils seem to have mostly struggled with language, mathematics, and physical education.

Interestingly, almost all the Turkish pupils supported the idea that science and mathematics should be taught online, even though mathematics, in particular, caused difficulties for them. However, just half of the Greek pupils supported this idea (!).

From the *question asking* perspective, all the Greek pupils had difficulties in asking questions during online classes, while just half of the Turkish pupils had experienced the same difficulty. This is very interesting since question asking is one of the most important elements of learning and studying. This is clearly one issue that must be studied further. That is, why pupils feel that it is difficult to ask questions during online learning and studying lessons?

From the helping and support perspective, for the Greek pupils the most important resource of help came from the family, while for the Turkish pupils it is the teacher the one who helps most. Interestingly, none of the Greek pupils mentioned the friends/school friends, and only a few from the Turkish pupils named friends/school friends as a resource for support or help.

Table 8: Most difficult subjects in distance learning

Most difficult subjects to follow by distance learning	Physical education 15	Language 16
	Music 11	Mathematics 15
	Mathematics 11	Physical education 5
	All subjects 1	

Table 9: Should science and mathematics be taught online

Should science and mathematics be taught online	Strongly agree 3	Strongly agree 11
	Agree 12	Agree 17
	Disagree 17	Disagree 2
	Strongly disagree 2	Strongly disagree 0

Table 10: Difficulty in asking questions in online classes

Difficulty in asking questions online classes	Strongly agree 26	Strongly agree 1
	Agree 8	Agree 13
	Disagree 0	Disagree 16
	Strongly disagree 0	Strongly disagree 0

Table 11: Who helps pupils when they have queries

Who helps pupils when they have queries	Family 24	Teacher 14
	Teacher 8	Family 13
	Nobody 2	Friends 3

As can be seen from the numbers in Table 12, clearly the Turkish pupils preferred to or thought that they learn better at school than at home. Surprisingly, the Greek pupils' experiences on where to learn better was not clearly reported.

Table 12: The fact that they learn better at school

Learn better at school	Strongly agree 3	Strongly agree 4
	Agree 12	Agree 18
	Disagree 17	Disagree 7
	Strongly disagree 2	Strongly disagree 1

7.2. Key Similarities

The main similarities between the Greek pupils and the Turkish pupils of primary schools were found in regard with the following issues: *Dislike and difficulties in online learning, likes in online learning, missing school and friends, keeping in touch with school friends, equipment upgrade and need of help,* and *where to learn the best*.

The majority of both Greek and Turkish pupils *did not enjoy* the distance online learning and studying. Both groups had difficulties in following their online lessons, while the majority of the Greek pupils and half of the Turkish pupils had additional difficulties in following the homework announcements.

Obviously online learning and studying require different skill sets than the face-to-face approach. It takes time to adapt to a new system. Also sitting down, concentrating, and staring for a relatively long time at the screen might be a rather demanding task for this age group. Further, both the Greek pupils and the Turkish pupils did not like writing tasks as well as homework. Both the Greek pupils and the Turkish pupils also liked listening and reading tasks.

The clear majority of the Greek pupils and the Turkish pupils did not support the idea that they would learn best at home. On the contrary, the clear majority of both of them were really looking forward to going back to school again, with one (rare) exception from Greece.

Almost all the Greek pupils were missing their friends/school friends a lot, with a few exceptions. While the Turkish pupils were missing a lot (or moderately) their friends/school friends both the Greek pupils and the Turkish pupils had kept in touch with their friends or school friends. Notwithstanding, the majority of the Greek pupils kept in touch on a weekly basis, but the majority of the Turkish pupils kept in touch on a daily base. This might explain why the Greek pupils were missing their friends/school friends (a little bit) more than the Turkish pupils.

Table 13: Feelings towards online classes

Enjoyment of distance learning	No 17	No 18
	Ok 11	Ok 9
	Hated 3	Hated 3
	Enjoy very much 3	
Difficulty in following online classes	Strongly agree 8	Strongly agree 5
	Agree 12	Agree 17
	Disagree 12	Disagree 8
	Strongly disagree 2	Strongly disagree 0
Difficulty in following the announcements about homework	Strongly agree 2	Strongly agree 3
	Agree 18	Agree 11
	Disagree 13	Disagree 16
	Strongly disagree 1	Strongly disagree 0
Hate most about online learning	Writing 11	Writing 14
	Listening 10	Homework 10
	Homework 8	Listening 4
	Reading 5	Reading 2
Like most about online learning	Listening 17	Listening 12
	Reading 7	Reading 11
	Homework 7	Writing 7
	Writing 3	

Table 14: How pupils learn best

How pupils learn the best	Strongly agree 1	
(learn better at home)	Agree 1	Agree 4
	Disagree 26	Disagree 22
	Strongly disagree 6	Strongly disagree 4

Table 15: Emotions about school opening and missing friends

Looking forward to school opening	Very much 29	Very much 23
	So and so 4	So and so 7
	Not at all 1	
Missing friends	Very much 31	Very much 19
	Moderately 1	Moderately 11
	Little 1	
	No at all 1	

Table 16: Connection to School friends

Connection to school friends	Every week 20	Every day 18
(keeping in touch)	Every day 7	Every week 6
	Not at all 7	More than once per day 6

Table 17: Upgrading equipment during pandemic

Upgrade equipment during pandemic	New equipment 13 Update existing equipment 7 No changes 14	New equipment 16 Update existing equipment 4 No changes 10

Table 18: Help with equipment from family

Help with equipment from family (overcome the difficulties of using it)	High 20 Medium 11 Low 2 Not at all 1	High 21 Medium 6 Low 3

Table 19: Other methods of communication and learning

Other methods of communication and learning (when no equipments)	Nothing 2 Parents 2 School blocks 1 Mobile 1	Home phone 1 Face to face at school 1 Face to face 1

Table 20: The fact that whether notes and exercises are sent to pupils by teachers

Notes and exercises sent to pupils by teachers at home	Yes 34	Yes 21 No 9

8.Limitations

All pupils who responded from both Greece and Turkey come from Ankara or from Thessaloniki which are major cities. For example availability and accessibility to broadband may not be available or reliable in the regions especially in villages.

The completion of the questionnaire was totally voluntary and, thus, it was not possible to ensure that all pupils engaged in the exercise. In addition to Greece and Turkey the questionnaire had been distributed to several other countries including Cyprus, Spain and the UK. Cyprus delivered only four (4) responses which reported that their parents had not been unemployed either before or during the pandemic. They all had access to facilities and their parents were able to help them with their online studying. These numbers were not included in the comparison because the results would be skewed.

It was decided to leave out from the questionnaire the aspects of online safety and cybersecurity because it was thought that the pupils might not understand questions regarding the aspects of online privacy and cyberprotection well. In addition a surprising finding was the use of the camera in both countries but more pupils were using video-camera in Turkey. Thus their online privacy could have been violated.

Hence the lack of questions about security and privacy information is a severe limitation of this survey because there is an increased number of incidents online in these age groups of primary education that indicate the significance of the issue in schools and the importance of taking measures against invention to pupils' privacy. The basic knowledge and awareness of the prospective ICT teachers [9] and parents but the alertness of students themselves can become the most significant cyberprotection mechanism.

9.Conclusions

It is important to listen to pupils' voices because they reveal the feelings, emotions, difficulties, as viewed by them. The originality and contribution of this research is exactly that. Knowing the sociocultural and socio-technical differences of two neighbouring South-East Mediterranean countries we can draw conclusions for many (primary) education stakeholders that can be key-holders and progressive change agents for i) the educational continuous process improvement and ii) governmental national and regional policies for pupils and their families' well-being.

The participating pupils live in Ankara, Turkey and in Thessaloniki, Greece both major city centres. From their responses we cansee that they have more similarities than differences in the issues we asked them about and unfold their opinions.
Future online classes are a certainty so it is of paramount importance to be aware of the likes and dislikes of the learners of any age and take them into consideration for authoring and designing instructional curricula on cyberspace or/and cyberplace with the right protection mechanisms and cybersecurity considerations in mind.

10. Acknowledgments

The authors would like to express their thanks to all the teachers, parents and other family members who motivated their children to complete the online questionnaire.

11.References

1. UNESCO. (2020). Education: From disruption to recovery. Retrieved 23 February 2021, from: https://en.unesco.org/*COVID*19/educationresponse.
2. Lai, J., Widmar, N.J.O. (2020). Revisiting the Digital Divide in the *COVID*-19 Era, *Applied Economic Perspectives and Policy*, 0(0):1–7, doi:10.1002/aepp.13104
3. Azubuike, O. B., Adegboye, O., Quadr, H. (2021). Who gets to learn in a pandemic? Exploring the digital divide in remote learning during the *COVID*-19 pandemic in Nigeria, *International Journal of Educational Research Open,* https://doi.org/10.1016/j.ijedro.2020.100022
4. Beaunoyer, E., Dupéré, S., and Guitton, M. J. (2020). *COVID*-19 and digital inequalities: Reciprocal impacts and mitigation strategies. *Computers in Human Behavior 111*, 106424.
5. Hofstede, G. (2001). *Culture's consequences: comparing values, behaviours, institutions, and organisations* - 2nd Ed. - Thousand Oaks, Calif.; London: Sage Publications
6. Hofstede, G. (1994). *Cultures and Organisations, Intercultural co-operation and its importance for survival, Software of the mind*, McGraw-Hill International, UK
7. Tzifopoulos, M. (2019). Teacher education for the digitally oriented school: the curricula of the Schools of Primary Education in Greece. Proceedings of the 11th PanHellenic Conference of the Hellenic Pedagogical Society on "Basic and adult education of teachers in a

complex and changing environment", Patra, November 23-25, pp. 460-471 [In Greek].
8. Tzifopoulos, M. (2020). Secondary teachers' subject matter expertise, pedagogical knowledge and digital skills: the 'Technological Pedagogical Content Knowledge' (TPACK) model.*International Journal of Scientific Research and Innovative Technology, 7*(2), pp. 21-37.
9. Tzifopoulos, M., & Bikos, K. (2016). Are kindergarten pre-service teachers trained with ICT? The curricula of the Schools of Early Childhood Education in Greece. *Educational Review, 33*(61), pp. 133-153 [In Greek].
10. Koutsogiannis, D. (2007). A political multi-layered approach to researching children's digital literacy practices. *Language and Education, 21*(3), 216-231.
11. Koutsogiannis, D. (2011). *Adolescents' Digital literacy practices and (language) education*.Thessaloniki: Greek Language Center [In Greek].
12. Marsh, J. (2010). *The relationship between home and school literacy practices.* In: D. Wyse, R. Andrews, & J. Hoffman, J. (eds.), The Routledge international handbook of English, language and literacy teaching, pp. 305-316.
13. EACEA (2021). Greece: Support to primary and secondary school teachers put in place during the pandemic, https://eacea.ec.europa.eu/national-policies/eurydice/content/greece-support-primary-and-secondary-school-teachers-put-place-during-pandemic_en (accessed 18/4/2021)
14. Akyüz, Y. (2001). *Başlangıçtan 2001'e Türk Eğitim Tarihi.* Istanbul: ALFA Basım Yayım.
15. Ministry of National Education (1992). *Öğretmen Yetiştirmede Koordinasyon.* Ankara: Ministry of National Education.
16. Ministry of National Education (2020). Uzaktan Eğitim Sürecinin Detayları. Retrieved from https://www.meb.gov.tr/uzaktan-egitim-surecinin-detaylari/haber/21990/tr. in 14th April 2021.
17. Berki, E. Reflections on e-Learning in the Time of Coronavirus: The Nordic Experience and Ethical Considerations - Back to the Future with The e-Learners Manifesto. In Proceedings of the 25th Annual INSPIRE Conference; Uhomoibhi, J., Dewar, E., Georgiadou, E., Linecar, P., Marchbank, P., Ross, M., Staples, G., Eds.; 2020; pp. 21–52. (https://www.bcs.org/media/6602/inspire-2020-proceedings.pdf).
18. Stantcheva, S. (2021). Inequalities in the times of a Pandemic. 73rd Economic Policy Panel. April 13, 2021
19. Saleh, M., Georgiadou, E. (2007) FIAIFM: A model towards bridging the Digital Divide, Network for Teaching Information Society NETIS Project,http://www.ittk.hu/netis/teachm.htm#Text_book, Budapest, July 2007 .
20. Georgiadou, E., Rahanu,H., Khan, N., Colson, R. and Sule, C. (2014) 'Bridging the Digital Divide: Towards Shortening the Road from Illiteracy to Information Literacy', Proceedings of the Western Balkan Information

Literacy Conference, (Bihac, Bosnia and Herzegovina) 11 - 14 June 2014, ISSN: 2233-1689
21. Karpati, A. (2011) Digital Literacy in Education: A Policy Brief, Retrieved 14th May 2015, from the UNESCO Institute for Information Technology in Education, http://iite.unesco.org/pics/publications/en/files/3214688.pdf
22. Hodges, C., Moore, S., Lockee, B., Trust, T. & Bond, A. (2020). The Difference Between Emergency Remote Teaching and Online Learning. EDUCAUSE Review, 27 March 2020. Retrieved on 2/2/2021 by https://er.educause.edu/articles/2020/3/the-difference-betweenemergency-remote-teaching-and-online-learning.
23. Andrew A. et al (2020) Inequalities in Children's Experiences of Home Learning during the *COVID*-19 Lockdown in England*, Institute for Fiscal Studies; UCL Institute of Education, University College London, UK, https://doi.org/10.1111/1475-5890.12240
24. Tumwesige, J. (2020) *COVID*-19 Educational Disruption and Response: Rethinking e-Learning in Uganda, Konrad Adenauer Stiftung, https://www.researchgate.net/profile/Josephine-Tumwesige/publication/342392949_*COVID*-19_Educational_Disruption_and_Response_Rethinking_e-Learning_in_Uganda/links/5ef21c5292851c3d231eb475/*COVID*-19-Educational-Disruption-and-Response-Rethinking-e-Learning-in-Uganda.pdf. Retrieved at 23th April 2021.
25. UNICEF Office of Research – Innocenti (2021). *COVID-19 and the Looming Debt Crisis*. Protecting and Transforming Social Spending for Inclusive Recoveries. Innocenti Policy, Brief series, Brief 2021-01, Florence, Italy. (https://www.unicef-irc.org/article/2119-pre-pandemic-data-show-1-in-8-countries-spends-more-on-debt-than-on-education-health-and-social-protection-combined-unicef.html) . Retrieved at 10th April 2021.
26. OECD (2020). Keeping the Internet up and running in times of crisis, OECD Publishing, Paris.
27. Peterson, A. et al. (2018), "Understanding innovative pedagogies: Key themes to analyse new approaches to teaching and learning", OECD Education Working Papers, No. 172, OECD Publishing, Paris, https://doi.org/10.1787/9f843a6e-en.
28. OECD (2020). Strengthening online learning when schools are closed: the role of families and teachers in supporting students during the *COVID*-19 crisis. OECD Policy Responses to Coronavirus. 24 September 2020. https://read.oecd-ilibrary.org/view/?ref=136_136615-o13x4bkowa&title=Strengthening-online-learning-when-schools-are-closed
29. Bol, T. (2020), Inequality in homeschooling during the corona crisis in the Netherlands. First results from the LISS panel, https://doi.org/10.31235/osf.io/hf32q.
30. Putri, R. S., Purwanto, A., Pramono, R., Asbari, M., Wijayanti, L. M., & Hyun, C. C. (2020). Impact of the *COVID*-19 pandemic on online home

learning: An explorative study of primary schools in Indonesia. *International Journal of Advanced Science and Technology*, *29*(5), 4809-4818.
31. Hofstede, G. (1984): *Culture's Consequences: International Differences in Work-related values,* Sage Publications

The Impact of the COVID-19 Pandemic on the Learning and Wellbeing of Secondary School Students: A Survey in Southern Europe

María Panteri[1,2], Annita Zirki[3], Georgia Lambrou[4], Juri Valtanen[5], Eleni Berki[6], Georgios Lampropoulos[7, 8], Demet Soylu[9], Kerstin Siakas[7,10], Elli Georgiadou[11], Adam Edwards[11], Harjinder Rahanu[11], Maja Stoffova[12], Carlos Morales[12]

[1]University of Cordoba, Cordoba, Spain
[2]Special Unified Gymnasium and Lyceum of Iraklion, Greece
[3] State Institute of Livadia and Larnaca, Cyprus
[4] Thekleio Gymnasium of Limassol, Cyprus
[5]Tampere University, Tampere, Finland
[6]Jyväskylä University, Jyväskylä, Finland
[7]International Hellenic University, Thessaloniki, Greece
[8] Hellenic Open University, Patras, Greece
[9] Hacettepe University, Turkey
[10]Vaasa University, Vaasa, Finland
[11]Middlesex University, London, UK
[12] IES San Fernando, Constantina, Spain

Abstract

The transition from the traditional model of learning and teaching to full online mode had to be implemented in many countries, in an extremely short time, as the 2020-2021 school year was in mid-stream. Secondary education, which includes students in the age range of 12-18, faced many challenges in this rapid change, as many research studies have shown. Researchers raise questions regarding the readiness of the secondary education community to transition to fully online learning. The pilot study reported in this paper deals with the impact of the transition to online learning on secondary schools in southern European countries. More specifically, this paper presents the results of a *literature survey* and an *empirical survey* using an *online questionnaire* which captured non-traceable responses from secondary schools that, voluntarily and anonymously, completed the questionnaire. The questions were mainly closed, with some open-ended questions for students to fill in. The study also aims to capture data on the socio-economic dimension, accessibility/ availability of the necessary technologies that enable online learning, as well as the

families' employment status and their ability to support students. A total of 90 students participated (62% female, 28% male) from three Mediterranean countries. The students' perspectives as seen by the students themselves along with the difficulties and the issues they faced are compared and contrasted. This investigation offers a pedagogical and socio-technical analysis and highlights the needs for wellbeing as well as quality learning and teaching in the new social distance reality.

Keywords: Covid-19 pandemic, questionnaire, e-learning, preparedness, secondary education, wellbeing, inequalities

1.0 Introduction: The New, the Old and the New-Old Problems

The new coronavirus (COVID-19), which in March 2020 was declared a pandemic by the World Health Organization, unexpectedly invaded our lives and the lives of millions of people around the globe. One year after its sudden appearance, the whole world is grappling with its impact on all aspects of life and life itself, undoubtedly experiencing unprecedented situations, which have significant social, psychological and economic consequences, the extent and duration of which cannot yet be accurately estimated.

According to the World Health Organization the confirmed cases until the second wave of the pandemic exceeded 130 million, with 2.5 million deaths and 63.5 million cases of patients having fully recovered [1]. In its weekly report the European Centre for Disease Prevention and Control describes that since the beginning of the pandemic in late 2019 until the 15th week of 2021, 141,805,956 cases of COVID-19 have been reported, including 3,026,902 deaths [2].

The impact on the education sector has also been unprecedented. UNESCO reported that COVID-19 pandemic affected nearly a billion and a quarter of learners worldwide, which corresponds to 67.7 % of the total number of students and learners [3]. The impact is multidimensional: economic, technical, political, environmental, social, cultural, legal, ethical and demographic. In this context, educational systems worldwide have been called upon to contribute appropriately to the management of this situation [4]. Initially they proceeded to suspend the operation of schools, universities and all other educational structures in order to reduce dispersion of COVID-19, in response to the recommendations of expert scientists. The extent of the suspension of the educational systems is shown in the map below (Figure 1) [4].

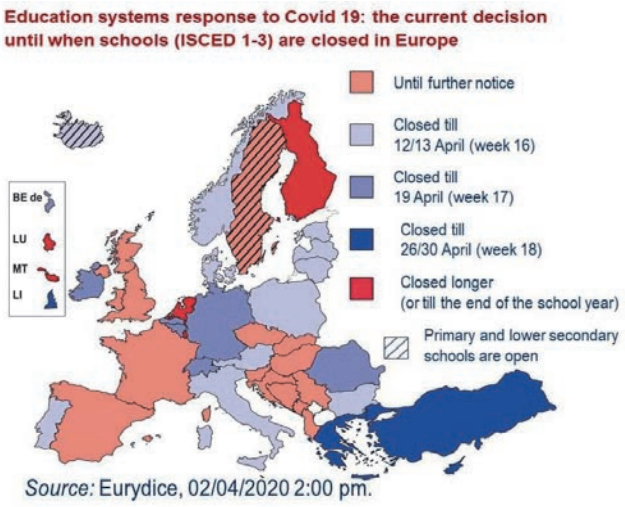


Figure 1: Extent of the suspension of the educational units

In the second phase, an attempt was made (in an extremely short period of time) to design ways and forms of distance education in order to respond to these emergency conditions.

The transition from the traditional model of learning and teaching to fully online had to be implemented in an extremely short time, since the academic session was in its mid-stream and with many researchers raising questions regarding the readiness of the educational community to transition to fully online learning. Sadly, the poor preparedness resulted in hasty and often inadequate decisions and actions being taken [5]. As the academics were required to ensure that online delivery was enabled within a very short period of time, they were in the front line of this transition. Many studies, including the one carried out by Georgiadou et al. (2020) [6], concentrated on the challenges faced mainly by educators in higher education.

The uncertainty caused by the pandemic and the long-term suspension of schools has affected students, parents and teachers. COVID-19 poses both direct and indirect threats to the wellbeing of individuals, either as a direct contributor to negative psychological states or as an important factor behind the reduced ability of students to experience social contact [7]. However, there has not, as yet, been any extensive exploration of how the pandemic affects students' wellbeing in these new online formal and informal learning environments.

Furthermore, it has been widely reported that the pandemic revealed and exacerbated pre-existing social and digital divides [8, 9, 10]. For example, Lai and Widmar [11] argued that in USA, the digital divide has limited the opportunities for those without ready access to the internet. In addition, due to the COVID-19 outbreak, many daily

activities transitioned to online, rendering internet services essential for many households. As a result, the impact of the digital divide and unequal access to the internet and technological devices were even more obvious.

The study reported in this paper deals with the impact of the transition to online learning on secondary schools. More specifically, this paper presents results of i) a literature survey that mostly comprises recent related research studies (and a few older) and ii) an empirical survey, using an online questionnaire, which captured non-traceable responses from secondary school and further education students who, voluntarily and anonymously, completed the questionnaire.

The purpose of this paper is twofold: On the one hand it seeks to capture the way in which education systems internationally attempted to deal with the impact of the pandemic and on the other hand to highlight students' beliefs about and their experiences, in the new learning environment, of distance education. Therefore, this paper illustrates an overall picture of how students and teachers interacted and worked together during the lockdown in three Mediterranean countries with references to similar experiences through the literature review findings. The authors chose to describe how their and other schools around the world moved very quickly from traditional ways of education to online and distant mode education. Reading and reflecting on the experiences exposed in this paper one can find out how both students and teachers managed to tackle similar or different problems, communicate and learn how to use new technologies.

2.0 From Traditional Education to e-Learning: The Need for and the Transition

The pandemic has caused the biggest education system upheaval in history, affecting nearly 1.6 billion students in more than 190 countries and on all continents. The suspension of educational facilities affected 94% of the global student population [12].

During the period of the first lockdown (spring 2020) the solution in the majority of the countries was the transition from traditional teaching to distance education, with the exception of Sweden and Iceland [4]. In this phase emphasis was placed on ensuring direct access to the internet, the use of learning platforms and the training of teachers in new technologies, in order to support students in new learning environments [13]. However, during the second lockdown (autumn 2020) the percentage of countries suspending their schools and universities was lower [4].

Education during the pandemic period is more accurately described as a form of distance education called Emergency Remote Teaching (ERT). ERT is distinguished from online learning by the fact that it reflects a sudden and unplanned shift of lessons within the classroom to the model of distance education, due to unpredictable and unplanned factors [14]. An ERT approach may include the use of digital learning

platforms but also sending of homework and notes in traditional formats, such as "homework packages" sent to students' homes. This format was mainly adopted in the first weeks, which followed from the closure of schools at the beginning of the pandemic, for example, sending assignments by conventional mail or in-person delivery.

The transition from traditional teaching to online learning depends on national systems, culture and the level of knowledge and familiarity of the educational community with new technologies and the philosophy of Distance Education [15]. The data shows that around 80% of Europeans use the internet very often and 65% use social media. At the same time many students that drop out of school, join diverse society groups and select online learning [16].

Although distance learning is an innovative form of education for many teachers, it dates back several years. As described by Palaiodimou [17], the term refers to "any organized educational process provided remotely in both primary and secondary education. It meets the needs of students and is in harmony with the challenges of the modern age and the society of knowledge". In recent years, several countries have adopted institutional applications of distance education, including Germany, Austria, France, USA and Australia. In other countries, such as Greece, until recently adoption has relied on individual efforts and pilot programmes, mainly in primary and secondary schools [18].

Although there are several models of distance learning, what prevailed in the era of the COVID-19 pandemic is a model of online learning which involves working in synchronous or asynchronous electronic teaching environments. Students have "remote access" to various multimedia or can interact with them, for example in virtual learning environments or teleconferencing. In the literature we see the following forms described [18]:

- *Autonomous distance learning*: This is identical to the traditional education system. It is provided via online teleconferences either in real-time or asynchronously. Such training initiatives go back many years in America and Australia and are called virtual schools.
- *Complementary e- learning*: This format works in support of and in parallel with conventional education, through attendance at individual courses and teleconferences, school network collaborations, etc.
- *Mixed education,* which is the combination of conventional methods of learning and distance online forms of education.

3.0 The Impact of Distance Schooling and Learning in Students' Wellbeing

Between March and May 2020, schools in many countries closed in whole or in part. Children have not been left untouched by the dramatic impact of the COVID-19

pandemic, as there is a growing body of literature that clearly correlates exposure to stressful events and crisis situations with a child's psycho-emotional state [19]. During the quarantine period, children were forced to stay at home for long periods of time, move away from their normal educational environment and change their daily routine due to the suspension of schools.

Numerous studies are being conducted to research the effects of school closures on students. For example, studies in China's enclosed student population reported *increased rates of depression, anxiety, phobias* and *difficulty in coping* with situations [20, 21]. Saurabh and Ranjan [22] found that children in India experienced feelings of *helplessness, fear, and less tolerance of rules* in daily routines. In a study in Spain and Italy [23], the majority of parents reported significant *changes in the psycho-emotional state of children, such as boredom, difficulty concentrating, irritability and feelings of isolation.* In Italy, parents also reported cases of regression of children's behavior in earlier stages, such as *demanding physical proximity* to their parents at night, and over 50% showed *increased agitation, intolerance to the rules, excessive requirements on parents and whims* [24].

Caffo et al. [25] noted that 30% of participating parents reported that their children overused computer games in the period when schools remain closed, while a similar percentage (25%) showed significant changes in daily habits and sociability, for example sleeping and eating habits, physical exercise and mood, withdrawal and isolation from both peers and family being commonly observed. Reducing physical activity as a result of interrupting classes, eliminating sports activities and increasing screen time increases the risk of obesity in children and the onset of physical symptoms which may increase the risk of developing a severe form of COVID-19. Similar findings have been found in other studies, mainly in countries most affected by the pandemic [26, 27].

School is not just a place of learning, but also a place where children and adolescents develop their social skills and socialization, which are necessary for cognitive and socio-cognitive development. The closure of schools and the transition of the educational process to home schooling, which was often quite impersonal (e.g. closed cameras and microphones) increased the level of stress of students and their feelings of isolation and withdrawal [25]. In addition, the degree of commitment and learning motivation in these conditions, seem to be significantly affected, as it is known from the literature that stimulating and maintaining students' engagement is enhanced by collaboration and interaction during the learning process and is recognized as a very desirable goal for both teachers and psychologists [28].

School closure entails high social and economic costs for children, especially from vulnerable environments. These effects, recorded by UNESCO [29], are:

- *Interruption of learning:* Educational inequalities were highlighted during this period, as less privileged students tend to have fewer opportunities beyond school.

- *Confusion and stress for teachers*: With the sudden suspension of schools, teachers felt very insecure about their educational responsibilities. The transition from traditional teaching to distance learning has often been frustrating.
- *Parents are unprepared for distance and home education*: When schools close, parents are often called upon to facilitate their children's learning at home, which was extremely difficult for many parents.
- *Childcare gaps*: In the absence of alternatives, working parents often leave their children alone at home when schools close and this can lead to child neglect.
- *Increased pressure on schools and school systems that remain open*: Local school closures burden schools as governments and parents redirect children to schools that remain open.
- *Increased dropout rates*: It is a challenge to ensure that children and young people return to and stay in school when schools reopen after closing.
- *Challenges of measuring and validating learning*: Evaluation in these new conditions is a difficult process and raises concerns about equity. Distance assessment leads to stress for both students and their families.

Studies also show a significant negative effect on the wellbeing of parents and the whole family, where parents describe *mental burdens, emotional stress, irritability and unhealthy behaviour(s) such as increased alcohol use* [30]. Humphreys et al., [26] point out that the risk of domestic violence is high during a pandemic, due to restrictive measures and the increased time spent at home. In a British study by the Office for National Statistics [31] one third of the participating parents, i.e. about 30% concluded that home schooling was negatively affecting their wellbeing, while 50% said it was negatively affecting the wellbeing of their children.

An equally important issue now is how education at home has affected children with learning and / or behavioural difficulties. These difficulties appear to be exacerbated in restrictive conditions at home, especially if support is not available. In particular, children with Attention Deficit Hyperactivity Disorder (ADHD) seem to experience this changed situation much more intensely than their peers and many of their existing "symptoms" are likely to intensify in the future [20, 32].

From all the above, it is clear that children's wellbeing is being affected during this period, especially when we consider that wellbeing is related to issues such as quality of life, positive emotions and engagement, relationships, meaning and purpose, and accomplishment [33, 34]. Hone et al. [35] argue that wellbeing is related to good mental health, physical health and good interpersonal relationships. All are factors that were significantly affected in “stay at home” periods.

4.0 Research Methodology

The related literature review in sections 1-3 demonstrates the importance of the need for further research and to take into account the perceptions of the students themselves on issues that directly concern them and to find suitable ways to research and study the impact and the consequences for them. For example, in the case of online distance education, if students' attitudes are negative, they are more likely to be reluctant to work with teachers to enable distance education in practice [36, 37]. At the same time, understanding how students' wellbeing operates, especially in a crisis situation such as this global pandemic, is essential for the implementation of new and adapted measures, so that students would have the best support for their education [38].

4.1 Research Aim and Context

Taking into consideration the need to further research the topics described in earlier sections 1-3 and in order to capture them in their national and regional contexts, we proceeded as follows: We conducted a survey on the impact of the COVID-19 pandemic on learning and wellbeing in secondary education schools in three southern European countries. The aim of the research study has been to identify and analyse the views and perceptions of secondary and further education students, from three different countries; Cyprus, Greece and Spain. The research study, through the survey, focuses on identifying the effects of both the period of forced quarantine and the transition from traditional to online distance learning on the learning, wellbeing and mental welfare of secondary education students.

4.2 Research Instrument

An anonymous online questionnaire was selected as the mean for data collection, as descriptive research has a prominent place in educational studies [39]. Questions were mainly closed (which makes the analysis of the data more consistent) but there were also some open ended questions for students to answer freely.

The first part of the online questionnaire consists of demographic information (gender, age, school grade) and data about socioeconomic issues, including the accessibility and availability of technologies which enable online learning, as well as the employment status of the family/supporting adults and their ability to support the students. In the next part the respondents are asked to reflect on the difficulties they faced/are facing and their problems of isolation and social interaction during the lockdown period. The last part of the questionnaire includes questions on cybercrime, fraud, fake news, misinformation and their consequences, given students might not have been prepared to deal with them. Finally, the respondents are given the opportunity to share their ideas and suggestions for improvement and future directions.

4.3 Data Gathering Procedure

The questionnaire link was distributed in March 2021 in various ways, e.g. via secondary schools' emails, teachers' emails, and in parental social networking groups. The questionnaire could be answered in approximately 15-20-minutes, was anonymous and the answers were treated confidentially. Participants had the opportunity to withdraw from the study at any phase. There was no reward for completing the survey, but participants were given the opportunity to be informed about the results of the study, if they wanted to, by leaving an email address.

5.0 Data Analysis and Research Findings

In this section the researchers and paper authors illustrate using tables and graphs some of the research findings, reflecting on possible explanations and critically reviewing the data.

5.1 Participants in Research – Demographical Data

The total, number of student responses was 90; 62 (69%) from Greece, 18 (20%) from Cyprus and 10 (11%) from Spain (Figure 2).

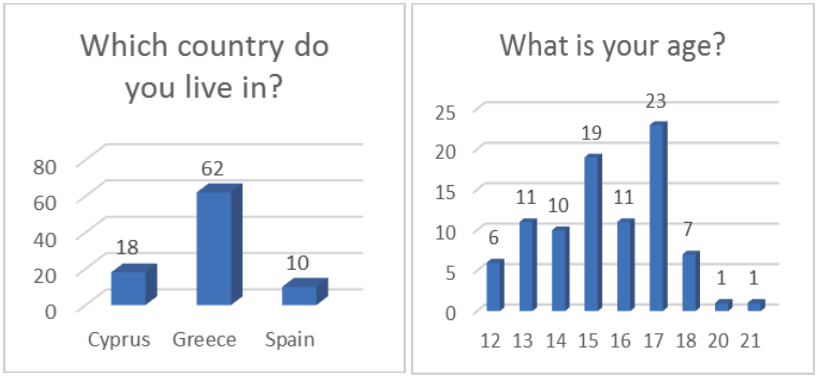


Figure 2: Country and age distribution

In total, 28 (31%) of the respondents were male and 62 (69%) were female. Most of the students were between 15 to 17 years old with average age being 15.55 (Figure 2). The usual age for secondary school students is 12-18. However, there are special schools for students with special educational needs and evening schools offering a second chance to adults who missed the opportunity of secondary education earlier, where the age of students exceeds the age of 18 years.

The percentage of parents or guardians working from home before the pandemic was 29% and 44% during the pandemic. A surprising result is that the unemployment rate of the respondents' parents/guardians decreased during the lockdown. The

percentage of unemployed parents / guardians before the pandemic was 21% (19) and 30% (27), compared to the percentage of those who declared themselves unemployed during the pandemic, i.e. 13% (12) and 19% (17) respectively. This phenomenon might be due to the employment type of the parents.

5.2 Access to Facilities (Section F of the Questionnaire)

In total, 89 (99%) of the students had internet access at home before the pandemic broke out.

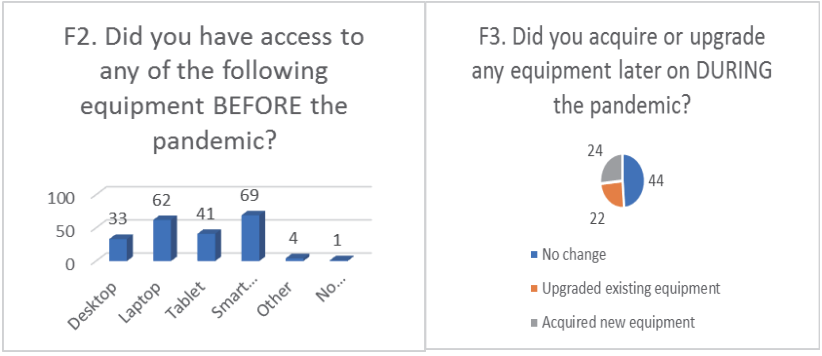


Figure 3: Access to equipment and need to upgrade.

Figure 3 (Question F2) shows that 69 (77%) of the students had access to a smart phone, 62 (69%) to laptop and 41 (46%) had a tablet. Several students had access to multiple devices. Only one student had no equipment at all.

From Figure 3 (Question F3) we observe that 44 (49%) of the students had access to satisfactory equipment and did not acquire new equipment or need to upgrade their existing equipment. However, in total 24 (27%) acquired new equipment and 22 (24%) upgraded their existing equipment. The expenditure was met mainly by families (33% - 30), followed by the students themselves (28% - 25). In 8 cases (9%), the school sponsored the acquisition of new equipment and in one case (1%) the municipality/local authority did.

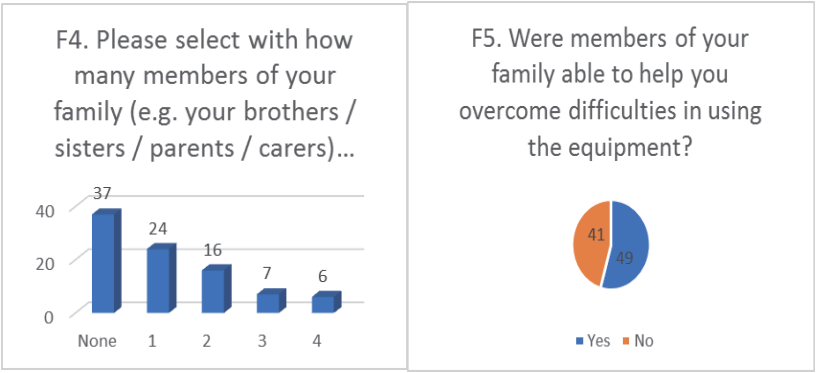


Figure 4: Number of family members sharing same equipment and possibility of help by family members.

From Figure 4, we note that most of the students (41% - 37) did not need to share the equipment with any other family members. However, 24 (27%) of the students had to share equipment with one other family member, 16 (18%) with two other family members, 7 students (8%) with another three family members and the remaining 6 (7%) with four family members. In 49 (54%) of the cases, family members were able to help students overcome difficulties in using the equipment.

In Table 1, students' most commonly used software platforms are displayed. It is worth noting that students used multiple platforms.

Table 1: Most commonly used software platforms by students.

Platform	Frequency
Webex	61 (68%)
Zoom	50 (56%)
Skype	40 (44%)
Google Classroom	35 (39%)
Microsoft teams	24 (27%)
Viber	24 (27%)

5.3 Teaching Mode Preferences

In total, 53 (59%) of the students prefer face-to-face learning, 26 (29%) a mixed approach and only 11 (12%) of the students prefer online learning. In total, 54 (40%) of the students believe that face-to-face teaching will not disappear in the next 10-20 years, while 36 (40%) believe that it will.

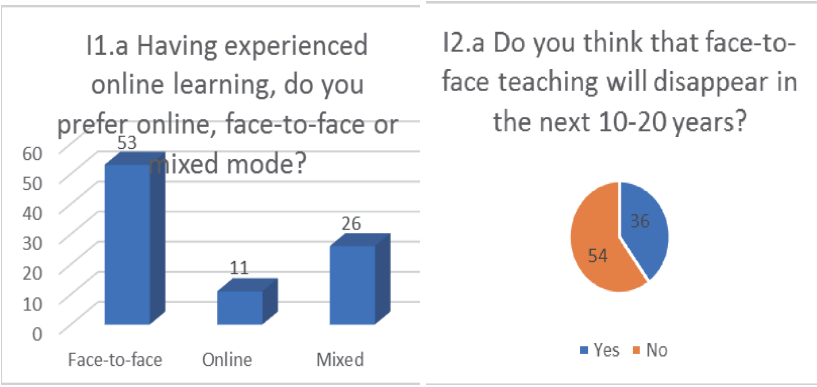


Figure 5: Learning mode preferences and how students see future learning modes.

5.4 Experiences of Distance Mode Teaching during the Lockdown

Courses that are recognized as the most difficult to attend by distance mode are science, like mathematics and physics (table 2).

Table 2: Most difficult subjects to follow while in distance mode

Subject	Frequency
Mathematics	58 (64%)
Physics	42 (47%)
Chemistry	35 (39%)
History	31 (34%)
Biology	30 (33%)
Language(s)	30 (33%)

In total, only 7 (8%) reported that they always used a webcam, 41 (46%) sometimes and 42 (47%) never. 79 (88%) reported that their teachers sent them notes and exercises at home. The majority (27%) of students answered that they enjoyed learning from home moderately and that they missed their school friends very much (60%). Only a few of the respondents had attended lessons which used radio (2%) or TV (7%).

As seen in figure 6, teachers provided most help to students in all classes followed by family members.

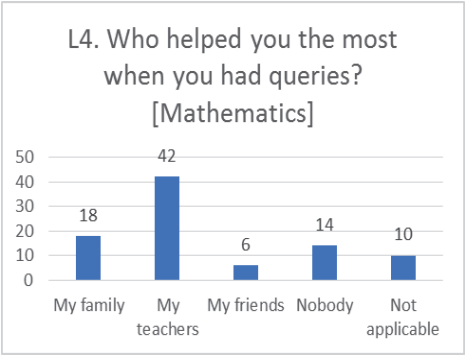


Figure 6: Who helped when queries regarding mathematics arose.

5.5. Interaction with Teachers and Friends

Based on Figure 7 we conclude that interaction with teachers was worse during the lockdown than before, which it is a quite expected finding.

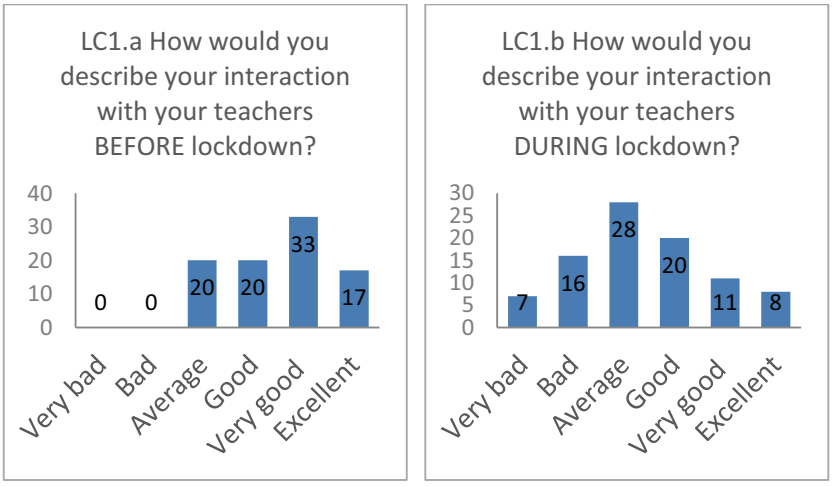


Figure 7: Interaction with teachers before and during lockdown

87 (97%) of the students lived at home with parents/guardians. Table 3, shows the time that the students spent communicating with their teachers before and during the lockdown, while Table 4 shows the time spent communicating with fellow students. Just a small percentage of students reported longer communication sessions while the majority reported communication sessions of less than 15 minutes during the lockdown.

Table 3: The average time students spent communicating with their teachers before and during the lockdown.

	Before Lockdown	During Lockdown
Less than 15 minutes	28 (31%)	49 (54%)
15-30 minutes	23 (26%)	16 (18%)
30-45 minutes	24 (27%)	12 (13%)
45-60 minutes	6 (7%)	5 (6%)
More than 1 hour	9 (10%)	8 (9%)

Table 4: The average time students spent communicating with their fellow students before and during the lockdown.

	Before Lockdown	During Lockdown
Less than 15 minutes	6 (7%)	21 (23%)
15-30 minutes	13 (14 %)	21 (23%)
30-45 minutes	14 (16%)	14 (16%)
45-60 minutes	14 (16%)	6 (7%)
More than 1 hour	43 (48%)	28 (31%)

5.6 Security and Privacy

Security and privacy are considered a part of wellbeing and social welfare for educational communities and wider society. Learners' safety is a significant part of general social welfare. Being able to learn and interact safely affects the mood and feeling and disposition of human. The data captured in southern European distance mode schooling and learning is given in the figures that follow and it is important for providing information on the levels of readiness of schools and trust to the internet-based facilities.

Obviously the need for distance online learning decreased the level of related training in secondary education. Thus, as figure 8 shows, 49 pupils of the 90 respondents had no training regarding cybercrime before the pandemic while, during the pandemic, 75 of the 90 respondents had no training related to cybercrime awareness.

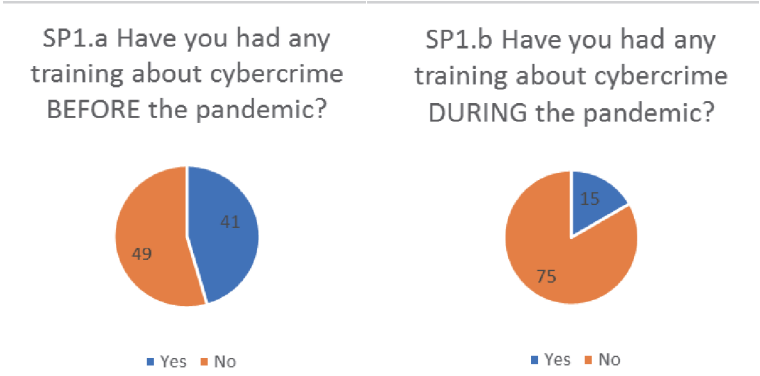


Figure 8: Training Provision about Cybercrime before and during Covid-19

According to Figure 9, awareness regarding protection measures taken for private data was not high since only 58 students replied that they were not aware but 32 pupils considered that they were. The majority of the students; 81 out of the 90, reported that they experienced no problems caused by cybercriminals before the migration to online learning.

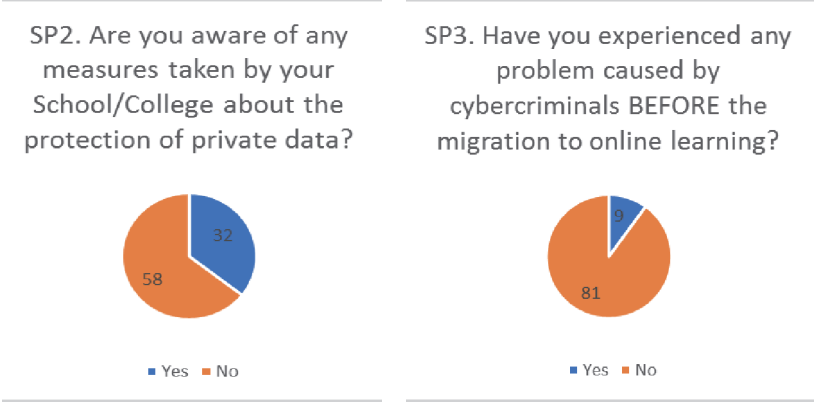


Figure 9: Problems and Measures for Privacy Protection and Students' Awareness

In the related question regarding additional problems experienced after migrating to fully online learning, from the 90 in total students, 71 replied no while only 19 replied yes (Figure 10). Interestingly (and perhaps justifiably), among the 90 in total, more than half (48 out of 90) show medium level trust in the information they find in the internet. Furthermore (Figure 2), for the same question, 21 out of 90 students responded that their level of trust is low and 4 pupils said that they do not trust at all the information found on the internet! Amazingly (but again justifiably), a small number of them, that is only 17 out of the 90 in total replied that their level of trust for the related question is high.

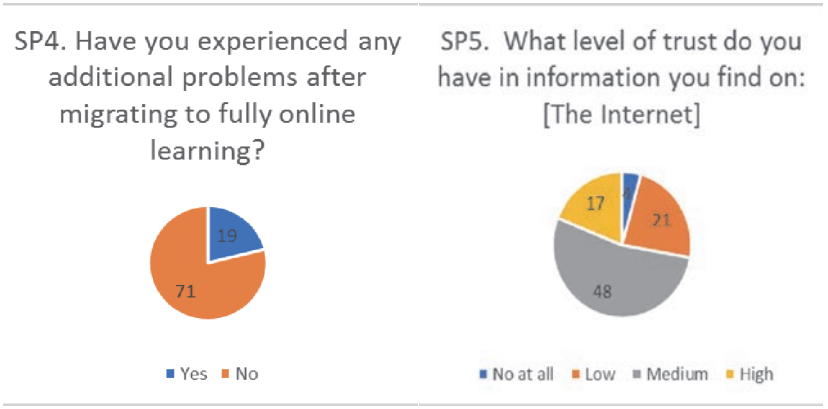


Figure 10: Problems in Online Learning and Levels of Trust

Another rather intriguing issue revealed from this study is illustrated in Figure 11 (SP5) as regards the level of trust the students exhibit for information found on social media, such as Facebook or/and Twitter. Comparing and contrasting the SP5 responses (see Fig 11), one can clearly see that 35 out of 90 pupils, that is less than half, have medium level of trust of social media and 26 out of 90 students have a low level of trust. Moreover, 21 students do not trust such information at all, while only 8 out of 90 students highly trust information found in social media.

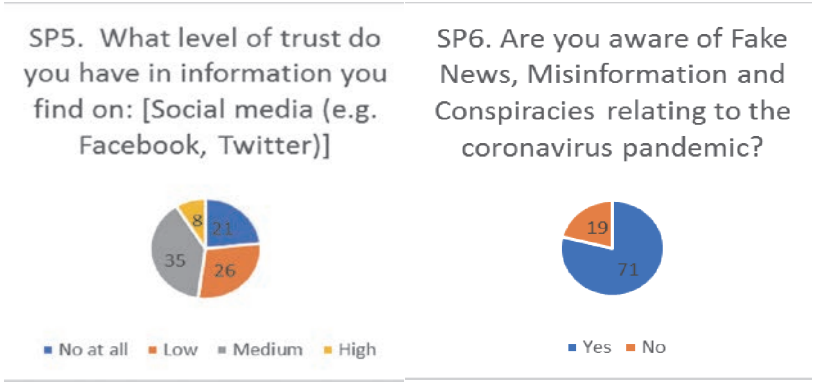


Figure 11: Trust and awareness regarding online (mis)information

A further question (SP6, Fig. 11) asked about awareness of fake news, misinformation and conspiracies related to the Covid-19 pandemic. The majority of students (71 out of 90) responded yes, that is they were aware of these while only 19 out of 90 responded with no as their answer.

The authors consider the above findings on online privacy and security significant in regard with the reality of students' cyber-security and social awareness and their feelings of safety while learning online. Further investigation will need to take place to find out more by scrutinizing the data provided and the beliefs of students in the three countries that participated in this research study.

Similarly to online privacy and security, the authors next examine the data by country on two important issues that are also related to students learning and wellbeing. These are the *concentration* and *interaction* of students in a cross-national and cross-cultural comparison.

5.7 Concentration and Learning: Cross-national and Cross-cultural Comparison

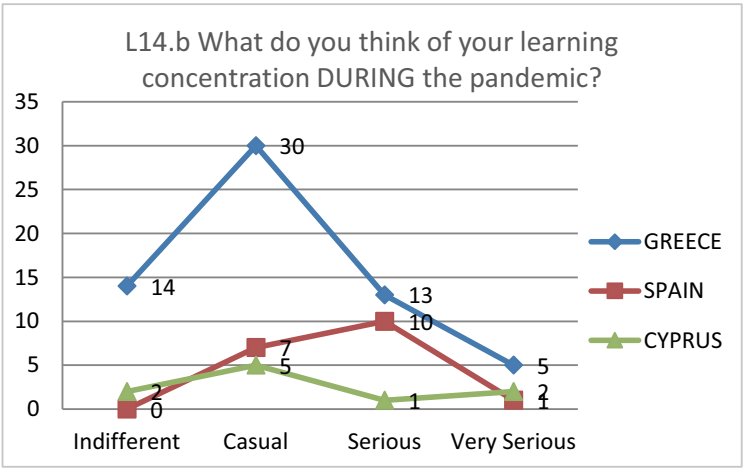


Figure 12: Concentration and Learning during the pandemic – Comparative Findings

Due to the differing numbers of respondents from each country the chart can be misleading. Thus the table below which takes into account the ratios of responses from each country (to the nearest whole number), might provide a better basis for comparison.

Table 5: Concentration & Learning during the pandemic – Comparative findings

Learning concentration **during** the pandemic	Greece %	Cyprus %	Spain %
Casual	48	32	50
Indifferent	22	0	20
Serious	20	56	10
Very Serious	10	2	20

5.8 (Online) Interaction with Teachers before and during the Pandemic

From Table 6 it can be seen that in all three countries interaction between the students and their teachers deteriorated during the pandemic. Responses from Spain were better both before and during the pandemic, but it should be noted the sample is very small.

Table 6: Interaction between students and teachers before and during the pandemic

	Greece (N=62)		Cyprus (N=18)		Spain (N10)	
	Before	After	Before	After	Before	After
Very Bad	0	9	0	5	0	0
Bad	0	19	0	11	0	20
Average	19	33	11	28	0	20
Good	19	16	33	33	20	40
Very Good	31	11	44	11	50	20
Excellent	19	9	11	11	30	0

6.0 Teachers reflective comments

In this section the personal experiences and reflections of teachers and professionals in secondary education from Cyprus and Greece are given in their own words.

6.1 Reflections on the integration of distance learning in Special Education from the perspective of a School Psychologist- by Maria Panteri

A year ago, none of us would have imagined that schools would remain closed for so long and all children would stay at home for an unusually long time. The extent of the issue is reflected in the numbers: According to UNISEF [40] more than 200 million students, at all levels of education, in 23 countries on all continents, have lost at least three-quarters of their total teaching time, in its traditional form, since the early spring of 2020. More specifically over 50% of schools remained suspended for about 100 days. According to the latest UNICEF data [40], by February 2021, 53% of countries worldwide have fully or partially opened schools, while 13% remain suspended.

Obviously, we are all facing an unprecedented educational crisis and although experts have assured us that students will adapt very quickly to the new everyday conditions, the educational reality has been very difficult for everyone. Students lost their classes and teachers were forced to immediately acquire new technical and functional skills, related to digital media, to respond to the emerging needs. It is of concern to note that the suspension of schools is expected to exacerbate the pre-existing educational crisis, affecting more the most vulnerable students [40]. Among vulnerable students are those who come from financially difficult environments and those presenting learning difficulties.

Most countries have offered distance education, through the use of various applications and platforms, through programs on educational television and others through mass media. But was there any special provision for special education?

The operation of special schools during the COVID-19 era

In Greece, special education followed partly the course of general education in distance learning. During the first period of the suspension of the operation of special schools, the asynchronous form of education was chosen, mainly by sending notes and exercises (via e-class, e-mail, skype). In the second wave of the pandemic, special schools in Greece did not close. Nevertheless, many special schools were closed in whole or in part, due to COVID-19 cases among members of school community. In this case, synchronous distance teaching was used, as required by the Greek Ministry of Education. The Ministry of Education provided for the creation of fully online classes for students belonging to groups vulnerable to COVID-19.

Special education is a sensitive part of education, as it has to manage great inequalities. These inequalities stem mainly from the lack of resources, financial, technological and educational, as well as financial and educational difficulties for parents and families [41].

During the COVID-19 era, in Greece, school coordinators sought to meet the needs of teaching staff, with frequent training seminars on the basic principles of distance education, new platforms and the role of digital tools in synchronous and asynchronous distance learning and the objectives of teaching and the parameters that affect its effectiveness. The transfer of teaching from its traditional form to remote modes requires continuous self-training, needs analysis, searches for appropriate tools and revised methods for reflection, goal setting and lesson planning [42], which seem to have been realized by special education teachers. Online training has also facilitated the dissemination of good practices applied by schools, other educational structures and other scientific bodies or community support structures.

Additionally, the Greek government provided for the treatment of the inequalities issues in the provision of distance education, through lending or free provision of electronic devices, while access to the educational platforms was free for all, students and teachers.

The role of Educational and Counseling Centers was emphasized during the suspension of the operation of special schools, but also throughout the pandemic. More specifically, professionals were invited to plan and organize remote counseling support for parents and students of all schools, as well as to coordinate the staff of special schools in order to provide corresponding distance services.

Reflections from a special gymnasium and lyceum from Greece

Special vocational gymnasiums and lyceums are secondary schools, where students are diagnosed mainly with issues such as intellectual development disorders, autism,

severe learning difficulties and behavioral problems. Classes usually consist of students with great differences, in terms of their educational, cognitive, emotional and social needs. Differentiated/ individualized teaching takes shape in a special school; otherwise the learning process becomes difficult or almost impossible. A key element for the smooth integration and cooperation of a student in a special school is cooperation between school and family, as well as the support of the school mental health specialists (psychologists and social workers).

Working as a school psychologist in a special secondary school, I found that the main goal of our work in the COVID-19 era is to reduce inequalities in the provision of education to our students [43]. In addition, due to the gap created in the educational process due to frequent lockdowns, the main goal set in the special school is to maintain the skills that students have already acquired and to continue their contact with the school. Fixation and regression of skills are processes that we often encounter in a special school and the current situation favors them greatly, since the normal flow of learning is interrupted.

Last year, our school adopted the model of Emergency Remote Teaching, using a combination of synchronous and asynchronous actions. Webex was used as a synchronous distance learning platform and the electronic School Classroom (e-class) of the Pan-Hellenic School Network, as a platform for asynchronous distance learning.

To ensure effective adaptation by all of us to the new conditions, an individualized framework of actions was formed, addressed to the special needs and capabilities of each family. With the cooperation of the teaching staff and the mental health professionals of the school, the following steps were followed:

- ✓ Communication with families to explore the needs and available technology resources.
- ✓ Formulation of an educational program, individualized as much as possible.
- ✓ Sending a folder with material and educational activities via mail, Microsoft Teams, viber etc.
- ✓ Individual or group support of students and their families for mental stimulation, learning mobilization and connecting the school and family environments.

Listening to the voices of children

In recent years, in order to improve the school, we have come to the conclusion that the voices of our own students must be taken seriously and by referring to the voices, we mean the words of the children, their feelings, their views; a variety of expressions within and outside the school [44].

In our effort to listen to the psychological footprint of the pandemic period in the lives of our students, we carried out a program of emotional expression and discharge of negative emotions. The children were given the opportunity to express

their feelings about the pandemic, the difficulties they faced and to identify new sources of help and mental strength. In the meetings with our students we listened to many of their concerns and made an effort to reframe many of them.

"I have learned to use the tablet to talk to my friends. Now how I can learn with this, I still wonder "(20 year old boy, autism)

"I feel so angry when I have to wear the mask that I am always looking for somewhere to break out" (17-year-old girl, intellectual development disorder)

"I did not enter the Webex much. I did not like my teachers to come into my room and see my things. I was ashamed to see my house" (22 year old girl, intellectual development disorder)

"I'm bored of school anyway. At least while we were closed I played PlayStation all day. "Nobody was telling me anything because everyone was either watching the news or were occupied with their cell phones." (15 year old boy, ADHD)

"I was seeing my parents distressed, sitting all day in front of the television and made me feel even more crap. I did not want to talk to my teacher or psychologists" (15 year old boy, emotional difficulties)

"What I felt during quarantine was boredom ... great boredom. I was bored doing housework, I did not go out at all because none of my friends went out and I was constantly fighting with my brother "(18-year-old girl, autism)

"My parents used to tell me that if I do not want to join the online class, it doesn't matter, it is not obligatory. That's why I was more involved with Instagram" (14-year-old girl, ADHD)

Emerging concerns from our experience at school

This unprecedented disruption caused to the daily lives of millions of students, created very big problems, especially for students with difficulties in life and learning. However, according to Tam & El-Azar [45], it is too early to weigh the benefits and disadvantages of this change in the educational process, as well as to judge how the education sector may be affected in the future.

Nevertheless, based on my personal experience from school, as well as the evaluation of the views of our students and teachers, important concerns are raised about the application of online distance learning in special education:

- *How can the digital classroom even temporarily replace the physical classroom, especially for children in special education, whose cornerstone is interaction and physical contact?*

- *Do all children have the appropriate, supportive environment at home, but also the resources to participate equally in the online educational process?*
- *How will it be verified that the children who acquired free digital media (tablet, PC) from the Ministry of Education actually used them for the purpose of learning?*
- *Is it possible for the specialist educator to differentiate his / her teaching for each child individually in the online classroom?*
- *Who is responsible for overseeing the education of a child growing up in a dysfunctional family environment?*

6.2 Reflections from Secondary Education teachers – Cyprus – by Georgia Lambrou & Annita Zirki

The COVID pandemic had a dramatic effect on life across the world. Cyprus was no exception. The education sector experienced major disruption which needed to be addressed.

The University and College sector were already offering several degree and postgraduate programmes online, but primary and secondary schools had no prior experience or plans for offering distance, online learning and teaching. This lack of preparedness made the sudden problem more acute. It required the co-operation of government, school management, teachers and parents.

Kafa & Pashiardis [46] provide a summary of government policies and actions during the early days of the 2020 COVID outbreak. The actions were to:

- Provide access codes for specific online programmes for over 110,000 students across Cyprus,
- Provide both parents and students with all the relevant information through the schools about the new e-learning environment and how students could participate,
- Help school principals, in collaboration with teachers, to develop a plan, based on the school curriculum which would be adapted to the new circumstances,
- Provide training for all teachers in the Microsoft Teams application (MS Teams) throughout Cyprus via the services of the Pedagogical Institute, whose main activities focus on teachers' in-service training.

Despite these decisions at a high level, the actual implementation proved quite difficult. Even a year after the first lockdown there are still problems of accessibility and need for further innovations. The challenges are impacting on the teachers, the students and their families.

The transition from traditional methods of teaching and learning to online was not easy. Both teachers and students were completely unprepared. Microsoft Teams entered our lives and everybody had to learn how to use it. Teachers with little

knowledge of computers had to study the instructions and watch online seminars on how to use Teams. Also they needed to change their teaching methods and the way they prepare their materials in order to keep their students engaged.

During the pandemic primary and secondary schools in Cyprus remained closed for several months. In April 2021 all students went back to their schools. If a student was COVID positive or was in contact with someone who was COVID positive, he had to stay at home and follow online lessons. In every secondary school in Cyprus both students and teachers had to have a rapid test every week and wear face masks all the time.

Quarantined students have to wake up early in the morning and start lessons at 7:30 and connect to teams until 13:30. They then continue with their extra private lessons in the afternoon. They have to download the material posted by their teachers and do their homework. The quarantined students do their tests after they return to their school.

Equipment was, and still is, one of the major problems the schools, the teachers and the students had to face. In many schools in Cyprus the computers are outdated and very slow. Their internet connection is often interrupted. The result is that the teachers cannot always connect with the students who are at home.

The job of a computer teacher is not only to teach programming or office applications but to change speakers, Ethernet cables microphones try to connect computers to the internet if the connection is down, connect projectors and solve other problems. If the problems cannot be solved on time the teachers cannot connect with their quarantined students. Also the time teachers spend connecting with their quarantined students means they leave their students who are in the classroom to work alone. The teacher's lesson time must be equally shared and this is not an easy task.

Foreign language teaching and learning is present in all levels of education in Cyprus. English is taught from very early age and French is introduced in the last years of primary school. English is one of the major courses in the first two years of secondary education and is taught till the end of it.

One of the major tools a foreign language teacher has and always uses in a traditional classroom is the e-book. With the e-book the foreign language teachers can keep their students' interest vivid, since it helps them follow the flow of the lesson by watching it on the board through the projector. In the same way, the students can see the page of their book with all the exercises and the reading texts or hear the listening texts or watch videos by "share screen" during online classes. On the other hand, e-books are one user and thus only the teacher can interact with the book, hence the teachers had to either prepare material for the students to work with or ask the students to scan or photo their work and send it to them. This made correction and evaluation of their work much more tiring and timing consuming.

On Monday 10th May 2021 schools will open again and students who have COVID-19 or were in contact with someone who had COVID-19 will stay at home and follow online classes. For the first three years of secondary education exams are cancelled. They will continue their classes until June and they will have written and oral assessments. The last three years will continue their revision classes and attend final exams. Final year students will attend both final and university entrance exams.

As the questionnaire reveals, the students are accustomed to electronic applications. As far as their studies are concerned, in order to complete their homework or study for a test they can ask for help from their teachers, members of their family or their friends. They use the Microsoft Teams platform or Viber or Messenger to communicate and exchange notes. The teachers send additional study material by using email or by uploading material in Teams.

During the three lockdowns some students were unable to meet their friends or go out to coffee shops or playgrounds. They felt isolated. Many of them played PlayStation games to pass their time and justifiably wondered why their parents complained about spending much time on gaming when they had to spend all morning at online school. They used Instagram and other social media applications to communicate with other people.

Some other children enjoyed staying at home because they got plenty of rest as they did not have to go to school in the morning and private lessons until 20:00 at night. Education in general is highly prized and respected throughout Cyprus, and this generates a competitive atmosphere.

School children from a young age attend their normal school hours but supplemented with private lessons, which even the poorer in society strive to provide for their children. This places even more demands on the children.

All their lessons were done online. Of course they missed going out during weekends, for socialising and meeting their friends. Many of them spent weeks at home without going out and were really tired of the confinement.

In this difficult situation everybody is trying to cope by doing the best they can. The teachers have acquired some experience on how to teach online and how to develop and deliver adequate material to all their students. The psychological comfort they offered their students was equally important.

7.0 Ethical Considerations and Research Limitations

Before presenting some concluding remarks on this research study, it is worth mentioning some important ethical and rules that were followed, as well as reminding the reader about this research survey's limitations.

7.1 Research Ethics: Ethical Considerations and Steps Followed

Every study has to handle ethical issues, especially during the research process (data gathering, anonymity, etc.), of which the researchers/authors and readers should be aware.

A signed approval letter was obtained for the application for ethical clearance for this particular research study, as part of a bigger project that also included similar research aims for primary and higher education. The submitted documents were approved by the Research Ethics Committee of Middlesex University in February 2021 and data collection took place in March 2021.

The rest of the section summarizes the important research points we considered and the action taken to assure ethical research was followed in this study.

First, the researchers must protect the participants from any danger and harm that participation might cause to them. In this study, we informed the participants that they can stop participating at any time, participation was voluntary and no reward was offered. We also informed the (potential) respondents early enough and clearly as to the purpose of this study and what participation required from them. For example, how much time they need in order to fill in the online questionnaire. Special attention was paid to the design of the questionnaire to ensure that it was easy to understand and easy to answer. We used simple words and questions as well as options that the secondary education students would easily understand. In addition, we emphasized that nobody outside of the research group will know who participated in this study.

Second, the results from the study must be honest. That is, the results have to be transparently shown without hiding negative findings or selecting only positive findings. Perceived or real conflicts of interest such as financial interests may influence the findings. For example, in sponsored studies the authors might be under a pressure (or even threat) to present only favourable, positive findings and neglect some not so favourable, negative or undesirable findings. This study was not sponsored by any external funding source. For this reason, external funding sources did not and could not influence the research findings and final research results.

Third, there might be some ethical issues concerning with whose voice is heard and not heard enough in the study. For example, in some studies, less influential and marginalized groups might have difficulties to be heard. This study included, within the secondary education students' context, voices from three different countries of southern Europe, and also students with special needs from one country.

Fourth, current research studies usually refer to (most) recent studies. However, there might arise some ethical issues concerning how appropriately relevant published studies were searched and selected. That is, how well researchers managed to consider the impact of potential search bias, such as availability bias, database

bias, or citation bias, and the impact of potential publication bias such as methodological bias or outcome bias. For example, already completed studies, to which other studies refer, might be more likely to be published and cited, when they use certain methodology, certain sample size, certain language, certain publication fora, or emphasize significant positive rather than negative effects. In this study, we included published research studies which were conducted during the pandemic. In addition, we did not limit our search and selection to just research studies written, reported or/and published in English. Our multidisciplinary and international research group was able to include studies that were published in many languages, among them in Greek, Finnish and Swedish.

7.2 Research Survey's Limitations

A study cannot cover everything that exists. For this reason, there are some limitations which the readers and the authors of this paper should be aware of.

First, this research survey/study had been designed to focus on secondary education students' experiences of distance education (including teaching, learning, studying, concentration, interaction and wellbeing) during the pandemic. Thus, primary education students' and higher education students' views were not included. The research focus of this paper was on teenagers as learners during the pandemic, rather than adults (more than 18 years of age) as learners or children as learners.

Second, the researchers were interested in secondary education students' experiences of distance education, not teachers' nor other school support staff members or parents' views.

Third, this research study was contextualised to *formal* (e.g. state-based) learning rather than *non-formal* (e.g. training) and *informal* (e.g. accidental) learning settings. That is, the distance education was organised around formal learning following the school's curriculum even though the students' were at home.

Fourth, the formal learning context and physical/virtual settings were located in southern Europe, and only three Mediterranean countries (Spain, Greece, Cyprus) were included, not every single southern European and/or Mediterranean country.

Fifth, the data sets collected for this study from two of the chosen countries (Spain and Cyprus) were relatively small while the data from one (Greece) of the three countries was over-represented. For this reason, the conclusions from the research results are, at best indicative, in the absence of representative data as hard evidence. However, the results and the conclusions drawn from the research outcomes make a notable contribution leading to understand how secondary education students' experienced distance education during the pandemic; and, naturally, that picture will be confirmed or challenged by other current or further studies.

Sixth, this study reviewed and referred to published empirical studies, which have been conducted during the pandemic, not before. There are many studies conducted before the pandemic that tackle students' experiences on distance education. But in this study those studies were not included. The focus of this study was particularly on this very early/immature era of distance education mode during the pandemic.

8.0 Conclusions and Future Work

From the first observations, it can be seen that this study confirmed that for students, school is much more than just a place for learning and studying factual information. School is a safe playground to learn not only relevant factual information but also a space (or place!) to develop necessary skills and experiences and to collaboratively identify and resolve current problems. The pandemic challenged the school systems' ability to fulfil this broad purpose. The very rapid transition from traditional face-to-face teaching and learning mode to online learning had an impact on the students' lives by forcing them to stay at home for long periods of time. For this (and other) reason(s) related to learning and wellbeing, students must change their daily routines and adapt to a new learning environment. How well did students manage to do this?

The immediate impact of the pandemic for students learning and wellbeing varied. This variation from small, temporary and easy to fix discomforts to big, long-lasting and complex difficulties depended not only on how the students' learning and wellbeing was before the pandemic but also on what kind of resources the students have had available, at home in particular, during the pandemic. This raises the question as to how ready schools, family homes and students themselves were for rapid transition.

Clearly levels of readiness and preparedness were not the top ones; did not even reach the optimum, in many cases all over the world. On the contrary, several negative issues and feelings increased. For example cognitive overload, stress, tiredness, boredom, tensions between family members, fears of domestic violence, difficulties coordinating distance schooling and parent(s)' working as well as shrinking social support networks.

Thus, attempting to organize teaching, learning and studying in a new way very quickly had an immediate impact on students' opportunities to learn equally and equitably. Unfortunately, for many students this meant inadequate support for learning. Distance learning and studying requires well developed readiness from students, such as self-directed learning skills and self-discipline. However, not all students were ready for this demanding independent (and sometimes self-directed) learning and studying. One of the main challenges for students has been to improve those necessary skills in order to cope successfully with distance learning and studying. For teachers and parents one of the main challenges has been to guarantee well timed and communicated support, guidance and feedback to improve students learning. For schools a key task has been to develop and improve teaching and learning practices as well as to find and design the best practice(s) for their particular

school. During the pandemic, many schools might have been forced to experiment to find the best methods of teaching, learning and studying for their specific context, as well as ways to support students' learning in distance mode.

The long term impact of the pandemic on students learning and wellbeing is still an unknown factor. On one hand, the answer depends on what countries, schools, teachers, parents and students really learned from their own experiences. On the other hand, the answer depends on how enthusiastically countries, schools, teachers, parents and students want to improve the level of readiness and preparedness as well as using digital devises for supporting teaching, learning and studying. However, while the answers are not yet available, it is possible to point to some indications of what the long term impact of the pandemic for students' learning and wellbeing will be in the future. Firstly, the dropout rates are a possible indicator. How many students felt that learning and studying became too demanding and decided to stop attending school? Has the attraction of specific subject(s) and/or field(s) dropped dramatically? Secondly, how many students felt that their studies did not progress as well as before the pandemic, and/or their results have decreased during the pandemic? Was their school graduation postponed? Was there a need to take extra courses/subject lessons in order to fill some (if any) knowledge gap? Thirdly, how many students could not start higher or further education or start at their working lives after school graduation?

By combining and examining both pupils' responses and teachers' personal reflections in this Covid-19 related research study, the researchers aimed to present the two groups' opinions in a learning-centered and well-being framework. Educating students requires that one should be very well acquainted with their opinions, feelings and problems. Educating the reflective teacher (or other practitioner) requires the educator to become acquainted with their reflective and critical thinking. This can be a rich source of facts, social reality, subjective and/or objective opinions, values, norms, strengths, limitations and feelings.

We consider this an original contribution because shapes a holistic managerial approach to handling educational crises that are not, necessarily, externally triggered. Beyond Covid-19 needs and rapid migration to online education, the process followed in this research study is a case study in using formal research processes for evaluation and improvement. The research methods followed (literature survey, questionnaire and teachers' reflections) can be used as a combined research instrument to find, analyse, compare and contrast and reflect at any time when there is a need for educational crisis management. The latter, if it is wisely performed, should enable progressive change and lead to educational transformation.

In conclusion, there is a need to further and deeper research into the effects of the Coronavirus era longer term and in each of the countries that participated in this research study. Comparing and contrasting this study's outcomes with other research

outcomes from EU and Mediterranean countries could provide more reliable results for the future of learning and wellbeing of secondary education students.

ACKNOWLEDGEMENTS

Our sincere thanks go to all the research participants and in particular to the respondents to the online questionnaire. Special thanks go to the teachers in the schools in Cyprus, Greece and Spain, who disseminated the link to the online questionnaire to their students and for all the assistance they provided us with during the data gathering process.

The online questionnaire used in this study can be found online at the following website:

https://forms.gle/PKAU9KEgPVempigi7

9.0 References

1 Spinelli, A., Pellino, G. (2020). COVID-19 pandemic: perspectives on an unfolding crisis. *BJS, 107*: 785–787.

2 European Centre for Disease Prevention and Control (2021). COVID-19 situation update worldwide, as of week 16, (retrieved 29 April 2021) https://www.ecdc.europa.eu/en/geographical-distribution-2019-ncov-cases

3 UNESCO (2020). UNESCO and partners launch of the Geneva Global Education in Emergencies Hub. Retrieved 21 February 2021, from https://en.unesco.org/news/unesco-and-partners-launch-geneva-global-education-emergencies-hub (last accessed 20/02/2021).

4 Anastasiadis, P. (2020). Distance learning in the era of COVID-19 Distance Education in the era of the Coronavirus COVID-19: the example of Greece and the challenge of moving to the "Open School of Exploratory Learning, Collaborative Creativity and Social Solidarity". *Open Education, 16*(2), 20-48. doi:https://doi.org/10.12681/jode.25506.

5 Akoth Odero, J. (2020). Online Learning in Kenyan Public Universities: Effectiveness and Challenges. In: Twenty Fifth International Conference on Software Process Improvement Research, Education and Training (INSPIRE XXV), 16 Jul 2020, ISBN 978-1-9996549-4-8.

6 Georgiadou, Elli, Berki, Eleni, Valtanen, Juri, Siakas, Kerstin V., Rahanu, Harjinder, Edwards, J. Adam, Paltalidis, Nickos, Agouropoulos, Andreas, Hatzipanagos, Stylianos, McGuinness, Claire, Cavanagh, Jerald, Kirby, Padraig, Ojukwu, Dili, Savva, Andreas, Stylianou, Vasso, Plastira, Mary, Gevorgyan, Rita, Ross, Margaret, Staples, Geoff, Knezevic, Ratko, Čolic,

Amela, Valkanou, Theodora, Siakas, Errikos, Deshappriy, Nelum, Zirki, Annita, Stoffová, Veronika, Lambrou, Georgia, Morales Calleja, Carlos, Stoffová, Maja, Panteri, Maria, Panteri, Valentina, Zamaraeva, Galina and Panov, Yuri (2020) Challenges of rapid migration to fully virtual education in the age of the Corona virus pandemic: experiences from across the world. Uhomoibhi, James, Dewar, Eleanor, Georgiadou, Elli, Linecar, Peter, Marchbank, Paul, Ross, Margaret and Staples, Geoff, eds. e-Learning as a solution during unprecedented times in the 21st century (INSPIRE 2020 Proceedings). In: Twenty Fifth International Conference on Software Process Improvement Research, Education and Training (INSPIRE XXV), 16 Jul 2020, Online. e-ISBN 9781999654948.

7 Burns, D. S, Dagnall, N., Holt, M. (2020). Assessing the impact of the Covid-19 pandemic on student wellbeing at universities in the UK: a conceptual analysis. *Front. Educ. 5*:204. doi:10.3389/feduc.2020.582882.

8 Kihato, C.W., Landau, L.B. (2020). Coercion or the social contract? COVID 19 and spatial (in)justice in African cities. *City and Soc., 32* (1), 1-9. DOI: 10.1111/ciso.12265.

9 Aguliera, E., & Nightengale-Lee, B. (2020). Emergency remote teaching across urban and rural contexts: perspectives on educational equity. *Information and Learning Sciences, 121*(5/6), 471-478. https://doi.org/10.1108/ILS-04-2020-0100

10 Chen, M. (2020). "To Die from Hunger or the Virus: An All Too Real Dilemma for the Poor in India (and Elsewhere)." Women in Informal Employment: Globalizing and Organizing. WIEGO Blogs (blog). (retrieved April 2020). https://www.wiego.org/blog/die-hungeror-virus-all-too-real-dilemma-poor-india-andelsewhere?utm_source=WIEGO&utm_campaign=776d31f892-EMAIL_CAMPAIGN_2020_03_30_03_33+ENG&utm_medium=email&utm_term=0_8.

11 Lai, J. and Widmar, N.O. (2020) Revisiting the Digital Divide in the COVID-19 Era. *Applied Economics Perspectives and Policy, 43*(1), 458-464. DOI: https://doi.org/10.1002/aepp.13104.

12 United Nations Sustainable Development Group (2020). Policy brief: Education during COVID-19 and beyond. https://unsdg.un.org/resources/policy-brief-education-during-covid-19-and-beyond.

13 Zhang, W., Wang, Y., Yang, L., & Wang, C. (2020). Suspending Classes Without Stopping Learning: China's Education Emergency Management Policy in the COVID-19 Outbreak. *Journal of Risk and Financial Management, MDPI, Open Access Journal, 13*(3), 1-6.

14 Eurydice Unit Montenegro (2020). LearnAtHome: the response of the Montenegrin education system to the COVID19 pandemic. (retrieved 26/01/2021). https://eacea.ec.europa.eu/national-policies/eurydice/content/learnathome-response-montenegrin-education-system-covid19-pandemic_en

15 Volungevičienė, A., Teresevičienė, M., and Ehlers, U., 2020. When is Open and Online Learning Relevant for Curriculum Change in Higher Education? Digital and Network Society Perspective. *The Electronic Journal of eLearning, 18*(1), 88-101. www.ejel.org.
16 International digital economy and society index (2021). *Final report 2020: a study prepared for the European commission*. European Union. DOI: 10.2759/757411.
17 Palaiodimou, A. (2017). Συμπληρωματική εξ αποστάσεως σχολική εκπαίδευση. Η περίπτωση του e-twinning στο Νηπιαγωγείο. [Complementary school distance education. The case of e-twinning in Kindergarten]. 9th International Conference in Open & Distance Learning - November 2017, Athens, Greece – PROCEEDINGS, 16-23.
18 Miminou, A., & Spanaka, A. (2013). Σχολική εξ αποστάσεως εκπαίδευση: Καταγραφή και συζήτηση μίας βιβλιογραφικής επισκόπησης [Distance Education Primary and Secondary Schools and Programs: A Literature Review]. 7th International Conference in Open & Distance Learning - November 2013, Athens– PROCEEDINGS, 78-90.
19 Bogin, B. & Varea,C. (2020).COVID-19, crisis, and emotional stress: A biocultural perspective of their impact on growth and development for the next generation. *Am J Hum Biol., 32*, 1-10. DOI: 10.1002/ajhb.23474.
20 Song, S.S., Wang, C., Espelage, D.L., Fenning, P., Jimerson, S.R. (2020). COVID-19 and School Psychology: Adaptations and New Directions for the Field. *School Psychology Review, 49*, 431-437.
21 Jiao, W., Wang, L. N., Liu, J., Feng Fang, S., Jiao, F. Y., Pettoello-Mantovani, M., Somekh, E. (2020). Behavioral and Emotional Disorders in Children during the COVID-19 Epidemic. *J Pediatr. 221*, 264–266.
22 Saurabh, K., & Ranjan, S. (2020). Compliance and psychological impact of quarantine in children and adolescents due to Covid-19 pandemic. *Indian Journal of Pediatrics, 87*(7), 532–536. https://doi.org/10.1007/s12098-020-03347-3.
23 Orgilés, M.; Morales, A.; Delvecchio, E.; Mazzeschi, C.; Espada, J.P. (2020). Immediate psychological effects of the COVID-19 quarantine in youth from Italy and Spain. *Front. Psychol. 11*, 1-10.
24 Pisano, L.; Galimi, D.; Cerniglia L. (2020). A qualitative report on exploratory data on the possible emotional/behavioral correlates of Covid-19 lockdown in 4–10 years children in Italy. *PsyArXiv*, 21 April [Preprint].
25 Caffo, E., Scandroglio, F. & Asta, L. (2020). Debate: COVID-19 and psychological well-being of children and adolescents in Italy. *Child and Adolescent Mental Health, (25)* 3, 167-168. https://doi.org/10.1111/camh.12405.
26 Humphreys, K. L.; Myint, M. T.; Zeanah, C. H. (2020). Increased Risk for Family Violence during the COVID-19 Pandemic. *Pediatrics, 146* (1), 1-5.
27 Golberstein, E., Wen, H., Miller, B.F. (2020). Coronavirus Disease 2019 (COVID-19) and Mental Health for Children and Adolescents. *JAMA Pediatrics, 174*, p.819.
28 Kahu, E. (2013). Framing student engagement in higher education. *Studies in Higher Education, 38*, 758-773.

29 UNESCO. (2020). Adverse consequences of school closures. Last updated November 7 2020. (https://en.unesco.org/covid19/educationresponse/consequences).
30 Russell, B. S., Hutchison, M., Tambling, R., Tomkunas, A. J. & Horton, A. L. (2020). Initial Challenges of Caregiving During COVID 19: Caregiver Burden, Mental Health, and the Parent–Child Relationship. *Child Psychiatry & Human Development, 51*, 671–682 (https://doi.org/10.1007/s10578-020-01037-x).
31 Office for National Statistics. Coronavirus (COVID-19) in 10 charts. (Last update 24/09/2020) http://www.ons.gov.uk/peoplepolulationandcommunity/healthandsocialcare/conditionsanddiseases/articles/coronaviruscovid19in10charts/2024-09-24.
32 Brandenburg, J. E. , Holman, L. K., Apkon, S. D., Houtrowd, A. J., Robert, R., & Scholas, M. G. (2020). School reopening during COVID-19 pandemic: Considering students with disabilities. *Journal of Pediatric Rehabilitation Medicine,* (Preprint), 1–7. https://doi.org/10.3233/PRM-200746.
33 Keyes, C. L. M. (2013). *Promoting and protecting positive mental health: Early and often throughout the lifespan*. In C. L. M. Keyes (Ed.), Mental wellbeing: International contributions to the study of positive mental health (p. 3–28). Springer Science + Business Media. https://doi.org/10.1007/978-94-007-5195-8_1
34 Seligman, M. (2011). Flourish: A visionary new understanding of happiness and wellbeing. (Accessed 24/6/2020). https://psycnet.apa.org/record/2010-25554-000.
35 Hone, L. C., Jarden, A., Duncan, S., Schofield, G. M. (2015). Flourishing in New Zealand Workers Associations with Lifestyle Behaviors, Physical Health, Psychosocial, and Work-Related Indicators. *JOEM, 57*(9), 973- 983. DOI: 10.1097/JOM.0000000000000508.
36 Buabeng-Andoh, C. (2015). ICT usage in Ghanaian secondary schools: teachers' perspectives. *The International Journal of Information and Learning Technology, 32*(5), 300-312.
37 Fu, J. S. (2013). ICT in Education: A Critical Literature Review and Its Implications. *International Journal of Education and Development using Information and Communication Technology, 9*(1), 112-125.
38 Cardona, M. C. (2002). *Introducción a los métodos de Investigación en Educación*. Madrid: Eos.
39 Montero, I., & León, O. G. (2007). Guía para nombrar los estudios de investigación en Psicología. *International Journal of Clinical and Health Psychology, 7*(3), 847-862.
40 UNICEF. COVID-19 and School Closures: One year of education disruption. (Retrieved 2/3/2021). https://reliefweb.int/report/world/covid-19-and-school-closures-one-year-education-disruption.
41 Heward, W. L., Alber-Morgan, S. R., & Konrad, M. (2017). *Exceptional Children: An Introduction to Special Education* (Eleventh). Boston: Pearson.

42 Glezou, K. (2020). *Application of synchronous and asynchronous distance teaching of programming in Gymnasium and Lyceum*. In Hellenic Network of Open and Distance Education – P.E.K.E.S. Proceedings of the e-conference "Distance education and school reality", p. 276, pekesexae2020.pdekritis.gr, (25-26/4/2020).
43 Stantcheva, S. (2021). *Inequalities in the times of a Pandemic*. 73rd Economic Policy Panel, April 13, 2021.
44 Gerosimou, E. (2019). *Empowering the "voices" of children in the context of promoting inclusive education*. In P. Angelidis (Ed.), Pedagogies of Inclusion (pp. 199-226). Athens: Diadrasis.
45 Tam, G., & El-Azar, D. (2020). 3 ways the coronavirus pandemic could reshape education. (Retrieved 2/3/ 2020). https://www.weforum.org/agenda.
46 Kafa, A., & Pashiardis, P. (2020). Coping With the Global Pandemic COVID-19 through the Lenses of the Cyprus Education System, *ISEA, 48*(2), 42-48.

Rapid migration from traditional or hybrid to fully virtual education in the age of the coronavirus pandemic: Challenges, Experiences and Views of College and University students

[1]Elli Georgiadou, [2, 3]Georgios Lampropoulos, [4]Errikos Siakas, [2, 5]Kerstin Siakas, [1]Adam Edwards, [6]Juri-Petri Valtanen, [7]Eleni Berki, [8]Nickos Paltalidis, [1]Harjinder Rahanu, [9]Ratko Knezevic, [9]Amela Colic, [10]Bozana Tomic, [11]Andreas Savva, [11]Vasso Stylianou, [12]Saltanat Meiramova, [13]Marwa Abd Elghany, [13]Nermine Khalifa, [14]Rita Gevorgyan, [15]Daniela Popa, [16]Jackline Odero, [16]Umulker Ali, [17,18]Maria Panteri, [19]Karen Dennis, [20]Veronika Stoffova, [21]Dilara Begum, [22]Sunil Chaudhary, [4]Maria Plastira, [23]Demet Soylu, [24]Margaret Ross, [25]Geoff Staples, [26]Galina Zamaraeva, [26]Jury Panov, [27]Xu Zhang, [11]George Portides, [28]Claire McGuinness, [29]Theodora Valkanou, [9]Sandra Knezevic

[1] Middlesex University, London, United Kingdom
[2] International Hellenic University, Thessaloniki, Greece
[3] Hellenic Open University, Patras, Greece
[4] Aristotele University, Thessaloniki, Greece
[5] University of Vaasa, Vaasa, Finland
[6] Tampere University, Tampere, Finland
[7] Jyväskylä University, Jyväskylä, Finland
[8] Queen Mary, University of London, United Kingdom
[9] University of Bihac, Bosnia-Herzegovina
[10] Slobomir P University, Bosnia and Herzegovina
[11] University of Nicosia, Cyprus
[12] Saken Seifullin Kazakh Agrotechnical University, Kazakhstan
[13] Arab Academy for Science & Technology, Alexandria, Egypt
[14] Armenian State Pedagogy University, Yerevan, Armenia
[15] Transylvania University, Brasov Romania
[16] Masinde Muliro University of Science and Technology, Kenya
[17] Special Unified Vocational High school & lyceum of Heraklion, Greece
[18] Cordoba University, Cordoba, Spain
[19] Illinois State University, Illinois, USA
[20] Trnava University, Trnava, Slovak Republic
[21] East West University, Dhaka, Bangladesh
[22] Norwegian University of Science and Technology, Norway
[23] Hacettepe University, Turkey
[24] Solent University, Southampton, United Kingdom
[25] British Computer Society, United Kingdom
[26] Vladimir University, Vladimir, Russia
[27] Beijing Institute of Technology, China
[28] University College Dublin, Ireland
[29] Copenhagen University, Denmark

Abstract

The abrupt outbreak of the coronavirus pandemic throughout the world in March 2020 resulted in the sudden closure of all schools, colleges and universities, institutions, and an unprecedented pivot to remote learning. Students and teachers were confronted with the overwhelming challenge of migrating from the traditional face-to-face or hybrid mode of education to fully virtual learning and assessment environments within an extremely short amount of time. This migration was exceptionally difficult, as it took place halfway through the academic or school year in most countries. While pandemic restrictions currently vary across different regions, the 2020-2021 academic session continues to pose challenges despite the experience gained. In addition to a review of the current state-of-the-art in relation to the effects of COVID-19 on teaching and learning, this paper reports on an empirical study carried out in 26 countries (from Asia, Europe, Africa, and America), by 36 academics from 29 academic institutions. Through an extensive global survey of college and university students, information was collected about the challenges (technological, economic, psychological) faced by them, as a result of the pandemic. We also asked the students to offer their ideas and suggestions for further improvements in teaching and learning, as we look toward a post-COVID-19 world.

In this paper, we address issues relating to the availability of, and accessibility to, necessary digital technologies (e.g., learning and communication platforms), isolation, disconnection, and loneliness among students, the overall impact of the pandemic on learning and academic performance, and the reliability of assessment methods, cybercrime dangers and fake information. A total of 1005 responses to the survey were received and analysed. The results are presented in this paper together with reflections of the authors. The paper concludes with a summary of suggestions for process improvements in distance education, and the need for preventive preparedness in the post-COVID period.

Keywords: Distance mode education, e-learning, cyber-protection, rapid migration, socio-digital divide, inequalities, Covid-19 pandemic.

1.0 Introduction

1.1 Worldwide Impact of the COVID Pandemic on Education

According to a 2020 UNESCO report [1], the enormity of the COVID-19 challenge was demonstrated by the fact that nearly a billion and a quarter (which is 67,7 % of the total number) of learners at all levels of education were affected by the coronavirus pandemic worldwide.

During the first few months of the pandemic, a group of 33 academics from 13 countries carried out a study of the immediate challenges and actions experienced by the educators, who were required to ensure that online delivery was enabled within a very short period of time without compromising the quality of education. The study examined what learning technologies were used, what problems and tensions appeared, what institutional supports were available, and the solutions and best practices that were employed during the initial online pivot. These findings were reported in [2], which offered a snapshot of practice across the world in the aftermath of the pandemic's first phase.

Undoubtedly, the changes in student learning and Higher Education (HE) in the Coronavirus era are worth reporting and examining from different viewpoints. During the worldwide migration to virtual/remote learning in HE, a number of educational reports and research papers have highlighted the effects of the pandemic on formal and non-formal learning in Colleges and Universities across the world. Some reports and papers also include detailed data on the experiences of students and teachers and their views on the rapid socio-technical and pedagogical developments.

One such example is found in Oyedotun (2020) [3], who suggested that the sudden transition from traditional teaching to online distance learning due to COVID-19 has required a simultaneous change in pedagogy. Developing countries, such as Guyana, have exposed not only inequalities and challenges related to online learning, but also benefits accruing from these sudden changes.

Her paper presented an excellent overview of the complex educational challenges, benefits, and mitigation strategies experienced in Guyana during the first year of the pandemic. They included the following factors, which are likely to be recognised by educators and students in other countries:

a. Lack of resources (students and teachers):

- **Digital inequalities** among students and teachers, because there is no internet accessibility in many of the villages.
- **Unavailability of computers, laptops and/or tablet facilities, cameras and microphones** for students and teachers.
- **No adequate prior training regarding the requirements of distance mode education** for both students and teachers.
- **Impossible to use lab or fieldwork because of social distancing**. Courses that required the use of lab, fieldwork or practical exercises were seriously affected.

b. Poor national infrastructure:

- **Slow internet speed** because of
  - sudden and unprecedented internet traffic,
  - internet providers were not prepared for the sudden enormous demands on their services.
- **Inconsistent power supply**

c. Course delivery problems:

- **Reduced student–teacher engagement**
- **Slow and extended work:** Students unable to submit assignments, lecturers unable to keep up with their schedules (power-cuts and internet problems)
- **Compromise with deadlines and standard expected of their delivery.**
- **Limited opportunity for monitoring assessments**: use of multiple-choice questions (MCQ) instead.
- **Malpractices** usual because of the limitation of the technological devices

d. Context problems

- **Inflexibility of students and teachers.** They found the online method burdensome and felt stressful to adjust to online education.
- **Domestic affairs**: Working from home was an enormous distraction and challenging due other domestic issues for both students and teachers [4].
- **Mental health challenges:** Depression, mental health issues, and suicidal thoughts increased due to difficulties to cope with the combination of academic rigour and domestic challenges.

e. Cybersecurity problem

- **Cybersecurity threats:** exposure to viruses, hacking potentials, and other cybersecurity threats [5].

f. General benefits

- **Use of online resources,** such as Moodle and other platforms that were under-utilised before COVID-19, and search for information and materials through online blogs, papers, websites, and other related resources.
- **Live cloud recordings** of teachings, meetings, lectures, and other interactions.
- **Personal growth**: Improvement of IT skills
- **Creation of Training sessions** by the university's Software Department for lecturers on various forms of digital learning and education.
- **Sharing of materials and videos** for the benefit of lecturers by colleagues
- **Upgrading of new technologies for the university**: purchase of many new facilities and licenses, especially add-ons, to support Moodle and Zoom video conferencing,

g. Pedagogical benefits/changes

- **Investigation of different learning options** by both students and teachers regarding technology use and other online tools for instruction and learning
- **Investigation of blended learning approaches** by lecturers and the university administration
- **Investigation of different options for working remotely.** Engagement outside the limits of a traditional university classroom.

h. Mitigation recommendations:

- **Recognition of disparities in technology availability** among students and teachers. The World Bank (2020) [6] argues that most students will have difficulties in transitioning to and accessing online education because of lack of internet access and other disadvantages
  - **Flexible rules as students migrate to online platforms.**
  - **Provision of** technical assistance
  - Provision of internet hubs by government at strategic and safe public places in the communities where students can access the needed academic and educational services.
  - Support regarding the provision of infrastructural tools including hardware and software support systems development and application of technology to enhance qualitative teaching and learning.
- **Gradual transitioning** to reduce tension and stress.
- **Practical training sessions:**
  - Education boards and university authorities should offer free training via media such as television, radio, newspaper, social media, etc.
  - step-by-step guidelines for use of platforms translated to native languages spoken by students to enable.
- **Exploration of mobile teaching/learning possibility.** For example, University of Bologna, Italy, distributed free SIM cards to students for mobile learning [7].
- **Striving to make staff and students comfortable** through:
  - **reduction in excessive demands and** workloads for both students and staff.
  - **Restructuring of teaching content:** preventing the teaching contents from becoming burdensome, repetitive, non-engaging, and resulting in learning being resisted
  - **Bearable schedules**: The faculty should break down contents in shorter slots for easier online delivery and management.
  - **Alternative assessment,** such as virtual presentations, interaction models, oral presentations, creative projects using 3-Dimensional modelling and graphics, skits or plays, blogpost journaling, one-to-one conferencing.
  - **Changing grading with letters or numbers to credit and no-credit**

Examples of other recent studies relating to the educational impact of the pandemic include Lily et al. (2020) [8], who investigated the research question "*What are the ramifications of implementing distance education amid coronavirus*?" focusing largely on the experience of Arab cultures. Their research compared traditional distance education (TDE) to Crisis Distance Education (CDE), in addition to critically analysing CDE, and examining the social impacts related to it. The study findings revealed multiple ramifications of CDE, which were captured in a detailed graphic (see Figure 1).

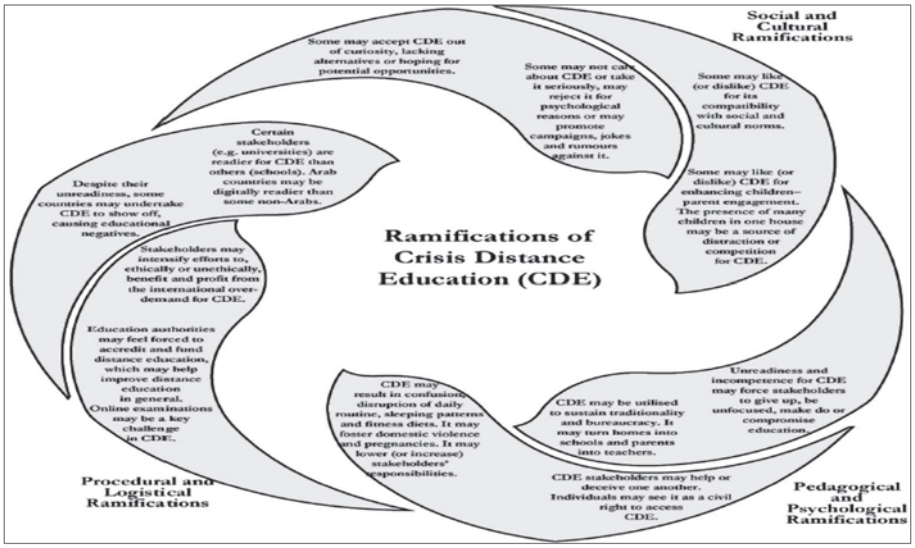


Figure 1. Conceptual Framework for Crises Driven Distance Education (Lily et al. (2020) [8]

A further study by Aguilera-Hermida (2020) [9] on the east coast of the United States focused on college students' perceptions of their adoption, use, and acceptance of emergency online learning. Both quantitative and qualitative data were collected via a 36-item questionnaire from 270 students and factors such as attitude, affect, motivation, perceived behavioral control, as well as cognitive engagement were explored. Aguilera-Hermida [9] suggested that perceived behavioral control is the capability and effort of students to facilitate conditions that affect the ability to use educational technologies and include ease of use, self-efficacy, and accessibility to technology.

The findings from the quantitative data gathered for the study showed that attitude, motivation, self-efficacy, and use of technology are significant in the cognitive engagement and academic performance of students, who preferred face-to-face learning over online learning. Key situational challenges were identified in the qualitative data as concentration difficulties living at home, stress balancing life, and financial hardship, while online educational challenges focused on the general difficulties associated with this mode of learning, as well as increased workload and distractions. Students also described struggling with motivation and negative emotions. On the positive side, the students reported, amongst others, increased family time, greater focus on self-care and personal growth, hobbies, and gaining new skills as beneficial side-effects of the online pivot. The paper also offered several suggestions for practice, to improve emergent online learning. They included the following:

1. Students and teachers should promote a positive attitude towards a temporary situation. They should talk about students' fears and transform them into opportunities. Flexibility, tolerance, and communication are important factors during remote classes.
2. The use of metacognitive conversations is likely to help both teachers and students to monitor the learning process and help individuals to act independently and to make their own free choices for what is happening.
3. Students need to be motivated and encouraged constantly.
4. Increase of accessibility is needed, not only regarding the Internet or a computer; family conditions need to be taken into consideration and training in new tools for both teachers and students is imperative.

Another study by Pragholapati (2020) [10] reported the findings of an online survey carried out in Indonesia, regarding the impact of COVID-19 on nurses and nursing students in Anhui Province. In total, 509 responses were received. The Self-Assessment Anxiety Scale (Carver, 1997) [11] and the Hamilton Depression Rating Scale (HDRS) [12] (1960) were used to evaluate each anxiety and depression symptom. The results showed that around 24.9% of the students had experienced anxiety due to the COVID-19 outbreak. Living with parents/guardians who have a stable family income, as well as living in urban areas were found to be protective factors for students against the anxiety experienced during the pandemic. Knowing a relative or acquaintance who had been infected with COVID-19 was seen to

increase the level of anxiety experienced. Other stress factors were found to be economic stressors and effects regarding daily life. The results also showed that the women appeared to experience more anxiety and fear than the men who participated in the research. Similarly, participants from cities showed more anxiety and fear than participants from the countryside despite the fact that they showed more sadness than the urban participants. The closer COVID-19 was found to the participants, the stronger the anxiety and anger. Comparing nurses to nursing students, nurses were found to have stronger emotional responses and were more willing to focuses on problems. The results of this study are in alignment with the general effects of pandemics on human experience - according to the WHO (2020) [13], the emergence of a pandemic causes stress to various levels of society. A number of other studies related to pandemics (including bird flu and SARS) have shown a negative impact on the mental health of sufferers [14].

Mishra et al. (2020) [15] also carried out an investigation into the online teaching-learning modes adopted by the Mizoram University in India, in relation to the teaching-learning process, as well as semester examinations. The study employed both quantitative and qualitative methods to investigate the perceptions of teachers and students regarding online teaching-learning modes. The study aimed to draw a holistic picture of ongoing online teaching-learning activities during the lockdown period including establishing the linkage between the change management process and online teaching-learning process in education as well as the implementation process of online teaching-learning modes. Twenty-six departments with seventy-eight faculty members and two hundred sixty students participated in the survey to assess their perception towards online teaching- learning. In addition, 20 teachers and 20 students were selected for semi-structured interviews using nested concurrent sampling design [16].

The results of this study showed that students found uploaded videos to be useful, as they can watch them again, pause, and take notes when needed. They also considered that the Google Classroom was the simplest and appropriate way to chat with teachers. Students responded negatively with regard to sufficiently understanding conceptual knowledge and discourse activities. They were not able to maintain the pace of their learning behavior or capacity with the teachers' teaching speed.

The major challenge was related to the unstable network connections, interrupted electricity connections and intermittent signal issues. Some of the students did not have essential resources to join online classes. Level of understanding, lack of scope for meaningful interaction, the range for innovative teaching, and mechanical conduct of classes were significant challenges reported by the teachers. Lack of motivation was perceived by both teachers and students. Teachers also expressed their concerns for laboratory activities that eventually could be arranged with simulation techniques in laboratory practical. Teachers did not know if their students were participating or only had the computer on because the cameras were switched off. The results also showed that online teaching mode is providing the feeling of psychological safety to learning community in COVID-19 afflicting period. The implementation process of the online teaching is shown in Figure 2 [17].

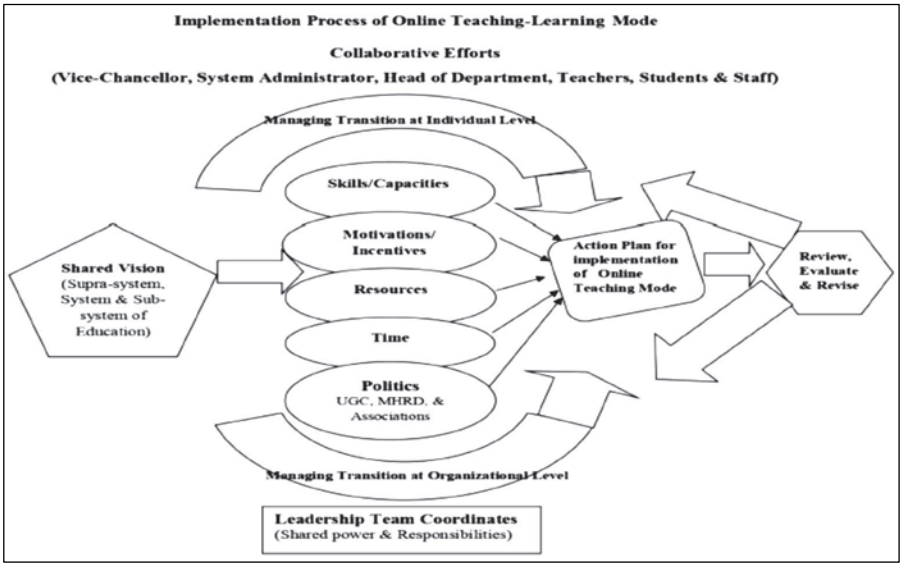


Figure 2. Implementation Process of Online teaching mode (Source: Speck, 1996) [17].

The changing process included: i) either adopting a new online mode similar to other institutions, or ii) innovating one's own. To provide context for the research, the authors of this paper collected secondary data and opinions from published research, reports and policy documents, some of which are outlined above [18, 19, 20]. The majority of these reports and academic papers reported views from academics at all levels of the College/University positions but few have reported the experiences and views of HE students in detail. One of the key motivations for gathering this information in the current study is a serious concern about the persistent phenomena of social exclusion and digital inequality across and within countries, where millions of households do not have adequate access to the Internet, Wi-Fi infrastructure and personal computers, essentially depriving students from continuing with their education during lockdown periods

1.2 The COVID-19 Pandemic Impact on Higher Education Across the World

Primary data was collected through a survey to which 1005 students from 26 countries responded. Students were invited to voluntarily and anonymously complete an online questionnaire which explored problems and challenges relating to the availability of and access to communications and learning platforms, also in addition to their experiences, their ideas, and suggestions for further improvements.

The paper presents findings relating to the availability of and access to the necessary technologies (learning and communication platforms), issues of isolation, impact on performance, and reliability of assessment methods, cybercrime dangers and fake information. Comparisons between countries are made as existing socio-economic inequalities, and the socio-digital divide have been exacerbated by the pandemic [21, 22, 23].

2.0 The Purpose, Design and Challenges of the Study

2.1 Purpose and Design of the study

In the early days of 2020 soon after the eruption of the COVID-19 pandemic the challenge to rapidly convert the pedagogic model from traditional face-to-face or hybrid to fully virtual demanded unprecedented effort from universities and educators in order to support their students' education. We studied the impact on educators and reported our findings in Georgiadou et al., 2020 [2]. In 2021 we focus our attention on the way students' learning and well-being were/are affected. Our aim was to involve as many students as possible from many countries across the world, in order to make comparisons and make useful suggestions based on the understanding gained through the study.

The study involved a literature review (referenced throughout the paper) for collecting secondary data, and a survey research method using a questionnaire for collecting primary data. To provide context for the research, the authors of this paper

collected secondary data and opinions from published research, reports and policy documents, some of which are outlined in the previous section [18, 19, 20]. The majority of these reports and academic papers reported views from academics at all levels of the College/University positions, but comparatively few have explored the experiences and views of HE students in depth. One of the key motivations for gathering information from students in the current study is a serious concern about the persistent phenomena of social exclusion and digital inequality across and within countries, where millions of households do not have adequate access to the Internet, Wi-Fi infrastructure and personal computers, essentially depriving students from continuing with their education during lockdown periods. Below, we describe the design of the questionnaire and the analytical framework employed for the data.

2.2 Questionnaire Design

The questionnaire was initially designed as a document with most questions presented in tabular form, comprising six (6) axes namely Demographics, Facilities, Learning, Communication, Privacy and Security, and a final section prompting for Free text so that students could express their anxieties and problems and could express their views and suggestions for improvement. This all-encompassing approach generated a 10-page long questionnaire (taking from 40-50 minutes to complete). The length of the questionnaire was later proved to be a deterrent factor. The initial questionnaire was converted to an online format using Google Forms. Strict ethical rules for ensuring voluntary participation, anonymity and non-traceability had to be observed, according to the ethics protocols of the participating institutions. In order to submit a formal application to the Research Ethics Committee of Middlesex University, London UK the questionnaire had to be converted to the Qualtrics platform. This process took a long time. Upon obtaining the ethical approval it was shared with colleagues from other institutions and other countries which also require such approval locally. Obtaining ethical approval at Middlesex University helped to expedite local approvals elsewhere. Finally, students in China were unable to access Google, due to a recent decision by the Chinese government. Thus, the questionnaire had to be transferred to the Chinese platform Wen Juan Wang (问卷网).

Colleagues from across the world were asked to motivate their own students, many of whom were reluctant to do so ‘since there is nothing in it for us’ as one of the students said. Several other students from a range of countries expressed the same view, and it proved challenging to recruit participants, although some countries had more success than others. It is also likely that some students are experiencing “survey fatigue,” as many institutions have carried out their own internal research into their students’ views and experiences of online learning during the pandemic, and the students may have been asked to complete multiple questionnaires during the past year.

Despite these difficulties it was encouraging that 1005 students from 26 countries responded.

3.0 Analysis of Data

As described above, the questionnaire was designed to include six (6) axes namely Demographics, Facilities, Learning, Communication, Privacy and Security, and a final section where students could express their anxieties and problems and express their views and suggestions for improvement. Responses came mainly from Google forms but also from Qualtrics and Wen Juan Wang all the responses were combined in an EXCEL spreadsheet which was used for the analysis of the data and their graphical representation.

The results are presented in diagrammatic form together with a brief discussion and explanation for each, in 6 sections corresponding to the six axes of the investigation:

3.1 Demographics

3.2 Facilities

3.3 Learning

3.4 Communication

3.5 Security and Privacy

3.6 Students' Views, Reflections, Ideas and Suggestions

3.1 Demographics

Figure 3 shows that the sample data was slightly dominated by female participants.

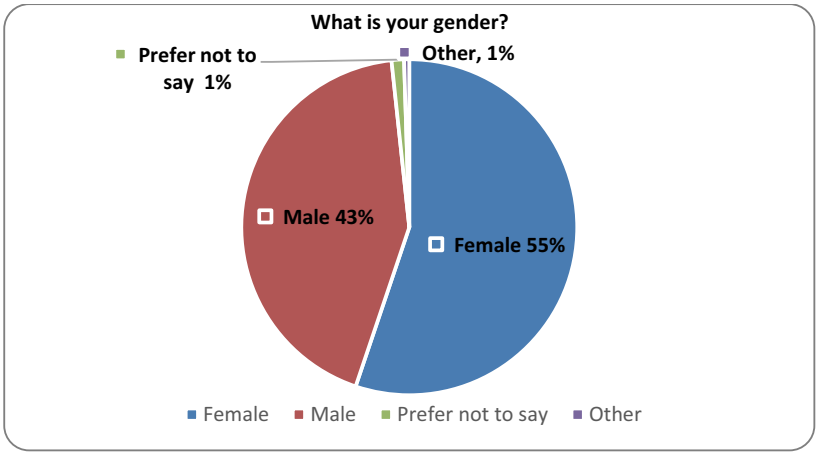


Figure 3: Gender of sample data

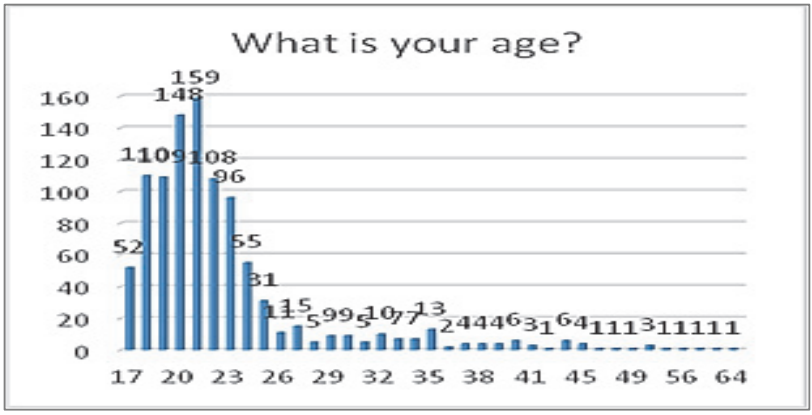


Figure 4: Age distribution of sample data

Figure 4 shows the age distribution of the sample participants ranged from 17 up to 59 years, while the majority were between 18 and 23 years old

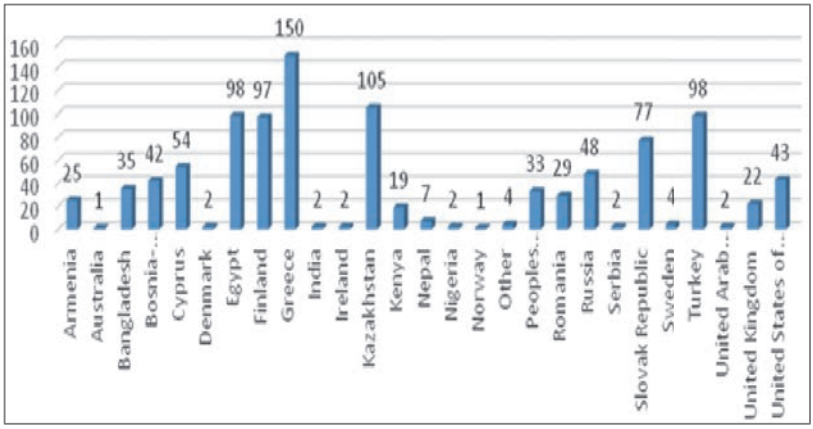


Figure 5: Country of Study

The main responses were collected from the following countries [Figure 5] listed in descending order: Greece (150), Kazakhstan (105), Egypt (98), Turkey (98), Finland (97), Slovak Republic (77), Cyprus (54), Russia (48), United States of America (43), Bosnia- Herzegovina (42), Bangladesh (35), Romania (29), Armenia (25), Kenya (19), and United Kingdom (13). Due to the fact that there was an irreconcilable disparity between the number of responses between countries, comparison of the responses between countries was not possible. Thus, we focused on the global dimension of the responses.

The sample contained students' responses majoring in 26 different subject areas. The main subjects of the respondents were Business (131), Computing, (129), Engineering (125) and Psychology (93).

3.2 Facilities

Online learning requires availability of and access to the necessary equipment, reliable internet connection and knowledge of how to engage in communication and learning. This section of the study aimed to identify the differences between the **before** and **during** the pandemic reality.

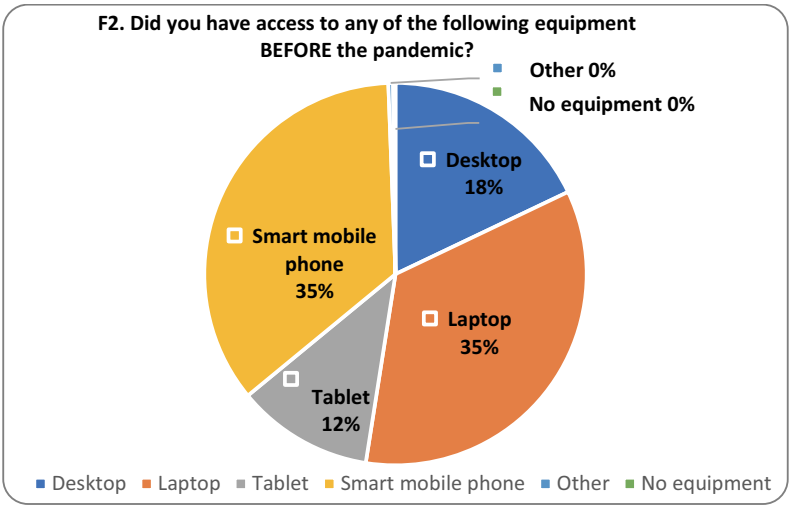


Figure 6 (a): Access to equipment BEFORE the pandemic

Figures 6 (a) - 6 (b) show that there are minor differences in the access to equipment before and during the pandemic. Some students have access to several devices.

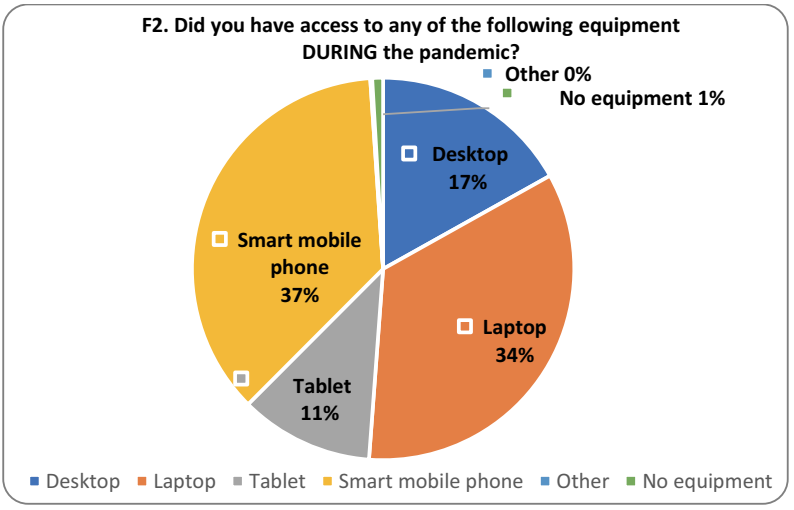


Figure 6 (b): Access to equipment DURING the pandemic

Figures 7 (a) and 7 (b) shows that more than half of the respondents did not need any equipment upgrades.

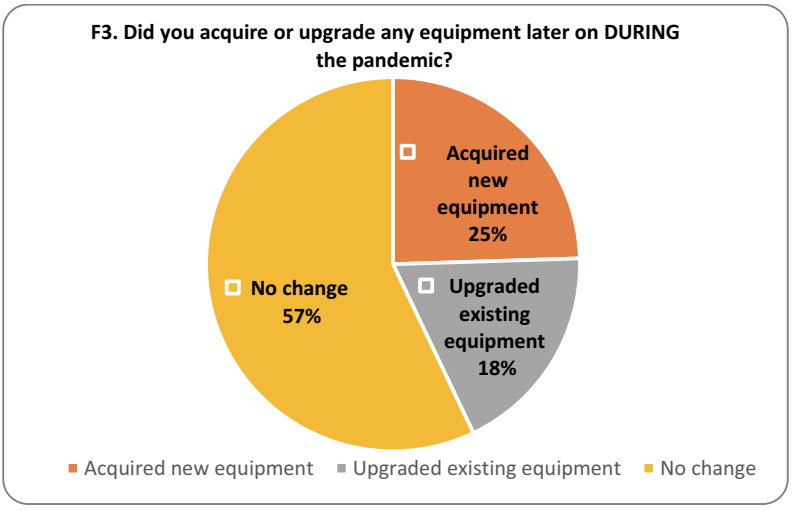


Figure 7 (a): Acquire and upgrade of equipment during the pandemic

Also, in more than 50% of the cases only one person used the equipment i.e. they did not need to share I with other members of their family.

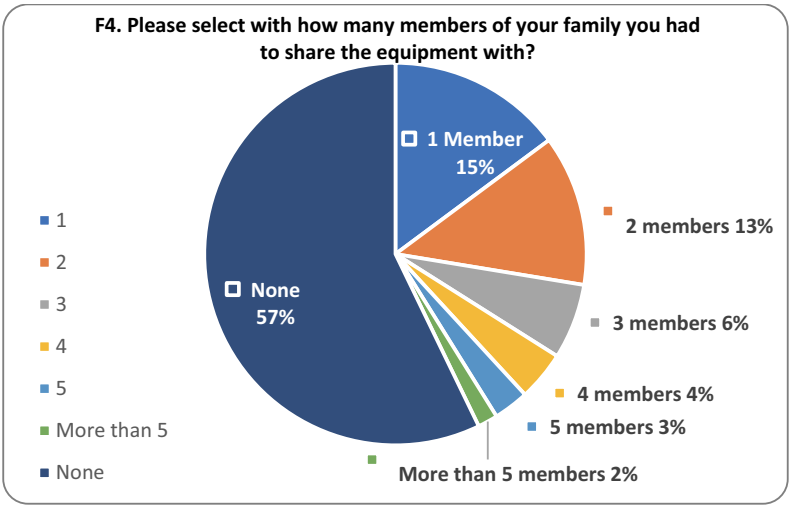


Figure 7 (b): Number of family members using the equipment during the pandemic

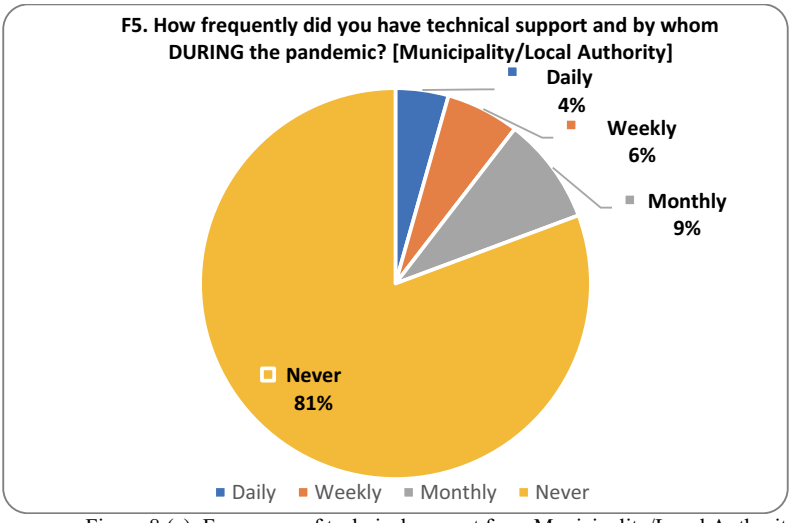


Figure 8 (a): Frequency of technical support from Municipality/Local Authority

Figures 8 (a) and 8 (b) shows that more than 2/3 of the respondents never received any technical support from Municipality/Local Authority.

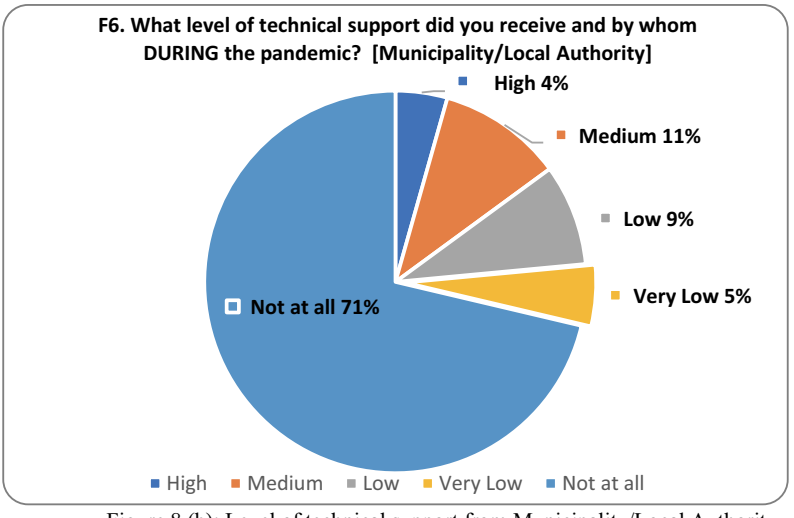


Figure 8 (b): Level of technical support from Municipality/Local Authority

Figure 9 (a) and (b) shows that the majority of respondents never received technical support from charity. Instead, family supported daily, weekly, and monthly in 2/3 of the cases. A third of the respondents did not receive any technical support from family.

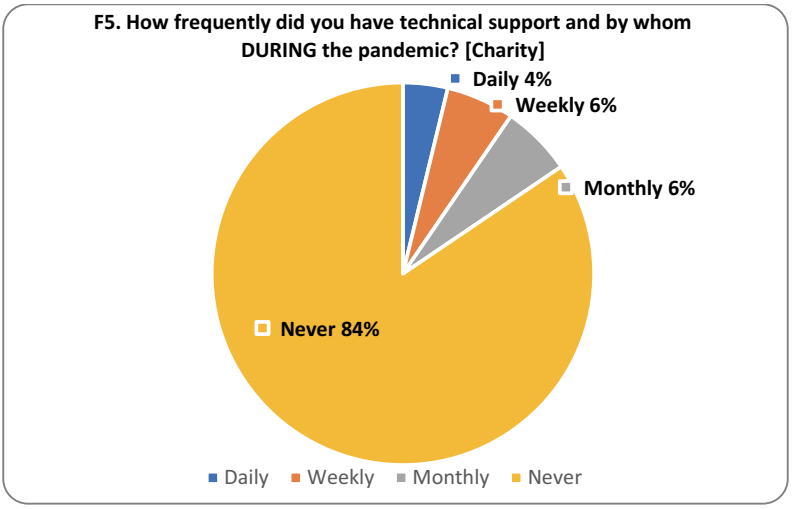


Figure 9 (a): Frequency of technical support by Charity

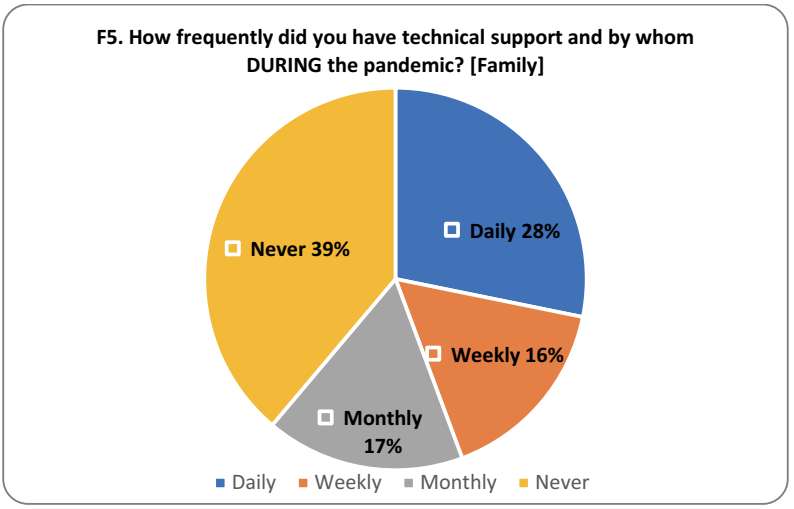


Figure 9 (a): Frequency of technical support by Family

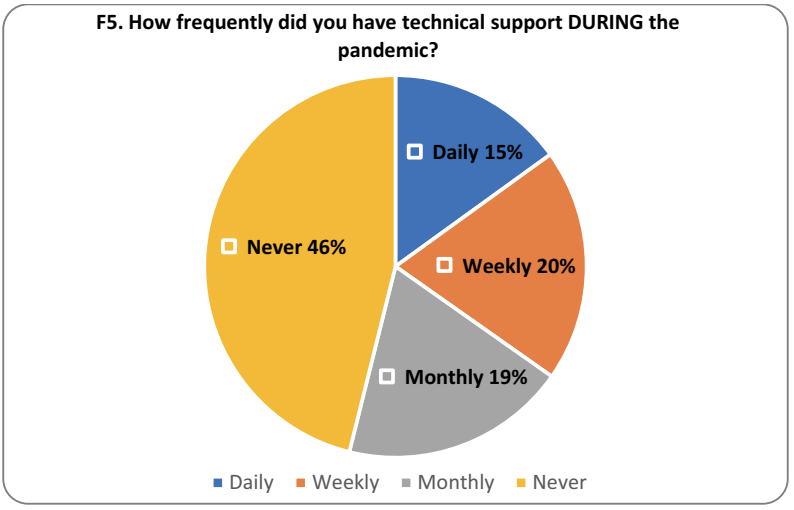


Figure 10 (a): Frequency of receiving technical support during the epidemic

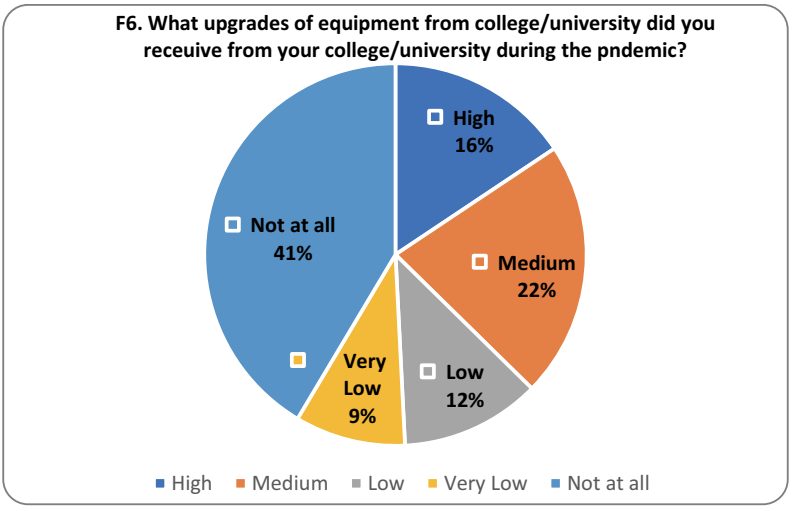


Figure 10 (b): Upgrades of equipment from college/university using the equipment.

The results depicted in figures 10 (a) and (b) show that almost half of the respondents never received any technical support from friends, nor from college or university during the pandemic. The other half received technical support by friend daily, weekly, or monthly to same degree and also from the college-university they received high, medium, low and very low technical support to similar distribution.

3.3 Learning

This section aimed to ascertain whether the students' learning was adversely affected during the pandemic.

Figures 11(a) and 11 (b) show that the majority of students prefer either face-to-face or mixed learning styles. They consider that lectures are best delivered through face-to-face learning.

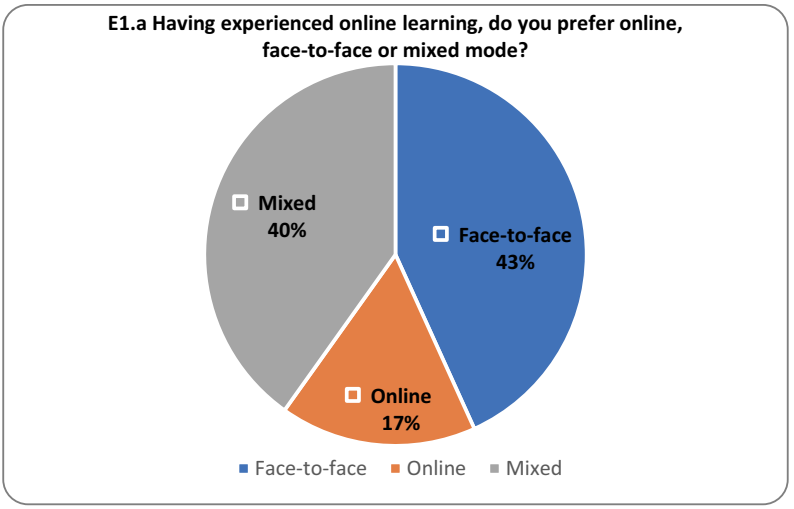


Figure 11 (a): Learning style preference

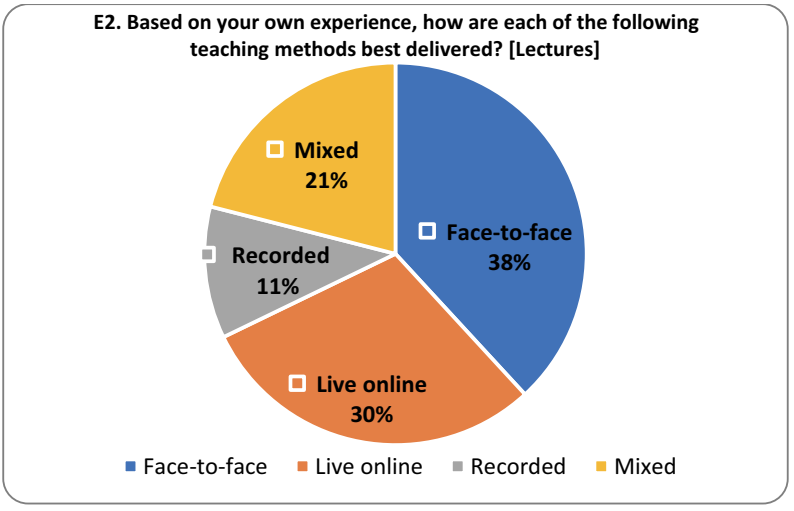


Figure 11 (b): Delivery of lectures

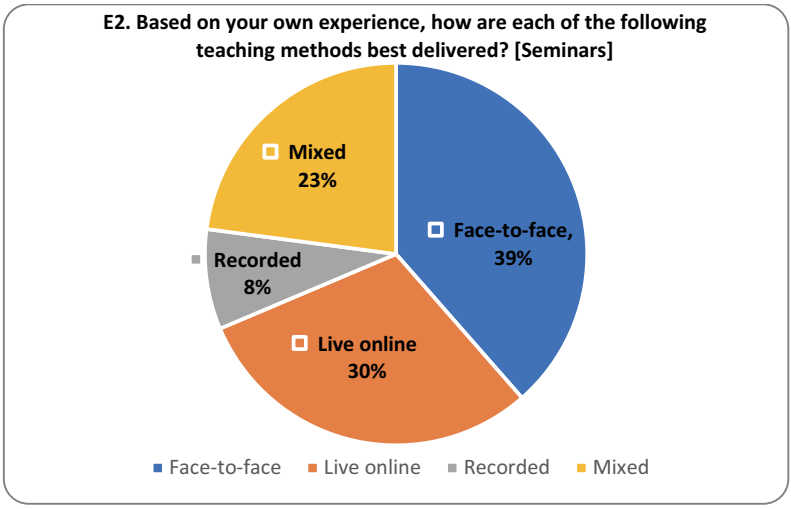


Figure 12 (a): Delivery of seminars

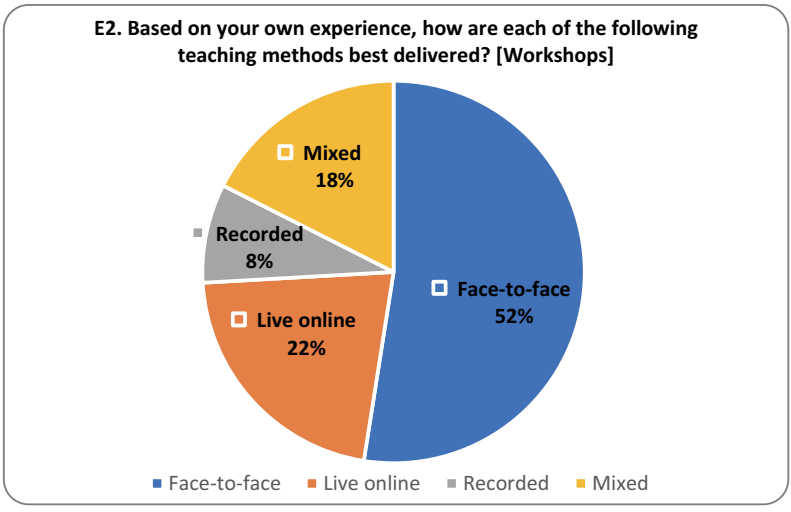


Figure 12 (b): Delivery of workshops

From figures 12 (a) and (b) we conclude that both for seminars and workshops the respondents prefer the face-to-face teaching method.

From figure 13 we see again that face-to-face teaching is preferred by the respondents. A big majority does not believe that the face-to-face teaching method will disappear in the near future.

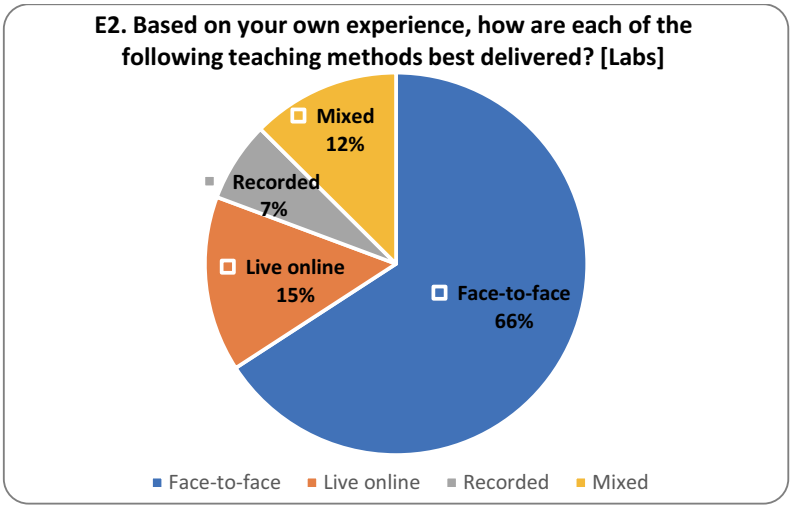


Figure 13 (a): Delivery of labs

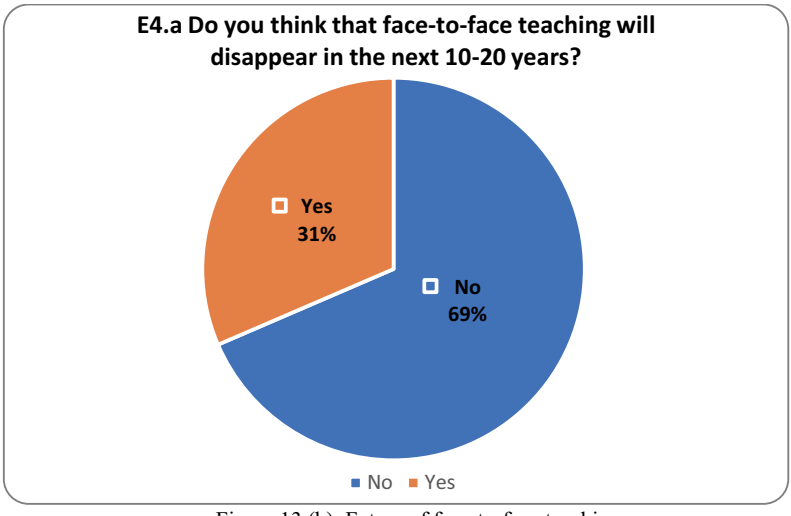


Figure 13 (b): Future of face-to-face teaching

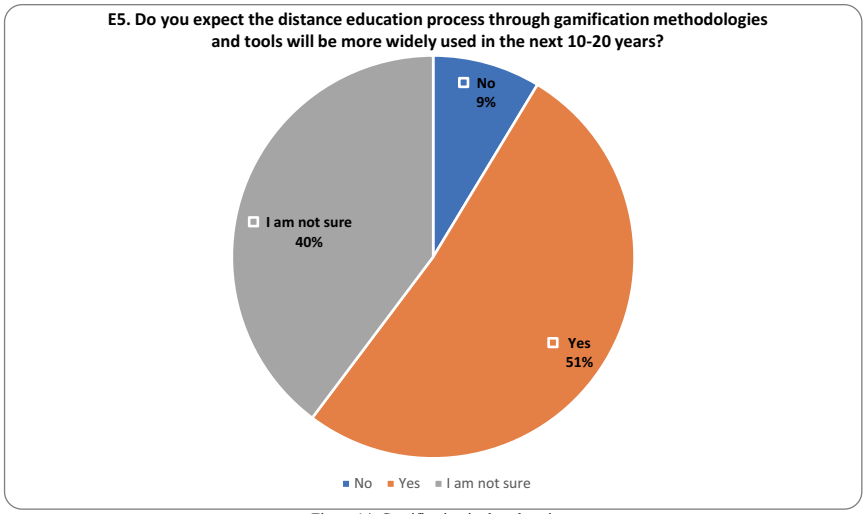


Figure 14: Gamification in the education process

More than half of the respondents believe that gamification will be used in the near future in distance education process.

Figures 15 (a) and (b) show that Live class was used in more than half of the cases during the pandemic. Recorded broadcast learning methods was used weekly in around 40% of the cases, as well as 30% not at all.

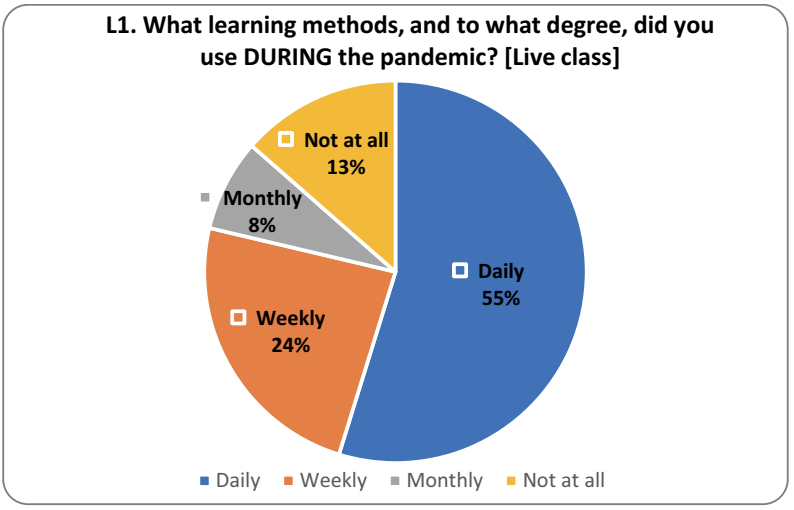


Figure 15 (a): Live class learning methods used during the pandemic

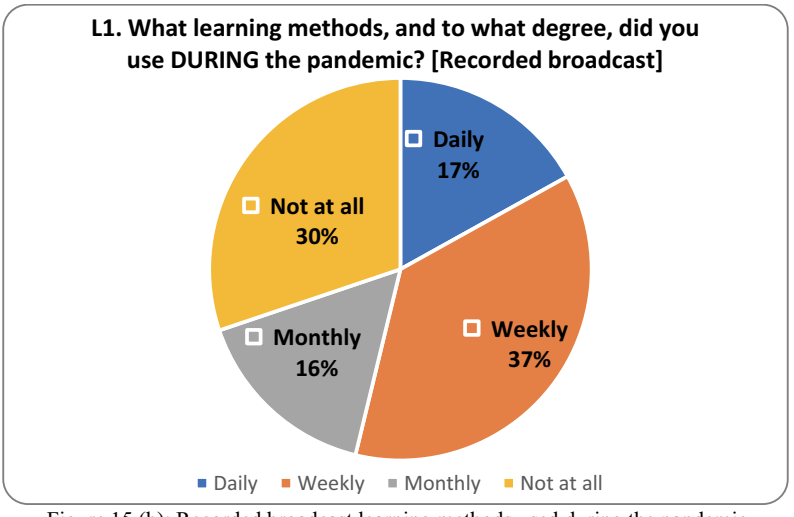


Figure 15 (b): Recorded broadcast learning methods used during the pandemic

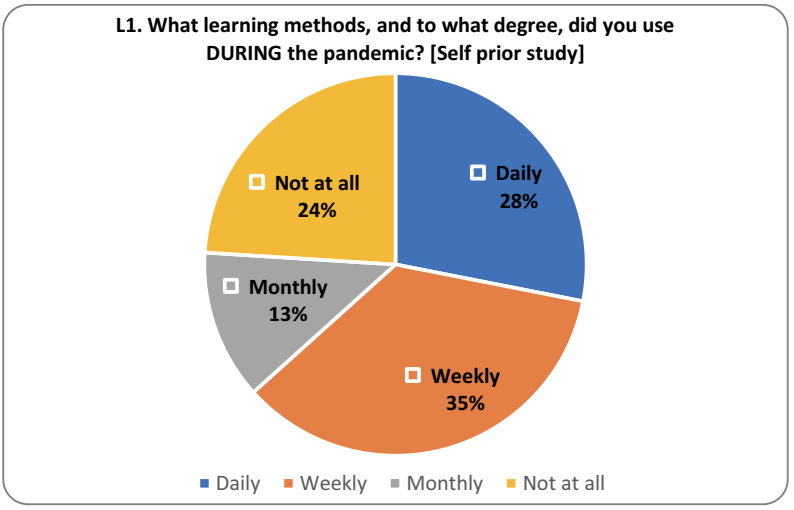


Figure 16 (a): Degree of self-prior study used during the pandemic.

From figures 16 (a) it can be seen that before the pandemic 28% of the students engaged in self prior study on a daily basis and 35% on a weekly basis.

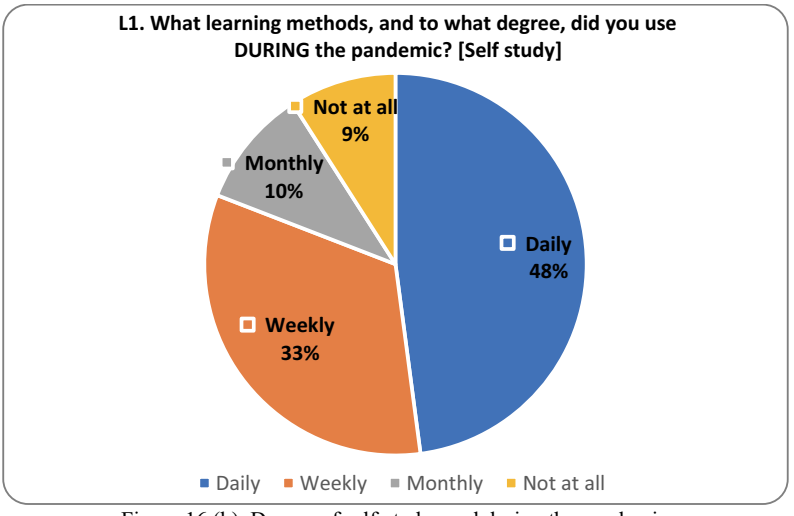


Figure 16 (b): Degree of self-study used during the pandemic.

During the pandemic (see figure 16 (b), the daily engagement in self- study increased to 48% and the weekly self -study had a minor decrease to 33%. The most interesting result however, is the degree of non-engagement in prior self-study which decreased from 24% to 9%. The changes can be attributed to the fact that the daily engagement increased by 20 percentage points.

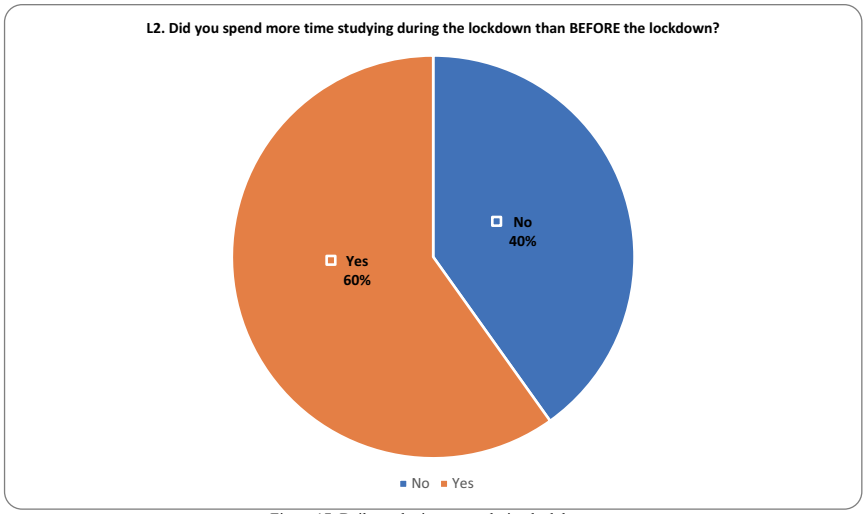


Figure 17: Daily study time spent during lockdown.

Figure 17 shows us that 60% of the respondents spent more time on studying during the lockdown.

Figure 18 (a) shows us that 70% (daily) and figure 18 (b) shows that 79% (weekly) of the respondents spent at least 75% more time on studies during the lockdown.

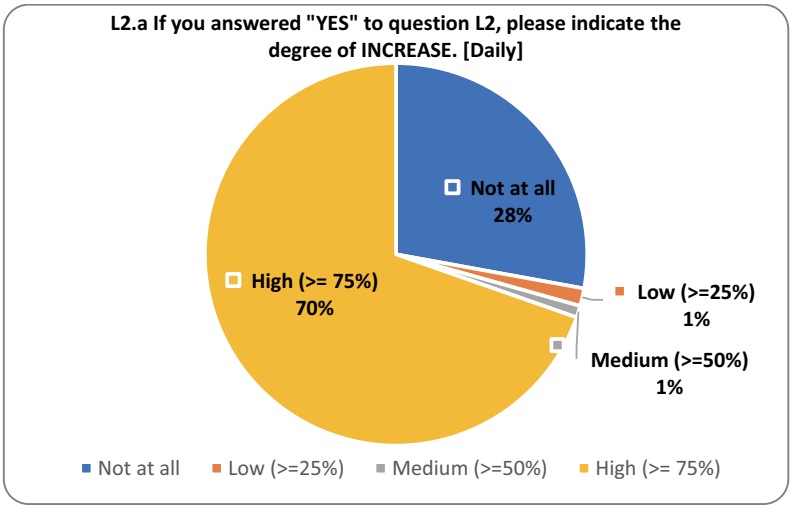


Figure 18 (a): Daily increase in study time during lockdown.

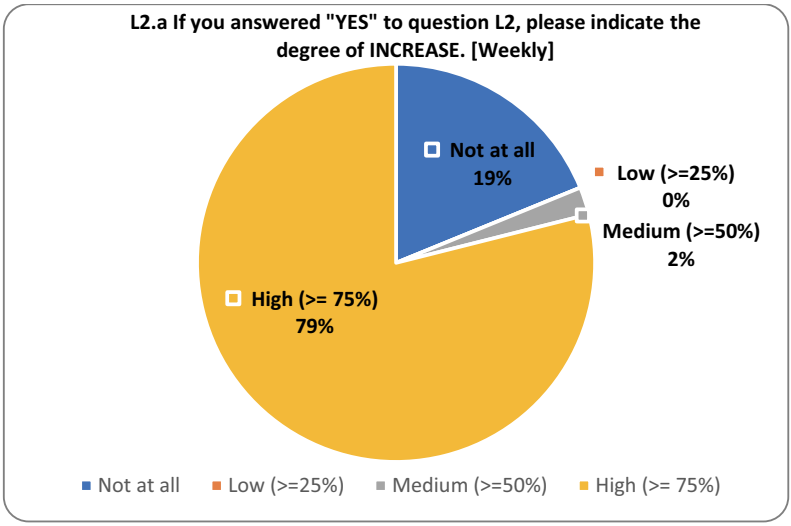


Figure 18 (b): Weekly increase in study time during lockdown.

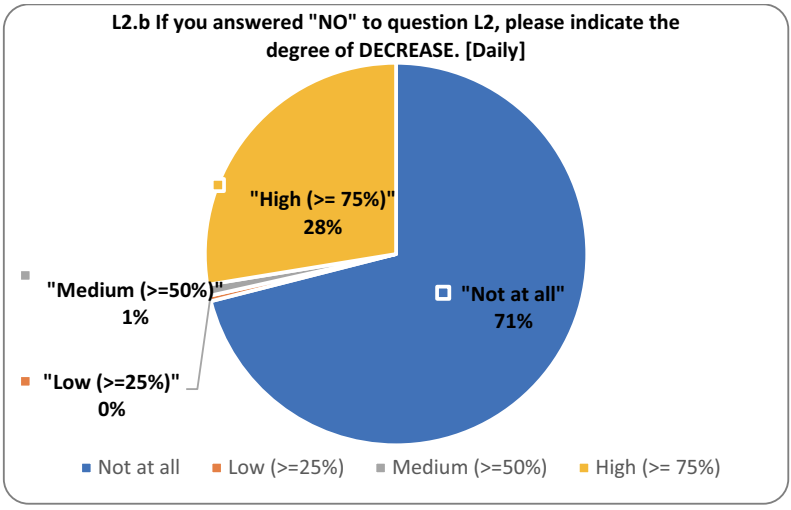


Figure 19 (a): Degree of decrease of time spent studying during the pandemic {Daily]

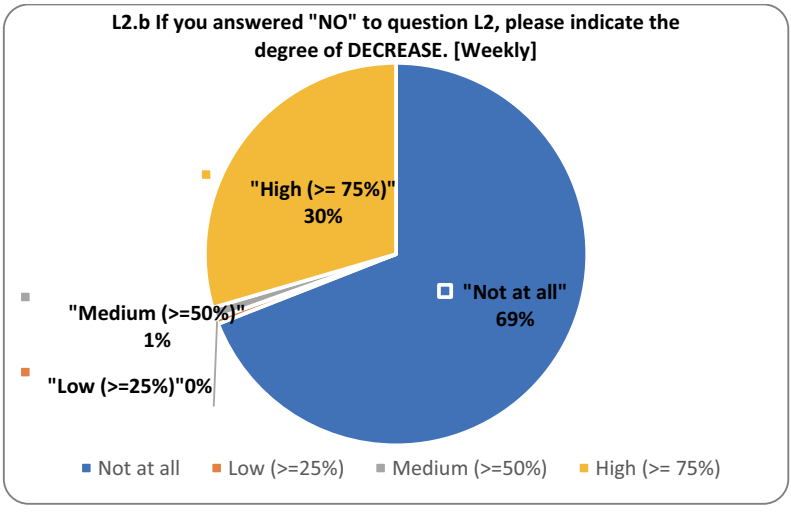


Figure 19 (b): Degree of decrease of time spent studying during the pandemic {weekly]

Figures 19 (a) and (b) show 1/3 of those who spent less time on daily or weekly studies during the lockdown approximately spent 75% less. The majority, however, spent the same time as before the lockdown.

3.4 Communication

This section attempted to establish whether students felt supported, whether they kept in touch with their lecturers, their fellow students, friends and family. There were anecdotal reports that students felt isolated or lost interest in their studies

Figures 20 (a) and (b) show us that communication was encouraged to a high degree both among students and between students and lecturers.

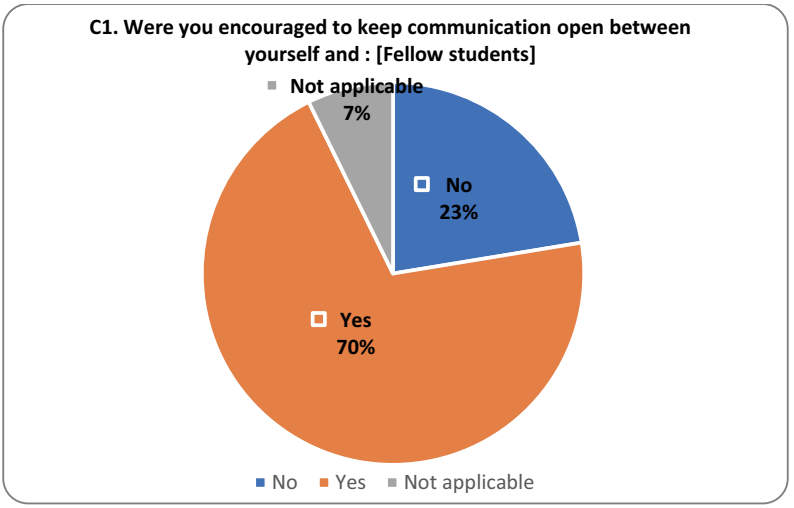


Figure 20 (a): Encouragement of communication between yourself and fellow students

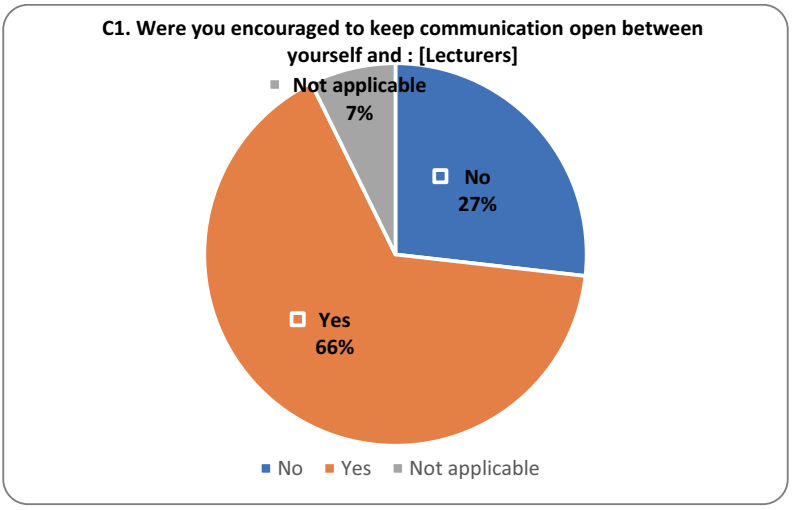


Figure 20 (b): Encouragement of communication between yourself and lecturers

Figure 20 (a) and (b) shows us that communication was encouraged to a high degree both among students and between students and lecturers.

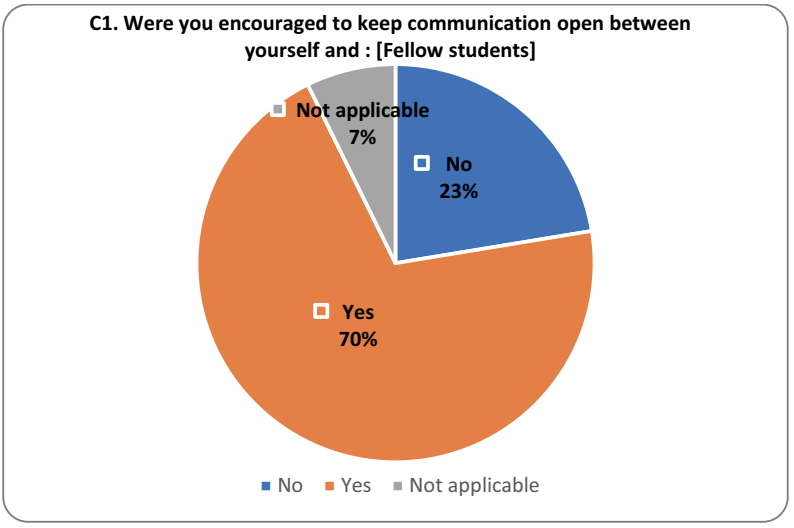


Figure 20 (a): Encouragement of communication between yourself and fellow students

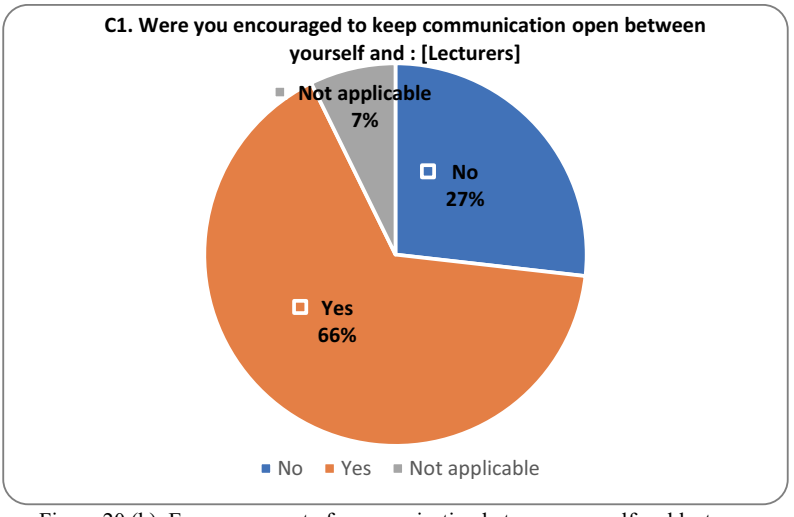


Figure 20 (b): Encouragement of communication between yourself and lecturers

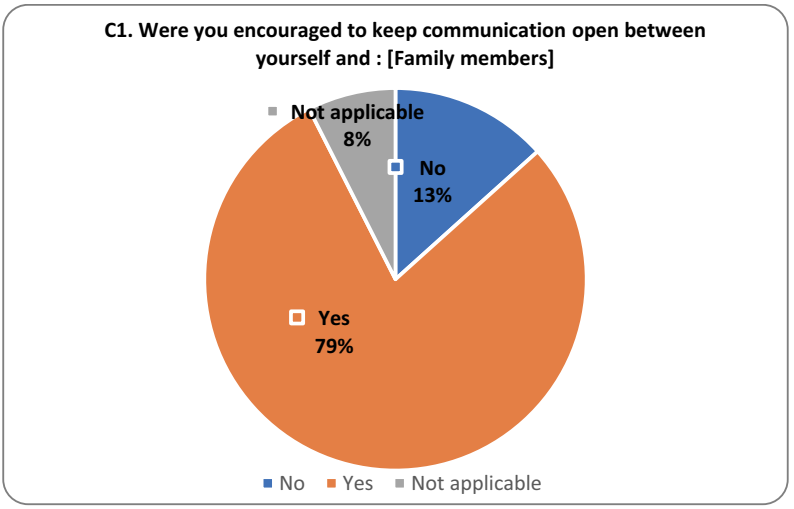


Figure 21 (a): Encouragement of communication between yourself and family members

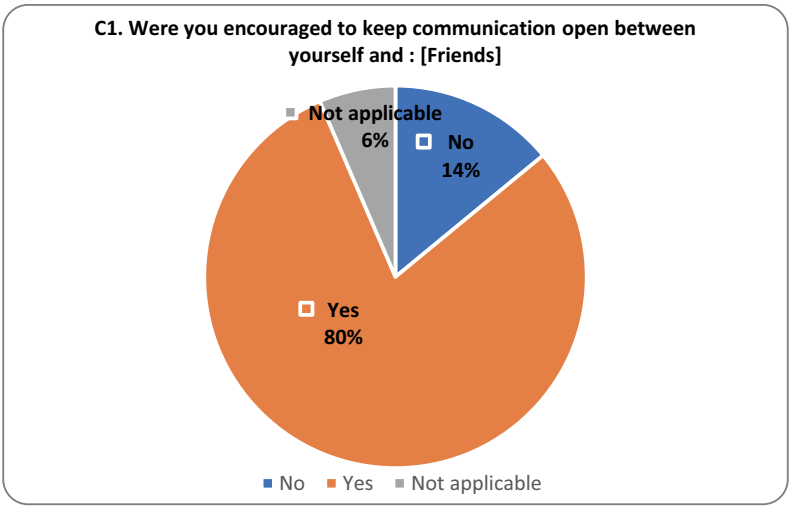


Figure 21(b): Encouragement of communication between yourself and friends

Figures 21 (a) and (b) show that communication was encouraged to a high degree both between students and their family member and between students and their friends. The rationale for posing this question was to understand whether students were challenged by the isolation. Keeping in touch with friends and fellow students as well as family is vital.

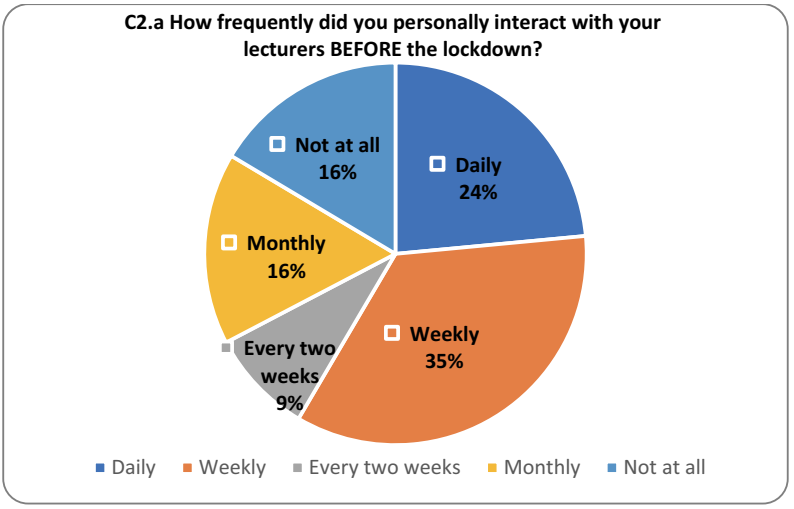


Figure 22 (a): Frequency of communication before lockdown

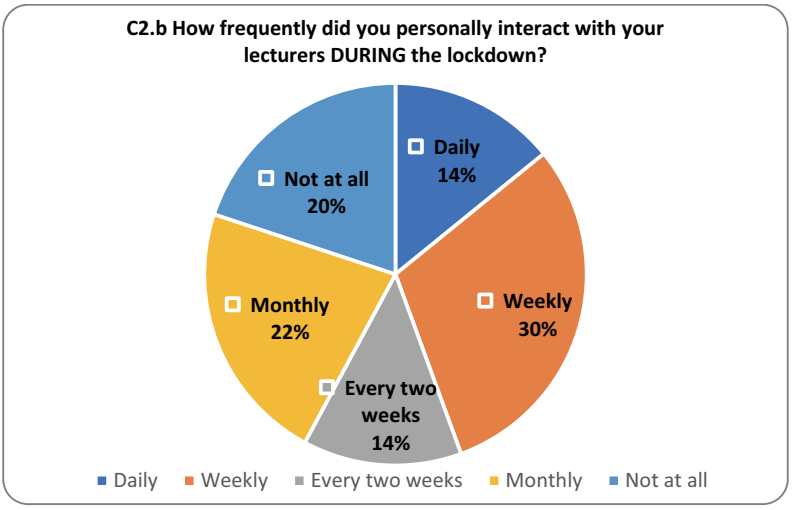


Figure 22 (b): Frequency of communication during lockdown

Figure 22 shows that the daily frequency of communication decreased during the lockdown, However, for the weekly, every two weeks and monthly communication the frequency increased.

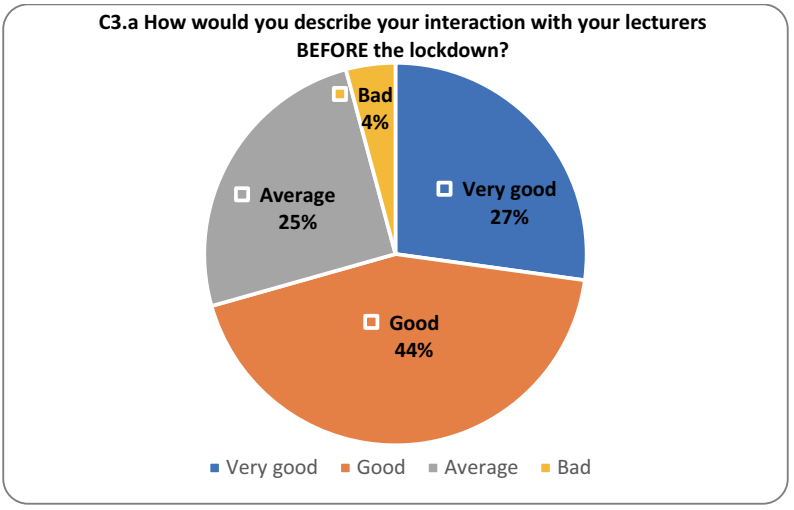


Figure 23 (a): Interaction with lecturers before the lockdown

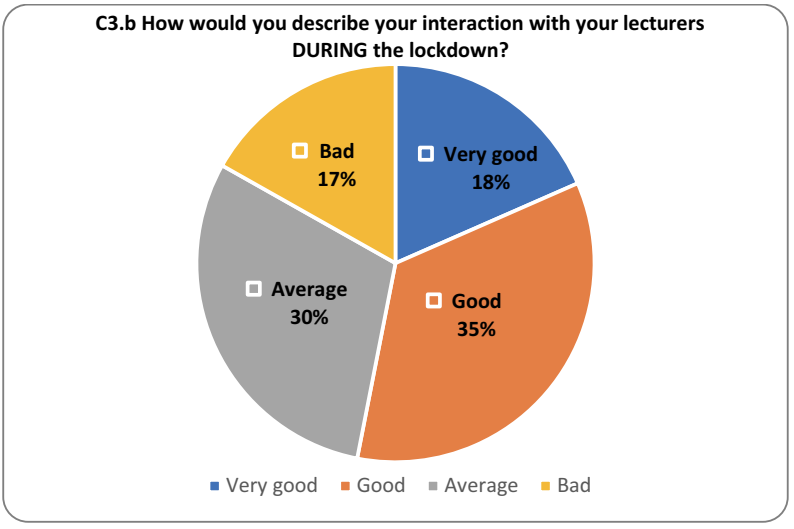


Figure 23 (b): Interaction with lecturers during the lockdown

Figure 23 shows that the quality of interaction with lectures increased during the lockdown.

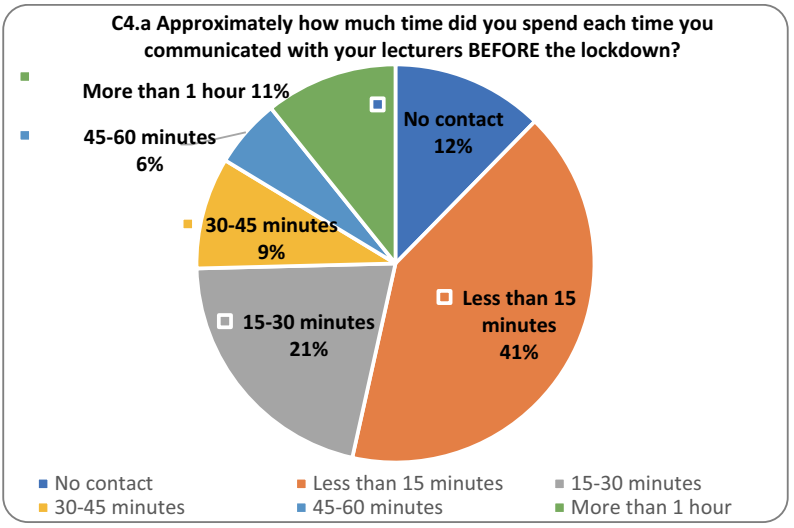


Figure 24 (a): Communication time before the lockdown

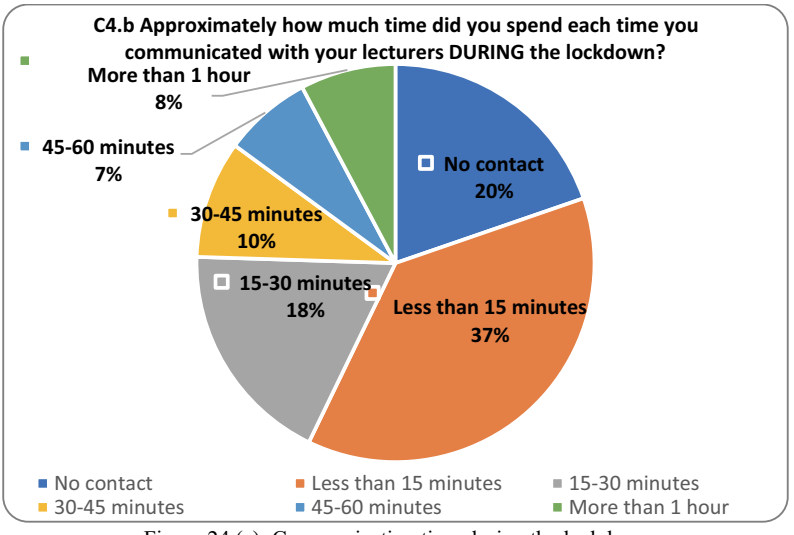


Figure 24 (a): Communication time during the lockdown

Figure 24 shows that more than 1/3 of the students spent less than 15 minutes on communication with their lecturers before and during the lockdown.

This section provided information about the frequency and length of interaction and communication between the students and their lectures, students and their parents and students and their friends. The results showed that as the students were connected, they seem to maintain contact throughout the lockdown periods.

3.5 Security and Privacy Concerns

As distance learning has undergone a spectacular development and use in recent years, especially in the COVID-19 era -when it was even temporarily established-, it is considered of the utmost importance to guarantee security in e-learning [24]. Common examples of cyber security threats mentioned last year by Anghel and Pereţeanu (2020) [25] include data leakage, authentication problems, malware installation, unreliable networks, and other. The European Union Cyber Security Agency (ENISA), in its annual report for 2020, identified fifteen (15) top threats [26], such as cyber-espionage, online identity theft, phishing, spam, data breach and other that compromise online privacy and virtual information.

An important part of cybersecurity is the processing of the personal data of all Internet users, which is regulated by the General Data Protection Regulation (GDPR) of the European Union [27]. Based on the literature there are some best practices and recommendations for organisations that have been identified on the need to implement cyber security policies [28].

3.5.1 Privacy and Cybersecurity Issues in Virtual Learning

In order to facilitate the virtual learning activities, various student activities and information are recorded and digitized that generally do not happen during in-person classroom setting; for example, recording virtual classroom discussions and tracking students' attendance online. These activities, related to collection, storage, and handling of students' personal information have raised the concerns for privacy and protection. This concern is more alarming if we consider the data breach incidents that different companies, including some companies owning the forementioned tools and services, suffer from time to time [29].

Migrating the teaching and learning activities to the Internet invites a plethora of cyber risks and security threats. The following are examples of such facts: i) Distributed Denial of Services (DDoS) attacks affect the access of educational resources, ii) phishing attacks can lead to stealing students'/teachers' login credentials and infect their devices with malware or, even worse, ransomware. Such incidents have been significantly increased during the current pandemic [30]. Likewise, there are inherent security risks (e.g., [31] [32]) connected to vulnerabilities in the Internet tools used for the same deceitful purposes.

3.5.2 Notable Survey Findings regarding Students' Cyber-Protection

The first question was: D1. Are you aware of any measures taken by your University/College about the protection of private data? The students' responses showed that 45% of the participants were not aware of any measures taken by their university/college to protect their private data (figure 25). This fact alone indicates the need for additional awareness training.

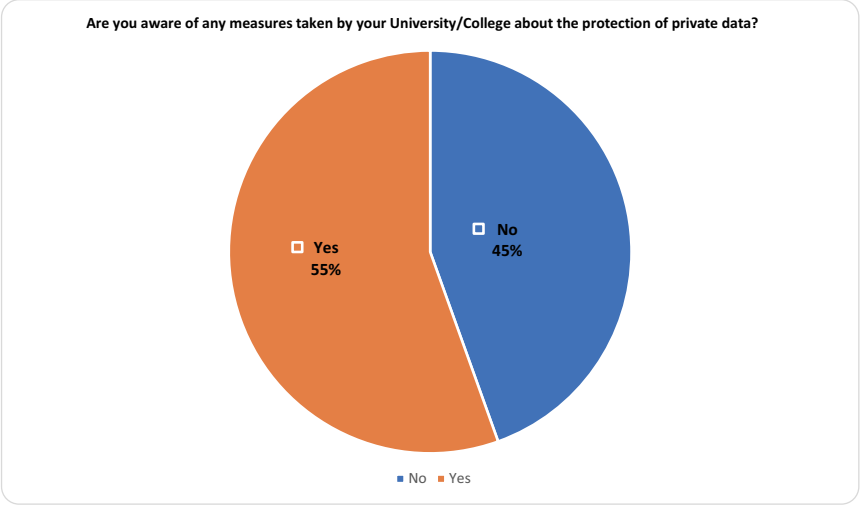


Figure 25: Awareness of measures taken by institutions on private data protection

A large portion of the participants had no awareness training on even basic cybersecurity issues both before and during the migration to online learning, such as phishing attack (before-67.93% | during-73.90%), online privacy (before-64.94% | during-70.22%), secure password (before-62.35 | during 70.52%). More specific details are illustrated and commented in the next figures 26-29.

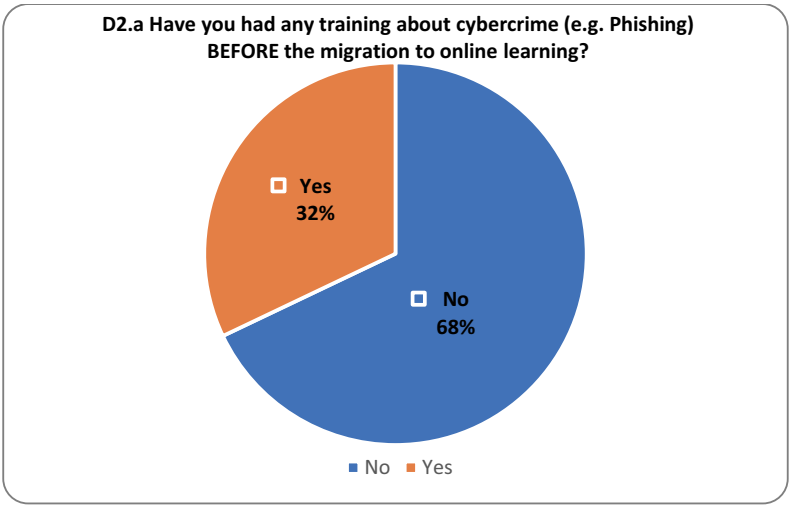


Figure 26 (a): - Training on cybercrime before the migration to online learning

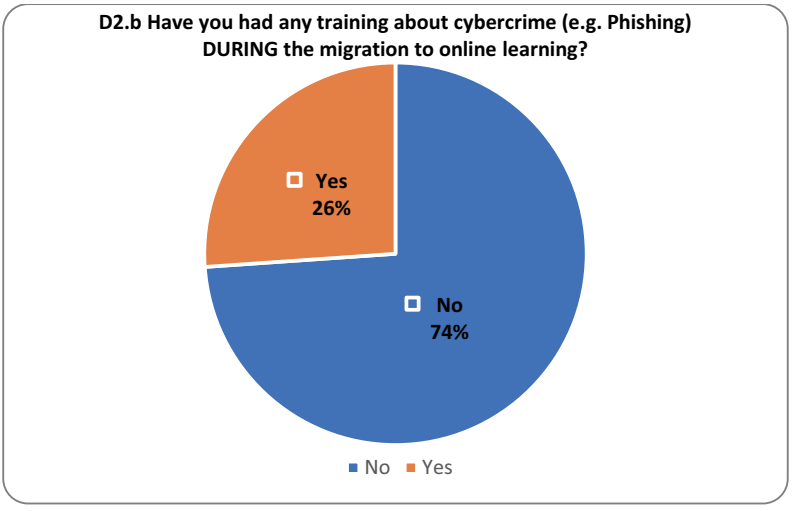


Figure 26 (b): - Training on cybercrime during the migration to online learning

Only 32% (before the migration to online learning) and 26% (during the migration) of the respondents received training on cybercrime again pointing to the need for further action by the educational institutions (figure 26 (a) and (b)).

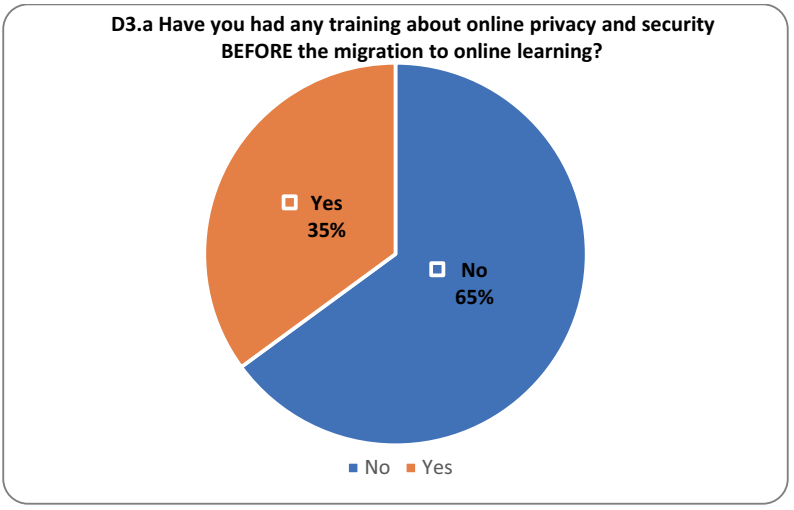


Figure 27 (a): Training about online privacy and security before the migration to online learning

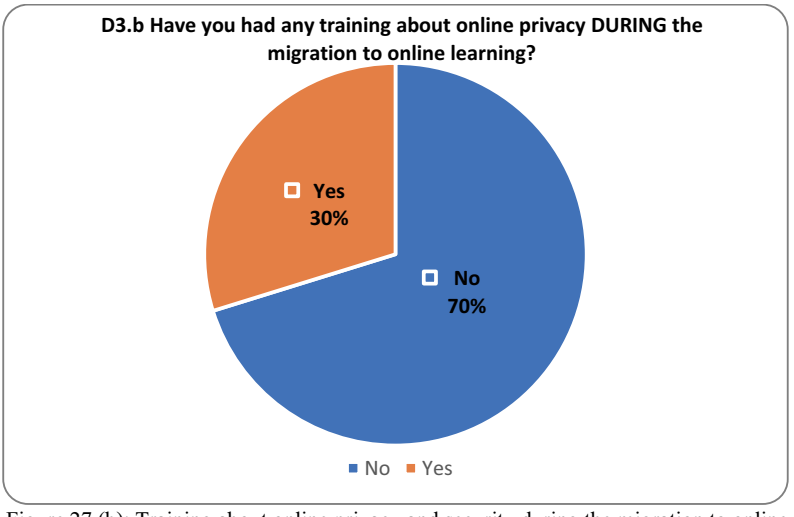


Figure 27 (b): Training about online privacy and security during the migration to online learning

It can be seen that 65% (before the migration) and 70% (during the migration) of the respondents received no training about online privacy and security (figure 27 (a) and (b)).

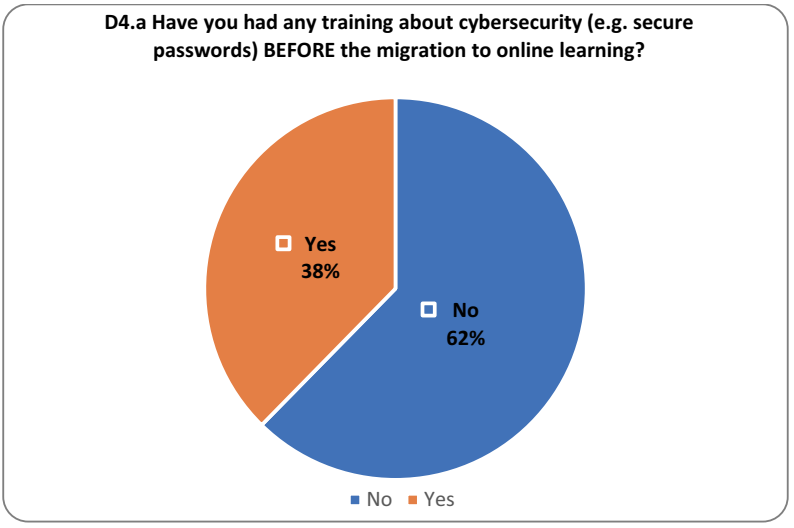


Figure 28 (a): Training about cybersecurity before the migration to online learning

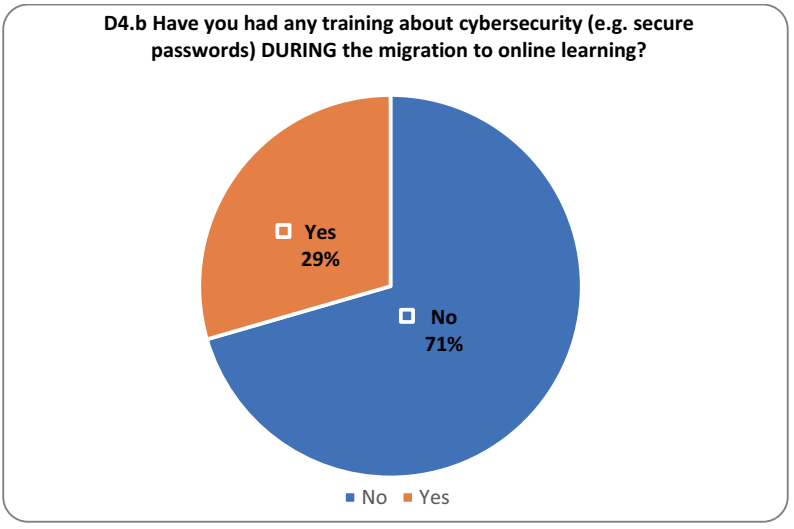


Figure 28 (b): Training about cybersecurity during the migration to online learning

As in the previous questions 62% (before the migration) and 71% (after the migration) had no training about cybersecurity (figure 28 (a) and (b)).

It is evident that the students seem not to have experienced any problems caused by cybercriminals before or during the migration to online learning (figure 29 (a), (b)).

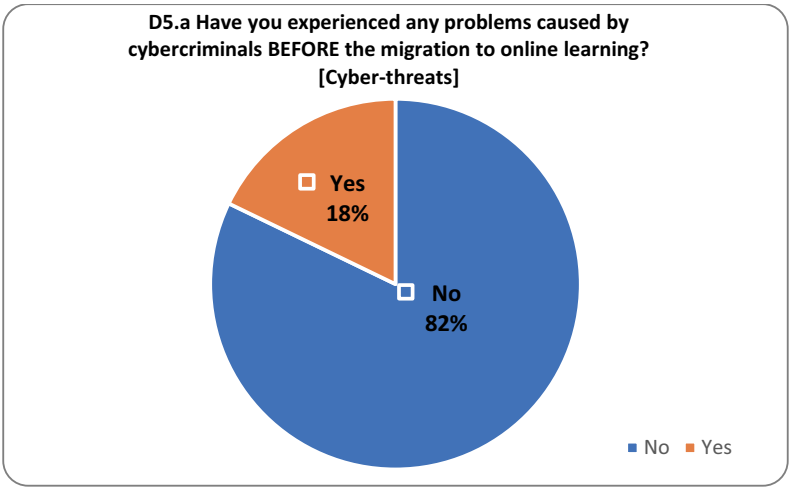


Figure 29 (a): Experiences of problems (cyber-threats) caused by cybercriminals before the migration to online learning

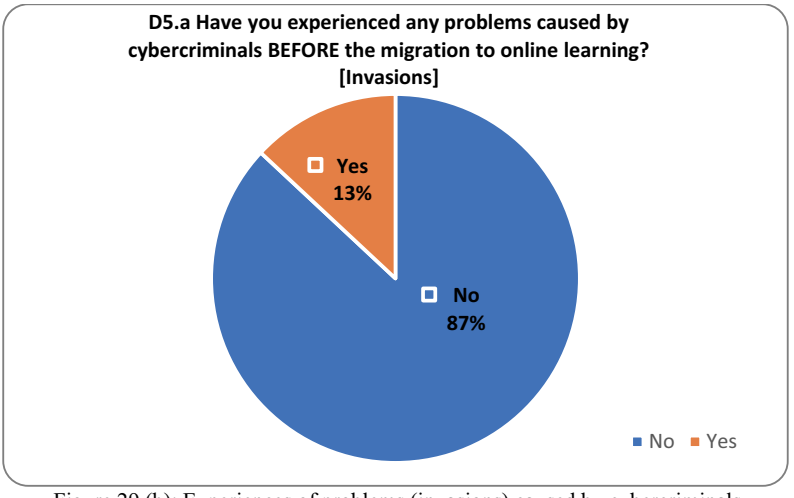


Figure 29 (b): Experiences of problems (invasions) caused by cybercriminals before the migration to online learning

Only a few of the participants had experienced cyber-attacks or their consequences before the migration to online learning, such as cyber threats (17.83%), invasions (13.04%), unwanted adverts (41.43%), phishing (28.59%), and identity theft (13.65%). These numbers show how naïve and unaware the students have been about the cyber-attacks and data breaches but also about other vulnerabilities.

Some of the participants experienced cyber-attacks during the migration to online learning, such as invasions (14.34%), unwanted adverts (38.55%), and phishing (25.10%). Some participants know some of their family members (34.27%), fellow students (30.18%), friends (38.65%), and online friends (25.80%) who faced online privacy and security issues.

These percentages are also illustrated in round numbers in the following figures 30-32.

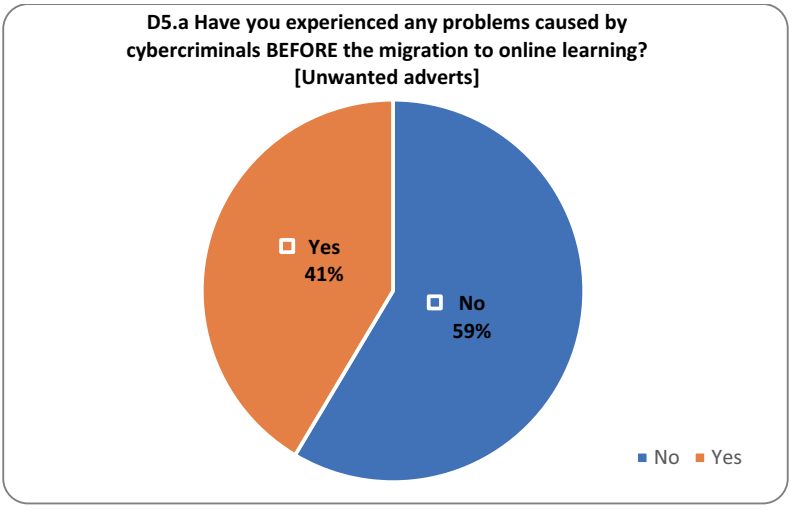


Figure 30 (a): Experiences of problems (unwanted adverts) caused by cybercriminals before the migration to online learning

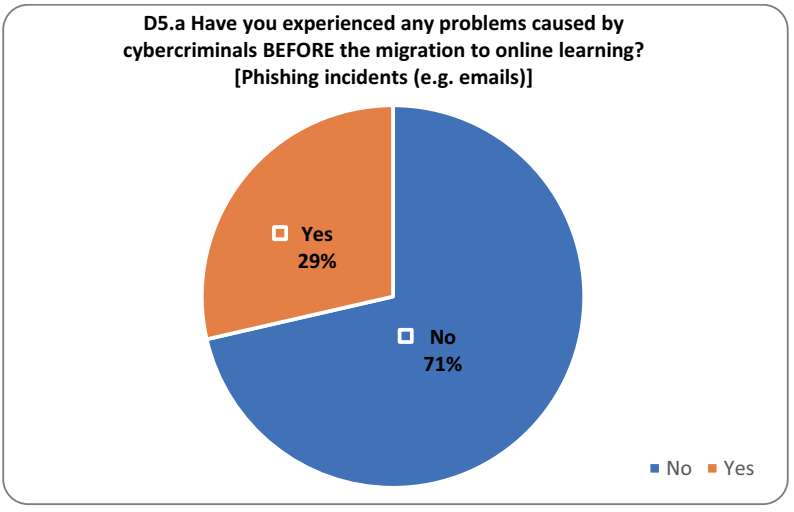


Figure 30 (b): Experiences of problems (phishing incidents) caused by cybercriminals before the migration to online learning

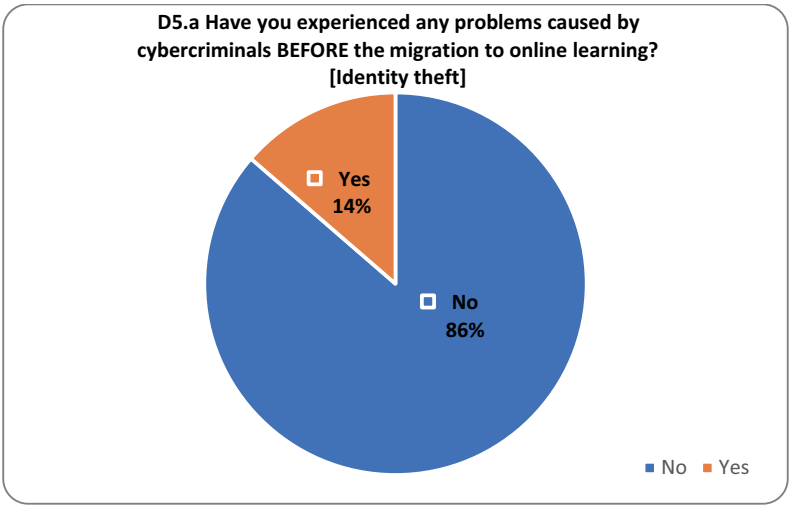


Figure 31 (a): Experiences of problems (identity theft) caused by cybercriminals before the migration to online learning

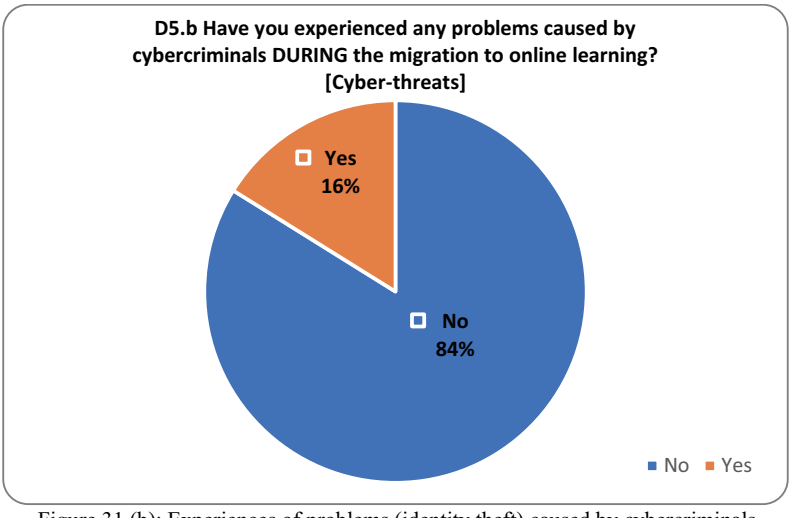


Figure 31 (b): Experiences of problems (identity theft) caused by cybercriminals during the migration to online learning

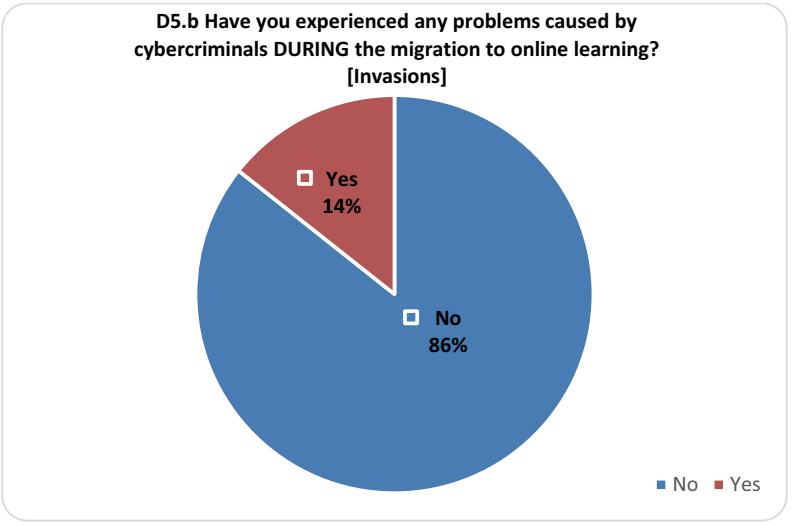


Figure 32: Experienced problems of invasions

The responses here again showed that 86% of the students did not experience any invasions (figure 32).

3.5.3 Potential Measures for Cyber-Protection

In general the survey questions on cybersecurity and online privacy revealed low levels awareness and low levels of training on matters of identity theft, phishing, unwanted adverts, and invasions. Considerable efforts must be devoted on developing and delivering such training in order to address these problems.
Providing training and resources to raise the cybersecurity awareness of the students, teachers, and staff will make them understand the risks and threats they are vulnerable to, how to recognize warning signs of those risks and threats, and ways to stay safe online. It should be reminded to students and staff that the IT staff will never ask for their login credentials via email or threaten to turn off access to their accounts if they do not click on a link. Other actions that will definitely reduce potential cyber risks include, for example, i) implementing two-factor or multi-factor authentication [33] whenever possible to reduce the chance of data breach and ii) providing security guidelines that explain the necessary security measures [34, 35] that students and staff should implement in their personal devices in advance to participate in virtual learning.

3.6 Students' comments, suggestions and questions

At the end of the questionnaire the students were given the opportunity (through an open question) to add anything else they wanted to say. Out of 1005 respondents,

245 students chose to enter additional comments, which included many suggestions for future improvements, as well as some criticisms, mainly around the length of the survey and the complexity of the questions.

In the following sections, we present a sample of the comments and suggestions given by the students, their own words (apart from the removal of some spelling errors) and *shown in italics*. Each individual answer listed below is preceded by a bullet point.

3.6.1 Simple and brief responses

Fifty (50) out of the 245 student provided simple and polite responses such as *"Thank You," "Thank you for this important survey," "Thank you for this interesting and valuable survey"*.
Forty six (46) students (including some that answered in their mother tongue) answered *"No", "No, thanks", "Nothing", "No comment"*.
Others exclaimed : *"Please face to face.", "Reopen universities", or "Keep going forward"*.

3.6.2 Critical Remarks

One student commented:

- *"It is too long a questionnaire, it takes a lot time. We lost interest in the middle of your questionnaire"*.
- *Provide "does not apply" or "I don´t know" options for all questions in the future. You will see some inconsistencies in my answer because the option was not available*

Another student provided an exasperated response in the form of a question *"More?"* Evidently after answering such a long questionnaire, this student was not prepared to answer yet another question!

Three students said that *the questionnaire was too long,* and another said *that some questions were not understandable.*

- *My impression of this survey is that quite a few questions could have been more clear or expressed in a different way for clarity and simplicity.*
- *Some of the questions in this questionnaire were not that clear. Maybe shorter questions one at a time will be best for the user to answer.*
- *I bet with great certainty that I was the only one who took this survey.*

Other criticisms included:

- *I just wanted to say that the last question about cybersecurity (the one where you say whether u trust the internet or media) is a little misleading. Of course, on the internet there is a lot of misinformation, but the amount of information is so huge you can find anything you want with a lot of sources. On the other hand, the media often base their information from one source (not going to say anything about it).*

- *I can see that you have acknowledged that Canada has two official languages in your "Thank you for participating" flag picture, but not Finland.*

3.6.3 Congratulatory/appreciative remarks

- *Very nice work on the questions. I hope you get detailed answers and impact with your results.*
- *Liked the survey. I hope this can improve things, but I feel very pessimistic.*
- *Thanks for the survey*
- *Wish you the best with your research!*

And a rather mysterious response

- *Thank you for all the fish! Unless this student misunderstood the concept of phishing…?*

3.6.4 Complex and elaborate answers

Many students gave extensive and very thoughtful comments, reflections, and suggestions, focusing mainly on the desirability or not of online education. Each individual answer listed below is preceded by a bullet point.
Below are some of their thoughts, feelings and criticisms. On the issue of desirability of online learning there is a wide spectrum from "*Please face to face*" to "*I hope and pray that face-to-face learning will still exist in the future. If it doesn't, human race doesn't deserve to exist".*

The students' responses fell into three main categories: positive, (those that like/prefer/appreciate online learning), negative, (those that dislike online learning, and prefer return to face-to-face), or mixed /hybrid (those that can see both and drawbacks and would thus opt for the hybrid model). In addition, the students provided suggestions for improvement.

3.6.4a Positive: Responses showing clear preference for adopting and continuing with virtual education

- *Proceed to the virtual education system properly and quickly as soon as possible.*
- *Distance learning is very affordable. The student has more free time for self-development.*
- *My engineering school had already implemented a lot of virtual classroom features to are studies and was surprisingly well prepared to go fully online.*
- *I was already studying on a distance course where I only visited the school once for every course to meet the teacher/lecturer. Since I was working full time this was the only way to manage my studies, to do them on distance. The tools in place are good today, but could be further improved to really up the quality.*
- *I think this is the future, but requires quite a lot of technical skills of the*

students and of course the equipment can be expensive and prevent many from being able to participate.

3.6.4b Responses showing clear preference for returning to the traditional method of learning and teaching

- *Face to face classes is the best communication for learning students.*
- *In these tough times it should be taken as a way to help students not an advantage to push us on extra work, assignments, homework ex.. we are all struggling especially students we need to change the way of thinking and the system it becomes a huge psychological problem towards students. Can we stop the online courses plz.*
- *Can we stop the online courses please.*
- *It is impossible to find energy and motivation to study during the pandemic if the situation has decreased your mental health. The fact that you don't have the energy and you get three times more work is a very bad combination. For some people the face-to-face lectures are the only human interaction they have and not having that will compromise their well-being even more.*
- *I am a first year student, and I feel like the pandemic caused my classmates never to get to know each other. We do not have a"bond".*
- *I hope this kind of education (on line) will disappear. Is much better education face to face.*
- *Please think about the students' well-being and mental health. It is very stressful for us to go through this pandemic with all the studying and lectures being online. Of course there needs to be safety precautions but I believe there is a better way to teach during this pandemic. Thanks for the survey!*
- *We want face-to-face learning back*
- *I mostly believe that we should take into consideration that online classes can be improved and replaced by physical ones.*
- *We want our classes .. it's very exhausting to learn everything online ..most of us have vision issues*
- *I hope that the universities open*
- *I think that online lectures are not effective in any way, they are providing superficial knowledge and it's really hard for students to focus on these lectures for so many hours in a week.*
- *Everyone wants to return to the old way of living. I don't know how will this happen but I want so much to go to my university because I haven't yet EVER.*
- *I am in my first year of studies and I don't even know where the entrance is :((*
- *I hope that online method of learning will not become our daily routine from now and then, and we will come back soon to our classrooms, where students interact better each other and where the lecturer can support*

freely her/his opinion without having the fear of being recorded and thus be penalised ted by her/his institution.

- *In my opinion life must not be furthermore filtered from electronic devises*

3.6.4c Responses expressing preference for a mixed/hybrid method of learning and teaching

- *When I started online learning I thought that it is very bad idea but now having experience in it . I found it fine. I hope and pray that face-to-face learning will still exist in the future. If it doesn't, the human race doesn't deserve to exist.*
- *I believe that online learning has its merits, it saved us transportation costs, made our lives easier by not having to wake up an hour or two earlier to attend uni on time, recoded lectures made time management more flexible, and made life generally easier for students overall. However, I still do believe that the core concept of uni, the idea of having a campus and interactions on uni grounds and lecturer halls, is generally needed and should be encouraged. The days on campus form the best days we can have as students at uni due to much needed interaction. I personally support a hybrid system to be used in the future, however not during the time of corona, as it doesn't make much of a difference if we are on campus one day of the week or several. In the end we are interacting with other students making it dangerous and life threatening.*
- *I just wanted to say that the last question about cybersecurity (the one where you say whether u trust the internet or media) is a little misleading. Of course, on the internet there's a lot of misinformation but the amount of information is so huge you can find anything you want with a lot of sources. On the other hand, the media often base their information from one source (not going to say anything*
- *I think the online learning won't be the problem but the situation. If it would be normal, I won't have motivation to study. The only motivating I'm close to graduate and do not believe things get normal during my studies. If I would be freshman I would not study and just wait things to normalize.*
- *I would imagine if the pandemic was not ongoing online courses wouldn't be bad.*
- *Online studies are good to some degree, it gives more freedom. But at the same Online studies are good to some degree, it gives more freedom. But at the same time it is very boring living and studying by yourself in a little apartment. And with time it gives you lack of motivation for studying.*
- *May this pandemic actually bring us a lot more together and provide us with a better way of learning. Anyone who sees this, stay safe and well.*
- *Studying methods should be improved, online education is very powerful, but still students need to have face-to-face interaction with professors*

The last ‘word’ however, belongs to the student who wrote the following extensive, confessional response with his/her feelings and suggestions. He/she took time to write the following:

- *Online lectures because of the pandemic were the only reason I could go back to university after more than 10 years (mostly due to health reasons). While the pandemic has caused me so many practical problems and sadness, the opportunity to go back to university has been a blessing. And while I will be so relieved and happy for myself, for my country and for the world to get over the pandemic, at the same time I feel some sadness that I won't be able to continue my university degree (or my university learning in general, even if I were not able to participate in all the exams I would have to pass to get my Bachelor's) because the lectures will not be taught online anymore.*

  Some of my lecturers seemed to think online lessons are tiring and distracting for the students. My experience as a student during the pandemic was completely opposite to that. I was able to focus on the lecture, because all my physical needs were met. My body was comfortable in the physical environment I had chosen and could improve however I saw fit (and if I were too tired and there wasn't a fit (and if I were too tired and there wasn't a presentation to pay attention to, I could wear my headphones, lie back and focus on my lecturer's voice. If, on the rare case that my health issues made me agitated, I could walk up and down my room wearing my cordless headphones or slightly rock on a rocking chair, which would, again, help me to better focus on the lecture. I was able to eat whenever I needed to and whatever I needed to without any compromise (same with any medication I had to take, and of course the need of toilet use). I had no lost time or lost energy over commuting to my university.

  An exceptional lecturer, while teaching live, also sound recorded the lessons and gave us the opportunity to download them through Moodle (along with the accompanying PowerPoint presentations, which many of the lecturers share anyway, thankfully). What a treat for a student who is not always well enough to watch the live lecture! I felt safe knowing I could still have access to what he taught (even if not live and even if I could not interact along with the rest of the class, which are the ideal) with the rest of the class, which are the ideal) at a later time, when I felt better. It reduced my anxiety so much!!!

  Also, any extra-curricular lectures and symposia suggested by our lecturers were also online due to the pandemic, so access was easy, comfortable, and much less uninviting than going to wherever in the city

you needed to go to attend them and sitting alone or scattered as students. And of course, this way we had access to such things that could be based anywhere in the country and even the world!) The building where my school is housed has always made me feel depressed. It has no personality or warmth and, it is very filthy (at least the latter one being mostly the students' fault, unfortunately). (As far as functionality goes, the elevators do not meet the needs of so many students and though I haven't visited them for a long time, I imagine the toilets are still as vandalised and unequipped as I remember them.

I loved my subject of study and courses much more now that I could detached them a bit from that building and from experiencing its "cold" unfriendly atmosphere) and its somewhat lack of functionality). (They only parts are the libraries, which are "warm" and relatively sunny. But I'd still prefer to mostly study at home, due to my health issues and possibly physically restless nature).

Though I am not an introvert for the most part, it has been difficult for me to find friends at university. That was mostly because at first I hung out with the wrong group of people for me (and then was hard meeting new ones once the groups were formed), but after that it was also difficult because I wanted to choose my classes according to what interested me the most and not on whether or not I had friends who chose the same classes, like many did.

Also, I find it hard to concentrate during the lecture if I try to socialise at the same time. And lastly, because now I am much older than most students, it would be hard to find friends among them for that reason as well. These issues were less prominent during the online lectures of the pandemic.

Though I did not find how to interact with my fellow students outside the lessons (I think Moodle supports it, but I didn't see anyone use that. They probably have Facebook -and communicated unofficially through that- and I do not.), through Zoom/Skype for Business chat I was able to communicate with them when I felt it would not distract me (and it distracted me much less than during the physical lessons anyway). So, I felt much closer to them, despite the age difference. Usually during the physical lectures, if it was a big amphitheatre, I would sit alone and there would be available seats all around me (as for anyone who went alone), if it was a small classroom, we could even be crammed, but it would still not guarantee my interaction with the people next to me.

Also, through the chat function of these two teaching interfaces (Zoom and Skype for Business), we could ask minor questions that the lecturer (if they have chosen to read the chat or are comfortable handling it while teaching)

will address only if they saw a point in it (so more questions being asked and answered) or if we missed something from the lecture, we could ask on the chat and, whoever of our fellow students from the whole class was available -so this was not limited to the ones sitting next to us in a physical class- and knew the answer, would sooner or later reply (as the question would remain on the chat, versus a spoken question), thus helping each other without interrupting the lesson or disturbing the lecturer. (And of course, there's the obvious benefit or sharing links on the spot, whether from/to the lecturer or from/to a fellow student).

In my school there is no student lounge, only a small basement cafeteria and a wide foyer which is unfortunately occupied by representatives of student parties. So, no welcoming place left for socialising anyway.

I'd like to add the fact that if there's a huge audience, during the online lectures. I can still see the lecturer's face and the presentation up close, while in a big amphitheatre that is not possible. So, overall, a much less lonely and impersonal experience, and a much more functional and engaging one, for me.

Note: Where my responses in the survey seem incongruent with the fact that I did not attend university right before the pandemic, it is because I have responded according to my experience of regularly attending my school (which was around 2004-2005). The responses that would be according to my absence, are easily deduced knowing this fact (the absence was total, except for keeping my status as a student at the school active, which only required communication or visit with my school's secretariat and my university's online services).

As can be seen the responses showed a preference to returning to the traditional face-to-face or adopt a hybrid model. A typical thumbs up is expressed by responses like "keep going forward" whilst a typical thumbs down is "face-to-face please". The mixed or hybrid approach received considerable support as well as suggestions for improvement as the following student response elaborates:

"I believe that online learning has its merits, it saved us transportation costs, made our lives easier by not having to wake up an hour or two earlier to attend uni on time, recoded lectures made time management more flexible, and made life generally easier for students overall. However, I still do believe that the core concept of uni, the idea of having a campus and interactions on uni grounds and lecturer halls, is generally needed and should be encouraged. The days on campus form the best days we can have as students at uni due to much needed interaction. I personally support a hybrid system to be used in the future, however not during the time of corona, as it doesn't make much of a difference if we are on campus one day of the

week or several. In the end we are interacting with other students making it dangerous and life threatening."

3.6.5 Main suggestions for future improvements by the students

- *Mental health factors should be more in focus rather than the technology and the different program solutions.*
- *I would kindly recommend institutions/universities to run mixed method (online and face to face teaching). Good luck with your research!*
- *I want to tell all the lecturers that knowledge is more important than teaching the course of study for students just to pass in the exam, no we really need real knowledge that helps us in our life and our work.er, students knew definitely which mode of study they prefer. Moreover, recording lectures prove useful to students that work (and can't attend live classes) and student's that want to revise. Wish you the best with your research!*
- *Platforms that are safe should be used more (If I am not mistaken Zoom has some bad history and as we were doing lectures everyone could access before they changed it to private e-classes after a whole semester.*
- *Tutors should make a Twitch channel so the students can support them with donations and subs.*
- *The EU needs to hurry up with the vaccination process so that I can go back to my life and continue my studies normally and how they were designed to be taught*
- *The books in the library should all be online*
- *I hope this pandemic teach people how much we need each other.*

4.0 Educators' Reflections

4.1 On teaching and learning under corona virus conditions

In addition to collecting responses from students, the authors of this paper (as educators and some as educators and PhD students themselves, or as parents of students) present brief reflections on the impact of the pandemic on the learning and well-being of the students. Although reflections are personal and largely subjective each author decided to concentrate on some or all of the themes listed below depending on their viewpoints, strength of feeling, experiences and the general situation in their institutions and their respective countries:

(a) your own perception of what your students felt like during migration to the virtual mode of education;
(b) how was their learning affected;
(c) how their psychology was affected;
(d) did they have adequate technologies;
(e) how do you think your students managed any of the laboratory work from a distance.
(f) what are the general government/education department policies that either facilitated or hindered the education process?

The idea was to attempt at finding common perceptions and practices in an attempt to gain a general understating, and to identify lessons learned.

4.2 Armenia

Digitalization has been a priority for education in Armenia. Since 2009 a few projects have been implemented in Higher Educationin digitalization, administering Higher Educationinstitutions, and integrating digital skills into teaching and learning activities.

The Government of Armenia initiated several activities to ensure online courses and distance learning for higher and postgraduate professional education. Afterward, the World Bank financed a project in Armenia to develop a web-based "Education Management Information System" and to monitor and improve education institutions' operations in Armenia [36].

In the following years, the government strategy was directed towards developing an online learning culture in the education field. Legislative regulations were drafted to improve this area.

As the situation became crucial with the COVID-19 crisis, educational institutions in Armenia, by the government decision, were transferred to remote delivery of education to ensure the continuity of studies.

This order clashed with the tangible realities of day-to-day work in educational institutions.

Despite insufficient capacity, universities and the Government directed their efforts to find various solutions to get through the situation. The resolutions introduced by schools and universities are:

- Application of a mixture of online, remote, distance, and digital learning modes.
- Usage of such digital tools and platforms as Zoom, Moodle, Blackboard, Google Classroom, Google Hangouts, and WhatsApp.
- Integration of materials from MOOCs via Coursera.

The National Center for Educational Technologies has managed to launch: Education Management information system, online repository of educational materials, online educational platform, online elementary school application system, interactive STEM learning platform [37].

After evaluating the results of numerous studies, the Armenian state pedagogical university administration decided to implement Google Classroom as an e-platform for learning and teaching, which was introduced to students and academic staff.

Armenian State Pedagogy University (ASPU) moved into the online delivery platforms quite smoothly. This is due to the cooperation and contract with Google, initiated four years ago, when the university did a lot of work on localizing the system, as well as training the faculty and students. Four years of experience enabled

the university to suggest appropriate technical solutions and effectively organize online training for schools' teachers [38].

ASPU and Central Bank of Armenia worked closely with the Ministry of Education, Science, Culture, and Sports of Armenia, organizing the "Financial Education at School" sessions for training the teachers. Under this program, "the financial competencies matrix for schoolchildren" was designed by the education experts to integrate financial education in schools [39, 40].

Before the pandemic, in 2019, the teachers participated in a face-to-face training course at the ASPU

and at the regional centers. In total, 2419 teachers from 339 schools had been trained. During the pandemic in 2020, the ASPU Information Technology Center has developed a website for providing online training with the implementation of the Google Meet tool. The tool allowed to continue the training program and to train additional 2050 teachers from 336 schools.

The training sessions were recorded for further review and analysis. Besides, this training of teachers' program allowed get feedback from the education experts immediately/live, which facilitated the incorporation of the feedback and constant improvement of the activity.

It was significant that the developed website was used not only for delivering online sessions but also became a HUB and a depository for training materials for teachers, including manuals, methodological guidelines, and an e-Toolkit for Teachers.

Building an online learning course requires some knowledge that will allow the instructor to create interactive lessons that meet modern requirements. The other problem is related to high-speed internet access, as not all regions of Armenia have a high-quality internet connection. Few technical difficulties arose among the teachers of several rural schools; however, we overcame the technical problems with the help of proper instructions. The Government also needs to agree with Internet providers for the free access in rural areas during the shutdown.

It was noticeable the positive predisposition of the teachers and enthusiasm throughout the entire training, their readiness to gain additional knowledge about dealing with financial matters/ financial proficiency. During the presentation, the trainers organized well-thought-out methods to ensure participants' active engagement and contributions to discussions. It helped to create a comprehensive environment which is an essential approach for distance learning.

In general, digital solutions are supporting professional and academic staff, as well as students, to re-frame learning and collaboration. We can state that despite the uncertainty and pressure caused by the COVID-19 pandemic, the cooperation and flexibility of universities and schools created solutions to address the challenge. The pandemic also posed a necessity to review the technology and internal competencies for digitized delivery of the teaching and upgrade the systems and knowledge to develop an online learning culture.

4.3 Bangladesh

In Bangladesh, the first Covid-19 patients were tracked on March 8 in Dhaka. Thus, the Government of Bangladesh (GOB) instructed to close all educational institutions due to the coronavirus outbreak from 17 March 2020. We are realising that the pandemic has no doubt caused massive problems in Higher Education. However, COVID-19 taught us how to become 'tech savvy'. Universities around the world have been facing lockdown challenges in engaging students in order to enhance academic success. Universities have developed diversified online services during the coronavirus pandemic situation. Likewise, other universities, East West University (EWU) started to convert face-to-face university courses online. With the help of digital technologies, online teaching and learning have been designing and organising so that students can continue to pursue their academic journey at this crisis moment.

East West University has been conducting online classes since April 2020. The following platforms are used for running online classes:

- Google Classroom as an overall Learning Management System;
- Google Meet for live video class/meeting with the students;
- Google Jamboard as a digital whiteboard tool when required.

Also, Google Calendar is used to schedule online classes to avoid any potential conflict of schedules for students.

Opportunities in online education:

- Becoming tech-savvy person,
- Affordable internet packages,
- Created a strong bond between students and teachers,

- Provide a flexible and all-inclusive opportunity with additional guidance and tutoring support from the instructors,
- Library conducts online information literacy class and introducing more online services,
- Provide financial support.

Challenges faced by learners in participating in online education during COVID-19:

- Ever widening Digital Divide because of which students from underprivileged families cannot join online classes,
- Because of closure of libraries and limited support, students cannot receive help from librarians or use library collections effectively,
- Complex systems (poor user interface, hard-to-understand software) which hamper smooth participation in academic activities by students,
- Poor infrastructural facilities, weak network, power disruption etc. preventing students from being connected to academic activities,
- Lack of free content, preventing majority of students from developing countries to join online classes,
- Poverty, lack of awareness and a negative mind-set – hampering the successful implementation of academic activities during Covid-19 pandemic,
- Because of cognitive differences, all students will not be able to reap the full benefit of online education.

Challenges faced by teachers in online education during COVID-19

- Organisation of work processes,
- Time management,
- Technophobia,

- Lack of trainings about how to operate contemporary technologies,
- Old-fashioned,
- Fear of accepting new things,
- Collaboration and Networking.

Using Kahoot; a free game-based learning platform

In the online pedagogy environment, pedagogues can choose various online games techniques based on the subjects as well as educational content. A well-known example of a live edtech game is Kahoot. It is a free game-based learning platform, used as educational technology in schools and other educational institutions. The department of Information Studies and Library Management, East West University has been using Kahoot since 2016. In this pandemic situation, this game-based learning platform helped us to engage students and boost their academic success. In order to alleviate the stress level of students during online exam, we found it very useful.

The University Grants Commission (UGC) of Bangladesh plans to launch a blended learning policy. The policy will be made to coordinate onsite and online education, so that universities can continue academic programmes and courses in a post Covid-19 era. It has been observed that blended learning is the need and demand of today and tomorrow. Educators should develop diversified skills to adopt contemporary technologies pertinent to blended learning.

4.4 Bosnia-Herzegovina

This observation was made upon the data collected from the University of Bihac and Slobomir P University, both from Bosnia and Herzegovina. The data collected from both universities in B&H although being far away from each other shown that there were no significant differences between the students' opinions and answers related to the unexpected transfer from face to face to online teaching mode. All of them highlighted the similar concerns, suggestions and preferred approaches to the online teaching mode. They all emphasized the same obstacles caused by virtual learning and recommended the necessary improvements in the future.

Unlike some other universities that used to have face to face teaching process only, the universities in B&H had a significant number of guest professors lecturing mainly online even prior the pandemics. Due to that fact the students were familiar with the online education approach and the transfer to virtual mode of education did not present an enormous difficulty for them. The online communication among the students and with the lecturers although maintained on a regular basis reduced the socialising and interaction effect. The attention of students at the beginning of the virtual teaching mode was on a high level but during the time and due the overall locked down situation became gradually decreased. Students' learning attitudes towards their homework assignments although they had more free time during the lockdown were not increased but rather lowered. The pandemics also stopped the well-developed students' international mobility. The interest of students enrolling in the last academic year although affected by pandemics remained the same as before.

Based on the data feedback collected from the students after they have evaluated the teaching process and teachers through the forms made on a regular basis it was noticed that they emphasized the difference in achievements of curricula between theoretical and practical subjects. Any practical work that required usually personal approach was done in an insufficiently well manner. Because of university library not having online access the students were encouraged to more individual way of data collecting from different sources as social media, online conferences and similar. Most of students and professors, while being on isolation caused by COVID-19, unless when suffering heavily from more severe symptoms attended and carried the online teaching process.

Based on the data collected from the questionnaire sent to the students as a method of this paper scientific research a SWOT analyses was done in order to complete the students' overall views related to teaching process during the pandemics. The analysed results proved that most of the students pointed out the same obstacles in the imposed online teaching mode.

Table 1 SWOT analysis on views of universities' students from Bosnia and Herzegovina

Strengths	**Weaknesses**
1 Internet access before pandemics 2 IC equipment in personal possession 3 Higher level of interaction	1 Sharing IC equipment with family members 2 Technical support during pandemics 3 Prior knowledge of often used platforms 4 Laboratory work during pandemics
Opportunities	**Threats**
1 Possibility of using more platforms 2 Assessments during pandemics 3 Students ideas for improvements of platforms and better teaching methods	1 Learning outcomes during pandemics 2 Subjects from Science affected by online teaching 3 Students' lower success at exams 4 Cyber-crime, privacy and security concerns

Most of the differences in students' answers were related to their affiliations, especially the obstacles in the subjects and laboratory/practical works from the Science courses.

The SWOT analyses on views of universities' students from B&H highlighted some of the most appreciated advantages like: Internet access before pandemics, IC equipment in personal possession and a higher level of interaction. It was pointed out as a strength that assisted students when unexpected transfer from offline to online teaching modes occurred. Although more than 97% of the students answered that they had Internet access before pandemics had started, only 78% of them had possibilities to use IC equipment in personal possession.

The main obstacles brought up through the survey were: sharing IC equipment with family members, technical support during pandemics, prior knowledge of often used platforms and laboratory work during pandemics. All of the students stated that they did not get any technical support and apart of commonly used platforms before the pandemics such as ZOOM and Viber 98% of them emphasized that they did not have any knowledge of other platforms that could be used. More than 60% of students stated that they felt a loss in laboratory and practical works during the online teaching.

Opportunities, as can be observed in the table above, were emphasized in possibility of using more platforms, assessments during pandemics and students' ideas for improvements of platforms and better teaching methods. Although there are lots of teaching platforms, only three of them were commonly used during the pandemics at the universities of B&H: Google Classroom, ZOOM and Viber and that is something where students want to have an improvement to be done, seeking for more communication platforms and the way of how they have been taught. As pointed out in students' opinions a higher reliability in assessment has to be achieved also.

The threats that students found can be considered in the following: learning outcomes during pandemics, subjects from Science affected by online teaching, students' lower success at exams as well as Cyber-crime, privacy and security concerns. Most of them stated that studying during the pandemics and consequently learning activities were not done in a serious way as it used to be when offline. Almost 75% of them believe that lecturing in Science lost more than in Social studies what influenced to lower marks in exams. However, the most significant thing highlighted by the students was the fact that almost 90% of them did not have any training on Cyber-crime, privacy and security before or even during the pandemic.

Moreover, the overall situation in Bosnia and Herzegovina as a jobless state with not well defined political and social security and daily bad political decisions brought up by the lawmakers also affected not only the students' knowledge acquiring but their mood in general. Apart of the challenge that online teaching mode caused and new overall life style the students' psychology suffered from worrying for the family members especially older affected by the lack of many required items such as protection masks, gloves, immunity medicines and other. However, some of them

managed to contribute to the society by making safety face-shields on 3D printing, preparation of disinfection liquids, psycho social support to the people in need, cotton masks manufacturing and assistance in teaching Bosnian and English to the minors' immigrants from all over the world passing by the area on the way to other European countries [40]

The students have been well information literate that helped them a lot in using technology in teaching process based on various online platforms. The complete technology they used was their ownership and unfortunately neither any authority nor institution provided or rented them any phones, laptops or similar. Socio-cultural differences were also noticed and they were caused by low level of parents' incomes, if any, and overall economic situation in the country. That is why the equipment like phones or PCs had to be shared often with the other family members or between the students themselves. At the end of the summer semester and prior to the final examination the university Senate made an initiative based on the better overall epidemiological situation to carry on all laboratory and practical works as well as exams in smaller groups in alive. One of the previous papers showed that "*In order to reduce differences in equity of approach we managed to change and update the HE law at the level of the Una-Sana county. In that way the legal basis to perform the whole education process online was created. Not only the education process but the assessment also and exams have been performed online also. Evaluation of the students' knowledge was conducted through the university info students' service and web conferencing applications*." [2] Comparing the results obtained from the questionnaire sent to the students with the previous research covering the universities' staff opinions, it was proved that the students and professors have highlighted the similar views from both perspectives. Overall online teaching process cannot implement the Bologna process in a proper way due to many areas that were partially or even not at all done such as fair assessments, consultations, interactions, mobility of students and academic staff.

In general, the challenges caused by the COVID-19 may be overcome by strengthening the university infrastructure, increased availability of technical equipment if needed, additional training of teaching staff in creation of online learning materials and especially more active international collaboration in distance research methods. It can nevertheless be concluded that even pandemics caused difficulties in the worldwide education process imposed new teaching approaches there are still lots of possibilities for improvement and further scientific research. Although lots of research and surveys have been made on national levels the results remain unknown to the wider audience there is a necessity of creating a co-operation, experts' network and exchange of experiences such as this international study did in order to point out the opinions from all over the world.

4.5 China

In January 2020, the COVID-19 suddenly broke out in China, when all Chinese people were in the preparation for the Chinese Spring Festival, and the long national holiday. At the end of January, universities started the winter vacation; all students had gone back to their hometown.
During the whole of February and March 2020, Wuhan was completely locked down. No public or private transportation was allowed in or out Wuhan. In some areas in Wuhan, people were not allowed to go outside of their home. While in other cities in China, there was no official lockdown, restaurant, shops, cinemas and many other businesses remained closed. Companies and government started working at home policy. Even though the public transportation in China still operated normally, but few people went out for business or recreational travel. For university, the winter vacation lasted for one month in February. The new semester started at the beginning of March. All schools remained closed since the end of January.

On April 8th, Wuhan officially lifted its lockdown. From then on, work and life in all Chinese cities were gradually returning to normal with very tight pandemic control measures, like testing, quarantine and tracing. But all schools including primary and secondary schools, colleges and universities were still closed till the summer, due to the high risk of gathering in face-to-face classes. In universities, the new spring semester started as planed in March, we carried out the online courses for the whole spring semester till end of July.

We got the notification in February during the winter vacation that in the spring semester all courses would be taught online. We had very short time to prepare the transition. It was a huge challenge and pressure to academics, technical staff and administration authority in the university. It was decided by the university authority that all courses should be delivered as planned. We had to give live lectures online at the same time as planned.

During the pandemic, most universities were open to faculty members from March to July, Students were not allowed to enter to campus. We could work in university to give online lectures to students. At that time, the resources of online teaching mainly included: existing MOOCs courses, teachers self-recorded SPOCs online courses in university. These educational resources had been established mainly for the supplement of classroom teaching, which couldn't fully adapt to requirements of online teaching. At the beginning of the spring semester, we anticipated the main problems might be:

1) Teachers are not familiar with the platform and technology of online teaching;
2) A large amount of course content needs to be quickly converted to online forms;
3) The practical experiments, demonstration, interactive discussion, etc. in the face-to-face teaching is difficult to be implemented in online teaching;

4) Some students live in remote areas, where the network conditions are limited, participating in online learning encountered certain difficulties;
5) Student engagement in learning is affected, because of lack of "collective" learning atmosphere, affecting students' attention to learning and participation;
6) International students take part in online classes with time differences.
7) Assessment of learning is difficult in terms of integrity and fairness.

Measures and actions were taken quickly at national and university level. On February 5, 2020, the Ministry of Education issued the Guidance on the Organisation and Management of Online Education in Higher Education During the Pandemic. This guidance clearly requires that universities should jointly promote and guarantee the online education of colleges and universities during the epidemic. In this process, the government took the leading role, and universities as the main body of implementation, and all sector in the society should participate and offer help to university and students. Each university should make full use of MOOCs and provincial and university-level high-quality online education platforms. Then, many China's Internet companies started to open their products to schools and students freely. Many online MOOCs were open to all students. At university level, measurements were taken urgently to purchase new equipment, upgrade the network and servers, upgrade Moodle system on campus, many technical support documents were provided to students and teachers.

The main online meeting platform been used in China is Tecent Meeting, which is very similar to Zoom. In my lecture, I use Tecent Meeting to give lectures online for 1.5 hours at a time. Slides, materials, and recorded lecture videos were uploaded to the university's Moodle system. It's required by university that we have to provide the videos of lecture to students, in case that the Internet connection is poor for some students, they can watch lectures at a later time. I had to record my lectures in my office. The assignments were given in Moodle, and students submitted homework in Moodle. We also used WeChat, which is a mobile app, to communicate with students for questions and answers.

So, it's been a huge amount of workload for lecturers to transfer the PowerPoint slides into online videos, which is difficult in terms of technical and pedagogical issues, and very time consuming. Some teachers preferred to use more interactive ways of teaching, like chalk and blackboard. T they had to change to another way of teaching. When in the classroom we can give students demonstrations using the real equipment, but online, we had to create animation or record the demonstrations in the lab. For those courses with laboratory work, we adjusted the curriculum, the laboratory work was done in the winter semester. So, we had to update our equipment, such as buying new tablet for using the whiteboard in online lectures.

For students, the challenges were not on "hardware" side, but more on "software". For Chinese college students, most of them are very familiar using Apps in Internet, students either have a strong knowledge and skills to use a variety of online teaching and learning platform, or can learn it very quickly, as well as a variety of online

learning tools. Laptops, Pads, and cell phones are very common for most students. In the 33 responses to the survey, all students had the broadband Internet connection at home. Of 33 students, there were only two students upgraded equipment form cell phone to new tablet or laptop, which were supported by their family. University also gave lots of supports for students in using online platforms. In my teaching, I didn't receive any complains on Internet connection, online meeting system, or Moodle.

On the other hand, even if most of students could move freely in their home city, since there was no lockdown in most cities in China, studying without partners still brought some psychological problems, such as time management, learning attitude, concentration, and engagement in studying.

From my own teaching experience, and the feedbacks of survey, half of the students said they spent 50% more time in studying in online courses. The other half said they spend about 25%-50% less time in learning. About 21% admitted that their ability to complete homework assignment was affected from good to bad, and only 6% said their learning attitude and concentration changed from positive to negative. Even though we can find that subjectively students are willing to take online courses as seriously as before, their performance during pandemic were affected. From the survey, 36.4% of students' overall grades were lower than previous years, which resulted partially from students' emotional status, poor communication between students and lectures, and among students themselves, and also imitation of online lecturing on engineering subjects. The other reasons might be the assessment methods, the reliability of online assessment is still a question.

According to the national statistics, as of April 3, 2020, 1,454 colleges and universities nationwide have opened online out of a total of 2,688 colleges and universities in China, accounting for 54.09 % of the total, and more than 950,000 teachers have opened 942,000 online courses, with a cumulative total of 1.18 billion students taking online courses.

Starting in the fall of 2020, all universities in China, as well as all primary and secondary schools have gradually resumed normal face to face teaching. But having the six-month of online teaching, it has been realised that online education became another opportunity to establish a better Higher Education system in China for teachers and students. The online teaching can be used as a useful complement to traditional offline education. The hybrid online and offline education model will be a new trend in China's university education system for a long time. It will also be the trend of Higher Education in the world in the future.

We have found the following advantages of online and offline hybrid modes of education:

1) Online education promotes innovation in university education;
2) Online education strengthens the exchange of teaching experiences, and the sharing of excellent courses;
3) The teaching process is more rigorous and standardised;

4) Students can have more flexibility to arrange their own study time;
5) Improvement of the effectiveness and utilisation rate of classroom teaching;
6) Improvement the motivation of students to learn independently;
7) Various forms of online education can attract students' interest in learning.
8) Provides students with multi-dimensional, multi-level, diversified development space.

Now, many universities are continuously promoting the online courses. The important purpose of implementing online courses and other forms of online education in China's Higher Education is to share educational resources and give students more space to acquire resources and knowledge. Globalisation and informatisation have always been the main driving forces for the reform of Higher Education in China. Implementing online education can also improve the internationalisation of education, attracting students from different countries around the world.

Finally, we are glad that we can come back to classroom to meet our students. The experience of teaching in classroom is not replaceable. We can also see from survey, more than 90% of students think face-to-face teaching will not disappear in the next 10-20 years. For them, the college life, and friendships are always the most precious in their whole life.

4.6 Cyprus

Corona virus took us by surprise. Before the pandemic nothing predisposed us to how our life was to be changed. We have changed our everyday life activities, our communication with our friends and relatives, and more importantly, we have changed our priorities. We now give more emphasis to “smaller things” that before we were not paying so much attention, such as a hag from our loved ones.

The virus had a great impact on our work as well, and as academics we never expected to transform our teaching style from in-class lecturing to online lecturing at such a speed. Of course, using online platforms was nothing new; we were using them for some years either as supporting tools or for online courses. However, in our university most of the courses were delivered in class. Thus, most of our teaching involved delivering the lecture using PowerPoint presentations, but were considered appropriate, especially in presenting examples or solving exercises, this was done on the whiteboard, allowing students to take part in the solution of problems.

And then it suddenly happened; all the teaching was delivered online. At first, we tried not to change our style of teaching, illustrating examples by drawing diagrams on whiteboard offered by online platforms or by using the “pen” of PowerPoint. It proved to be quite a mess.

So, we added animation in our PowerPoint presentations and implemented application programs to illustrate a number of course concepts. Two examples are

given below. Figure 33 presents a program that solves the "Towers of Hanoi" problem, which was implemented in order to teach students the concept of recursion in a Data Structures course. Figure 34 presents an application developed to explain Geometric Modeling algorithms in a Computer Graphics course.

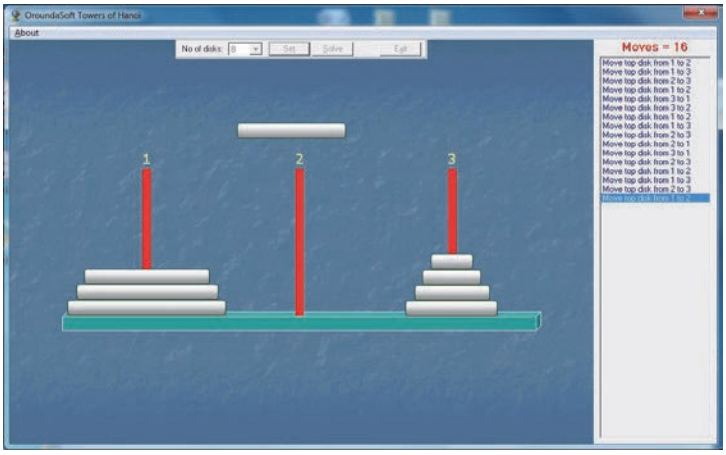


Figure 33: A software application that solves "Towers of Hanoi"

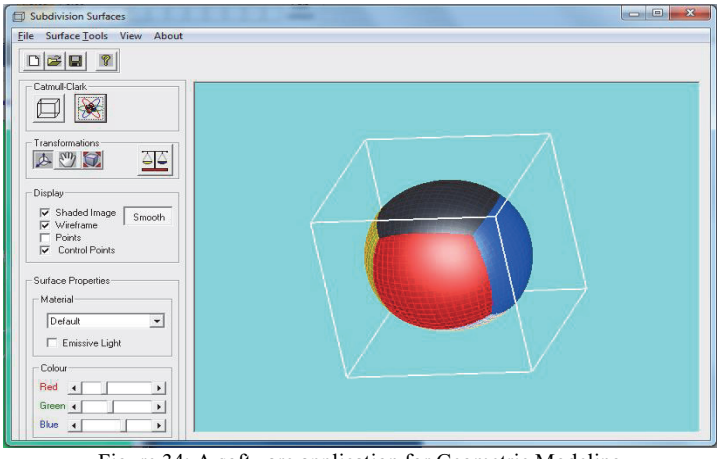


Figure 34: A software application for Geometric Modeling

We also sought ways to involve the students more into the learning process. Ways that would promote student interactivity with each other and with the lecturer, promote group work during class time and outside that, and overall strived to make our courses more interesting to our students. As a result, our course content was enriched with a lot of new activities such as video presentations, demonstrations of problem solutions, class debates and discussions and other. During the class, students were often put into groups and worked in breakout sessions on different

tasks. They then returned to the class to report on the results of their activity. Online forums were utilized for discussions on a variety of topics, and project requirements often included a video demonstration. We also placed a lot of emphasis to our communication with students; we requested that they made intermediate submissions of project work and tried to give them prompt and helpful feedback throughout the course. Receiving feedback from them was also valuable to us and we tried to get that from our students at several occasions.

According to feedback we got out from our students, the pandemic outbreak at first did not really catch their attention. They felt that all this was far away and would not affect them. Suddenly, after the lockdown they were overwhelmed with all the changes that were happening. A late night in March they were notified that the University would be closed until a later date and classes would continue to run online.

We started online classes on the upcoming days, and they did not complain. They were happy to continue their studies and not left behind, but many stated that it was not the same not being able to be in the class with their friends physically. Some expressed that they thought taking courses online would be difficult, however, they enjoyed it.

Now, after more than a year several of students expressed their wish to be back to classes and of course to be able to go out and enjoy their student life. A student also stated that if this situation continues, he would rather drop out of the university and seek for a job because he cannot stand being at home all day long.

Concluding, the last year has affected everybody's life in a strange way, in a way that we could never imagine. The good news is that we all spend more time with our families. It was nice to have everyone gathering around the table again with only each other to talk to.

Unfortunately, however a number of people lost their jobs, do not have money for them and their families, and even worst, some people lost their lives due to the virus.

We feel lucky that we and our loved ones are safe and healthy, and we are able to continue passing knowledge to our students in any way available.

4.7 Egypt

The transition to virtual learning affects not only students but also their parents. The entire online learning process is new to both university professors and their students, creating a great deal of uncertainty. During the current crisis, the entire faculty worked tirelessly to improve digital literacy for all students and faculty members.

Some faculty members lack digital skills, while others dislike using it. Additionally, some teach subjects such as theatre for example, which are difficult to teach with technology. Some people were overwhelmed by the paradigm shift, whereas others, who are generally comfortable with technology, have tried blended learning, and do a lot of online things for their classes anyway.

Age is thought to be a determining factor in acquiring digital skills. Although the younger you are, the more likely you are to be comfortable with technology, and there are many older faculty members who are comfortable with technology while students struggle with it.

Professors were trained on tools purchased and supported by the institution, but they were also given guidelines on how to use other tools. It is crucial that in times of crisis, if someone is already familiar with something, they be allowed to use it. Though in many institutions, they request one way and do not accept any other even though, the laptops' hardware may not support it.

Personal skills are also important in online teaching success. Some people are generally better teachers than others in their subject, and it also depends on how much time people are willing to devote helping hands to their students.

Another important consideration is the availability of high-speed Internet access. Some people have expensive Internet, but it has limited capacity, and with everyone staying at home and working online, Internet packages frequently run out. In the midst of all of this, professors should simply do their best with the resources available to them and their students.

The corona virus outbreak has caused everyone to reconsider online learning. Previously, online teaching was thought to be something that would happen in the future, but it was thought to happen to some people but not others, and it might be impossible to do for certain things. Everyone can now try to imagine how everything worked all over the world.

In the current situation, all of the good practices related to online learning are not necessarily occurring, nor should it be expected to occur, nor should pressure be put on people to make them occur. Because there is so much anxiety and stress in this situation, the most important thing is to learn to be kind to one another and to ourselves.

If online learning is to be expanded in the future, the technology infrastructure will need to be improved, although it has held up quite well so far. Also, professors should be taught digital literacy so that they are not forced to use the same tool if they are not comfortable with it.

Another critical issue is to reconsider curriculum content and make it more adaptable. It is vital to understand what is essential, important, and relevant. Another crucial aspect was rethinking assessment. The Ministry of Education at the

beginning of the Corona crisis required students to hand in projects instead of sitting for exams. However, one of the most difficult questions is how to do something other than an exam and ensure that everyone is doing their work without cheating or paying someone to do it for them. In the midst of all of this, one must consider equity.

One of the efforts that has been helpful in this regard is the Egyptian Knowledge Bank, which is a well-thought-out project with a large amount of educational material that is available to everyone equitably. Hopefully, the world will make resources available for free to everyone. During the crisis, many libraries made their content available for free, but these were only temporary solutions. It is critical to ensure that people, including those with special needs, have access to the resources they require.

Another issue is that the combination of working from home, Internet bandwidth, supervising children, and house responsibilities is very complicated and tiring that feels like education should not take up the rest of people's free time.

It has also been observed that parents are having fights with their children in order to get them to work; they do not understand that it is too much for them. They are overly stressed as a result of what is going on. In fact, there is a lot to be concerned about that teaching should not be added to the list. Everyone on the planet has a unique educational experience. Some people may be able to manage, and others may not. Nobody has chosen to be in this situation, and accordingly nobody should be punished for it.

Last but not least, one thing has come out of this situation; students are eager to return back to the University's campus. They now recognise the value of university experience, which is truly a win.

4.8 Finland

a) Searching worldwide reported information [23, 41] and scrutinising personal perceptions on what learners (students and teachers) in Finland and worldwide felt can be time-consuming and could probably be very subjective by its very research nature. In general, it seems that the perceptions and experiences of the new learners are like a cold shower to lukewarm water for swimming! That is, the feelings of the learning actors about the learning process and the current results seem to be mixed, ranging from satisfaction to dissatisfaction and the opposite.

There is, however, a variety of non-finalised (ongoing or non-temporal) initiatives taken from many perspectives and ethically and professionally authorised bodies that are currently active. These, presently and continuously, concentrate data collection sources under the circumstances of the new, remote (online or/and offline) mode(s) of education. These projects, along with the present one we are currently involved, might, later on, bring a refinement and clarity on the complexity and perplexity of the up-to-date findings.

Nevertheless, it is worth reporting and reflecting on personal observations and most updated findings on the **points b) – f)** below, because they are mostly of socio-technical and economical nature and originate from a pedagogical and social science perspectives. For example, comparing and contrasting own and other findings, someone can clearly evidence that some of our research study outcomes are common to all the countries throughout the world and some differ significantly from country to country. This diversity and differentiation are also true among similar administrative regions and even within the European Union, where there have been years of strategic decisions supporting integration efforts for digital divide disappearance and equal opportunities policies. In particular, notable differences and disperse issues can be seen among also similar geographical regions of the world and (yet) even within the same country.

b) For instance, we have observed that the financial status and the knowledge of the Finnish and other countries' parents played a major part in the learning of the students during studying from home. Thus, the learning process and its outcomes were directly affected by the unequal opportunities to useful knowledge access in addition to the relative comfort in the means for providing the basics for a common decent life; wherein the general standard of living has been endangered and threatened to deteriorate during COVID-19 [42].

(c) Consequently, the psychology of the learners was reportedly affected because of the variables of change specified earlier but also because of the lack of the physical contact and face to face communication. The certainty of the online interaction and in-house safety did not overcome the feelings of the fear of isolation, nor the insecure emotions regarding the lack of freedom of movement and the sense of timing. Not knowing when the Coronavirus situation ends and not even being able to have a rough estimation on the return to normal (previous) life slowly created a sense of hopelessness and a lack of positive thinking in learning, schooling and life.

(d) There seemed and still seems to be an insurmountable amount of change in learning modes, models and styles with the adoption of adequate communication technologies and learning tools available through private and public, open and closed technology-based platforms. Many private collective initiatives also proceeded in providing their own packages of learning technologies and educational materials online e.g. in the Nordic and Baltic region. However, the digital divide exists in nearby regions and worldwide and there are many cases reported in developing and developed countries where different (than online mode learning) measures and practices [23, 41, 42] had to, unavoidably, take place.

(e) Most of the socio-technical and socio-cultural differences regarding e.g. nationality, social class, social status and economic situation appearing worldwide due to the COVID-19 invasion have been commented and their effects have appeared, some from the first days already. Personally, speaking we believe that two phenomena, though being referred in a limited manner by researchers, have been overshadowed and have rather been under-researched or under-estimated by decision and policy makers in particular.

i) One is the gender discrimination where there is a general agreement on the deterioration of the women's rights due to the different role they were called to play for family and work support abandoning work duties or completely giving up work. Yet, it is still unsure if women were the first to be dismissed by their employers. Nevertheless, worldwide organisations such as OECD refer to the deterioration of women's position in work and society outlining that gender equality has clearly been worsened during COVID-19 era.

ii) The other phenomenon that has been neglected is the cyber-security knowledge and online safety guidelines in virtual presence navigation [43, 44]. There seems to be neither social awareness nor public education awareness on the choice, use and deployment of safe and secure learning environments. Usable security should, on one hand, be the A-Z in online mode of learning for the sake of all parties involved because it shows caring and well-being proactive thinking by the online education/knowledge providers and policy makers for the future citizens. People's safety and (cyber) security should, in general, be part of a strategic welfare programme of the countries. *"Those in the weakest position do not necessarily have the same social networks that create security as those in a better position. That is why we must ensure that public services are also effective in sparsely populated areas, so that no-one's security and well-being is dependent on informal assistance alone,"* [45] says Finnish Minister of Internal Affairs Maria Ohisalo [46].

(f) Certainly, with a lack of suitable technological equipment many (perhaps most of the) students did not manage any laboratory work from distance mode. In fact, no much laboratory work took place in virtual mode and many essential laboratory-based courses in Higher Education were not transferred to virtual mode. In so doing, courses in Medicine and Agriculture, for instance, took place on-campus and not online with students and laboratory instructors meeting face to face; hence, with safety distance but not distant at all!

Further and Other General Remarks during COVID-19 in adult and Higher Education

Further, someone could easily observe and mention general governmental and organisational or departmental policies that either facilitated or hindered the education process nationwide or worldwide. It has been observed that educational equality has not been achieved during COVID-19 even in many advanced technologically countries. It is worth noting, though, that countries with women prime-ministers or central ministers (e.g. in Health, Social/Internal Affairs and Education) performed better in handling the COVID-19 crisis. This can be argued to be a genuine political observation given the fact that the women in the political power span the range of political colours from right to left and they do not exclusively belong to any particular political side.

Sadly, some trade unions in Higher Education report that during COVID-19 there are unusually frequent phenomena of overwork, unpaid overtime and burnouts for their members. Problems also arose with bad management of human resources as well as labour-intensive and unequal or favourable work task distribution. Many

trade unions have had to arrange special training sessions for supporting their members and providing counselling with legal and other advice and coping strategies. Feelings of hopelessness and job dissatisfaction and fatigue deriving from sisypheian work efforts and lack of management's understanding appeared very regularly and many teachers in general decided to leave their jobs and change careers.

Last but not least and irrespective of any political and socio-cultural norms the degrees of readiness and preparedness of every country along with the technological advancements and local initiatives had varied a lot. And these four parameters signified and dignified the level of well-being in virtual Higher Education during COVID-19 crisis from its begin (February-March 2020) until now (April 2021). Yet, there is no way of telling who and which outperformed; it is up to current shaping HE policies and future considerations of the rising knowledge-shaped national economies as components of the recovering from COVID-19 glocalised societies.

4.9 Greece

According to Eshet (2007) [47] 'the Minister of Education gives the impetus for the technological equipment that needs to exist, for the educational staff and their training in Information and Communication Technologies (ICT) and for the cultivation of (a) synchronous survival skills'.

However, teaching in distance mode education has been 'fragmentary, away from interdisciplinary and holistic approaches and far from the digital school logic. In essence, it is found that digital tools are part of the teaching, mainly in the computer science course, with a technology-oriented approach (with negative sign') (Koutsogiannis, 2007b) [48].

Due to the sudden transfer to distance mode education as a result of the COVID19 pandemic was chaotic.

Students in Greece seem to be quite familiar with technology, but use it in their daily practices, such as communication (social networking by Instagram, Facebook, Messenger), entertainment (YouTube), playing digital games (e.g. Roblox). Parents consider this activity to be natural, but not particularly natural in school environment (Koutsogiannis, 2007a; 2011) [49, 50].

The policy makers tried to support distance learning in the light of COVID19 through distance learning by providing synchronous form of learning, with digital libraries and websites (e.g. Photodentro (http://photodentro.edu.gr/lor/) [51], digital school (https://dschool.edu.gr/)[52], digital platform "e-me" (https://auth.e-me.edu.gr/) [53], platform "Aesop" (http://aesop.iep.edu.gr/) [54], video lessons from the state television channel ERT (https://webtv.ert.gr/category/mathainoume-

sto-spiti/) [55]. Teachers were adequately trained to upload material to the platforms and accept the assignments of their students.

The study of the curricula of the Schools of Primary Education in Greece (Tzifopoulos, 2019) [56], counted the courses, either compulsory or optional, which are offered to pre-service teachers. In particular, 7 of the 9 university departments offer from 4 to 10 ICT courses to primary school candidates. In total, of the 84 courses offered, which concern computer and ICT, 12 of them (16.7%) are compulsory and, as can be seen through their contents, the 8 courses combine theoretical orientation knowledge and laboratory issues. 2 are theoretical courses and 1 course has a laboratory character. It is noted that the student, who prepares for teaching in primary school, mainly through free elective courses, has the ability to acquire more specialized knowledge and enhance his/her technical and pedagogical skills with the contribution of digital technology (Programming Languages, WebQuests, Digital Games, Digital Comics, Virtual Learning Environments, Wikis, Blogs, Websites, STEM Applications, Video Editing, Google Apps, etc.).

In the study programmes of the University Schools that prepare tomorrow's preschool teachers in Greece, there are theoretical and practical courses, including a smaller number of courses related to distance education (Tzifopoulos & Bikos, 2016) [57]. In total 44 courses are aimed to Information and Communication Technologies (ICTs), and only one third of them (14 courses) are compulsory. 7 of the compulsory courses (half of them) are Computer Science courses. Three courses have theoretical orientation for technology (theories for educational technology and ICT learning) and four have a laboratory viewpoint, linking theory to practice.

Seferis G. [58] (Greek poet laureate 1963) in his poem "An Old Man On The River Bank" wonders and suggests….

> We *the patient dough of a world that throws us out and kneads us,*
> *caught in the embroidered nets of a life that was as it should be,*
> *and then became dust and sank into the sands leaving behind it*
> *only that vague dizzying sway of a tall palm tree. (ll.32-35).....*
> *And yet we should consider towards what we go forward to.*
> Cairo, 20th June 1942

The academic terms of Spring 2020, Fall 2020 and Spring 2021 will long be remembered, by both students and professors. For some, these semesters will be thought of as a time and learning waste, for others, they will be held as an adventure with new opportunities for learning.

Due to the crisis caused by COVID19, Aristotle University of Thessaloniki, along with universities across the globe, was compelled to shift abruptly and with no former preparation to remote teaching and learning.

Especially for educators in the Humanities this was a *terra incognita*, an unfamiliar territory which we had to navigate alone. Few, if any in our Department had taught an online course and I doubt if any member of the faculty had any experience designing or teaching in the online environment.

Here are my reflections to the following points:

(a) In the midst of the pandemic each of us, students included, had their own fears and unknowns about the uncertainties of the situation which unfortunately still remain for some. Also, many mentioned isolation, loneliness and information bombardment.

Some students seemed to be uncomfortable sharing their living spaces on screen so although I was not happy with the practice of switched-off cameras in the beginning, eventually I permitted them to keep their cameras switched off if they preferred.
I had the feeling and some students overtly complained that they were overloaded with classes and that it was tiring to be stuck sitting for long hours in front of a screen. They missed even simple exercise such as travelling or walking to college. Hence they seemed unable to manage their time effectively, or prioritise their weekly tasks.

Although collaboration has not long been part of our culture, students seemed to cooperate well. Chat was used to answer questions posed, either by me or amongst themselves and small groups, were also formed on social media to discuss classes, solve problems or exchange notes. On my part to maintain the feeling of a learning community in Spring term 2020, at the beginning of this online learning adventure, I organized a short series of extra curriculum seminars in which we explored what the classical texts reveal about the human experience of past epidemics and the issues of health and disease in ancient Greece. These seminars ran in parallel with the term's lectures and continued in the Fall after the summer break.

Unfortunately, members of the staff tasked all of a sudden with taking teaching online exposed no collective cooperation to help each other. We were not united to face the new reality with its plethora of common and urgent problems. Our ethos, unfortunately not being one of participatory culture and community, remained rigidly the same. We, the staff, saw each other only in the Classics Department meetings and in Faculty meetings which were also held online, not often, and mostly dealt with dreary bureaucratic procedures.

(b) Judging from the oral examination results and the participation in class I have the feeling that the students' learning was negatively affected. This was probably due to initial unfamiliarity with working in distant mode at an academic level. There were inadequate learning supports as many references were unavailable online and only accessible in our departmental and Central library, both of which were closed for more than a year.

(c) The loss of in-person interaction and social life was felt acutely. All were affected, especially those who were more gregarious by nature and they all seemed to resent the lack of freedom of movement especially during the second lockdown.

1st and 2nd year students had no chance to taste the pleasures, charms and challenges of college life, no chance to experience university as a temple of knowledge but also as a hub of cultural and political engagement.

It was considerably difficult for students coming from other places outside Thessaloniki. Some remained in their hometowns to save money while others, forced to sacrifice their independence, returned home evacuating the city. Those who remained in Thessaloniki were trapped in small flats often alone.

(d) One advantage was that all students had their own personal laptops and were familiar with installing apps. So setting up Zoom was not a problem. Prior and during the lockdown 1st year students of Philology had attended six two-hour compulsory seminars which aimed at familiarizing them with New Technologies and the tools for research.

The main shortcoming for research purposes was the inability to access our excellent and unique Library of the Department of Classics and develop the habit of utilizing and working in such a scholarly and stimulating environment.

(e) The Department of Classics does not require laboratory work, but has great dependence on libraries instead, both local and international. During lockdown we were handicapped with the inability to access many resources as not everything is digitalised.

(f) The continuing budget restraints in the Humanities and Social sciences were even more acutely felt during this period. Fortunately, funds were provided to the university for buying platforms which enabled distant mode education to run.

As time progresses there is increasing demand from both students and staff to reopen the campus following the COVID 19 precautionary protocols. If infections rise after the summer tourist season and the university does not open one may predict student unrest.

In conclusion: this whole experience has taught me as educator that we had put an effort to function under the circumstances but we are facing a distortion of the teaching procedure. Our aim as educators is not merely to transfer skills and information but to stimulate lifelong learning, to provide support, discussion and feedback, to encourage critical thinking, to set standards and demonstrate professionalism, all while acting in flesh and in freedom.

4.10 Ireland

As with most countries, the impact of COVID-19 on students in Higher Education in Ireland has naturally been marked by adversity, inequality, shock, and a profound sense of collective grief at what has been lost. Well-documented challenges included digital poverty and marginalisation, assessment confusion, loss of community, motivational struggles, isolation and loneliness, digital distraction, and inadequate learning supports in places. However, it is also true that the closure of physical campuses, and the sudden (and ongoing) digital pivot have equally given rise to examples of immense resilience, innovativeness and solidarity, as students, teachers, politicians, families, and all those associated with Higher Education have endeavoured to come together in different ways to develop and implement supports and solutions for the practical and personal difficulties that arose in, or were exacerbated by, the coronavirus pandemic. For instance, a major initiative by the Irish Dept of Further and Higher Education, Research, Innovation and Science in July 2020 was the announcement of a €168 million package of supports for further and Higher Education institutions and students - €15 million of this package was specifically ringfenced for providing students with access to the necessary tools to continue learning online, including laptops. By early 2021, 17,000 laptops had been delivered to students via this initiative (O'Brien, 2021) [59], which aimed to improve digital equity. However, the collective history of this period is still being written. To date, two special issues of the *All Ireland Journal of Higher Education* have been devoted to documenting the impact of COVID-19 on Higher Education in Ireland, including staff (teaching, library) and student perspectives and practical approaches [60]. The response to the pandemic within Higher Education continues to be captured in multiple ways, including research studies, webinars, blog posts, documentaries and conference presentations.

One of the most important effects of the pandemic relates to how students have helped *each other* during this time. All institutions have their own stories to tell of how students rose to the occasion time and time again. In Ireland, one of the most impressive examples of student peer support was the work of the student interns in the Irish Universities Association's **EDTL** (Enhancing Digital Teaching and Learning) project, which is a 3-year project, funded through the Higher Education Association's *Innovation and Transformation Programme* (https://edtl.blog/) [61]. The project aims to enhance the digital attributes and educational experiences of university students through integrating and mainstreaming digital technologies across teaching and learning practices in Irish universities; however, the onset of COVID-19 in the first year of the project led to a refocusing of the project goals to explore approaches to blended learning. A central pillar of this project is the idea of *students-as-partners*, working with faculty and policy-makers to enhance the digital learning experience for all. EDTL student interns were appointed in Ireland's 7 universities, to raise awareness and share their experiences of digitally-enhanced learning with the project partner. Working together, the interns produced a range of resources designed to support their fellow students during the online learning period – for example, *EDTL Approach for Students: planning for effective learning during Covid-19* (link) [62], a colourful infographic containing tips and guidelines for

students studying from home. In addition, through participating in regular webinars, the interns shared their invaluable perspectives and experiences of online learning, providing insights into what has worked well, and what can be improved Another example of student solidarity came from the students in the *National Student Engagement Programme* (NSteP), who contributed a reflective piece on student engagement and partnership during the pandemic to the *All Ireland Journal of Higher Education* (Hassan et al, 2020) [63]. The focus of this article is on the role of students in institutional decision-making, particularly relating to decisions made at different stages during the online pivot – a key focus is on ensuring the continued involvement of students in all decisions affecting their learning experiences in their institutions, even during the period when they are not physically on campus. These, and the many local examples of students working together in a spirit of collegiality and support, represent one of the few silver linings along the cloud of COVID-19.

Personal reflection

My first reflection on the initial response of my institution, UCD, to COVID-19 is included in the interdisciplinary paper presented at INSPIRE XXV in July 2020 (Georgiadou *et al,* 2020) [2]. This brief reflection focuses on my more recent experience during the current academic year (2020-2021), which has taken place fully online, and what I observed about the effect of the pandemic on my students' engagement with learning and how they navigated the year.

While the loss of in-person interaction and social life was felt acutely by the students during the academic year 2020-2021 as we moved in and out of lockdowns, and they studied from their homes or student accommodation on campus, some of the approaches we took as instructors helped to partially mitigate this. Student feedback for my first year digital literacy module (Autumn 2020) highlighted what worked for them under challenging circumstances. Some of the key observations are included below:

- Holding live classes via Zoom each week, rather than just providing asynchronous lectures to be watched in the students' own time. This helped to build a sense of community for the module and allowed the students to "meet" each other in the online space. It also provided a structure for the week, which the students found to enhance their motivation. Breakout rooms allowed students to chat with each other without the presence of the instructor, which is important for bonding. I also permitted students to keep their cameras switched off if they preferred, as some students might have been uncomfortable sharing their living spaces on screen.
- Recording each class, and making it available immediately afterwards, for students who may have lost connectivity, were unable to attend the live session, or simply wished to review it again. This is especially useful for students in different time zones (which was the case for some), or others living in noisy environments, where there may have been multiple distractions during live classes.

- Using online polling and the "Chat" function extensively during the class to generate lively discussion – to do this effectively, I engaged a tutor to monitor the chat and respond to students, since it was a large class (180+) and therefore difficult to manage alone. Many of my colleagues reported increased student engagement via chat, when compared to typical in-person classes – this has led us to consider how we might retain some of the more positive aspects of online teaching when we eventually return to the classroom.
- Careful structuring of weekly module content in the virtual learning environment (VLE), Brightspace, with a clear pathway through the learning activities and materials – again, this helped students to manage their time effectively and prioritise weekly tasks. While good practice in normal times, it is especially important during a period where students lack the typical structure of a day on campus.
- Retaining group project assignments (despite my apprehension). This turned out to be the correct decision, as it provided another opportunity for the students to get to know each other, although groups dynamics had to be very carefully managed in the online environment.
- Encouraging students to set up social media groups outside of class, to promote socialisation and bonding – most classes had their own WhatsApp groups, which they used for communicating with each other informally.
- Perhaps most importantly, maintaining consistent and friendly communication with students throughout, checking in with students who appeared to have disengaged, responding quickly to emails and messages, offering support where needed and providing clear instructions for everything. While this is essential in normal times, it is absolutely crucial during COVID-19, when students may be stressed and feeling vulnerable. A welcoming environment is an absolute pre-requisite for effective learning, whether in-person, blended or fully online.

As we slowly move towards a return to on-campus teaching and learning, we carry the lessons of 2020-2021 with us. Many of us, including students, are now more technologically savvy than before – the digital pivot has equipped us with new skills, that we may choose to harness in the future. Blended or hybrid approaches to learning may become more common in the post-COVID period. However, the pandemic has also raised awareness of the deep inequalities that frequently exist in educational contexts, from technological, socio-economic and cultural perspectives. It is to be hoped that the disruption and loss caused by the coronavirus may yet be channelled towards an improved future educational landscape for all students.

4.11 Kenya

Online learning as a mode of delivery is not new but due to COVID 19 higher educational institutions had to drastically embrace it. The decision to temporarily close educational institutions was actually prompted by the need for social distancing, self-isolation and to avoid large gatherings of persons as it posed a serious risk during the pandemic. The impact of the pandemic on Higher Education institutions was abrupt and as such there was no contingency plan other than attempting to continue classes remotely, through online classes.

(a) For students who usually undertake online learning, it was normal but for students who were used to face to face learning it was a whole new experience as it impacted on their socialization and also had an economic impact in terms of costs involved that was prohibitive.

(b) Learning was disrupted in Higher Education institutions in Kenya and the students had to shift from face to face learning to online learning. Some students feared the transition to online learning as they feared the unknown. Those in the most remote parts of Kenya with poor internet connectivity and lack of electricity were the most affected as they could not access the internet and lacked digital devices. They were left out as they could not attend virtual classes as such they could not move with the rest of their classmates.

A recent study on use of electronic resources by postgraduate students during COVID-19 pandemic at Masinde Muliro University using desk top research through review of different studies was done and an online survey conducted using Google forms; this methodology was adopted to elicit the required information. A sample of 18 postgraduate students at Masinde Muliro University of Science and Technology were selected from sampled faculties. The findings showed that electronic resources provide benefits for learning that are impossible physically, virtual libraries are accessible at one's convenience and everywhere as long there is reliable network connectivity [64].

The findings further revealed that a total of 66.7 % postgraduate students reported using electronic journals during the COVID-19 pandemic. 50% used e-books, 38.9 % used electronic thesis and 38.9% went for electronic research reports. 16.7% used electronic manual scripts while 16.7% reported they did not make of use any e-resources. The findings therefore indicate the preferred e-resources for majority of postgraduate learners are electronic journals and books. Liewet Foo and Chennupati [65] and Tenopir [66] established that that majority of postgraduate learners used e-journals.

(c) Students were affected psychologically as they were used to face to face learning, and they wished they could maintain that. Loss of social contact and socialization routines also affected them resulting to anxiety and even depression. Additionally, the students were used to being in personal contact with the lecturer but now this changed. El-Mansour [67] posited that traditional undergraduates were not adequately prepared to deal with online learning. Most faced the anxiety of the unkown, as they had never had any access to online learning, except for first years

who had done one course that was conducted using the university Learning Management System(LMS- https://elearning.mmust.ac.ke/).

(d) Some of the students lacked the digital devices required as they did not have computers, laptops or even smart phones. Some lacked electricity or missed out due to frequent power outages. The students also lacked internet connectivity and some who had it complained that there was low internet connectivity. The high cost of internet was the main challenge for most of the postgraduate students at 72.2%, followed by limited finances to purchase electronic resources at 44.4% and lack of computers to work on at the same rate. Poor network connectivity was another challenge at 27.8 and lack of login credentials, 5.6% mentioned limited knowledge on how to access internet resources. 56.6% of postgraduate learners reported that the library staff are not available for assistance when faced with challenges in accessing e-resources, while 44.4 % got support. An overwhelming 61.1% highlighted that they do not get any updates regarding e-resources during the COVID-19 pandemic, while 22.2 mentioned that the support is weekly and 16.7 % monthly [64]. Lack of infrastructure poses a serious challenge [68, 69, 70].

(e) Sociocultural differences were experienced by the students in terms of social class as students from well off families had an advantage over students from poor families. Those from well off families can afford laptops, computers, smart phones and can even access internet unlike those from poor families. Students from the marginalized parts of the country and pastoral families were the most affected. The nomadic lifestyle causes them to move in search of pasture for the livestock. They are equally affected by tribal conflict, natural disasters and displacement. There is definitely need for action by the government to support education in emergencies and displaced communities. Further those living in rural areas do not enjoy good infrastructure such as such they experience challenges of poor electrification and poor internet connectivity unlike those living in towns.

(f) Lecturers and students were trained on e-learning. Further some institutions of higher learning partnered with mobile phone providers to issue data bundles to both lecturers and students at a low cost. In some institutions such as Masinde Muliro University of Science and Technology lecturers and students were provided with data bundles and the institution catered for the cost of data bundles. The university LMS has played a critical role and has had some success. There technical support provided to staff has been instrumental for staff in preparing for their lectures successfully.

The closure of educational institutions is likely to affect education quality negatively due to disruptions in learning. However, by embracing online learning there may be continuity in learning. Students and lecturers should be continually trained on the use of various Interactive audio and even videoconferencing platforms and applications for instance Microsoft Teams, edX, Moodle, Zoom, WhatsApp, Google Classroom and Skype. Students should be enlightened on the importance of online learning especially in the wake of COVID-19 so that they may have a positive attitude towards it. Online learning should thus be embraced fully by institutions of

higher learning as this seems to be the new norm. There should be efforts by the libraries on availability of extended access or new additional e-resources including databases. The Library should organize regular virtual trainings through different platforms such as Zoom, Microsoft teams or Google meet to provide students with necessary search skills for relevant e-resources and exploring on the immense opportunities at their fingertips such as webinars, virtual conferences and online courses.

4.12 Nepal

In Nepal, there are 11 public universities with 1442 colleges that include 150 constituent colleges (directly managed and financed by a university) and the remaining are affiliated colleges (offers programs that lead to a degree by the affiliated university, but is funded and managed by either a community or a private sector) [71] These higher education institutions (HEIs), except for Nepal Open University, use in-person classroom set up for teaching and learning activities. After the government-imposed lockdown as a measure to contain the COVID-19 virus, some of these HEIs sought ad-hoc solutions in the form of virtual classrooms. Among these HEIs, Zoom is found to be the most popular tool used to conduct virtual classes followed by Google Classroom and Microsoft Teams. This may be because, Tribhuvan University (TU), the largest university in Nepal that enrolls around 79% of the students [72] started virtual classes using Microsoft Teams in the university's main campus and its constituent colleges. The university urged its constituent and affiliated colleges to conduct virtual classes wherever possible. [73] A few other universities also followed and started virtual classes, for example, Kathmandu University (KU) used Moodle and Google Meet for teaching-learning activities [74] Some affiliated colleges that comprise the largest portion of enrolments depended on the free subscription of Zoom to conduct their virtual classes.

HEIs decided to move their teaching-learning activities to virtual classrooms almost overnight. This was perhaps the only viable solution at the time. But the question is, was it a pragmatic solution in the case of Nepal. It may be a reasonable solution for other countries, but the situation is not the same in Nepal. Based on our survey data and discussions with HE teachers in Nepal, we will dissect and explain the problem in adopting the solution in terms of its *reachability* and *effectiveness*.

By *reachability*, we meant whether a virtual class is inclusive enough so every student can participate. Due to the ununiform distribution of university resources, many of its constituent colleges lacked both infrastructures as well as human resources with the knowledge and skills needed to run virtual classes effectively. The situation was not different for the affiliated colleges. Besides, their students come from different socio-economic backgrounds. A significant percentage of students come from poor families who could not afford a computer with an Internet connection. In addition, due to the rapid increase of COVID-19 cases in the city, many students left the city to return to their rural homes where there is no electricity and Internet connection. Not to mention, power outages and Internet disruption are common phenomena even for city dwellers in Nepal. The university's decision to

adopt virtual learning affected every student's reachability, but those with a weak economic background and living in the rural areas of the country were completely excluded.

The *effectiveness* of virtual classes in terms of student's academic performance has yet to be seen. But the picture depicted by our data and some recent survey studies [75], [76] do not leave room to be very optimistic. Students who participated in the virtual classes faced several challenges, for example,

- Students can use their own computer and Internet connection, but along with that they also required the necessary software to conduct and participate in virtual classes. Moreover, they need technical support from the HEIs to effectively and efficiently use the technologies that were almost alien to them some time ago. HEIs are found to be unprepared to effectively organize a virtual class. Many colleges do not have even institutional email for their faculties and students. Only a few HEIs use a learning management system (LMS). To host virtual classrooms, the affiliated colleges luckily had free services of Zoom and Google Meet. The students rarely received any technical support from their university/college and other organisations.
- Along with necessary hardware and software, reliable Internet connection and uninterrupted power supply are must both for conducting and participating in virtual classes. In Nepal, unreliable Internet connection and power cut are common problems. The situation of Internet connection and speed had aggravated during the lockdown due to a high demand bandwidth.
- To exacerbate the situation, the lockdown occurred towards the end of the academic year. This disrupted and delayed syllabus completion for the academic year, examinations required for transition or graduation from HE, and admission examinations and procedures for entry into HE. This has a significant impact on the university academic calendar. Moreover, it put pressure on course teachers to complete the syllabus in reduced contact hours. Consultation with a teacher when facing difficulties became rare and shorter for students in the virtual classes. Eventually, this has impacted students' academic interest and satisfaction. Most students who reported having a serious learning attitude before the pandemic now have degraded to a casual learning attitude. Furthermore, the pandemic has made an adverse impact on the students' learning, reading, writing, and studying concentration.
- The course designed and assessment method practiced by HEIs are highly based on face-to-face learning where most courses at bachelor level (this is important because 88.28% of the HE students are enrolled at bachelor level [72]) have laboratory works, which were most affected by the lockdown. For several study programs, they practice two levels of assessments. In the internal assessment, the course teacher evaluates a certain percentage of the

total grade. The students who have passed in the internal assessment are allowed to appear in the final exam conducted by the university for the remaining percentage of the total grade. The internal assessment was conducted online with a lot of uncertainty and confusion among students and teachers. Most of the students who participated in our survey are dissatisfied with their internal assessment grades. Add to their woes, their final exams have postponed and cancelled several times, and more importantly, the universities have no alternative plan or feasible option to replace this exam with.

- Decision to migrate to a virtual classroom was sudden and without any proper consultation from the related stakeholders, such as affiliated college managements, course teachers, students, and parents. Private college managements had difficulty in monitoring and managing their teaching and learning activities. Many teachers from non-technical fields of study lack even basic IT knowledge and skills, and they seldom use IT tools and services for teaching and learning purposes. Further, they have no formal training and experience in teaching online. Therefore, putting the responsibility on them to conduct virtual classes without any formal training was definitely not a rational decision. Then, there were no formal guidelines from the university on how academic affairs like internal assessment, laboratory works, field works, and attendance (some programs required 80% student attendance to be allowed for the university exam) should be dealt with. Students had not the same level of collaborative engagement as in a classroom, and a friends-packed classroom environment that they relished. And finally, parents were unsure about if virtual classes are worth the expensive tuition fee they pay.

Presumably due to these all challenges, the students believe face-to-face classes to be more productive and practical and thus preferred over other modes of classes. However, along with all these challenges, the students reported some positive prospects of the pandemic lockdown. They reported spending more time with family, and on physical activities that were waning due to busy life and increasing screen time.

Although this is the first time HEIs are encountering such an uncertain situation, they must learn from this pandemic and reform the education system in the country. University administration and educationists must revise and adopt appropriate and affordable curricula, pedagogy, and evaluation methods that can be fit for such situations in the future [76]. The government has the responsibility to solve the issues of Internet connection and power supply. Moreover, the government's perspective and priority towards HE must change and reflect through its policies, governance, and resource allocation. This is the time to be proactive and digitize HE in Nepal. Last but not least, IT knowledge and skills are must-have for every field of study. So, teachers from every field of study should learn and get familiar with needful IT knowledge and skills and utilize them for teaching activities.

4.13 Romania

Despite the chaos created by the onset of the COVID 19 pandemic, Higher Education in Romania reacted quite well to the challenges created. The vast majority of universities already had online platforms in place, which they used mainly for students enrolled in distance learning programmes.

Also, immediately after the first lockdown, the Universities' management created online meeting platforms for members of the teaching staff, distributed by faculty. These meetings created opportunities for professional development and efficient utilization of digital tools. This effort has continued through numerous training sessions and online conferences with this focus. If until March 2020, some teachers were still reluctant about communicating with their students virtually, this aspect not only has changed but has also met a completely new direction.

Even though it represented a new way of work, totally unknown for some, most of the teachers started to perfect their way of conducting teaching activities in an online environment.

Still, this year has also brought longer hours spent at the office, in front of a computer. The price paid was materialized in back and eyes pain, headaches, and a high rate of tiredness.

In 2020, at "Transylvania University" of Brasov, all the teaching activities were conducted online, throughout many concurrent activities, especially videoconferences. There were also asynchronous activities, formative evaluation activities, browsing of informative materials (course support, book chapters, scientific articles).

In order to find out students' opinions, we developed a questionnaire and distributed it to them through social media groups and conducted interviews via phone. Most students perceived the transition to the virtual model of education as very abrupt. Many were rather reluctant to the proposal to move to the online learning environment, but they still felt that they had adjusted at some point. One of the students confessed that "Initially, I liked the idea because I stayed with people I loved and didn't have to stay in the dormitory. However, after a few months of isolation, I wanted to go to university because I understood the teachers' explanations differently." Other students felt a higher level of anxiety, stress, or even disappointment with what they were initially offered. Fear of failure, lack of socialization, low levels of interaction had the most profound negative effects, even leading to a decrease in interest in a particular subject.

Student learning has been greatly affected. Many students felt they had to put in extra effort to cope with the demands. Also, the most demanded skills were organisational skills, especially time management. Many experienced difficulties in staying focused in front of the computer while watching online courses that were running synchronously. Some recognized falling behind in the material. But some

opinions highlighted the role of willpower in adapting to the new form of learning and felt that they performed very well, not being influenced by these changes. "I had the impression that I would not learn anything, but I was wrong."

All students felt that they had the appropriate technology to conduct their courses. Cases of socio-economically disadvantaged students were reported at the beginning of the pandemic to the university management. The measures taken were: provision of a high-performance device (laptop) for teaching activities and the creation of internet access for those who could not connect from home. However, many of the students noted these socio-cultural differences between students. Most of them refer to those related to economic status and social class. Gender, nationality differences were not noted.

In order to cope with the labs and seminars conducted online, many students felt that only by being actively involved could they understand the subject matter. Some aspects were extremely difficult to understand, but from January 2021, "Transilvania University" of Brasov switched to a hybrid mode of teaching and learning. Therefore, labs, seminars and practical work are conducted face-to-face, in small study groups, and courses are conducted online. Many of the teachers have been vaccinated before the new format started and meticulous procedures have been put in place to work in proper hygienic conditions.

4.14 Russia

Spring 2020 brought us to the challenges nobody could have imagined. Chinese coronavirus pandemic seemed to be far away and unrealistic. So when we were told to leave our classrooms for an uncertain period because of the danger of this virus it sounded like a nightmare. Having no experience (or rather poor) in online teaching, first feeling a babe in the woods, we had to learn new ways of sharing knowledge with our students, teaching them not only academic issues but ways to survive in new environment.

Both teaching staff and students thought of this transition to the digital world as an absolutely temporary change. Some were going to relax for a while before coming back to their university classrooms. Then the situation turned out to be much worse brining lots of people to stress. Everyday news on the number of people getting COVID19 and having health problems, reality of virtual mode of education, lack of access to the necessary equipment and the Internet, lack of face-to-face communication made the stress even more severe.

Samantha K Brooks et al [77] in their paper *The Psychological Impact of Quarantine and How to Reduce it: Rapid Review of the Evidence* published in *Lancet* in February 2020 introduced the results of a Review of the psychological impact of quarantine

using three electronic databases. They stated that most reviewed studies (the total number of papers found and analysed was 3166) reported negative psychological effects including post-traumatic stress symptoms, confusion, and anger. According to the research stressors included longer quarantine duration, infection fears, frustration, boredom, inadequate supplies, inadequate information, financial loss, and stigma. We could see similar problems in our students majoring in any fields at any level.

We teach different courses, English, Interpreting, Chemical Engineering (in particular, Modern methods of plastics processing and research) included. So it seems obvious that students studying Linguistics, Foreign languages and other Humanities didn't have as many problems as their fellow students studying Engineering as the former can get access to various linguistic materials (learning resources such as theory, exercises, videos) to master their skills even themselves in addition to their classes arranged by their professors. As for those studying Engineering they could have felt great lack of access to their laboratories and plants to develop their ability and skills in practical issues, e.g. carry out real plastics processing working on industrial equipment.

More and more students got tired of on-line education as they had to develop new skills in their course added to their common specialized knowledge and learning skills. As a result some students skipped all or most of online classes. Some students failed to send their homework done or missed classes because of technical issues (bad access to the Internet, failure of their hardware, etc.). The situation at the University was similar to that indicated in an analytical report *Lessons of Stress-Test: Higher Educational Institutions in Pandemic and after it*, [78] in particular more than 10% of students didn't have devices capable enough to provide them with all the characteristics and tools necessary for on-line education in the very beginning of lockdown.

New reality made impact on lots of students. As a result most of them would prefer face-to-face mode to online (those who felt lack of communication with both their professors and fellow student), though there are students realizing advantages of both modes and ready to enjoy blended mode as they have an opportunity to save time and money (spent for getting to the university and back home) as well as keep away from overcrowded buses and trains thus safeguarding themselves from the virus. They also appreciate new opportunity to manage their time and studying. Interestingly the frequency of personal communication with lecturers during distant education period decreased slightly while the duration of it at a time increased a little. At the same time both the frequency and duration of communication with fellow students decreased.

Thanks to university management students staying at the university halls of residence in spring 2020 got better access to the high-speed internet; engineering courses labs were postponed till the next term. As for autumn 2021 almost three months were delivered off-line in the university classrooms with safety measures

provided (requirement to wear masks, installing air-cleaning equipment, providing on-line lectures delivery, etc.)

4.15 Slovak Republic

My direct observations and experiences that I want to present are from the Trnava University in Trnava, where I work as a university professor at the Department of Mathematics and Computer Science (Computing) of Faculty of Education. The position of our department is specific in that we are responsible for preparing all students of teacher training programs for the use of modern educational and digital technologies in school practice. In addition, our department guarantees quality training of teachers of computer science and mathematics in connection with another approbation subject. All accredited study programs can be freely combined in pairs. The most popular and numerous study groups include computer science with mathematics and computer science with English language and literature. In smaller numbers groups for computer science as second subject, our students (future primary and secondary school teachers) will choose biology, chemistry, German language, etc. Our task is not only to equip students with theoretical knowledge of their approbation subjects but also to prepare them for the future teaching profession - to be a good teacher. Therefore, pedagogical practice directly at primary and secondary schools is a part of teacher training at the university. However, the study programs did not take into account that pedagogical practice will also be implemented remotely in a distance way. A difficult situation arose that needed to be addressed. During pandemic primary and secondary schools had enough problems of their own and refused to admit students to practice. The well-established system of pedagogical practice did not suit, it was necessary to change it during the process. At the same time, other shortcomings in the training of future teachers surfaced.

The training of teachers in the field of implementation of modern didactic tools and technologies to support education was focused on the full-time (present) form of teaching. The creators of the study programs, as well as the authors and implementers of educational software products and electronic educational materials, did not anticipate that distance education would become the main form of education in compulsory school attendance. Distance teaching and distance learning were rarely used under normal condition, and individual study programs were also implemented only rarely. (This is only the case with integration in different ways and to different degrees of disabled pupils, athletes, excellent sportsmen, exceptionally gifted children, etc., who could not fully and regularly attend daily classes). Developments during the COVID-19 pandemic have shown that distance learning can become a harsh reality overnight. At that time (already during the first wave of the pandemic) all schools were forced to accept this reality and solve the problem of education operatively. A situation arose where a number of problems had to be solved "on their own" and answers were found to many questions related to the operational solution of the problems.

How to continue teaching? What tools to use? Which environment to apply? How to involve students in the educational process? Will students have sufficient and suitable technical and technological equipment? Will online learning work on

mobile phones, tablets, computers or laptops? These and many similar questions have been asked by teachers and school principals. Each school chose its own path, its own approach and strategy, and used different tools and environments to implement distance (online) education. It was common practice to use many video conferencing systems in one school. Each teacher chose the one that suited him best (or who he knew) from those that were available.

There was a lack of any central coordination (or arrived late), not only in connection with the use of tools, but also with the preparation and implementation of the learning process. Sometimes students had multiple online activities scheduled at the same time and had to learn to use numerous environments that they were not used to. The instructions of the Ministry of Education came too late and the schools acted to the best of their knowledge and belief and at their own discretion and assessment of the situation and conditions in which they found themselves. Higher education institutions preparing teachers have solved the problem of changing the concept of study programs and innovating the content of many subjects in teacher study programs. To carry out a curricular transformation, they had to find the right answer to many questions. What needs to be included in teacher education programs at universities? Which problems and topics are general regardless of the studied teacher specialization and which are specific and are related to subject approval?

Forced distance learning during the COVID-19 pandemic indicated various problems and confirmed certain facts that did not manifest themselves in the daily forms of teaching implementation, or they were not so obvious. These include the following:

- Schools, teachers, and students have not been and still are not well prepared for the distance form of education;
- Teachers, although skilfully preparing various e-learning tools and applications for full-time teaching, still lack experience in creating online materials and providing online education;
- There is a lack of coordination, cooperation management and planning of the process of creating educational materials, both in terms of content and form;
- School information systems are rarely used in full and many of their functions are not known to teachers or school management;
- For the lack of competencies, professionalism, knowledge and information about SIS for the management of primary and secondary schools and school facilities as well as their selection for a particular school, it may be pure coincidence without the belief of the correct choice;
- Teachers did not meet and, until the pandemic, did not use any complete software systems for distance (online) education in the full range of curricula;
- Schools have used and continue to use different distance education systems, and in some schools very often more than one at a time;
- Schools are not sufficiently informed about distance learning opportunities as well as the digital learning materials they have at their disposal, the educational portals, websites and nests (and their contents), which are freely accessible and which they are free to use.

Therefore, it is important that future teachers in the field of higher education acquire sufficient knowledge about the forms and means of distance education and also that they know the basic school information systems that are currently used. Teachers' knowledge of information systems must be broader and deeper than at the level of a skilled intelligent user. They need to know what SIS services they provide and how to use these services effectively. As part of pedagogical practice, they must also gain practical experience in using SIS. Computer and Internet security, personal data protection and current legislation cannot be ignored in the use of ICT and modern SIS. Security and reliability of information systems are among the basic requirements for their deployment. Information systems are constantly exposed to various risks, such as information leakage, information system failure due to weathering or human error. For the proper functioning and credibility of the information system, the mentioned risks should be prevented, or at least timely preparation of potential users - teachers and school management. Therefore, knowledge about SIS must be included in every study program of teacher training. It would be best to include their teaching in the common ground that is the content of all teaching programs.

Another acute problem that needed to be solved was the problem of how to implement the teaching of practically oriented subjects. Examples include laboratory work in physics, chemistry, biology, computer science, design tasks, construction and programming of robots, and many more. Here came the word implementation of practical exercises according to the video-instructions, the use of educational films and videos, the use of virtual and remote laboratories, trainers, emulators, modeling, the use of simulation tools, virtual and augmented reality, etc. A comprehensive solution to this problem is more difficult and there is no room for us to discuss in this paper. We have described and presented some solutions in more detail at many national and international conferences in 2020 (IATED, IMSCI), [79, 80]

For example, in teaching programming in distance for online, we have successfully used the MS-Teams screen sharing function. The teacher could present the problem on his/her screen to show and explain the solution to the problem and the procedure for debugging the program. Similarly, the student could present his/her suggestions and ideas for a solution, and the teacher and other classmates could advise and help him/her complete the program and improve the software application.

It is true that the teacher stayed more at home during the pandemic than under normal circumstances, but this does not mean that she/he had more time for the family, to enjoy time together, to relax and have fun. Obligations of children in distance learning; preparation of study materials and own teaching; control and correction of submitted tasks are very time consuming. Teachers are exhausted and tired and often "burned out", but they live with the hope that the emergency will end in the foreseeable future.

4.16 Spain

As humanity today faces an unprecedented, multifaceted crisis, its consequences have not left the education sector unaffected, at all levels [81]. In fact, the phrase "I attend the university" takes on new dimensions in the time of the coronavirus. The scenario of uncertainty created by this pandemic is on the agenda for future actions and guidelines, as the challenge that arises is the management of today and the preparedness for tomorrow.

(a) The transition of Higher Education from the traditional form to the online has disrupted the regularity of academic life. In Spain, schools and universities were initially closed precautionarily in early spring of 2020, following a similar course with most European countries, as Greece. In the universities any academic activity is carried out at a distance and research, teaching or supervision is conducted remotely, via e-learning or digital platforms. Indeed, ministries issued instructions for the conduction of distance examinations at universities and the support of the doctoral dissertations of PhD students.

But the question remains; how satisfied were we with this rapid migration to fully virtual education in the age of the Coronavirus pandemic? As the direct interpersonal contact, along with the interaction, which are key components of every learning process [82, 83], are lost, not only the form of education but also its qualitative elements have changed.

(b) As a person, who has multiple roles, I faced special challenges during this period, trying to personally address the needs arising from the pandemic. The psychological footprint and the impact of the pandemic is part of my daily life and is something I have been reflecting on from the perspectives of being a school psychologist in a special education school, a PhD researcher in psychology at a Spanish university and a member of a family and a community that is being affected this period.

For the last 3 years I have been researching the roles and tasks of the school psychologist, a profession that has changed significantly in the last year. In particular, a variety of strategies have been adopted to continue the psychological support of children, through online counseling, etc., involving both in-person and remote strategies [84]. Moreover, it is quite possible that psychologists themselves have changed as professionals, in significant ways as the pandemic develops [85]. In fact, what the pandemic brought about was a shift in mental health and mental resilience.

One of the difficulties I had to face was the change of both my working status and the subject of my dissertation under investigation. At the beginning of the pandemic, as observed by Farmer et al. (2021) [86] while many educational institutions have chosen to adapt instructional materials to be delivered online, it was not clear whether the same was expected from the school psychological services. This uncertainty was reflected in all aspects of my activities.

The above conditions have raised strong doubts about my research ideas and whether they are now obsolete. Doubts arose about whether the roles traditionally assumed by the school psychologist, actually meet the psycho-emotional needs of the school

community and families during the pandemic. In addition, I began to wonder whether the role of the school psychologist should now be expanded in order to meet the needs of the wider community, as the school is part of it. What is the role of the school psychologist in strengthening the mental resilience and well-being of teachers and families began to concern me. Given the relevance of psychology to the current health crisis, it is a new challenge for me to include the above issues in my research projects.

Within the new working conditions, what it was needed was to maintain a balance between working demands and academic requirements. The paradox encountered at this phase was that while I was also affected as a person by the lockdowns and the pandemic I had to mentally strengthen the students and their families and at the same time to study the role of the psychologist, as an external observer. This certainly seems like a major challenge for a professional.

(c) Undoubtedly, doctoral research is a complex, demanding and time-consuming process, which can offer a path full of opportunities for critical thinking, learning and insight. Regarding my university studies, they have been moved from person to person in online work, through applications such as Zoom and social media, e.g. Viber, Skype. At the same time, during the period of the temporary closure of universities' operation, the Education Ministries in both Greece and Spain, decided that the process of public support for doctoral dissertations should be carried out by distance methods, via video conferences.

Although I try not to affect the speed with which my dissertation is processed, when events are in full swing, the course of the dissertation goes backwards, especially considering the fact that Spain is among the countries most affected. The frequency of communication with my supervisors has decreased significantly, particularly in the second wave of the pandemic in Europe.

During this period, the paradox is observed that while we all have much more time, we tend to remain more immobile and inactive. However, this situation seems to have worked in my case, as I managed my time quite wisely. Thus, the time I would once devote to activities outside the home and work, is now devoted to my doctoral dissertation.

(d) Research efforts since the beginning of 2020 have shown the impact of the pandemic on the psychological functioning of both students and adults, with a particular focus on the impact of lock-in, school / university closure and quarantine on adaptation, especially in more affected countries, e.g. China, Italy and Spain.

Indicatively, the literature shows that during the quarantine period many people experience anger, confusion, symptoms of post-traumatic stress, etc., as a result of changes in their daily routine and working conditions [87, 88]. Additional challenges include feelings of loneliness and sadness, social alienation, increased time in front of screens and reduced physical activity.

Personally speaking, the pandemic situation also has a significant effect on my personal resilience. Practically, my support network was limited, as my friendly and relative network was forced to move away and thus I turned to other spiritual

influences for guidance and motivation. This lack of support in the current situation prompted me to discuss these issues within my doctoral dissertation.

An important struggle during this period has been the inability to separate work from home. Working from home and the lack of space as an office, both for my work as a psychologist and for my research work, I feel is a form of intrusion into my family and personal life. Undeniably, this condition is a very stressful situation for many people.

The COVID-19 pandemic has created instability, anxiety and fear, and there is great uncertainty about when schools and universities will reopen and this crisis will subside. The things that until recently we took for granted (education, work, etc.), are now on hold for an indefinite period, which affects our mental well-being.

In conclusion, I believe that these reflections, although subjective, emphasise the universality of emotions in such circumstances. Sharing common views and emotions can give us a sense of security and acceptance, as we do not feel alone in this scary and anxiety- provoking period. As we often tell our students, in order to show them the need to seek psychological help and support, ***"even Superman goes to his psychotherapist to discuss how he feels about his accomplishments,"*** it is helpful to seek for help, if necessary, especially in the "stay at home" period.

4.17 Turkey

(a) In the midst of March (13rd march), 2020 face-to-face education stopped in in Higher Educationinstitutions. For two weeks there was an empty period. As it was the beginning of new pandemic period, which was quite unknown initially, Higher Educationinstitutions and Higher EducationCouncil needed to prepare infrastructure for distance education and make new regulations, make new decisions and choose the following path to go. When the teaching and education activities stopped, students left the dormitories and went to the cities where they parents live. For a week students and lecturers waited. During this time Higher EducationCouncil of Turkey took infinitives.

(b) Approach of Higher EducationCouncil of Turkey: According to the press speech of Prof. Dr. M.A. Yekta Saraç (Head of Higher Educational Council of Turkey [89], in one week time model planning was made and examples from the world were analyzed. Decisions of the authorities of Higher Educationcouncils and universities from United States of America and European Countries, where the pandemic crisis reached the top, were examined and analyzed. Universities in Turkey were asked to inform the Higher Educational Council about their infrastructure, capacity, sufficiency or insufficiency for distance education. Pandemic Consulting Commissions were established in the universities in Turkey. Route Map of Digital Transformation during pandemic crisis was prepared. This roadmap has five sections:Legislation, Infrastructure, Human Resources, Content, Implementation. In terms of Legislation, major changes were made in the Rules and Procedures of Distance Education. According to the new decision made, distance education will be activated providing that it shall be limited with only this pandemic period. As for the Infrastructure, feedback from the universities were evaluated. It is satisfying that

many universities have capacity for distance education. Before the pandemic 123 universities in Turkey had UZEM (Distance Education Teaching Implementation and Research Center). Also for the field of Human Resources, there were some investments. For example, within the frame of Digital Transformation Projects, training was given to more than 6000 faculty members and 50.000 students 2 years before the pandemic by Higher Education Council of Turkey. The other factor was Content. Yekta Saraç told that many faculty members and lecturers in Turkey have experience of preparing content. After his speech, in the new starting pandemic education period, the universities opened their course materials and contents for open access. Also Anadolu University and Istanbul University, which were providing open and distance education, besides their formal education program, opened their digital materials and recorded courses for open access.According to the decision of YÖK (Higher EducationCouncil of Turkey), common course materials were opened for access.

(c) What did universities do?: With the sudden outbreak of pandemic crisis, universities improved their distance education infrastructure, rapid meetings were held out with lecturers, faculty members. New working bodies and teams were established within the universities to manage the Distance Education System of Universities. Committe meetings were held out within the universities. Some universities employed new IT staff to contribute to the efficient running of the distance education systems. Orientation programs were applied to students and lecturers. Also various trainings on how to use distance education tools, how to make video edit, how to prepare video material were made for lecturers and faculty members.

(d) From the perspective of students: As a research assistant working in the university, I witnessed what students experience during this process. Some students reported that they found it hard to adapt to the new system, their social life has ended and they cannot concentrate on what they do. They were concerned about how the exams would be carried out, how they would make their presentations and how their performance would be graded. Some students did not have Internet facility at home, some had fewer financial opportunities to get Internet service for their home. I the university I work (Ankara Yıldırım Beyazıt University) we had some international students from Africa and other less developed countries. Some of our African students returned to their countries. Due to the poor infrastructure of Internet, they could not access to courses or distance education system. Some of the students did not have necessary equipment and they used their mobile phones to connect to the system. From the other hand, there were also students who enjoyed this period and who found it more fruitful to work from home. Some of my students reported that their scores got higher during Pandemic. Some of the exams turned into assignment version and they told that they found it more practical than multiple choice or open ended question format exam.

(e) From the perspective of lecturers: Some of the lecturers I witness during COVID 19 pandemic reported that working from home is saving time and energy. We do not spend time for transportation or driving but we put our all effort to enable the student participation in the class, or dealing with system errors, problems that occur two or three days a week. They told that sometimes their Internet connection got poor as

well. Even though working from home seemed attractive at the beginning, it can be problematic to resolve system problems in the middle of the course. They reported that because of the system problems, they lose their concentration in the course. Also they say that when the camera of the students are closed, it is hard for them speak to the screen and get motivated. They also spent a lot of time to prepare video recordings for the courses. They recorded some of the live courses with students but some said that it took time to edit the videos later. But now they also report that they got used to this system and the infrastructure is getting more stable. They have learnt to cope with this process and this process might be the beginning of new hybrid system and they prefer to use hybrid system in the post-pandemic process.

4.18 United Kingdom

4.18.1 The impact on students in the UK: reflections of a parent

United Kingdom (UK) universities have mostly been functioning online since March 2020. In 2021 we have been allowed to run some health related programmes on campus where there was no other way of delivering the curriculum. Some research students have been able to return to their labs under very strict safety measures. Current UK government advice [90] is that we can return to campus in May 2021, but the reality for most UK students is that the academic year is over by then. September 2021 is now the planning date for any significant return to face to face teaching.

I have two daughters, one who is in final year at university and the younger who is at a further education college and will go to university in September. These are my reflections on their experiences and those of students at Middlesex University where I work as a library manager.

Our youngest has done the entire university application process virtually. There have been no visits to campus. Visits may become possible later this term, but that is too late decision making as choices have already been made. She will be arriving at a University to study and seeing it for the first time the day she arrives. This is reflected in the Middlesex University information for prospective students [91].

For our eldest the move online have had benefits. Of all the changes, recorded lectures online are much preferred as she can do the lectures in the best order for her. This is something she would like programmes of study to keep, rather than going back to live in person lectures. She told me of the advantages of focussing on one subject in the morning and another in the afternoon rather than back to back live lectures where the second lecture overwrites the learning from the first. Our younger daughter is dyslexic and so lectures she can pause and rewind are much preferred to trying to keep notes and keep up with the tutor. For students who have other disabilities the recorded lecture is a vastly better option. It is ironic that COVID has delivered for disabled students a vast improvement in provision in a way that years of campaigning never did.

On the down side 2020-21 has not been the final year my eldest expected and it has on occasions been an isolating experience with very limited social contact outside her flat of six friends from January to April. Her boyfriend, who she met shortly before going to Canada for her 3rd year, has seen very little of her since she hastily came back in March 2020 because of lockdowns and the need to protect parents and grandparents from the risk of infection. It did not help his home city was a viral hotspot under the strictest of lockdowns for much longer than other parts of the UK. Worse still, the year below my eldest daughter are students who were supposed to go overseas to study as she had and have found themselves studying overseas from the UK. Not the gap year they had hoped for.

Middlesex has 65% of its students who normally commute from home. The reductions in public transport and in particular bus capacity means that even if we had been able to move back to campus this year, travel to and from campus would have been challenging for our students. In the absence of teaching on campus, they have had a very limiting social experience. This is not how university was meant to be.

This situation has been even harder for new first years who might be in a hall of residence flat with people they have not chosen to live with and harder still for those international students who came to use and had to quarantine. Middlesex students have told us how hard it is to live and study in a single room day after day. We have also had to meet more basic needs with Student Welfare having deliver food parcels to self-isolating students. We have seen an increase in demand for mental health support. That team have found online support works much better than expected and has enabled them to be more flexible in times of delivery, so has actually improved the service we can offer students.

To support our students Middlesex University has lent out over 1000 laptops to students with none and spent hardship funds on internet and WiFi for students in homes with poor connections. We have many students from poorer families, a situation compounded by parents being furloughed from jobs. Students have found themselves in competition with siblings still at school needing access to the family computer and, in the case of one programme, the professional body requiring an exam means whilst the exam is in progress no one else in the family can use the home internet lest the proctoring software reads their use as an attempt by the student to cheat. This is very much an exception, most assessment having moved away to more realistic formats. My eldest has become familiar with the open book exam run over a 24 or 48 hour period, the assessment assuming books are being used but designed to ensure it tests students reflective and critical thinking, which is harder to cut and paste.

Where will students be next academic year? The hope is that the UK vaccination programme will have reached 18 year olds by July 2021. Will this enable a return to normal or will mask wearing and some social distancing need to continue? At the time of writing, we simply do not know.

4.18.2 United Kingdom - Reflections of an academic

The majority of the Faculty of Science and Technology students at Middlesex University London, UK have had their teaching delivered online. There is still much uncertainty with regards to students returning to campus but there is talk of using a blended approach at the start of the 2021/22 academic year in the Autumn of 2021. At an operational level, the suggestion is that large lectures will remain online, whilst smaller, more intimate, lab sessions will take place on campus. Academics were given choice over which platform they chose to deliver their teaching. I chose Adobe Connect because this was used by the majority of colleagues in the Business Information Systems teaching cluster. Here are my reflections to the following questions.

(a) At the very beginning, the overall feeling amongst students was of anxiety over the uncertainty that the pandemic bought. These feelings of unease and worry dissipated, but never totally disappeared, after the first month of online teaching. Once the students had acclimatised to the new online environment, and a structure and regime had materialised, the majority did feel comfortable.

A minority did feel frustration over the denial of having face-to-face, on campus teaching. They felt that the university owed them a partial refund on the fees that they had incurred and paid. Interestingly, my observations are that those who voiced these concerns were the usually those weaker students that struggled with independent learning.

(b) The Systems Analysis and Design module that I teach on the Business Information Systems and IT degree programmes was well-suited for the online environment. My experience would argue that their learning might have actually been enhanced. This is substantiated by the final grades achieved by the cohort in this pandemic year, which were markedly better than the performance of students in past years. The pass rate went up and the average modal grade for individual assessment components also slightly improved across the board. Also, very positive feedback was received from the student boards where students' representatives are given a chance to feedback to departmental management concerning students' learning experiences.

(c) Every week, I ran a three hour online Academic Advice Surgery. This timetabled session was open to all students and offered both academic support with taught modules and pastoral care. Many used the sessions as an opportunity to socialise, as opposed to using it for any academic purposes, allowing them to share their personal experiences. Over half of these attendees did comment on the difficulty of working from home and the denial of in person, human interaction. Interestingly, in one case a student did state that the whole purpose of attending university was to escape the domestic setting, where she felt enslaved, and to be liberated and free to enjoy the company of friends and peers on campus. She was basically escaping servitude. The denial of escaping this due to the pandemic had a severe impact on her psychological health. However, there was also a subset of the cohort, approximately 40%, who were typically highly motivated and academically strong, who enjoyed the challenge

of working independently from home. They were students that had the support structure at home (usually free from any domestic responsibilities, a personal space in which to learn, the access to unfettered access to good technology, etc).

(d) Middlesex University London has been able to loan laptops to the student cohort. Staff, including I, have been able to have laptop machines delivered to our addresses, in order that we can deliver teaching from home. There was a sudden realisation, a week into delivering the online course that my internet and WiFi connections were poor. Thus, a new Internet Service Provider was sought, and an upgrade followed a week later. There was a financial cost, which was not picked up by the employer. The online learning and teaching sessions did reveal that a number of students also faced the experience of having poor internet connection. However, some were less unfortunate and did not have the means to upgrade.

(e) The students registered on the Information Systems Analysis and Design module managed their lab work quite effectively from a distance. Adobe Connect has a Whiteboard facility, which was used extensively by students to draw and model schematic models, when sharing their answers to lab exercises. Likewise, tutors could annotate these answers instantaneously with feedback in a live setting. In order to reduce the load on available bandwidth, most of the tutor/student communication was via audio only. On many occasions, when video was used there would often be buffering on the connection, thus reducing the quality of the leaning and teaching experience. The Breakout Room facility in Adobe Connect did permit small groups of students, typically 3-4, in a lab session of 20 students, to be able to talk and share screens in real time. This facilitated the social aspect to learning in the lab sessions.

(f) There were clear guidelines and support provided by the department and the wider university in terms of delivering online teaching. Although I would argue that it was not comprehensive. A small example to illustrate this is the failure to consider whether both students and staff are working from home in an ergonomically safe environment. For example, is the learning and teaching taking place in a well-lit, well ventilated environment, is the furniture (chairs, tables) minimising physical effort or discomfort, etc. Because the pandemic has shifted work online it does not mean that an employer or service provider abdicates all duties and responsibilities of health and safety of its workers/consumers. And this should be addressed by all employers and fought for by all employees and trade unions.

4.19 United States of America

The academic terms of Spring 2020 and Fall 2020/Spring 2021 will long be remembered, by both students and professors. For some, these semesters will be thought of as time and learning lost, while for others, they will be remembered as an adventure with new opportunities for learning. During the Spring 2020 semester, I was living and teaching in Vladimir, Russia as a Fulbright Scholar. When news of university closures and the ending of face-to-face instruction in Russia was announced, my teaching as a Fulbright was finished, and I had to return home to the

United States. As such, I did not have to rapidly migrate my courses to the online format for the Spring 2020 semester. I would have to transition all of my courses to the online format for the 2020-2021 academic year. However, I did have some time to plan and prepare for this. Here are my reflections:

(a) During this time there were so many unknowns. What is this virus? Will I get it? Will I die? Will someone in my family be affected? What about my job and my income? What if? Life as we knew it changed in an instant. During such a stressful time, it is hard to imagine that much academic learning could occur. However, I believe that there are students that thrive in the online classroom, while there are some students that are best situated in the face-to-face classroom environment. According to a report by Celia Miller (2021) [92], 43% of college/university students enrolled in traditional face-to-face classes had not taken online classes prior to the transition to online due to COVID policies. Furthermore, in 2019, only 46% of faculty members stated they had taught an online course. Given that, consider that about half of the student population had little to no idea what to expect for online learning, while only about half of the faculty had any experience designing or teaching in the online environment, all in the midst of a pandemic with its own fears and unknowns.

(b) I believe there are some courses that are absolutely well-suited for the online environment; and for the student that is well-suited for the online environment, their learning might have actually been enhanced. There are, however, some courses that are not or actually cannot be taught online. For example, I teach an Electrocardiography and Clinical Exercise Testing course each fall semester at my university. I have been teaching this course as a hybrid course for several years now. I have found that teaching the electrocardiography (ekg) component of this course online has actually improved learning outcomes. It is impossible, however, to practice clinical exercise testing online. Due to CDC guidelines and COVID restrictions, students and faculty were not able to meet in the lab to practice these skills, and the equipment required for skill development is very expensive; in other words, no one has an ekg machine capable of running a treadmill in their home to practice clinical exercise testing. It is one thing to watch a video of it; it is quite another thing to operate all of the equipment independently while working with a test subject walking on a treadmill and hooked up to an ekg. Lab-based skill development learning most certainly was negatively impacted.

(c) As mentioned previously, with so many unknowns, this pandemic has been a highly stressful time for everyone. That alone impacts ones' psychology. I do believe, though, that the required online learning modality affects individuals differently. There are some for whom the transition has been accepted and embraced, while for others, it is has had a negative impact on their psychology. Data from my students in the US indicated that just over half (56%) preferred face-to-face learning, while 35% preferred mixed online/face-to-face, and 9% preferred online only. Common themes for why students preferred each are as follows:

i. Face-to-face – human interactions, they hate technology, need it for motivation and focus.
ii. Mixed and Online – accessibility, no class cancellations, flexibility for work schedule and family life, not having to leave home

Given these reasons, it is easy to understand that depending on the perspective and personality of the student, a student's psychology would be affected differently. For those that desire human interaction in-person, their psychology would tend to be more negatively affected, while a student who enjoys working independently from home and is now able to manage school requirements with family and work obligations would tend to be more positively affected.

(d) It is a requirement for students attending our university to have a computer or laptop. All respondents to the study survey indicated that they had some form of technological device and Internet service.

(e) As discussed previously, some forms of laboratory work are very difficult, if not impossible to study outside of a laboratory. However, it is possible for some types of laboratory sessions to be held and potentially even offer superior results. For example, I teach two sections of a course called "Personal Fitness." This course consists of "lecture" and "laboratory." The lab component of the course consists of teaching of and training in various forms of physical activities. Obviously, some of the workouts have had to be adjusted – we are not able to teach/train with weight machines or meet in-person for group exercise; however instead, lab sessions have been meeting via Zoom where instruction is based on activities that can be conducted in the home, with equipment found in the home. As lab classes are held via Zoom, we are able to see our students completing the activities and can provide feedback, and they are able to watch us leading the instruction.

I believe that this type of instruction, at least for some students, may potentially be superior to how we have always taught/conducted lab classes. By this I mean that students are now being taught for an entire semester all different types of at-home exercises, all while they learn and realize that they can exercise from home. The reality of physical activity participation is that a majority of Americans do not get the recommended amounts. As always, the most common reasons for this are lack of time and lack of money for gym membership. Our students are now being taught that they can find time to squeeze in some exercise using what they have available in their home, so time and money are no longer valid excuses for not exercising.

(f) I believe that most all of the policies that we received came from the Centers for Disease Control and Prevention (CDC). While some of these policies hindered the education process (such as not being able to practice skills in the laboratory as stated previously), these policies were designed to stop the spread of the virus.

4.20 Summary of section 4 on reflections

Reflections by their nature are bound to be largely subjective. However, through the different experiences of the authors it was still possible to identify common themes, problems, anxieties, and opinions.

The uncertainty and pressure caused by the pandemic presented challenges which had to be addressed within a short time. Availability of and access to suitable/adequate technologies as well as training of the staff, who were unfamiliar with using online teaching platforms is a shared problem faced even by institutions within advanced economies. A regional variation in internet technologies continues to pose problems.

Social divides were exacerbated during the pandemic. Sociocultural and socioeconomic differences were experienced by the students in terms of social class as students from well off families had an advantage over students from poor families.

Lab-based skill development learning was negatively impacted upon. Much creativity on the part of the academics enabled the development of simulations which addressed these problems.

Despite the uncertainty and pressure caused by the COVID-19 pandemic, the co-operation and flexibility of universities and schools created solutions to address the challenge. The pandemic also posed a necessity to review the technology and internal competencies for digitized delivery of the teaching and upgrade the systems and knowledge to develop an online learning culture.

One of the authors who is a PhD student concluded that "Sharing common views and emotions can give us a sense of security and acceptance, as we do not feel alone in this scary and anxiety- provoking period students do not feel alone in this scary and anxiety-provoking period."

5 Proposed strategies for alleviating the effects of the Covid-19 pandemic on HE

It has been argued in Mystakidis et al. (2020) [93] that the HE world of e-learning and social virtual reality learning environments, in general, should historically be examined as in the pre- and post-coronavirus times and that any HE learners' needs and learning innovations should be classified accordingly. In this section, the authors based on the needs analysis that appeared from the international research study present suggestions for future improvement action and learning innovations generated by the university and college educators and co-authors of this paper and by the HE students themselves.

5.4 Proposals from co-authors/educators

In the light of experience gained from February 2020 to May 2021 it was found that online education (despite the initial shock) with appropriate attitude and policies could:

- promote learning innovations in university education;
- strengthen the exchange of teaching experiences, and the sharing of excellent courses;
- make the teaching process more standardised;
- enable all students to have more flexibility to arrange their own study time;
- improve the effectiveness and utilisation rate of classroom teaching;
- improve the motivation of the students to learn independently;
- attract students' interest in learning through the variety of forms and style;
- provide the students with multi-dimensional, multi-levelled, diversified development spaces.

Notwithstanding, problems persist and, thus, the authors propose the adoption of a strategy based on openness, transparency, and sharing of resources and knowhow. In particular, the authors propose the following:

- Provide training to educators: Although many educators might be able to use various e-learning tools, applications and platforms they still require training for the preparation of materials and for providing online education. Educators from non-technical subjects are likely to require additional training and support.
- Encourage and identify innovations used by the academics (such as animations, simulations, videos, as well as group work) which can alleviate anxiety and enhance the engagement of their students.
- Ensure co-ordination and co-operation between management and academics for the migration to and implementation of a virtual model of education.
- Identify students from socioeconomically disadvantaged groups, so that additional help can be provided (at least for WiFi access & loaned laptops).
- Identify students vulnerable to isolation, depression, and well-being: provide support through more regular contact and encouragement.
- Develop and use awareness training to both academics and students on the dangers from cyber-fraud, violation of privacy, and cybersecurity.
- Seek ways to involve the students more into the learning process.
- Seek ways that would promote student interactivity with each other and with the lecturer, promote group work during class time and outside that, and overall strive to make courses more interesting to the students.
- Enrich the course contents and context with new activities such as video presentations, demonstrations of problem solutions, class debates and discussions.
- Incorporate group work which encourages co-operation and support from student to student.

5.5 Proposals for improvement made by the students

All the proposals made by students are listed below in italics.

- *Mental health factors should be more in focus rather than the technology and the different program solutions.*
- *Moreover, recording lectures provide useful to students that work (and can't attend live classes), and students that want to revise. Wish you the best with your research!*
- *The books at the library should all be online.*
- *Platforms that are safe should be used more (If I am not mistaken Zoom has some bad history and as we were doing lectures everyone could access before they changed it to private e-classes after a whole semester).*
- *Tutors should make a Twitch channel so the students can support them with donations and subs.*
- *The EU needs to hurry up with the vaccination process so that I can go back to my life and continue my studies normally and how they were designed to be taught*
- *The books at the library should all be online.*
- *Platforms that are safe should be used more (If I am not mistaken Zoom has some bad history and as we were doing lectures everyone could access before they changed it to private e-classes after a whole semester)*
- *I would kindly recommend institutions/universities to run mixed method (online and face to face teaching).*
- *I want to tell all the lecturers that knowledge is more important than teaching the course of study for students just to pass in the exam, no we really need real knowledge that helps us in our life and our work.*
- *Students know definitely which mode of study they prefer.*
- *I hope this pandemic teaches people how much we need each other.*

6 Conclusions, Limitations of Study, and Further Work

6.4 Summary of Findings

The Crisis Distance Education (CDE) that was foisted on HE institutions, students and academics across the world presented many challenges to the governments, educational institutions' leadership, staff (academic and support), and of course to the students, who have been the focus of the international research study presented in this paper. The sudden and rapid migration from traditional or hybrid (in some cases) to fully virtual, online education had considerable ramifications regarding the social, cultural, economic, political, ethical, and technical dimensions. Pre-existing social divides were exacerbated by the socio-digital divide. Pedagogical and psychological repercussions have already been faced and are expected to persist in the near future and in the long term.

Reports from the universities and countries of the authors show that much progress has been made since the initial outbreak of the COVID-19 pandemic. There was already an infrastructure and relevant knowhow mainly for hybrid education. The

Crisis or Emergency transition to a forced fully virtual model in most of the cases still poses challenges, especially for the students.

The effects of lockdowns on the students were widespread ranging from indifference, lack of motivation and cognitive disengagement.

There is an inherent difficulty in using the survey method for obtaining voluntary responses to a questionnaire which offers no incentives. Ensuring anonymity and non-traceability forbids collecting contact details. The questionnaire was very long and that was something that deterred students, many of whom reported to their professors/lecturers, who had pointed them to the online questionnaire; some abandoned the completion half-way through. The low response rate in many cases affected the originally intended, comparative analysis of data. Thus, cross-country comparisons were not statistically possible.

The overwhelming majority of the authors, professors and lecturers (who motivated their students to complete the questionnaire) come from the Engineering and Computing fields. They and their institutions had substantial experience in the use of technologies for e-learning. The students themselves are likely to also have familiarity and experience of online learning. As the data collected clustered around six axes we present below some important highlights from each of the six axes:

Demographics

A total of 1005 students (55% female. 43% male, 1% other, and 1% chose not to indicate) completed the questionnaire. The age of the sample participants ranged from 17 up to 59 years, while the majority were between 18 and 23 years old. This age distribution is expected for College and University students especially for those studying for their first degree. A small number of Masters and Doctoral students were among the respondents.

Facilities

Undoubtedly online education pre-supposes the availability and reliability of hardware and software, internet connect and uninterrupted power supply at the delivery end and at the students' own houses. This is not the case in many countries (e.g. Kenya and Nepal) or regions (e.g China). The unprecedented level of demand and high bandwidth exacerbates the problems of non-availability of high-speed Internet access.

In addition, most academics needed to familiarise themselves with the use of communication platforms, and also produce materials and record lectures as backup for asynchronous use especially by students without reliable connection to the internet.

Learning
The sudden migration to online learning overwhelmed the students and their lecturers. The changes happened very quickly and the danger of the pandemic started to be felt. Yet education had to continue.

The responses of the students showed some variations particularly where we were asking with all the changes that were happening. For example during the pandemic the daily engagement in self-study increased from 28% to 35%. In fact 60% of the students reported spending more time studying during the pandemic than before the pandemic.

Innovations used by the academics (such as animations, simulations, videos, as well as group work) alleviated anxiety and enhanced the engagement of their students, and improved the motivation of students to learn independently.

Communication
The questions in this section aimed to understand whether the students kept in touch with their lecturers, their fellow students, their family, and their friends**.** In addition to the anxiety felt by everybody because of the pandemic, studying from home meant distance from people, social isolation, anxiety, anger, confusion, even post-traumatic stress, increased time in front of screens and reduced physical activity. In some cases, students developed resilience to the challenges.

Many students sought technical help but also communication and company from their friends and fellow students.

Privacy and Security
The online international survey revealed considerable gaps in awareness and training about online privacy and cybersecurity issues. For example 65% (before the migration) and 70% (during the migration) of the respondents received no training at all about protecting their privacy and did not have awareness of cyber-security risks.

Additionally, the most significant outcome from this survey's questions that was highlighted by the adult and higher education students was the fact that almost 90% of them did not have any particular knowledge or training on cyber-crime, cyber-protection before or even during the Covid-19 pandemic. This can be seen in more details from the summarised information presented in section 3.5 and in extended reporting with a comprehensive list of proposals for future improvements in Berki et al. (2021) [94]. The latter can be found in this tome of conference proceedings.

6.5 Final Section prompting students for free text responses

As has been see the final section of the questionnaire was a totally open question prompting the students to provide to share their thoughts even after answering the lengthy part of the questionnaire with structured questions. This time they were free

to express their anxieties and problems and share their views and suggestions for improvement. Their responses were categorised in those that have embraced the move to virtual learning and teaching, those that are passionately longing for a return to the traditional face-to-face model, and those that opted for a mixed/hybrid model providing reasons and justifications for this choice. Finally, they provided suggestions for future improvement.

6.6 Looking towards the post COVID-19 era

This study involved a diversity of views and cultures from across the world. By sharing the collective experiences, knowledge, feelings, ideas, and suggestions for improvement the authors will contribute to the debate and to the improvement of the students' experiences. By proposing strategies for avoiding or at least alleviating the major problems caused by drastic events such as a pandemic the authors go a long way towards addressing issues or mitigating future disasters.

As there is a slow move towards a return to the on-campus teaching and learning, the lessons of 2020-2021 are carried with us. Many HE educators and students are now more technologically savvy than before – the digital pivot has equipped them with new skills, that they may choose to harness in the future. Blended or hybrid approaches to learning may become more common in the post-COVID period. However, the pandemic has also raised awareness of the deep inequalities that frequently exist in educational contexts, from technological, socio-economic, and socio-cultural perspectives. It is to be hoped that the disruption and loss caused by the coronavirus may, yet, be channelled towards an improved future educational landscape for all students.

Engaging in online learning exposes students to dangers regarding security and privacy, but also to false information. "In the post-truth era, everybody should be aware of the fact that certain individuals, organisations, agencies and even governments may generate misinformation, dis-information, or mal-information. Thus, awareness of the dangers of fake news, and the means of discerning the truth and credibility of information, are of paramount importance. By far the best strategy for dealing with these problems is the development of critical thinking and critical literacy as early as possible within formal education." [95].

The lack of preparedness by governments should not be a surprise. Donahue et al. [96] in 2014 established through extensive literature research that politicians under-invest in prevention because the electoral payoffs are higher for bringing in disaster funding through post-disaster declarations to provide help. The lessons learned from the COVID-19 pandemic show that on- going preparedness is and will continue to be necessary in order to save lives and livelihoods. In the case of education, preparedness will ensure that the education activity continues, and the quality of education is maintained or enhanced with on-going preparedness.

Finally, all stakeholders and society, the whole world indeed, need to develop mechanisms for ensuring future preparedness for dealing with disasters such as virus pandemics, but also for dealing with other disasters whether natural or manmade.

7 Acknowledgments

The authors like to thank all the students that completed the questionnaire. We also thank all the colleagues, from across the world, who motivated their own students, but also invited colleagues from their own institutions, from other universities in their country, and from other countries to motivate their students in order to participate in the survey.

8 References

1. UNESCO News, https://en.unesco.org/news/unesco-and-partners-launch-geneva-global-education-emergencies-hub (accessed 6.04.2021).
2. Georgiadou, Elli, Berki, Eleni, Valtanen, Juri, Siakas, Kerstin V., Rahanu, Harjinder, Edwards, J. Adam, Paltalidis, Nickos, Agouropoulos, Andreas, Hatzipanagos, Stylianos, McGuinness, Claire, Cavanagh, Jerald, Kirby, Padraig, Ojukwu, Dili, Savva, Andreas, Stylianou, Vasso, Plastira, Mary, Gevorgyan, Rita, Ross, Margaret, Staples, Geoff, Knezevic, Ratko, Čolic, Amela, Valkanou, Theodora, Siakas, Errikos, Deshappriya, Nelum, Zirki, Annita, Stoffová, Veronika, Lambrou, Georgia, Morales Calleja, Carlos, Stoffová, Maja, Panteri, Maria, Panteri, Valentina, Zamaraeva, Galina and Panov, Yuri (2020) *Challenges of rapid migration to fully virtual education in the age of the Corona virus pandemic: experiences from across the world.* Uhomoibhi, James, Dewar, Eleanor, Georgiadou, Elli, Linecar, Peter, Marchbank, Paul, Ross, Margaret and Staples, Geoff, eds. e-Learning as a solution during unprecedented times in the 21st century (INSPIRE 2020 Proceedings). In: Twenty Fifth International Conference on Software Process Improvement Research, Education and Training (INSPIRE XXV), 16 Jul 2020, Online. e-ISBN 9781999654948 (accessed 6.04.2021).
3. Oyedotun, T.D. (2020). Sudden change of pedagogy in education driven by COVID-19: Perspectives and evaluation from a developing country, *Research in Globalization,* 2, 100029, Elsevier, pp. 1-5.
4. Sutton, H. (2020) (ed). Keep your mission student-centered, even in the face of crisis. *Dean & Provost,* 21(10):12 Wiley Periodicals, DOI: 10.1002/dap
5. Nam, T. (2019). Understanding the gap between perceived threats to and preparedness for cybersecurity. *Technology in Society*, 58 101122.
6. World Bank. (2020). The World Bank Education Global Practice Guidance Note: Remote Learning & COVID-19, available at https://www.worldbank.org/en/topic/edutech #COVIDedtech (accessed 15.02.2021).

7. Ali, W. (2020). Online and remote learning in Higher Educationinstitutes: A necessity in light of COVID-19 pandemic. *Higher EducationStudies,* 10(3), 16–25.
8. Lily, A.E.A, Ismail, A.F., Abunasser, F.M, Alqahtani, R.H.A. (2020). Distance education as a response to pandemics: Coronavirus and Arab culture, *Technology in Society*, 63, Elsevier, https://doi.org/10.1016/j.techsoc.2020.101317
9. Aguilera-Hermida, A.P. (2020). College students' use and acceptance of emergency online learning due to COVID-19, International Journal of Educational Research Open 1, 100011, Elsevier.
10. Pragholapati, A. (2020). COVID-19 Impact on Students, Available at https://edarxiv.org/895ed/ (accessed 14.02.2021).
11. Carver, C.S. (1997). You want to measure coping but your protocol' too long: Consider the brief cope. *International Journal Behavioral Medicine,* 4, 92, https://doi.org/10.1207/s15327558ijbm0401_6 (accessed 6.04.2021).
12. Hamilton M. (1960). A rating scale for depression. *Journal of Neurological Neurosurgery Psychiatry*, 23:56–62
13. WHO (2020) World Health Organisation announces COVID-19 outbreak a pandemic https://www.euro.who.int/en/health-topics/health-emergencies/coronavirus-covid-19/news/news/2020/3/who-announces-covid-19-outbreak-a-pandemic.
14. Cao, W., Fang, Z., Hou, G., Han, M., Xu, X., Dong, J. (2020). The psychological impact of the COVID-19 epidemic on college students in China," *Psychiatry Res.*, vol. 287, no. March, p. 112934, 2020
15. Mishra, L., Gupta, T., Shree, A. (2020). Online teaching-learning in Higher Educationduring lockdown period of COVID-19 pandemic, International Journal of Educational Research Open, 100012
16. Johnson, B., & Christensen, L. (2012). Educational research: Quantitative, qualitative and mixed approaches (4 ed.). Thousand Oaks, California: Sage Publications.
17. Speck, M. (1996). The change process in a school learning community. *The School Community Journal*, 6 (1): 69–79.
18. Kress, M.., (n.d.), Principals Without a Playbook: Leadership Amid the PandemicHow school leaders are working to support their students and teachers and keep learning going while schools are closed because of the Corona Virus. https://www.teachforamerica.org/stories/principals-without-a-playbook-leadership-amid-the-pandemic (Accessed: 21/01/2021)
19. The Impact of Corona Virus on Higher Educationin Germany (2020) https://www.studying-in-germany.org/the-impact-of-CoronaVirus-on-higher-education-in-germany/ (Accessed: 21.01.2021)
20. Coronavirus: What Can German Universities Do for International Students (2020) https://www.studying-in-germany.org/coronavirus-what-can-german-universities-do-for-international-students/ (Accessed: 21.01.2021)
21. Hussain, T., (2020). Education and COVID-19 in Nigeria: tackling the digital divide. Found at: https://www.soas.ac.uk/blogs/study/COVID-19-nigeria-digital-divide/. (Accessed: 27.01.2020).

22. WLF, (2020). Education and COVID-19 in Nigeria: Tackling the Digital Divide. Published at: https://worldliteracyfoundation.org/education-and-COVID-19-in-nigeria/. (Accessed: 16.06.2020).
23. Education: From disruption to recovery (2020), OECD Policy Responses to Corona Virus (COVID-19), https://en.unesco.org/COVID19/educationresponse, (Accessed: 27.01.2021)
24. Bandara, I., Ioras, F., Maher, K. (2014). Cyber Security concerns in e-Learning Education. Proceedings of ICERI 2014 Conference, 17th-19th November, Seville, Spain, pp. 0728 – 0734.
25. Anghel, M., & Perețeanu, G.C. (2020). Cyber security approaches in e-learning. Proceedings of INTED2020 Conference, 2nd-4th March, Valencia, Spain, pp. 4820-4825.
26. ENISA Threat Landscape Report (2020). List of 15 threats. https://www.enisa.europa.eu/topics/threat-risk-management/threats-and-trends, (accessed 6.04.2021).
27. European Commission, "Data protection under GDPR", available online at: https://europa.eu/youreurope/business/dealing-with-customers/data-protection/data-protectiongdpr/indexamp_en.htm (accessed 6.04.2021).
28. Kleinberg, H., Reinicke, B., Cummings, J. (2015). Cyber Security Best Practices: What to do? *Journal of Information Systems Applied Research, 8*(2), 52-59.
29. Tunggal, "The 56 Biggest Data Breaches (Updated for 2021)," UpGuard, https://www.upguard.com/blog/biggest-data-breaches, (30.4.2021).
30. Securelist by Kaspesky, "Digital Education: The cyber-risks of the online classroom" https://securelist.com/digital-education-the-cyberrisks-of-the-online-classroom/98380/ , (accessed 6.04.2021).
31. Price, D. "Is Zoom Safe to Use? 6 Privacy Issues to Consider," MUD, https://www.makeuseof.com/is-zoom-safe/, (accessed 21.11. 2020).
32. Odusanya, M. "Top 8 Microsoft Teams security issues," INFOSEC, 10.3.2021. https://resources.infosecinstitute.com/topic/top-8-microsoft-teams-security-issues/. (Accessed 6.04.2021).
33. Chaudhary, S., Schafeitel-Tähtinen, T., Helenius, M., Berki, E. (2019). Usability, Security and Trust in Password Managers: A Quest for User-Centric Properties and Features. *P. 69-90, Computer Science Review. Elsevier. Vol 33,*. https://doi.org/10.1016/j.cosrev.2019.03.002 (accessed 6.04.2021).
34. Chaudhary, S., Berki, E., Li, L., Valtanen, J. (2015): Time up for phishing with effective anti-phishing research strategies. *International Journal of Human Capital and Information Technology Professionals (IJHCITP) 6(2)*. http://www.igi-global.com/gateway/article/128310 (accessed 6.04.2021).
35. Li, L., Berki, E., Helenius, M., Ovaska, S. (2013). Towards a contingency approach with whitelist- and blacklist-based anti-phishing applications: what do usability tests indicate? *Behaviour and Information Technology, BIT Vol 33, No 11, pp* 1136-1147. (10.1080/0144929X.2013.875221).
36. EAIE 2021 Virtual Conference and Exhibition https://www.eaie.org/ [Accessed: 27/04/2021].
37. NAS RA, International Scientific Center, https://www.isec.am/en/admissions/online-education (Accessed: 27.04.2021).

38. Gevorgyan, R. Enhancing the Quality of the Teaching and Learning Process Though the Implementation of E-Learning Tools *(Armenian State Pedagogical University Kh. Abovyan, Armenia)* . e-Learning as a solution during unprecedented times in the 21st century (INSPIRE 2020 Proceedings). In: Twenty Fifth International Conference on Software Process Improvement Research, Education and Training (INSPIRE XXV), 16 Jul 2020, Online. e-ISBN 9781999654948. https://www.researchgate.net/publication/348169750_Challenges_of_Rapid_Migration_to_Fully_Virtual_Education_in_the_Age_of_the_Corona_Virus_Pandemic_Experiences_from_Across_the_World (accessed 6.4.2021).
39. Armenia Statae Finace https://finance.aspu.am/ (accessed 6.4.2021).
40. Popa, D., Knezevic, R. "Academic Mobility Polices in Higher Education of Bosnia and Herzegovina" https://www.researchgate.net/publication/32618965 , (accessed 6.4.2021).
41. UNESCO. (2020). Education: From disruption to recovery. Retrieved 23 February 2021, from: https://en.unesco.org/COVID19/educationresponse (accessed 23.02.2021).
42. COVID-19 International Student Well-being Study. 2020. Autumn. https://www.uantwerpen.be/en/research-groups/centre-population-family-health/research2/COVID-19-internation/(accessed 6.4.2021).
43. Berki, E. Reflections on e-Learning in the Time of Coronavirus: The Nordic Experience and Ethical Considerations - Back to the Future with The e-Learners Manifesto. In Proceedings of the 25th Annual INSPIRE Conference; Uhomoibhi, J., Dewar, E., Georgiadou, E., Linecar, P., Marchbank, P., Ross, M., Staples, G., Eds.; 2020; pp. 21–52. https://www.bcs.org/media/6602/inspire-2020-proceedings.pdf. (accessed 6.4.2021).
44. Chaudhary, S.; Zhao, Y.; Berki, E.; Valtanen, J.; Li, L.; Helenius, M.; Mystakidis, S. A Cross-Cultural and Gender-Based Perspective for Online Security: Exploring Knowledge, Skills and Attitudes of Higher Education Students. *IADIS Int. J. WWW/Internet* **2015**, *13*. http://www.iadisportal.org/ijwi/papers/2015131105.pdf , (accessed 6.4.2021).
45. Berki, E., Kandel, C. S., Zhao, Y., , Chaudhary, S.. A Comparative Study of Cyber-Security Knowledge in Higher Education Institutes of Five Countries, EDULEARN17 Conference, Barcelona, Spain, 2017. http://lib.uib.kz/edulearn17/proceedings/papers/1591.pdf. (accessed 6.4.2021).
46. Ohisalo, M. (Minister of Internal Affairs, Finland). Comprehensive assessment of safety and security in sparsely populated areas Ministry of the Interior, Finland, 23.10.2020 9.02. Press release 127/2020 https://pelastustoimi.fi/en/-/1410869/comprehensive-assessment-of-safety-and-security-in-sparsely-populated-areas, (accessed 6.4.2021).
47. Eshet, Y. (2007). Teaching online: survival skills for the effective teacher. ACM SIGCSE Bulletin, 39(2), 16-18.
48. Koutsogiannis, D. (2007a). A political multi-layered approach to researching children's digital literacy practices. Language and Education, 21(3), 216-231.

49. Koutsogiannis, D. (2007b). Exploitation of Information and Communication Technologies in the teaching of literary courses and especially in the Greek language teaching. Research on the philologists trained in the Odyssey project. Thessaloniki: Greek Language Center [In Greek].
50. Koutsogiannis, D. (2011). Adolescents' Digital literacy practices and (language) education. Thessaloniki: Greek Language Center [In Greek].
51. Photodentro, http://photodentro.edu.gr/lor/ (accessed 6.4.2021).
52. Digital school, https://dschool.edu.gr/ (accessed 6.4.2021).
53. Digital platform, "e-me" https://auth.e-me.edu.gr (accessed 6.4.2021).
54. Platform "Aesop", http://aesop.iep.edu.gr/ (accessed 6.4.2021).
55. State television channel ERT, https://webtv.ert.gr/category/mathainoume-sto-spiti/, (accessed 6.4.2021).
56. Tzifopoulos, M. (2019). Teacher education for the digitally oriented school: the curricula of the Schools of Primary Education in Greece. Proceedings of the 11th PanHellenic Conference of the Hellenic Pedagogical Society on "Basic and adult education of teachers in a complex and changing environment", Patra, November 23-25, 2018, pp. 460-471 [In Greek].
57. Tzifopoulos, M., & Bikos, K. (2016). Are kindergarten pre-service teachers trained with ICT? The curricula of the Schools of Early Childhood Education in Greece. Educational Review, 33(61), 133-153 [In Greek].
58. Seferis, G. (1942) , An Old Man On The River Bank from "Mythistorema" from Collected Poems (George Seferis). Translated, edited, and introduced by Edmund Keeley and Philip Sherrard. Copyright © 1995 by George Seferis. Reprinted by permission of Princeton University Press (1995).
59. O'Brien, C. (2021, January 19). 'Students get almost 17,000 laptops in online learning scheme.' *Irish Times*. https://www.irishtimes.com/business/work/students-get-almost-17-000-laptops-in-online-learning-scheme-1.4461321 (accessed 6.4.2021).
60. All Ireland Journal of Higher Education, https://www.aishe.org/aishe/journal/ (accessed 6.4.2021).
61. Irish Universities Association (2020) *Enhancing Digital Teaching & Learning in Irish Universities.* https://edtl.blog/ (accessed 6.4.2021).
62. EDTL Approach for Students: planning for effective learning during Covid-19, https://ulsites.ul.ie/itd/sites/default/files/itd_edtl_student_infographic.pdf (accessed 6.4.2021).
63. Hassan, O. et al (2020). Supporting Student Engagement and Partnership in Higher Education Decision-Making during the Pandemic: A reflection from the National Student Engagement Programme (NStEP). *All Ireland Journal of Higher Education, 12* (3). https://ojs.aishe.org/index.php/aishe-j/article/view/545 (accessed 6.4.2021).
64. Abdillahi, U. A. (2020) Use of Electronic Resources by Postgraduate Students during COVID-19 Pandemic: Case of Masinde Muliro University of Science and Technology, In Kenya. World Journal of Innovative Research. (WJIR), ISSN:2454-8236, Volume-9, Issue-5, PP 62-66

65. Liew, C. L., Foo, S., & Chennupati, K. R. (2000). A study of graduate student end users' use and perception of electronic journals. *Online Information Review*.
66. Tenopir, C. (2003), Use and Users of Electronic Library Resources: An Overview and Analysis of Recent Research Studies, available at: www.clir.org/pubs/reports/pub120/pub120.pdf. (accessed 6.4.2021).
67. El-Mansour, B. (2011). Institutional challenges facing online Education. Education in a technological world: Communicating current and emerging research and technological efforts A. Méndez-Vilas (Ed.) pp266-269
68. Tarus, J. (2011). Adoption of E-learning to Support Teaching and Learning in Moi University, MPhil Thesis (Information Technology), Moi University, Kenya.4
69. Tarus, J., Gichoya, D., & Muumbo, A. (2015). Challenges of implementing elearning in Kenya: A case of Kenyan public universities. The International Review of Research in Open and Distributed Learning, 16(1).
70. Mutisya,D.N. & Makokha,G.L (2016). Challenges affecting adoption of elearning in public universities in Kenya. E-Learning and Digital Media 2016, Vol. 13(3–4) 140–157
71. University Grant Commission, https://www.ugcnepal.edu.np/frontpage/21. (accessed 6.4.2021).
72. World Education Services, "Education in Nepal," https://wenr.wes.org/2018/04/education-in-nepal. (accessed 6.4.2021).
73. Edusanjal, "Notice Regarding Online Education from Tribhuvan University," https://edusanjal.com/news/notice-regarding-online-education-tribhuvan-university/. (accessed 6.4.2021).
74. Kathmandu University School of Education, "Guidelines for Online Teaching and Learning," *http://soe.kusoed.edu.np/guidelines-for-online-teaching-and-learning/.* (accessed 6.4.2021).
75. A. A. e. al., "Internet-based Online Higher Education in Nepal admist COVID-19," *https://edarxiv.org/r85bc/.* (accessed 6.4.2021).
76. D. G. a. P. Gautam, "Transition to online higher education during COVID-19 pandemic: turmoil and way forward to developing country of South Asia-Nepal, J*ournal of Research in Innovative,* vol. 14, no. 1, pp. 93-111, 2021
77. Brooks, S., B. Rebecca K Webster, R. K.., Smith, L.E., Woodland, L, Wessely, S., Greenberg, N., Rubin, G. J., (2020) The psychological impact of quarantine and how to reduce it: rapid review of the evidence, The Lancet, 2020. 26.02.2020.
78. Lessons of the Stress-Test: Higher Educational Institutions in the Pandemic and after it. Analytical Report. Moscow. Ministry of Science and Higher Education. 2 June 2020. https://drive.google.com/file/d/1GMcBIoP8ITzE_WDVh4nFksX6lceotZY3/view (accessed 6.4.2021).
79. Czakóová,K, Stoffová,V.. Training teachers of computer science for teaching algorithmization and programming. In: IMSCI '20 : the 14th International Multi-Conference on Society, Cybernetics and Informatics. - [1. vyd.]. - Winter Garden: IIIS -International Institute of Informatics and Systemics, 2020. - ISBN 978-1-950492-46-6. - S. 231-235.

80. Hyksová,H. Stoffová,V. Teaching practically oriented subjects in a distance form In:ICERI2020 : 13th international conference of education, research and innovation :9th-10th November2020 :conference proceedings.-ISSN2340-1095.-[1.vyd.].-Valencia:IATEDAcademy,2020.-ISBN 978-84-09-24232-0.-p.6387-6396. (accessed 6.4.2021).
81. Burns, D. S, Dagnall, N., Holt, M. (2020). Assessing the impact of the COVID-19 pandemic on students' wellbeing at universities in the UK: a conceptual analysis. *Front. Educ., 5*, 204. doi:10.3389/feduc.2020.582882 (accessed 6.4.2021).
82. Stone, E. J. (2012). A Vygotskian Commentary on the Reggio Emilia Approach. *Contemporary Issues in Early Childhood, 13*(4), 276- 289. http://dx.doi.org/10.2304/ciec.2012.13.4.276 (accessed 6.4.2021).
83. Vygotsky, L.S. (1990). Imagination and Creativity in Childhood. *Journal of Russian and East European Psychology, 28*(1), 84-96. http://dx.doi.org/10.2753/RPO1061-0405280184 (accessed 6.4.2021).
84. Pisano, L.; Galimi, D.; Cerniglia L. A qualitative report on exploratory data on the possible emotional/behavioral correlates of COVID-19 lockdown in 4–10 years children in Italy. 2020. [Preprint] PsyArXiv. Available from: https://psyarxiv.com/stwbn (accessed 6.4.2021).
85. Callahan, J.L. (2020). Introduction to the special issue on telepsychotherapy in the age of COVID-19. *Journal of Psychotherapy Integration, 30*, 155–159. https://doi.org/10.1037/int0000231 (accessed 6.4.2021).
86. Farmer, R., McGill, R., Dombrowski, C. S., Benson, F. N., Smith-Kellen, S., Lockwood, A. B., Powell, S., & Stinnett, A. T. (2021). Conducting psychoeducational assessments during the COVID-19 Crisis: the danger of good intentions. *Contemporary School Psychology, 25*, 27–32. https://doi.org/10.1007/s40688-020-00293-x (accessed 6.4.2021).
87. Humphreys, K. L., Myint, M. T., Zeanah, C. H. (2020). Increased Risk for Family Violence during the COVID-19 Pandemic. *Pediatrics, 146* (1), 1-5.
88. Golberstein, E., Wen, H., Miller, B.F. (2020). Coronavirus Disease 2019 (COVID-19) and Mental Health for Children and Adolescents. *JAMA Pediatrics, 174*, p.819.
89. YÖK. Basın Açıklaması. Retrieval address: https://www.yok.gov.tr/Sayfalar/Haberler/2020/universitelerde-uygulanacak-uzaktan-egitime-iliskin-aciklama.aspx. (accessed 6.4.2021).
90. UK Government Publication, https://www.gov.uk/government/publications/higher-education-reopening-buildings-and-campuses/higher-education-reopening-buildings-and-campuses (accessed 6.4.2021).
91. Middlesex University https://www.mdx.ac.uk/study-with-us/autumn-2020-coronavirus (accessed 6.4.2021).
92. Miller, C. (2021, March 14). Online Education Statistics. Retrieved from https://educationdata.org/online-education-statistics (accessed 6.4.2021).
93. Mystakidis S, Berki E, Valtanen J (2021), Deep and meaningful e-learning with social virtual reality environments in higher education: A systematic review, Applied Sciences, 11 (5) (open access).

94. Berki E, Chaudhary S, Panteri M, Valkanou T, Valtanen J-P, Bamford J, Zolotavkin Y, Plevraki A, Li L, Holcombe M, Staples G. Guidelines and Multidisciplinary Knowledge Advice for Cyber Protection in e-Learning: Hey, Teachers! Don't Leave the Kids Alone Online! e-Proceedings of Ross M et al. (Eds) INSPIRE 2021 Online International Conference 21-23.6.2021 (this tome of the conference e-proceedings).
95. Georgiadou, Elli, Rahanu, Harjinder, Siakas, Kerstin V., McGuinness, Claire, Edwards, J. Adam, Hill, Vanessa, Khan, Nawaz, Kirby, Padraig, Cavanagh, Jerald and Knezevic, Ratko (2018) Fake news and critical thinking in information evaluation. WBILC2018 - Proceedings International Scientific Conference "Western Balkan Information Literacy": Alternative facts, Fake News, getting to the truth with Information Literacy, 21-22 June 2018. In: Western Balkan Information Literacy Conference WBILC 2018, 21-22 June 2018, Bihac, Bosnia and Herzegovina. ISBN 9780954158279.
96. Donahue, A.K., Eckel, C. C., Wilson, R.K. (2014) Ready or Not? How Citizens and Public Officials Perceive Risk and Preparedness, The American 332 Review of Public Administration, Sage Journals, Vol. 44, Issue 4_suppl, page(s): 89S-111S.

Authors Index INSPIRE 2021