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e-Learning as a Solution during Unprecedented Times in the 21st Century

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This volume contains the edited proceedings of papers from the twenty fifth International Conference on Software Process Improvement Research, Education and Training, INSPIRE 2020 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 2020 has attracted papers from international sources, covering a broad spectrum of practical experience and research. The topic areas include e-Learning in the UK and Scandinavia, use of e-Learning and tools for schools, HE and the wider public, augmented reality, virtual laboratories, social media, programming in schools, gamification, cyber security in teaching and learning, multi choice assessments, case studies in use of e-learning in 2020 in various 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.

We would like to thank the many people who have brought this twenty fifth 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.

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The Editors

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Keynotes

How e-learning has developed in the UK during 2020, and where it might go in the Future

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Abstract

This article discusses the challenges faced by UK universities in the wake of the Covid-19 pandemic which began in March 2020. It captures a perspective at a point in the summer of 2020 when universities had made it through the 19-20 academic year, and are planning for 2020-21 and beyond. It discusses the overnight transition to online teaching, the challenges in planning for teaching in Sept 2020, and articulates some hoped for benefits for the future as a result of the pandemic.

Keywords: e-learning, Pandemic, Covid-19, Higher Education.

1.0 Introduction – lockdown to present day

In the UK, lockdown began on 23rd March 2020. On Friday 13th March, universities knew lockdown was coming but it was unclear when. Most universities had only a few weeks of teaching left, so hoped to teach for another week or two in order to limit the impact on that semester's teaching, however the situation changed very quickly that weekend, and few were able to continue for another week. At Abertay University, the last teaching day on campus was Monday 16th March and overnight it went online from Tuesday 17th March.

Alongside most higher education institutions in the world, Abertay University transitioned to "Emergency Remote Teaching" [1], a term coined very rapidly by the sector to draw a distinction between high-quality online education and the pedagogy that was possible overnight, generally classroom teaching put online, which would not be the chosen approach given time to prepare. At Abertay, for those as yet unfamiliar with how to record their lectures, guidance was provided overnight on a simple approaches to achieving this, such as how to record audio to PowerPoint slides. Both staff and students went online overnight, as did most of the sector, using technologies already in place such as an institution's Virtual Learning Environment (VLE), to support staff – student communications. It was an extraordinarily smooth transition. At Abertay, the vast majority of the students followed the staff online and many staff later reported increased engagement from

their students, the captive audience of being in lockdown and not having to commute to the campus, being two reasons offered by staff.

Everyone had seen their "normal" world turned upside down. Many staff at Abertay also noted the importance of not just continuing to teach students online, but also taking time to share experiences and thoughts about the current crisis, in a rapidly moving situation, with students, many of whom understandably needed to share their experiences with their colleagues. There were of course students with extremely challenging circumstances, for example, family members with Covid-19, financial worries due to loss of their jobs, lack of equipment to engage online and home schooling demands. Most universities tried to help students with equipment, for example by loaning them laptops etc. but they had to prioritise equipment for staff to ensure they could continue to work from home. Many were unable to help all their students, especially as the world went online and time to purchase laptops increased [2]. In terms of students' mental health, support mechanisms and counsellors endeavoured to provide online / phone support however some students were unable to find somewhere private to talk in their own home. Many used their one daily exercise slot to make a call, others hung on for a face-to-face session with a counsellor.

At the start of lockdown, new information and advice was emerging daily from a variety of sources, such as the Government and Sector bodies, all wanting to help. The world was entirely new, most university staff found workloads significantly increased, not only was everyone trying to continue to run their university remotely, as normal, there was considerable additional work to do as a result of the pandemic. An example of this was the concept of a "No detriment" policy which swept the UK sector. As defined by the National Union of Students "A 'no detriment' policy acts as a safety net to ensure students obtain at least their average grade so far. Put simply, the grade students currently have is the lowest they can achieve." [3]. Whilst in concept this would seem fair given the circumstances, however it is potentially a license for students, happy with their current grades, to put their feet up and do nothing more for the remainder of their semester, potentially not meeting the learning outcomes of their modules. For many programmes, the concept was also in breach of PSRB (professional, statutory and regulatory bodies) regulations. In the UK, where the quality of University provision is overseen by the "Quality Assurance Agency", they were understandably providing sector guidance offering guarded statements which included "Awarding bodies have a responsibility to protect the academic standard of the qualifications they award" and suggesting Universities ask themselves reflective questions such as "Do you have reliable evidence that the student has achieved the intended learning outcomes?" [4]. However, the advice from sector bodies was often too late given the pressure the sector was under to explain to students what changes were being made to complete the academic year. With Universities being under pressure from students and the media, a variety of "No detriment" policies swept the sector, but they varied greatly in how they worked, often for good reason in that universities were at different stages in their semesters, and had different volumes of work and grades to judge the performance of a

student prior to lockdown. For the most part the policies seem to have found the right balance in upholding standards and supporting students to achieve their potential, noting that some students were able to perform better in online assessments than in traditional exams.

Revising regulations at a pace behind the scenes, was just one additional activity universities had to work through. There was a huge amount of advice from a wide range of bodies, and invitations to many meetings to share experiences so sector bodies could understand the challenges and provide ongoing advice. However, capacity to engage in many similar discussions became more and more limited, to the point most university managers had to filter quickly what it was important to engage with, and as above, whilst the advice was appreciated, it often arrived too late to impact a decision that had to be made quickly.

All universities have moved their face-to-face meetings to virtual ones. And for the most part it has worked. Netiquette developed quickly, for example ensuring microphones are switched off when not speaking to reduce feedback, or switching both incoming and outgoing video off when internet bandwidth was low.

2.0 Planning for the Academic Year 2020-21

The UK has a large population of international students, as do many other countries such as Australia, USA and Canada. Since lockdown began, many organisations had undertaken regular surveys of international and home students to establish if their plans for higher education study in the UK from September 2020 had changed. Reports of intended participation varied however there was a consistent message that the expected number of international students would be significantly lower than planned for. Coupled with the likely loss of income from other sources such as student accommodation fees and conference income, some universities were reported to be facing a financial cliff edge [5]. The home student numbers are predicted to hold up however they cannot compensate for the significant loss of income from reduced numbers of international students coming to study in the UK (one reason being that there are restrictions regarding the allowable increase in numbers any one university can take [6]). There are concerns that the impact could be so severe that some universities may not be viable going forward, even if supported by loans and other financial support available, for example from banks and the Government. Restructuring universities to cope with an enormous and sudden loss of income is not quick however the sector has already seen many measures implemented such as temporary pay freezes, promotion freezes, temporary pay cuts by senior staff or all staff except for the lowest paid, and the loss of hourly paid staff and those on zero hours contracts etc. [7].

In terms of the teaching and learning challenge, classroom pedagogy put online was acceptable in an emergency but not going forward. The sector has to step up a

notch, however it is recognised that a high quality online distance provision takes longer than a summer to prepare, from a standing start, especially when staff need to have a break and take some annual leave. Most institutions are providing additional guidance to staff and students on how to teach online and how to learn online, alongside a wealth of good sector practice already published. There are however additional challenges to ensure the right systems and technology are in place to support a good quality online learning experience, and it takes time to procure, install and train staff on new software.

There is often a perception that online distance learning is low quality [1] and therefore the fees for online study should be reduced. Some providers have done this in the past however, most academic staff will find that providing even a good quality (as opposed to high quality) online distance learning experience, especially when it is new to them, requires more work than they have been used to, when preparing for face-to-face teaching. An additional challenge is that students, having not chosen to study some or all of their higher education online, will also likely need more support to achieve their potential. So where will this additional resource come from given universities are generally losing not recruiting staff, in this tough financial environment? It is likely that some of that resource will impact research and knowledge exchange activities which will be reduced in order to devote more time to preparing for online teaching.

Many research and knowledge exchange activities have already been severely impacted with months of experimental work lost from labs when lockdown began. Many PhD students in the middle of experiments have also lost months of work and researchers who were on fixed term contracts have not had them renewed. Samples have also been lost from fridges which broke during lockdown and could not be rescued in time. There is real concern in the sector about a “lost generation of researchers” [8] which will hit UK universities hard in the longer term as those researchers are forced to seek work outside academia. An additional challenge relates to an early analysis of publication submissions to journal which has also shown that females in particular have been hit hard by the pandemic, with many editors are reporting an increase in submissions by males and a reduction by females. The general conclusion being that women traditionally take the lion’s share of household duties and caring responsibilities [9]. All this will leave a significant long-term impact on people’s careers and research outputs. Universities need to consider hard how to help mitigate the effects.

Virtually all UK universities are planning some on campus experience in the 2020-21 academic year however, a university experience is so much more than just the teaching and learning, students come to university to meet other people, make lifelong friends etc. and it is unclear how many extra-curricula activities will be possible but it is hoped that more virtual clubs and societies might help to mitigate some of the impact. In terms of the ability to teach on campus face-to-face, with social distancing rules in place, universities across the UK are planning for between 1 and 2 metres social distancing (devolved nations have different rules) which significantly reduces a room’s capacity, typically to about 20% of a normal

room capacity for two metres social distancing and 45-50% for 1 metre, however the capacity depends on the size and shape of the room, the location of entry and exit doors etc. This means classes will need to be duplicated in order to teach an entire cohort of students on campus, who no longer fit in to the same room that they used to. The implications of this are that either one member of staff has to undertake a lot of duplicate teaching, or it needs to be spread amongst additional staff, who of course need to have the required expertise. There are a mass of other considerations in timetabling such as trying to limit the number of times students travel to campus to reduce their chances of picking up the virus on public transport, trying to keep students in the same "bubble" for both teaching and accommodation, so that if one student does become infected, it will hopefully limit the spread of the virus to that bubble/group [10]. This might mean it is better to timetable groups of students by cohort than module, for a block of time on campus but it is challenging to deal with option modules if groups of students have not all chose the same set of options. Other complexities include, both staff and students needing to remain at home to shield themselves or to protect vulnerable members of their family which, if these students are to be supported, would mean an entirely online version of all modules needs to be provided. Some home schooling may remain from Sept 2020 in which case both staff and students find teaching / learning during the day more challenging than in the past. It is clear that if all the needs of students are to be supported then all teaching materials need to be online, which then provides academics with a challenge about how to provide a meaningful experience in a socially distanced classroom for students able to attend. Duplicating a lecture on campus which is already online, is unlikely to be the best use of face-to-face classroom time as, in the current circumstances, it is unlikely that students would attend campus to hear it again. A primary mode of learning is through discussion and social interaction [11], but undertaking group work in class will be hard if all members of a group are sitting 1-2 metres from each other, and projecting their voices in order to be heard by a local group or the entire class, could also help spread the virus across a room quicker [12]. Should any university go into lockdown during the next academic year – local lockdowns have already occurred in the UK - it will be important to have identified the skills development and assessment that can't be done online so these can be prioritised when a campus reopens, for example, laboratory skills which cannot be replaced by simulations. Note that the issues discussed here only scratch the surface of the complexity involved in the planning for timetabling and teaching in the 2020-21 academic year.

3.0 Conclusions and the Future

In terms of e-learning in UK universities, there are some potential benefits from the pandemic, for example academics will likely feel more confident about the use of technology in teaching and will have learned skills they didn't have before. However, whilst many will embrace new technology and be happy to continue to try out new technologies and ways of working, many will remain uncomfortable in

that domain, however it is hoped that academics will continue to experiment with how technology can continue to support teaching and learning going forward. For example, some may retain the concept of a flipped lecture in order to reinvent how they use of that precious staff/student time in a classroom.

Although as referenced above, many people have the perception that online means poor or low quality [1], there are some learning experiences which can only be provided online for example simulations such as those provided by virtual reality, provision of a personalised learning experience and the ability of a student to learn at their own pace (in a classroom, students all generally move through the material in that session at a similar pace). Of course, equally, there are experiences that can only occur in the classroom, and going forward, it is hoped that academics will take with them the best of the online, to support the best of the face-to-face, in order to provide the highest quality teaching and learning environment for future on campus students, post-pandemic.

If some online remains to support a campus-based face-to-face provision, then universities will also likely offer a broader range of study modes in future than has traditionally been the case, however the quality of the online provision will likely need to be higher than most will achieve in the 2020-21 academic year. If delivered, UK universities will be able to cater for a wider variety of study modes and hopefully to a broader audience, perhaps providing more capacity to switch modes during studies or study in mixed modes in future e.g. studying half the modules on campus and half online (perhaps because of a clash with work commitments).

Only time will tell. For Abertay University students, it is clear already that some are relishing the new flexible mode of study online, and others are not – one size never fits all - but it will be interesting to see how learners change in future having had no choice but to adapt the way they learn to this new world we all live in. Given the predictions regarding the automation of jobs in future and the mantra around the need for constant reskilling and upskilling going forward [13], it has been clear for a long time that much of that future learning through life will be online, often delivered direct to the workplace, and delivered just-in-time etc. so helping our students to learn how to learn online, is perhaps a skill that cannot come too soon.

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Reflections on e-Learning in the Time of Coronavirus: The Nordic Experience and Ethical Considerations - Back to the Future with *The e-Learners Manifesto*

Keynote Talk-Based Paper

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Abstract

A new social distancing reality and new distance learning challenges were created by the new Covid-19 virus and the threat of its further spread. This research study critically presents the collaborative ways that *formal*, *non-formal* and *informal* education invested in e-learning technologies and virtual communication platforms to respond to *the new social/learning normal.* A compare and contrast approach with social software quality criteria will build upon presenting *the Nordic countries' experiences* through summary statistics, formal reports and public media news. The presentation will first outline highlights of distance/e-learning strengths and weaknesses as evidenced in governmental strategies and teachers trade unions' actions during the era of Corona-virus. Critical points and pedagogical considerations will be presented along with a roadmap for i) alleviating potential e-learning socio-economical obstacles, and ii) increasing educational opportunities with Open Educational Resources and social software. Concluding, privacy and cyber-security threats along with ethical considerations in the online presence of people/e-learners are scrutinised in order to underpin the need for a manifold thinking manifesto for the quality of learning and people's well-being in the new socio-virtual reality.

Keywords: Nordic countries, Covid-19 pandemic, preparedness and readiness, social distancing, e-learning and social software, software quality and well-being management.

1.0 Introduction, Aims and Motivation

During the problematic times of the current pandemic of Coronavirus the Formal (organised by the State), Non-formal (training and work-based) and Informal (e.g. incidental, edutainment-based) learning [1] worldwide were forced to quickly adapt to flexible, online modes of delivery. Further, a new flexible and agile set of digi-didactic principles served as the new teaching normal while online learning instructors were (not) guided to consider new/old pedagogic methods, communication tools and dissemination technologies in cyber-digital worlds and virtual learning communities.

It has recently been claimed that, in the broader e-learning context and online/virtual practice, what had always been discussed but never realised for the last twenty years was rapidly and rather efficiently implemented in a flexible and 'agile quality' way in just a few weeks!

Such a rapid development, deployment and use of e-learning environments [2], e.g. the use of Massive Open Online Courses (MOOCs) [3, 4, 5] worldwide, gave rise to public concerns and social awareness [6] regarding, among other, the following: i) the safety of the online premises [7], ii) social software for socio-constructive learning [8, 9], iii) openness [3, 4, 5, 8], iv) privacy and cyber-security [10, 11, 12], v) learning process improvement and effectiveness [13, 14, 15, 16, 17], as well as the vi) understanding and vii) realisation/implementation of the content management and software quality management concepts [18, 19, 20, 21] by the learners, citizens and netizens.

1.1 What's in a Title? - What's the Problem?

Replying to a question with a question might not sound a promising start; but is there another better way!? The main motivation of this conference keynote talk-based paper title is rooted in two (well, perhaps more!) works of art; both briefly mentioned below.

a) One source of inspiration is the book "Love in the Time of Cholera" (1985) by Nobel Laureate (1982) Colombian author Gabriel García Márquez (1927-2014). "**The problem in public life** is *learning to overcome terror; …*" writes Márquez in that book. Naturally, other inspirational quotes of Márquez also came to mind while writing these lines and are also placed throughout the paper.

b) The other source of inspiration is the film trilogy "Back to the Future" (1985) by R. Zemeckis, B. Gale and S. Spielberg. **Another problem in private/secret life** described in the film's advertising film poster is: "He was *never in time for his classes*... He wasn't *in time* for his dinner... Then, one day, ... *he wasn't in his time at all.*" In so thinking, taking a *timely* decision whether learning (or e-learning) and schooling (or e-schooling!) are of our past, present or future time is not that simple! Otherwise, *Learning in Time* is/not everything, and that could be the problem! Notwithstanding, other relevant films are also mentioned throughout this work.

The dimension of time and the aspects of timing fed the motivation and individual desire for further questions for i) timely learning, ii) learning in (the right) time and, most importantly, iii) lessons learned. Consequently, the research aim and personal ambition have been to inform and critically comment on the reality and

virtuality of Open/Distance e-Learning. The Nordic countries' practices and actions during the past few months of national lockdowns are taken as a focal point of reference.
Considering in general the appraisal and criticisms for the latest convenient (because of the Covid-19 virus) types of learning worldwide there still seem to be pitfalls and issues in a) socio-technical design and b) real learning needs capture. These are mostly related to the educational aims set to holistically address ethical e-learning technologies, virtual education, digital edutainment and online game-based learning in the curricula design and in society. Additionally, the citizens' safety and privacy along with other human rights are at stake [10, 11, 12, 22, 23, 24]. Consequently, there is a further urgent ethical need to create something stronger than a future cost-effective, industrial and societal roadmap for e-learners and e-citizens: we need *the e-learners-centred design manifesto,* which should lead to e-citizens *empowerment with manifold thinking* for their *well-being.*

1.2 What's in the (Rest of this) Paper? - *Learning in Time!*

This paper is based on the invited keynote talk for The 25th Anniversary of the British Computer Society INternational Software Process Improvement in Research, Education and training INSPIRE 2020 conference. The talk was delivered online on Thursday 16th of July during the INSPIRE 2020 conference. The rest of this paper's content is organised as follows.

First, there is a brief *historical perspective* on worldwide health hazards and perceived dangers and their associations to enforced social distancing, remote schooling and distance learning practices. Next, the Nordic countries distance learning and schooling management experiences during the Covid-19 crisis are outlined, compared and contrasted along with lessons learned for preparedness and readiness. The last two were somehow reached through agile and/or well-planned process improvement approaches where a highly responsive and participative decision making process following by speedy action for realisation was required.

A discourse on the re-organising of e-learning following a *manifold (*meaning *creative*, *critical*, *reflective* and *caring/ethical)* thinking [25, 26] strategy will finally be presented. The latter is considered along with a future strategy/manifesto for the social/virtual boundaries, educational bottlenecks and equal opportunities of digital learning within its socio-economical context, particularly in times of crises like the current one of Coronavirus.

2.0 The Society's Well-Being: Distance Schooling and Learning in Perceived Dangers and Health Hazards

In public health, **social distancing**, also called **physical distancing**, is a set of non-pharmaceutical interventions or measures intended to prevent the spread of something contagious, e.g. a disease (or, sometimes, a contagious idea) by maintaining a physical distance between people and reducing the number of times people come into close contact with each other. It typically involves keeping a

certain distance from others (the distance specified may differ from time to time and country to country) and avoiding gathering together in large groups [27]. Historically, from the ancient until modern times there have been events like wars, health hazards and perceived dangers that enforced social distancing with or without remote schooling (see examples in [28]). In these situations the learners had to follow certain procedures, and obey specific rules. Research on aspects of stress-resistance, coping, and resilience of children and adults as learners became the main research focus themes of many researchers from a variety of scientific disciplines including medicine, biology, archaeology, political/social science, educational sciences, (educational) psychology, social anthropology and other. Some representative examples of research about distance learning in these diverse scientific domains will be made available herein, too.

In so doing, many researchers dedicated time and efforts to find out *when* and *where* did the hazard or/and turmoil start, the *conditions of living and learning* therein, *how long* did they last as well as *what triggered* and *what ended* them. It is also very important to consider the following research question: *Which were the most affected countries in turmoil (e.g. during pandemics) and why (these only)?* For society it is also of great research significance to find out *who* and *what* guided humanity to safe life, secure interaction and healthy survival. *How were the latter realised under exceptional circumstances like the Covid-19 crisis? Were any of these related to open/close and/or distance learning increase, and how did the affected groups experience schooling?* Sections 2.1 and 2.2 provide some research-based answers to these questions and, in the light of this knowledge, section 2.3 sets the new research questions for the present worldwide state of learning in the time of Coronavirus.

2.1 Perceived Dangers for the Well-being that Enforced Social Distancing with Social Exclusion and Remote Learning

There were many cases in the recent history of humankind where *enforced social distancing* and/or *enforced social exclusion* were combined with distance schooling and/or distance learning, with the official support of the State. Social distancing and social exclusion with or without distance education (if and when were considered necessary) were historically approved as viable and necessary solutions. Hence, socially excluded individuals were accommodated in specially isolated spaces, e.g. sanatoria premises or isolated schools in prisons or in exiles of political activists, in war and peace conditions [see 28, pp. 24-43] and the list can go on.

In so reflecting, worldwide, when leprosy was mistakenly considered as a fatal contagious disease and during the times of lepers colonies in history, the existence or the absence of learning and schooling therein had raised many controversial discussions. Two of those lepers' colonies existed, in different centuries, in the mysterious islands of *Själö (Seili)* in the Nordic Archipelago [29] and *Spinalonga*, in Crete [30]. The first island also hospitalised patients with mental disorders as a psychotherapy hospital [29]. Both the first (during 17th -20th centuries) and the

second (during 18th-20th centuries) have, respectively, been notable examples of the absence and/or the existence of school-based learning and other forms of remote informal learning for the ill people/learners in enforced social exclusion.

Social isolation combined with remote disciplinary schooling with limited mail communication for children whose parents were socially excluded (imprisoned) as political activists during the Greek civil war (1946-49) is described in detail by researcher **A. Mando Dalianis-Karambatzakis** in [28]. The research is a longitudinal study carried out in Karolinska Insitutet and Lund University, in Sweden. The researcher, who served as a pediatrician and was a political activist and prisoner herself, in her exact wording, as the children's doctor, observes the following: … most of these 52 (11 still exist) large children's "villages (simple barracks, poorly equipped, with primitive sanitary facilities) were equipped with a school. There were some villages for *primary education*, others for *vocational training* … Military discipline was applied and corporal *punishment* was used for *'educational purposes'*. Since the *schools were situated in the countryside*, the children were *isolated from normal society*. They could *only communicate infrequently* by letter with their mothers in prison, their fathers, if alive, and relatives." [28, pp. 21-22]. The italics in the text written by the researcher **A. Mando Dalianis-Karambatzakis** are the initiative of the author of this paper for focusing on the relevant research items.

Notwithstanding, and perhaps unamazingly, social distancing and distance learning of the recent past is somewhat similar to both social exclusion and distance learning of the present. They, however, differ in reference to the practices and perceptions of what has been considered as a contagious hazard or infecting danger in society.

2.2 Health Hazards and Turmoil Enforced Distance Schooling and Learning with or without Social Distancing

Looking back to the recent past (20th century) one easily understands that state-based or formal education has mostly been combined with school-based learning. In the light of this evidence, educating in school premises as in the 1918 pandemic, brings along many lessons learned from the recent past and the particular pandemic. According to **Mary Battenfeld**, Clinical Professor in Boston University, some of the 1918 pandemic important recommendations and guidelines were the following [31]:

1. Invest in school nurses,
2. Partner with other authorities,
3. Tie education to other priorities.

Naturally, all of the above can always be very relevant!

Figure 1: Covid-19 Influence on Global Education Feb-Apr 2020 [32]

From the most recent pandemic of Covid-19 one can only be certain about the immense impact on a high percentage (67,6 %) of total enrolled learners and have been affected by the national school closures worldwide. Figure 1 illustrates this clearly, providing statistical data between February and April 2020 from the UNESCO website [32].

It is natural to consider a learning (an e-learning) shelter in the Internet. When natural communities are in danger people find virtual shelters [33] because they are longing to interact and learn courageously and with safety. Life and learning and life-long learning (must) continue in times of devastation. During his speech at the 1982 Nobel Prize ceremony, G. G. Márquez said: *"To oppression… we respond with life."*

During the bombing of NATO in Yugoslavia in the 90s, the presence of online formal and informal virtual communities significantly increased from the simple existential need of people in the natural war shelters to communicate with others. Their virtual communication happened unofficially or officially through the states of anonymously, eponymously, pseudonymously [33] and various other creative ways of expressing their online identity and authentication. **S. Antonijevic** was at a time a graduate student in the Department of Social Anthropology in the School of Philosophy at the University of Belgrade. In her published online paper [34] *"Sleepless in Belgrade …"* the results of research on the role of a *virtual learning community* during wartime were reported in the periods before, during and after the NATO bombing of Yugoslavia. The community had gone through significant changes during the War, with the number of participants increased while the users spent much more time online noting that the reason for communicating changed dramatically. "*During war, online efforts focused on information gathering, social interaction and the expression of political opinions. In a period of crisis strong*

interpersonal relationships were established within the studied online group". [34].

The researcher concluded that *"in such state of affairs the Internet became an important source of information"*. Nowadays, it is amazing to think the latter, but then again at the end of the 90s and beginning of 2000 there was still not so much rise in fake news dissemination. Perhaps, the existence or/and physical destruction of controlled mass media (e.g. TV, radio, newspapers) news during the war resulted in turning to other forms of finding and exchanging reliable information. Therefore, under those circumstances, the Internet proved to be the last reliable resort for the learners and citizens.

Hence, because of the possibilities of their virtual presence anonymously or eponymously, or even with more virtual identity management possibilities [33], socially excluded people could still be socially present and active within their social groups given the fact of the connectedness and the absence of the digital gap or/and digital competencies. It is still up to the latter if the social inclusion can happen within the cyber boundaries of our e-learning or online presence in general. Social awareness for privacy protection mechanisms (e.g. identity/image management and steganography) with or without learners' control and citizens' surveillance [12] is an intriguing and multifaceted question.

2.3 What/Which Research Questions to Ask Regarding Open and Distance Learning?

Social distancing is, once more, enforced but many students do not obey the rules. Why? *"How should students who refuse to social distance be handled? Failure to act robustly risks legal, reputational and financial consequences for universities"*, says S. Matthews [35] and opens up a hot topic discussion in Twitter [36]. Since the right questions provide the right answers, the questions that follow below expose exactly this perspective.

A number of additional (to the previously stated research questions at the beginning of section 2.0) should be asked in order to lead the researchers from various scientific disciplines to the suitable research outcomes and answers within their research purpose and scope. Next, some of these questions that were also utilised herein, are presented.

In the absence of TV, telecommunications, Internet:

- How did information and knowledge dissemination happen?
- How was the reality reported, described, avoided, praised?

In the absence of Internet, ICT, e-learning/m-learning:

- Were there any learning? Any teachers? Any students?
- How were schooling and learning organised?
- Which countries outperformed? Why (these only)?

3.0 e-Learning in the Nordic Countries during the Covid-19 Crisis, Mar-Jun 2020

Notably, all five Nordic countries outperform in exercising social/physical distancing and distance schooling. Social distance and remote education/communication practices and technology-based learning/interaction are among shared values, social norms and traditions.

Much attention to the five Nordic countries was paid during the Coronavirus crisis. The practice and success (or failure) of the measures taken somehow varied and that alone brought controversies and unavoidable criticisms and comparisons from and to the Nordic region countries but also from other countries worldwide. The latest comment was publicly given on the 7th of August 2020 by the previous **President of Finland Tarja Halonen**, who praised women-led Nordic and other countries in dealing with the corona crisis: "Sweden does not seem to be doing very well" [37]. The rest four (4) of the Nordic countries have women Prime Ministers.

Figure 2: The Five Nordic Countries

Attention to the different policies in the Nordic region started already when **Elena Sanchez Nicolas** reported from Brussels, on the 15th of April 2020, on the following facts [38]:

- In Denmark, they were expected to start re-opening some kindergartens and schools from this week, although children should be at home if they were in contact with someone who was ill.
- Additionally, Finland had recently extended the restrictions on face-to-face teaching until 13th of May, while the country was preparing for school closure until the end of the term 30th of May 2020.

- Meanwhile, primary and lower secondary schools had remained open in Sweden; they had been open since the beginning of the Covid-19 crisis.

The next five sections provide summarized information [39] on what happened in various learning communities of the five Nordic countries, spanning formal, non-formal and informal education.

3.1 Sweden: A Mixture of Open Schools and Distance Learning

The education trade unions focused on emphasising the role and safety of their union members (educators), since schools remained mostly open. While local authorities had a mandate to call for school closures, trade unions criticised this, and called for national guidelines on whether schools should be closed.

- Upper secondary and HE at some point closed; distance teaching/learning was realised.
- Education International's affiliates – *Lärarförbundet*, *Lärarnas Riksförbund* and the Swedish Association for University Teachers and Researchers – provided and continue providing up-to-date information on developments with links to the website of the education directorate (*Skolverket*).

3.2 Norway: Cooperation and Communication

The three member organisations of Education International's in Norway – the Norwegian Association of Researchers, *Skolenes Landsforbund* and *Utdanningsforbundet* –were consulted and cooperated with the government prior to the adoption of crisis packages by the Parliament. The education workforce was well protected and (for the time being) has financial security.

- All schools, kindergartens and universities were closed, as part of emergency measures that lasted until April.
- Unions and their members stood together, built trust and showed social responsibility. Communication is vital and the unions cooperated with the education ministry and employers to provide professional advice to educators.
- Students and teachers had access to whatever equipment they required and were using educational and school-based platforms.

3.3 Denmark: Online Assistance to Union Members

The Danish National Federation of Early Childhood and Youth Educators, the Danish Union of Teachers, the *Dansk Magisterforening* and the *Gymnasieskolernes Laererforening* – affiliates of Education International – immediately decided to set up informative and easily accessible webpages focusing on educators' rights and other practical information.

- The online resources gave (and continue giving) critical advice related to health and on how to interact with children.

- The websites of the educators unions also outlined ways for members to continue their teaching during the school closure. A sufficient number of links to the websites of local education authorities and UNICEF were provided and members were encouraged to follow all official advice on the COVID-19 crisis.

3.4 Iceland: LL e-Learning, Adult Education and Edutainment

The LifeLong Learning (LLL) and Adult Education Centres offered online courses on physical exercises, job-related and for fun lessons and courses teaching people to relax. The following are facts recorded in [40].

- Idan Education Centre, which provides training for Vocational Education Training (VET) professionals, had made courses available to its target group. The most popular was the funny "breaks on a Friday" provided by comedian Ari Edjárn. He worked from home, equipped with a laptop and a bottle of sanitizer.
- Many teachers of the Universities of Iceland and Akureyri held *online educational camps*, where they shared useful tools and techniques for online teaching.
- Students of psychology offered online consultations for their co-students and their families, who were/had been suffering from various forms of stress and different anxieties.
- Private Initiatives - a mother and her son developed courses for elderly people on the utilisation of all sorts of online tools; simple YouTube videos.

3.5 Finland: Dialogue on Distance Learning, Day-Care, Duties, Special Needs

On the 16th of March the Finnish government announced a state of emergency. Nationwide school closures to help prevent the spread of COVID-19 started on the 18th of March and were set to continue until the 13th of May. Day-care centres stayed open but parents were asked to keep their children at home if possible.

- Parents in jobs critical to the functioning of society could send their children to specially arranged care.
- Adjustments to the quarantine of students with special needs were made available.
- Most education was delivered via distance teaching/learning.
- Educators retain their salaries and rights when they transfer to distance-based teaching.
- Distance work and e-Learning for the teachers becomes a new (virtual) reality.

The Finnish teachers trade union *Opetusalan Ammattijärjestö OAJ* [41] was fully supportive of the Government's decisions and participated in discussions for schools closing. Two key issues were:

- Distance teaching requires particular competency, knowledge, equipment, programmes, and *education of teachers* themselves. Whilst many teachers were familiar with distance-based learning, it was a new experience for others. The OAJ said that employers must ensure that every teacher has adequate skills and equipment to teach.
- In the collective agreements, employers have a right to define where a teacher should undertake their work. Some local authorities told teachers to deliver their distance teaching from the school premises. OAJ tried to convince employers to allow teachers to work from home.

As Finland adapted to *the New Normal* and Finnish teachers moved classes online, family routines changed and parents role became crucial, having to actively support their children in (new ways of) online learning [42]. Some Finnish Universities also started applying distance and online learning practices due to the Coronavirus situation [43] and eventually they all moved online. The majority of online learners at all levels of education seemed to rather like the situation [44] no matter the difficulties it created to teachers and parents. Some HE institutes (e.g. Tampere University) observed that their students participated more actively and also collected more study credits than before.

4.0 Handling the Covid-19 Crisis in the Nordic Region - Similarities and Differences

There exist various differences and similarities among the Nordic countries and also between them and their neighbouring countries. Hence, their (re)actions in general and during the Covid-19 pandemic situation in particular also differ [45, 46]. Before going to explanatory details in sections 4.1-4.3 a general, required political description is outlined.

Three (Sweden, Norway and Denmark) out of five Nordic countries are a Kingdom with a Parliament and Prime Minister. The rest two (Finland and Iceland) of the Nordic countries are Republics with President of Democracy and Parliament and Prime Minister. Two (Finland and Sweden) of them are not members of NATO (North Atlantic Treaty Organization). Two (Iceland and Norway) of them are not members of the European Union while from the rest three (Finland, Denmark and Sweden) who are EU members, only one (Finland) is a member of the Eurozone. These political particularities alone bring along to consider various other socio-cultural and socio-economic practices.

4.1 Fundamental Reason 1: Differing Administrative Traditions

- Whereas Finland and Sweden have small ministries and rather autonomous administrative (e.g. in health and education) authorities, …
- ....the politicians were/are the ones who are more directly in charge of the administration in Norway and Denmark.
- Thus, it was/has been easier in Denmark and Norway to react quickly with political decisions - and even to overrule authorities and their expertise when it was/has been considered politically necessary.

- The Danish government, for instance, swiftly imposed restrictions and closed its borders even though the epidemiologists of the Danish Health Authority (*Sundhedstyrelsen*) said it was unnecessary.

4.2 Fundamental Reason 2: Different State Expert(ise) for the Citizens Well-being

- In Sweden, the state epidemiologist **Anders Tegnell** was/is more often on television than the Prime Minister **Stefan Löfven**, and he is considered the expert captain who will take Sweden out of the stormy health hazard.
- In Norway and Denmark, the Prime Ministers **Erna Solberg** and **Mette Frederiksen**, respectively, are the clear front figures with the main responsibilities.
- In Finland, Prime Minister **Sanna Marin** is also a front figure, but constantly emphasises that she follows the recommendations of the Finnish Institute for Health and Welfare, especially when the State Health experts are not present in the occasion.

Another difference is, perhaps, worth reminding here. Finland, Denmark, Iceland and Norway have women Prime Ministers. Gender differences in governmental polices have been commented though sometimes passed unnoticed. For instance, previous **President of Finland Tarja Halonen** referring to the handling of the Covid-19 crisis in the Nordic region expressed the opinion that countries with women prime ministers (e.g. Germany and Angela Merkel and most of the Nordic countries) handle the crisis better and that *women have a different experience base, which can help deal with a new kind of security risk like an epidemic* [37].

4.3 Fundamental Reason 3: Different Experts for the Crises

According to Henrik Stenius, the founder of the Centre for Nordic Studies at Helsinki University [47], the central expertise in crises situations are:

- *economists* in Sweden;
- *historians* and *philosophers* in Finland;
- *lawyers* and *historians* in Norway;
- *political scientists* in Denmark …

Reflecting on the above observations, one can only see how true is, at present, the fact that the Finnish people relate to their historical past and try to learn their lessons from that by philosophising and reconsidering the problems in the new situations. The Covid-19 crisis was often compared to the second world war by people and authorities and preparedness in war-like crises practices were revisited.

It is also true that Sweden, a nation that invented the Nobel Prize of Economics, pays a lot of attention to the good state of economy because this will guarantee the well-being of their citizens; and not what has been said that economy is over the

health of people in Sweden. A convenient comparison could be to those developed and developing countries, where during the Covid-19 crisis poor school children fainted from hunger [48] because their suddenly unemployed parents could not provide them with food. The increase of unemployment and poverty in national lockdowns, where physical health itself had to be prioritised (through also enforced physical distancing) created, among other inequalities, huge income differences and unjustifiable job losses with more people suffering financially and psychologically.

The Norwegian history, and especially the recent one of the Second World War, was never forgotten in Norway. The Norwegian film *"Kitchen Stories"* [49] is an account of the latter, demonstrating with bitter humour the war-related relations with the neighbouring Nordic countries. Also, for the Norwegians the laws are a source of regulation and Justice for the quality of everyone's life and this is particularly true when, during the Coronavirus crisis, countries like Finland and Hungary had to reconsider the power of specific laws for authorising their governments' specific actions regarding readiness.

Schooling and learning are, unavoidably, considered differently and handled differently in these state and governmental traditions. Notwithstanding, the researchers' and educators' trade unions play an important role in collectively interacting with the government administration for the learning process and the needs and well-being of their members and students in all Nordic countries.

5.0 e-Learning in the Nordic Region, Covid-19 - Issues Raised and Lessons Learned

The handling and management of schooling and learning in the Nordic Region brought up many issues on the discussion agenda along with valuable lessons learned. Many of them are worldwide phenomena with regular (re-)appearance and are summarized below:

- e-Learning and/or distance teaching are very *different* from just making video conferences and webinars.
- Interacting and engaging with students online, as well as assessing and evaluating them, require *specific pedagogic methods, safe tools, pedagogic expertise and socio-technical skills.*
- Conventional educational content cannot just be moved online – it must be adapted (e.g. to learning styles, needs, available infrastructure …); and … it does take time!
- Investing in school medical care and collaborating with doctors, nurses and school psychologists are of paramount importance.
- The parents' roles, attitudes and knowledge background are crucial factors in successful distant learning – perhaps this is not new, at all!

- Not all students, families and schools have reliable internet access; or car; or lunch meals; (or any food, or electricity, or home address, or home, … elsewhere!). For instance, in Germany, in the absence of Internet the schoolwork tasks were delivered to the addresses of the pupils by the teacher every day. In many areas in Nepal this would not be possible because of the lack of postal address system.
- Blended learning, suitable digital tools, security of the digital presence, availability of open/free teaching and learning materials can be the drive for the teachers, students and parents to be motivated, involved and committed to learning.
- Collective power for timely negotiations and progressive actions exist in the trade unions of the educational researchers, instructors and teachers. Consensus (where possible) and/or representative participation with frequent feedback cycles (to eliminate errors) in learning design processes are key success factors for holistic organisational learning.
- For the learner: In a 'breathing' curriculum, many times *less is more*! However, sometimes *less is not adequate*.

Three more important lessons learned are discussed and analysed next in more depth.

5.1 Important Lesson 1 (For the Present Learning Process): *Collaboration of Private and Public Sector for Open Educational Resources.*

Below is a summary on how this important initiative was praised in *Computer Weekly* by **Gerard O' Dwyer** on 16.4.2020 [50].

- *Coronavirus: Nordic digital educators collaborate with authorities amid pandemic.*
- Concerning closing the schools, teaching and learning moved fully online. To support the teachers and parents in this new situation, Nordic countries opened up their e-learning solutions for the world for free.
- Nordic education technology start-ups support education establishments in offering continued education.
- Leading Nordic e-education providers Sectra and Koulu deepen collaborations with national education authorities to deliver cost-efficient home schooling and remote learning.

It is true! In the Nordic and Baltic region e-learners have had access to 40+ remote open/free learning solutions; they are available online [51] all over the world! This is a win-win situation for all the stakeholders (providers, learners, teachers, parents, schools, government, OER creators/owners, …) because of the potential collaborative feedback for the educational materials' continuous improvement, availability, low or no cost, effectiveness and variability/richness in the learning

process and the list can go on. The times call for solidarity and there are many initiatives and ways to realise it.

5.2 Important Lesson 2 (For the Future Knowledge-based Society) – *Focus on Children and Learners: Defend the Child!*

The future of the country and humanity is guaranteed if the children/learners are protected and taken good care of. Humankind has hope if the children/future citizens everywhere are safe! The Finnish Government of **Sanna Marin** organised *the first* press tele-conference for children on the 24th of April 2020 (Figure 3). This was an online tele-conference [52] where journalists did not ask questions but children of various ages asked their own questions and the Ministers of Education **Li Andersson** and Science and Culture **Hanna Kosonen** together with the Prime Minister of Finland Sanna Marin answered the children's questions and listened to their worries. This was of great significance for the children because except them being learners in this crisis, they had also been participating in many different roles and their daily routines had dramatically changed.

Figure 3: Press Conference for the Children organised by the Finnish Government 24.4.2020

Finland just took one more initiative to continue its tradition for the caring of the child and the future. *The first* international symposium on Children and War was arranged in March 1983 in Finland, by the Geneva International Peace Research Institute (GIPRI), the International Peace Bureau (IPB) and the Peace Union of Finland. [28, p. 42]. The city of Tampere was also a UNICEF city in 2007; to name but a few significant activities on defending the children and the future.

There are many cultures and countries in the world that prioritise children and invest in education for their future. A traditional Masai greeting is: "How are the

children?" It is reassuring to know that there is future if the children are doing well. Thus, ensuring the children's/society's future is an obligation that must be kept in mind and constantly checked: How are the children doing? **Nelson Mandela** once mentioned that what the political prisoners mostly missed in prison were the faces of children, thus the hope for the future.

On the same grounds of optimism, Greek composer Mikis Theodorakis wrote the music for a poem by Lefteris Papadopoulos which contains the following lyrics: "… And when the time comes That the candle goes out In the storm *Defend the child* Because if the child escapes it There is hope." *(Original: "*Και οταν θα 'ρθουν οι καιροι Που θα 'χει σβησει το κερι Στην καταιγιδα Υπερασπισου το παιδι Γιατι αν γλυτωσει το παιδι Υπαρχει ελπιδα."). [53].

An appropriate question to ask next, is: *How (well) the countries defend the child, defend the security of the learners for the sake of their future*? Defense and safety are, normally, concepts that are associated with securing the future, though the responsibility for that is not, apparently or entirely, in the domains of learning and technology.

Traditionally Japan, a non-NATO country member, used to allocate to Education the same amount of the State's annual budget funds that are allocated for Defense. In so equally allocating, the government wants to make it obvious that i) there is care taken for the country's Defense, protection and future and ii) Education is as important as the Defense of the country. Finland and Sweden, also non-NATO countries, as mentioned earlier, normally allocate the biggest share from their annual financial budget to the Ministries of Education and the Ministries of Health and Social Affairs, while the Ministries of Defense have a proportionally much lower share. This is not the case, for instance, with Greece, a NATO member country, where the Ministry of Education gets a small amount of money from the annual financial budget and the Ministry of Defense gets the lion's share for expenditures in military equipment.

Therefore, defending and protecting the child through learning (technologies) can have very different practices and interpretations in different socio-political and socio-cultural contexts.

6.0 The Most Important Lesson: *Equality is not, Necessarily, Justice!*

The five Nordic countries are some of the world's most equal on a number of quality measures and world index metrics. They often are the top ones in the Transparency International list for Trust or in the world' s index of Happiness or in the PISA (Programme of International Student Achievement) learning results. It makes, therefore, sense to look into these countries for lessons on how to build a more equal education and society. For the needs of his film *"Where to invade next"* [54, 55] film director **Michael Moore** included in his European tour two

Nordic countries, Iceland and Finland. He chose to discuss with particular people and reached his own conclusions, after investigating gender issues, politics, equality, justice and education and well-being of school children.

- **In Iceland:** *women in power;* speaking with **Vigdís Finnbogadóttir**, the world's first democratically elected female president; the Best Party with **Jón Gnarr**, being elected Mayor of Reykjavík City; the 2008–11 Icelandic financial crisis and the criminal investigation and prosecution of bankers, with special prosecutor **Ólafur Hauksson**.
- **In Finland:** *education policy;* (almost no homework, no standardized testing, best performance, highly achieved results in PISA worldwide comparisons), discussing with **Krista Kiuru**, the Finnish Minister of Education in the past. **Moore** noted that music and poetry had been eliminated in the American K-12 education system [54, 55].

6.1 The Finnish/Nordic Model in Education: Free Education Access

The Finnish education system, as **Pasi Sahlberg** describes in his available online book *"Finnish Lessons"* [56], has been praised a lot throughout the world during the last twenty years and the Finnish Ministers of Education have been interviewed a lot for this. Past **Minister of Education Krista Kiuru** features in the film of **Michael Moore** answering the questions of an astonished Michael Moore, who seems to idolise the Finnish Education System [54, 55]. Yet, many consider this film as a pure artefact of edutainment!

On Mon, Aug 19 2019, 6:59 AM EDT, on the CNBC TV network on Educating for the Future [57] the current **Minister of Education Li Andersson**, said that:

1) Teaching is a highly-valued profession in Finland;
2) the country has built a system of education that is *accessible for all* students;
3) *equal access to education is a Constitutional right.*

Having dedicated teachers that are valued for their profession and equal access to education by Constitution are two quality management factors that document the learner-centred consent for successful learning and a knowledge-based society.

6.2 What Can the World Learn about Equality in e-Learning and Education from the Nordic Model?

As noted earlier countries where women have a strong position and a female leader have, until now, managed their survival during the corona crisis better. **Ex-President Halonen** also said in Yle's Political Radio's Life and Politics programme [37] that the Covid-19 epidemic has been better understood when there is *a broader concept of equality*. The previous President of Democracy in Finland supported that a broader concept of equality is the case *even when it comes to a*

northern welfare society that is very equal. In the book *"Finnish Lessons"* by *P. Sahlberg* [56] there is more information on equality and equal access to learning in the Finnish education system.

Equality, however, is not equity! This is what the world can learn about equality in education from the Nordic model. Thus, in times of crises, the State must remember that equality does not always mean equity and, thus, take care of people affected by various misfortunes, inequalities, sudden needs, special needs, disabilities and the list can go on. An example of this caring thinking for more equality in citizens protection has been, according to Swedish newspaper *Hufvudstadsbladet* the recent decision (August 2020) of the Finnish cities authorities of Helsinki and Turku that they will distribute free face masks to low-income residents during the Coronavirus pandemic.

This and other similar initiatives of the State are very important, exactly because in many cases equality is not, necessarily, justice! Figure 4 demonstrates this in case of citizens education.

Figure 4: Equality versus Justice

With reference to educational equality and justice, figure 4, a public image's adaptation with added text, illustrates the difference between equality and justice. Hence, for being able to *reach, get and use* the fruits of knowledge one should also establish and use reliable and efficient measures and metrics for the testing and evaluation of the learning process (being that online or offline) and its learning outcomes in society, both in the short and in the long run. But, this is not the end of this discourse, because *who* decides for the measures or constructs the metrics and the evaluation index and *for whom*, are also, questions of dominant significance.

Apparently, the current Coronavirus crisis intensified the social impacts of inequality and they are, now, more understood. Thus, lower educational achievements together with mental illnesses, universal access, health and psychological problems and other are the results of inequality caused worldwide. But what are the causes of inequality, what triggers and grows it rapidly and what are its socio-economic and political impacts globally? **Joseph Stiglitz**, winner of the *Nobel Prize for Economics*, gives a detailed analysis in his book *"The Price of Inequality"* [58].

7.0 Evaluating e-Learning and Distance Schooling *Efficiently* and *Reliably (Why?)* - Measures and Metrics

There have been many critical voices about education in Coronavirus times wondering if all the e-learning efforts are just, by and large, merely of 'trial and error!' nature. Others have supported that net-based learning cannot, simply, be a *temporary measure* but must be a vital part of a standard education policy [59]. Meanwhile, could a numeric evaluation of the EU citizens' digital skills be more specific? The EU/EC informs [60] that there is a digital gap and that the 42% of the European Union citizens lack basic digital skills. How could these EU citizens and potential e-learners take care of their self-organised digital learning, privacy and cyber-security?

As the Coronavirus era forces online learning, a recent virtual learning project in Turkey with Syrian refugees that offers training in acquiring digital skills and competences [61] already set an example and drew the recent attention of the media. The online learners have been Syrian refugees of various age and background. The ones that were interviewed and presented in the media seemed to be very satisfied with what they learn/ed and how they learn/ed in an apparently well-focused, lightweight, flexible and "breathing" curriculum. So, once more, less was more, regarding agile processes and speedy delivery outcomes!

Perhaps the fact that EU pays and wants Turkey to keep Syrian and other refugees in the Turkish territory and outside the EU borders makes the acquisition of digital learning skills and competences itself a useful and practical but illogical and irrelevant e-learning activity. This is so because there will, probably, be no need for these knowledge and skills use since the future of the (work) lives of Syrian and other refugees is almost decided in pre-determined education curricula. This type of e-learning and remote (from their home country) schooling might or might not allow them to realize their dreams of happily living and flourishing in their chosen physical space of peace and well-being, without war or education barriers. After all, do their (work) lives matter? Can these people breath, even while following a "breathing" curriculum?

Except the ongoing Syrian and other refugees migration crises (for the events' causality see, for example, Chomsky, [62]), at the same time with the worldwide Coronavirus spread, humankind also evidenced phenomena of appalling violence

and discrimination that were triggered by societal inequalities and insecurity behaviours. These resulted in activating people to demonstrate wondering if their lives matter and if they can breath. Thus, along with *more reliable* measures and metrics that are needed for a 'free of barriers' education and society of justice, people should also i) be allowed to have dreams, ii) learn to have dreams and iii) be given adequate equal opportunities to realize their dreams; for a fair and safe well-being utilizing their knowledge and skills in the pursuit of happiness.

Following this Aristotelian discourse, one could naturally ask: Where on earth online or offline could someone find less (cyber)bulling and (more) happiness!? Further, for the present and future of (online) learning one should also ask: Do/could our (digital) learning boundaries offer a *cleaner and greener* brave new world of … *equality and equity? … transparent and secure e-learning? … more or less learning opportunities? … equal opportunities? ... less violence and less discrimination? … more justice? … more and better (opportunities for) dreams to realise?*

Consequently, building the future (online) learning technologies requires an intelligent manifesto of thinking that is both human- and learner-centred; above all child-centred, if we plan for the future well. A constant reminder for this end of education must be that we are all citizens/netizens but, as a known song is paraphrased, … just people/learners; people/learners who need other people/learners of other ages, values, races, cultures, societies, background knowledge, experiences, countries … to accomplish our diverse knowledge trip and flourish in life. A poetic (by poet K. P. Cavafy) reminder herein is that we should also wish for such a rich in experience, adventurous, full of knowledge and discovery long trip and value it more than its destination, which, after all, might be poor. But what it really matters is the rich in knowledge and full of diversity trip which also, by now, includes the understanding of our (digital) learning and thinking boundaries in a given or not universe of discourse.

There exists a myth far in the past that demonstrates the use of technology, creativity and other thinking tools for the humans' well-being. In the ancient Greek mythology brothers Epimetheus ("afterthought") and Prometheus ("forethought"), are assigned by the Gods to create the animals and the humans … Prometheus gave the fire, which is the technical know-how and creative thinking to humankind to survive and develop. Later on Zeus *had to* also give caring thinking in a form of ethical intelligence, a sense of right and wrong. In so doing, humankind could thrive with collective moral judgement, a form of social contract of responsibility, or a manifesto of planned action.

Three notable existing manifestos that never stopped influencing for plan and action are the Agile Manifesto [63], the Software Process Improvement (SPI) Manifesto [63, 64] and the Communist Manifesto [64, 65, 66]; neither keeping the order of their chronological appearance nor the order of importance, herein. All were sources of inspiration, motivation and change through following a plan to

improve the quality in education and work-life balance of *all* people. For instance, a very well known quality-centric demand for improvement, encapsulated exactly the request for the establishment of the following three human rights: 8 hours for work, 8 hours for sleep and 8 hours for free time/education! While historically education (along with food, work and freedom) has proved to be one of the very basic needs and human or/and constitutional rights of the human existence and a basic factor for human flourishing and happiness, the basic right for (equal access to) education has been only partially realised. Even when e-learning and virtual (reality) technologies make this human right possible with online learning, edutainment and other forms of formal and informal learning there seem to be other socio-economic barriers in providing safe and efficient e-learning.

All three manifestos mentioned earlier stood the test of time and the test of learning in time while they never stopped imposing challenges and controversies. The latter hold in regard with software quality management, the manifestos' socio-cultural dimensions and the quality in problem-solving and learning in work-life balance of people. The e-learners manifesto should be equally influential and inspirational for learners in order to activate them to demand their learning and human rights as equal partners in the shaping of the future of learning technologies. The learners' and citizens' future cannot be decided without them; it can neither be safe nor secure, for them and their children, without the learners' input and consent for building usable and secure e-learning cyber-spaces.

8.0 For a Better Present and Resilient Future: What Needs to be Done and for Whom?

Before the Covid-19 crisis many in the Nordic region and in Europe did not take the threat of an epidemic seriously, as the epidemic was mainly spreading outside Europe. Attitudes changed when the danger came into their own territory, with the first three European contagious cases in Italy, France and Finland.

According to the President of Finland **T. Halonen** [37], the change in the concepts of safety and security is important to acknowledge: *"In the past, there has been mainly armed security, in old-fashioned terms, war"*. There is much more to (online) safety and (online) security when humanity everywhere on earth has to deal with potential dangers and hazards such as a corona-like epidemic threat and other. The impact to learning and education can be tremendous with very serious consequences to the equality, justice and well-being measures in society.

In that respect, it is unacceptable that so much public tax-based funding is being collected and re-allocated by many governments to private companies' funding for closed and proprietary educational and other software-based resources. In a society for equality and justice, equity should be a priority. Thus, public money should be allocated for public software open to every citizen for use and free/open educational resources available to and accessible by each and every learner.

Back to a safe present and secure future with wisdom and ethical judgement is a huge material and philosophical challenge to face and resolve; but there is no other

way and we have to come to terms with it! The current Coronavirus crisis is also an opportunity for instilling an ethical vision in humanity, far and beyond e-learning, to protect human life and privacy online and offline. *"All human beings have three lives: public, private, and secret."* (Gabriel García Márquez).

Summarising past and present ongoing research activities, our Consulting Group in the Nordic region has taken initiatives for research projects with fruitful research outcomes that have resulted in consultancy services and products. As educators, researchers, developers and, above all, people we have been focusing on people whose needs we address in terms of providing software quality design criteria and quality solutions that are in the heart of people's well-being (Figure 5). We aim at bringing quality of living and lifelong learning through safe information and secure knowledge providers.

Figure 5: General Data Protection Regulation for Work-Life Quality

We have been designing and tailoring resilient solutions in problem-finding and problem-based e-learning frameworks for many groups with different needs and requirements. Examples from our long consulting experience and industrial and academic work are listed next.

- Parents/families support with ICT design tailored to their particular needs, e.g. *ICT for mothers' needs* [67].
- Gender Equality and e-Learning design – Women Lost and Found in Virtual Reality. *Work-Life Balance (WLB)* advice and mentoring for women in ICT, Management and R&D [68, 69, 70, 71].
- Learning instructors and ICT/IS stakeholders support with *usable security guidelines*. Usability should not be sacrificed for security. And the opposite! [72, 73, 74].
- Online courses and consultancy training sessions, e.g. in FLOSS *software quality and software business models* [75, 76, 77] and in *"the basics of cyber-security for online learning"* [78, 79].

- Internet and Dark Creativity - Phishing and Social Engineering. Protect yourself and your beloved ones from the cyber-dangers. [72, 73, 74, 78, 79].
- Cyber-crime and Organisational Security – How much do you know? How vulnerable are you and your organisation? [78, 79].
- Software/online tools evaluation - Learnability and Resilience for all [80].
- Secure and safe Open Educational Resources for Creative Thinking.
- MOOCs – knowledge content creation and availability, design quality and deployment criteria and reliable evaluation metrics, e.g. for the secure learning process, knowledge transfer and its learning outcomes.
- LL e-Learning creativity and Learnability Evaluation.
- Collaboration with UNIFEM, UNICEF, UNESCO, EU/EC e.g. on creative thinking and learning.
- Consultancy and Support for Policy Makers through Recommendations and Plans.
- How private and secure can classrooms be/become online? Usable cybersecurity rules and simple steganography principles can give you the answer!
- Manifold Thinking Design for Edutainment Products: Games and Gamification [81], Scriptwriting e.g. for women in IT [68, 69, 70, 71] and new ICT-based evaluation methods and tools for emotions' capturing [82, 83].
- *GDPR for all!* - General Data Protection Regulation by the European Union. Our Unofficial Acronym: ***G****et to know your* ***D****igital* ***P****rivacy* ***R****ights!* It is easy and possible with our consulting advice and workshops designed for the understanding of the GDPR and its use worldwide. (Currently designing the use of our own games and game-based learning processes for the understanding of the GDPR).
- For All: Must always keep learner in the mind! Ongoing and Towards: The (formal, non-formal and informal) e-Learning Manifesto with motto: Affected learners of all the world unite! You have nothing to lose but your exploitation. You can gain your dignity and your own flourishing!
- The current times of crisis are a reminder call for humanity to show solidarity. Hence, during the Coronavirus crisis we offer *pro bono (publico) consultancy to all those affected groups and individuals who need advice!*

9.0 The Condensed Ideas in a *Nutshell of Solidarity*: Quality, e-quality, equality (and … justice!)

Hey teachers, don't leave the kids alone, online! Think: How easy, motivational, safe and secure is this new e-learning environment? In a few concise words: i) mind/save/defend the children! - mind the future! and ii) mind and close the gaps! – (cyber)security, learning and equality gaps!

"I have a dream …" means I learn and dare to have dreams online and offline, in my own private public/virtual space and I know that this is safe and secure and

possible. I also learn how to think and interact online and offline with motivation and security and without violations of my own privacy in my online or offline presence. Realising dreams in the public or private boundaries of physical or virtual learning communities is possible if the boundaries are safe and the human presence secure. In these conditions, safe interaction, teamwork, collaboration as well as quality, e-quality and equality could also be realised.

During vulnerable periods when people's privacy and security are threatened the re-thinking and re-designing of knowledge technologies and tools in a Life-Based Design [84] framework is a necessary and essential condition. Life-Based Design for re-thinking the processes of transmitting data, transferring information and communicating knowledge could transform the quality of the e-learners' lives and the quality of the information and knowledge providers. Re-evaluation can happen through the lenses of manifold (meaning creative, critical, reflective and caring/ethical) thinking [25] that can lead to *eudaimonia*, that is the state of human flourishing.

A new social/learning normal needs a new manifesto of manifold thinking and progressive planned action in solidarity to identify the social determinants of e-learning. Crises like the Covid-19 can immensely deteriorate the well-being of the learners and affect the quality of learning. Public and social software (like social medicine) proponents can re-consider global education and e-learning through quality design criteria in proactive (and not reactive) educational strategies with highly responsive educational software to the learning needs and learning styles. Adaptation to change along with wide stakeholders participation should be part for the best plan for preparedness and readiness.

Further, a new social contract for learning with free and open social software with well-being design principles, e.g. for usable (cyber)security and safety, question asking and problem-based learning could potentially motivate, emancipate and empower learners to human flourishing. Preparedness and readiness go hand in hand with proactive and reactive practices in life management in the same way that learning leads to human flourishing and leads learners to happiness. Why is this important? The answer is given in the quote of Gabriel García Márquez. *"No medicine cures what happiness cannot."*

The worldwide effects of causality and consequent transformations can be triggered anywhere by anything, be that the wings of a butterfly somewhere to change the weather elsewhere, the metallaxis (mutation) of a virus somewhere to originate a world pandemic, …, the creation of a new, powerful manifesto somewhere to start a worldwide revolutionary new way of progressive thinking and improvement action. For people's eudaimonia and well-being it is up to humankind to learn and demonstrate the appropriate levels of preparedness and readiness for the resulted waves of changes that could follow triggered by so many predictable and unpredictable events.

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Papers

A Framework for Introducing Social Media in Education: A Student Perspective Survey

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Abstract

Social media plays a vital role in providing us with information about different aspects of our daily lives and it has evolved in an integral part of modern society. Moreover, social media has increasingly gained credibility in recent years as a bottom-up platform where people can communicate, collaborate, create and share content and interact. Hence, it is of great importance to capitalise on the benefits and services that social media provides by implementing them in various domains. The use of social media in education allows students, who are mainly digital natives, to connect with educators, other students and diverse learning groups in a way that is familiar to them. This study proposes a framework concerning how social media could be used in education to make learning more enjoyable and engrossing and students more motivated and engaged in learning. Additionally, it analyses and discusses the outcome of a survey regarding students' perspective on the introduction and use of social media in education. The results of this study show that the students regarded social media as a helpful and essential educational tool that can improve learning when applied in a student centred manner. Additionally, they considered social media as a means to promote, improve and facilitate group work which can boost their

communication, collaboration and knowledge sharing with both their fellow students and educators and positively affect their academic performance.

Keywords: Social media in Education, Social networking services, Educational technology, Technology-enhanced learning, Computer mediated learning.

1.0 Introduction

Nowadays, technology has enhanced learning, embracing easy access to information and services and new virtual learning environments and has become a fundamental part of higher education [1]. Rapid advances in Information and Communication Technologies (ICTs) and social media, as well as emphasis on pedagogy in student centred learning have paved the way for using social media in teaching and learning. Social media is used as a means to communicate, collaborate and interact within a common information space, as well as to participate in diverse social and interactive activities, such as tagging and organising, creating, posting and sharing content, pictures and video, rating matters etc. [2, 3, 4]. The foundations of social media are content sharing, communication and collaboration [1]. Social media, which is a well-known technology to students of this generation, is found to increase their engagement in online learning communities [5].

Learning to learn seems to have a greater impact on future experiences than the construction of domain specific knowledge itself. In today's learning environments with increased use of on-line and social media technologies, learning how to take advantage of different learning aspects and environments is a key skill for both educators and learners. The most difficult aspect of efficient knowledge sharing and learning in online environments seems to be concerned with people, pedagogy, educational processes and culture [6]. The main advantages of using social media in education and learning originate in activities that harness collective intelligence in contrast to the hierarchical teacher-centred approaches [7].

In this study, we go over how social media can be used to enhance the educational process and we present relevant studies. Furthermore, we present our proposed framework for planning and designing social media-based educational activities. Additionally, we describe our survey and analyse the results regarding students' perspective on the use of social media in education. Finally, we reach certain conclusions and make suggestion for the direction of future research.

2.0 Social Media in Education

Social media is changing the attitudes and behaviours related to information and learning and the impact of social media is radically changing the way education has traditionally been delivered [8]. Social media is also likely to change the way educators teach and the way students learn and are willing to learn. They can motivate and facilitate students and educators to create their own content and share it with a broad network. Social media provides students and educators with an exceptional way to access, communicate, socialise, publish and co-create. The use of social media in education is based on creating an environment that will facilitate learners to use available technologies, co-create materials, connect and share ideas and interact with other learners [1]. However, many teachers and teacher educators remain uncertain about how to meaningfully integrate this technology or assess its impacts [9]. Incorporating these contemporary and innovative teaching and learning practices into formal education seems to be a slow process that is likely to meet resistance by some educators due to their previous experience as traditional learners and teachers [1]. Moreover, established educational structures usually do not encourage new ways of teaching and learning. Many educators may not have the necessary skills at using social media in teaching and learning and they may be reluctant to learn and incorporate new technologies into their teaching and learning practices [7].

Makkonen et al. [10] carried out a study by using a survey on 71 Finnish Information Systems (IS) students regarding their viewpoints on motivation and constraints while using social media in education. The study revealed that students consider the meaning of social influence to be relatively important. According to the respondents, a major constraint is the suitability and relevance of the infrastructure in the planning stage of learning activities based on social media. The gender variable turned out to be of less importance, although it appeared that female respondents were more motivated towards comprehensive use of social media than male respondents. Makkonen and Siakas [11] examined the main factors and problem areas in the use of social media in higher education. The results of their survey with 66 Finnish IS students showed that the respondents considered that understanding content sharing is the most important issue in the planning of teaching and learning activities based on social media. The study conducted by Makkonen et al. [12] indicated that security (malicious software, apps and phishing are the most notable security threats) is a major issue compared to availability (errors in the logic of the software and disturbances in planned maintenance are the major concerns) and performance. However, the performance of the network was considered important in the design and use of social media in higher education. Additionally, the studies conducted by Makkonen et al. [13] and Kanakaris et al. [14] also went over various social media security and privacy concerns regarding the use of social media in education.

3.0 A Framework for Planning and Designing Social Media-based Learning Activities

It was evident from both the literature review and our study that educators who lag behind new generations of largely digital native students need to acquaint themselves with these new social media technologies and approaches to ensure smooth and effective application of social media in higher education. Social media is also likely to provide opportunities for disadvantaged groups to participate in studies. In Figure 1 we propose a framework for planning and designing educational activities using social media. The framework was created as a result of the literature review and the responses in our survey and it can be used in all educational levels. Additionally, the described stages can be used in parallel or in different order from the one proposed.

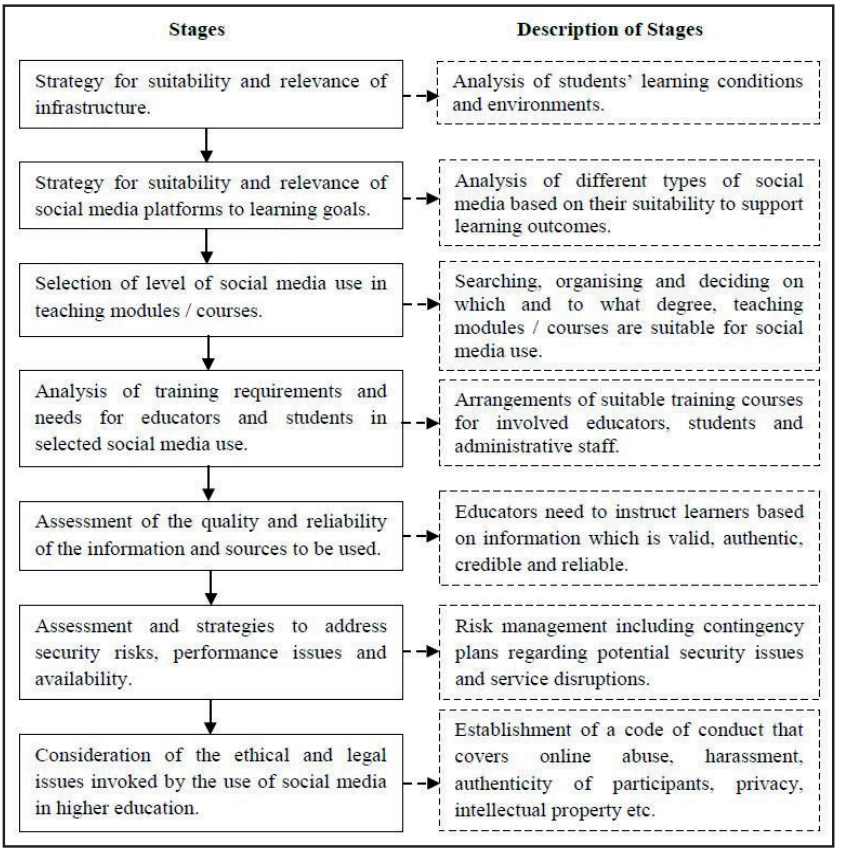

Figure 1: The educational social media planning and designing framework.

4.0 A Survey Regarding Students' Perspective on Social Media in Education

The aim of this survey was to pinpoint and analyse students' viewpoints concerning the use of social media in teaching and learning activities and more specifically, to get a better understanding on how students perceive social media as an educational tool that promotes and enhances collaboration, communication and knowledge sharing and helps them improve their academic performance.

4.1 Questionnaire structure and sample

The questionnaire consisted of questions about the respondents' social media use as well as questions regarding their perspective on the use of social media in education which the respondents rated based on a 4-point Likert scale. In total, 63 students, 11 females and 52 males, aged from 18 to 20 years from the Department of Information and Electronic Engineering of the International Hellenic University in Greece participated in our paper-based survey.

4.2 Results and data analysis

According to the result analysis of the respondents' replies, we tried to understand and explain their perspective and insight regarding the use of social media in education. When asked about how long they had been using social media, 9 (14.3%) of the students answered for about 3 years and 54 (85.7%) answered that they had been using social media for more than 5 years. In addition, when we asked the students how much time they spend on average per day on social media, the majority of them (frequency: 29 and percentage: 46%) answered that they spend more than an hour and a lot of them (frequency: 25 and percentage: 39.7%) answered that they use social media for at least three hours per day (Table 1). Moreover, when the students were asked if they believed that social media plays an important role in modern society, the majority of them agreed that social media indeed constitutes a major factor in the current day and age (Table 2). Based on these facts, we can conclude that these students have been using social media from a young age. Hence, they are more familiar with and more accustomed to using this technology on a daily basis and they consider them to be of vital importance.

Table 1: Frequency of the responses regarding the average time spent per day on social media.

	Less than thirty minutes	About an hour	More than an hour	At least three hours
How much time do you spend on social media on average per day?	2 (3.2%)	7 (11.1%)	29 (46%)	25 (39.7%)

Table 2: Frequency of the responses regarding the important role of social media in modern society.

	Strongly disagree	Disagree	Agree	Strongly agree	Mean (scale 1 - 4)
Does social media play an important role in modern society?	2 (3.2%)	6 (9.5%)	27 (42.9%)	28 (44.4%)	3.29

Furthermore, we asked them their opinion in regard to the use of social media in education and the impact that it may exert when used as an educational tool and platform to benefit their academic performance as well as to enhance and promote communication, collaboration and knowledge sharing. Table 3 showcases the results of their perspective on this matter.

Table 3: Frequency of the responses regarding the impact and use of social media in education.

Do you consider that …	Strongly disagree	Disagree	Agree	Strongly agree	Mean (scale 1 - 4)
… social media can be used as a means to improve learning in education?	1 (1.6%)	10 (15.9%)	40 (63.5%)	12 (19%)	3
… social media is an indispensable educational tool?	1 (1.6%)	15 (23.8%)	34 (54%)	13 (20.6%)	2.94
… the usage of social media can benefit your academic performance by any means?	3 (4.8%)	5 (7.9%)	45 (71.4%)	10 (15.9%)	2.98
… social media can improve communication among students?	0	7 (11.1%)	43 (68.3%)	13 (20.6%)	3.1
… social media can improve collaboration among students?	0	8 (12.7%)	41 (65.1%)	14 (22.2%)	3.1
… social media can increase knowledge sharing among students?	0	5 (7.9%)	39 (61.9%)	19 (30.2%)	3.22
… social media is indispensable for communicating with both their educators and fellow students?	0	12 (19%)	40 (63.5%)	11 (17.5%)	2.98
… social media provides a useful platform for academic group work?	2 (3.2%)	4 (6.3%)	44 (69.8%)	13 (20.6%)	3.08
… the use of social media to share work with your peers for academic purposes has a positive impact on your studies?	1 (1.6%)	11 (17.5%)	37 (58.7%)	14 (22.2%)	3.02

Taking the students' answers into consideration, it is clear that the majority of them consider social media as a helpful and indispensable educational tool when applied in a student centred manner. More specifically, the students described social media as a means that can improve learning and that can boost communication, collaboration and knowledge sharing with both their fellow students and educators in an educational context. Furthermore, they deemed social media as a tool that can promote, enhance and facilitate group work and collaboration and which can positively affect their academic performance.

5.0 Conclusion and Future work

In recent years, as social media has become pervasive in modern society, the pace of their development and use is growing rapidly. Social media has evolved in an integral part of modern society as it is essential in providing us with information about different aspects of our daily lives. Hence, it is of vital importance to capitalise on the benefits and services that social media provides by implementing them in various domains.

Because of the emergent of social media, it is important to review the whole educational system. Moreover, due to the fact that students use social media in their everyday lives from a young age, they are engrossed in them and they are also keen on using them in learning. Hence, we believe that there is no better way of communicating with students than in their own language that is social media. Educational institutes of all levels should incorporate social media into their curriculum as an important supplement to technology-enhanced learning to support reflection, knowledge sharing and content creation and sharing and to promote communication and bottom-up collaboration.

The results of this study showcased that students considered social media as a tool that can improve the educational process and enhance their learning while simultaneously boosting communication, collaboration and knowledge sharing with both their fellow students and educators. Moreover, they regarded social media as a means that promotes, supports and facilitates group work and collaboration. Finally, they deemed social media as a helpful and indispensable educational tool which when applied in a student centred manner it can positively affect their academic performance.

In the future, we plan to validate our framework in different educational settings and also to assess the effects of using social media in education and how their use can improve the quality of learning experience as well as how students' engagement and motivation in learning activities can be enhanced.

6.0 Acknowledgements

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Digital Content Strategy, The Higher Education View

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Abstract

The majority of modern prospective students view a Higher Education Institution (HEI) website as the first step in their consideration and evaluation of an HEI. This market development has led to new market requirements for UK universities, who have had to adopt commercial practises in line with this trend. Modern prospective students expect the HEI's websites to deal with the latest technology at their best, from the smart software and the speed of the download, to the user journey and overall digital user experience, comparing it "with the best possible experience they have ever received online". The universities so far have managed to adapt a number of these commercial practices; the issue, nonetheless, remains with the actual content on these websites, as this is the key for the student recruitment. Researchers insist on the achievement of both of these targets via established processes and procedures for digital data creation and management. Universities should not merely dump the available data online; it is necessary to use a digital content strategy. Furthermore, the mindset of those who are involved in the digital processes/procedures will also benefit from this change. A number of institutions, regrettably, still neither have the processes/procedures in place, nor the required attitudes and/or perception from the staff professionals on the new ways of dealing with digital content. This, nonetheless, is essential for the Post-92 institutions, in particular, as their financial position in the market is heavily reliant on student recruitment. In this work, the researchers investigated the issue via detailed personal interviews with all HEI professionals who were at any point involved in the digital content creation and/or management. The selected institution received the best-dealing-with-digital-content award in 2019 as an exemplary example among the UK institutions within this group.

Keywords – Digital content strategy, higher education institutions, HEI websites, student recruitment, online content management

1.0 Introduction

The majority of modern prospective students view a website of a Higher Education (HEI) Institution as a first step in their consideration and evaluation of an HEI, even prior to the actual visit; thus, "College and university websites play an important role in the college search process" [1]. Currently, however, "A significant trend in higher education evolving from the wide accessibility to the Internet is the availability of an ever-increasing supply of data on Web sites [2]. The wave of commercialisation additionally diverted the UK universities towards the perception of higher education as a commercial product/service, where HEI's "websites communicate a message consistent with private purposes of education and inconsistent with those linked to public purposes" [1]. Modern prospective students do behave like customers, expecting the HEI's websites at their best to deal with the latest technology, from the smart software and the speed of the download, to the user journey and overall digital user experience [3], "comparing any digital content and support with the best possible experience they have ever received online" [4].

2.0 Background

The universities so far have managed to adapt a number of commercial practices. This has been reflected in the variety of aspects, from the measuring user experience [3] and the use of website indexes [5,6], the effectiveness of branding [7,8] and social media [9,10], through to tracking customer behaviour online by using cookies [11,12]. The issue, nonetheless, remains with the actual content on these websites, as this is the key for the student recruitment. Researchers insist that to achieve both of these targets, some processes and procedures have to be put in place for the digital data creation and management. The universities should not merely dump the available data online. It is necessary to use a digital content strategy [13]. Furthermore, the mindset of those who are involved in the creation and/or management of the digital content will also benefit from this change. A number of institutions, regrettably, still neither have the processes/procedures in place, nor the required attitudes and/or perception from the staff professionals on the new ways of dealing with digital content. This is essential for the Post-92 institutions, in particular, as their financial position on the market is mostly based on student recruitment.

3.0 Methodology

Research settings

The researchers had to be integrated into a Post-92 HEI in the South East, UK. This personal interaction enriched the outcomes of the research work when the researchers managed to observe a phenomenon in its natural setting, via a productive dialogue with the informants. The researchers conducted eight detailed (combined over sixty questions) interviews with carefully selected individuals from various departments during the period of February-June 2019 (Table 1). The aim was to select all the roles at the Higher Education Institution which at any point were involved in the creation and/or management of the digital information. The participated departments could be summarised as: digital team, content team, marketing team, public relations and design studio – all contributing to the process either regularly or on an occasional basis. The researchers intended to select this particular institution as an exemplary example of the HEIs to follow, as in 2019 it received a national award for the best use of content. See the questions in Table 2.

4.0 Primary data

Semi-structured interviews

The researchers conducted semi-structured in-depth interviews to investigate the HEI's digital content management procedures for the website in terms of student recruitment, as well as to identify if there were any standardised processes and procedures at universities, the roles and responsibilities for the parties involved and the aspects taken into account when the content was prepared. The work also aided to reveal the actual existence of a digital content strategy aimed to achieve the desired student recruitment.

The questions were based on the Digital Content Strategy framework (Figure 1) presented in the form of a ladder by Razina, Al-husban, Ross and Ahmad in 2019. "The framework strategically offers key steps in order, allowing for progressive discovery…[it] ensures the natural development of content creation. The cyclical nature of the content development allows for online "survival" after accomplishing the first layer; while attempting to achieve the rest of the layers, develops content creation and management in a far more advanced, complex and sophisticated nature." [13].

Table 1: HEI employees participated in the research project

Position/ Team	Team responsibility (as seen by the respondents)
Senior Content and Production Manager **Content and Production**	The creative and design work and the production cycle for the University's electronic, multimedia and hard copy publications. **Team size: 6**
Content and Production Editor **Content and Production**	The creation and maintenance of University's websites' content in written, visual, video or other forms of media. **Team size: 6**
Content and Production Manager **Content and Production**	The creation of all the content, focusing on recruitment and reputation, including digital channels, researching best practise. We work closely with the Digital and Marketing teams. **Team size: 6**
Marketing Officer (CRM) **Marketing**	The building and executing strategic marketing plans, focused on student recruitment, including working with the schools, in the UK and internationally. At a corporate level – running recruitment cycle campaigns and creating bespoke communication plans using data captured in the customer relationship management system. **Team size: 5**
Digital Marketing Executive **Digital Marketing**	The responsibility for all university's externally facing websites, web development and management. **Team size: 4**
Senior Graphic Designer **Design Studio**	The in-house design and print buying, including the creative and design work and the production cycle for the electronic, multimedia and hard copy publications. **Team size: 4**
Head of Communication & Alumni Relations **PR and Communications**	The management and promotion of the reputation of the university through a range of activities, including media enquiries and responses to secure positive media coverage; provision of advice and support to colleagues in talking to the media. **Team size: 6**
Marketing Officer (Undergraduate) **Marketing**	The building and executing strategic marketing plans, focused on student recruitment, including working with the schools, in the UK and internationally. **Team size: 5**

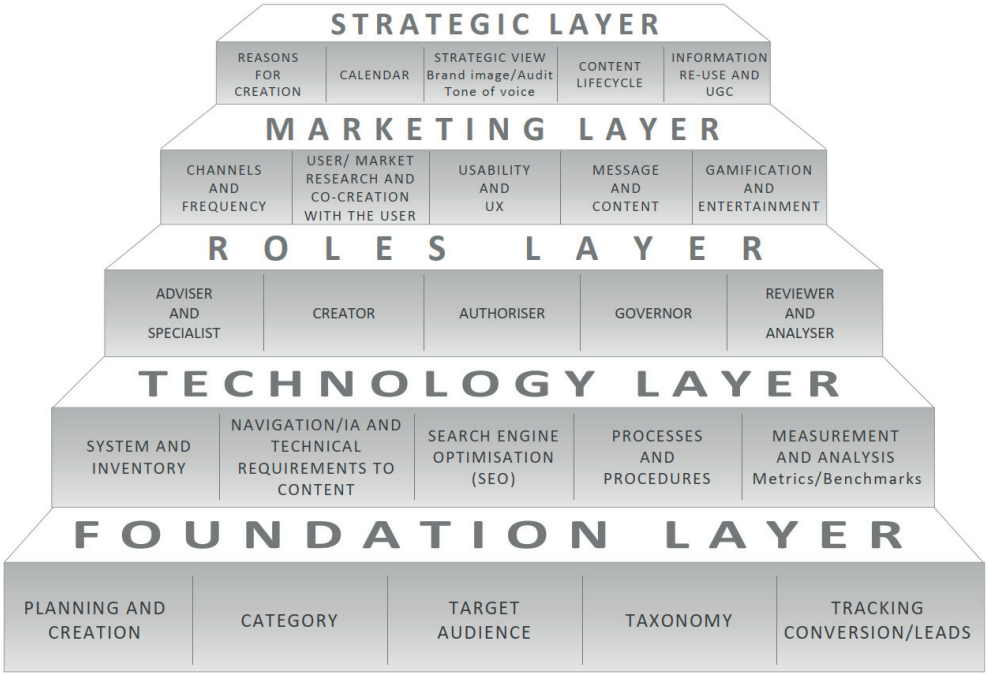

Figure 1. Digital Content Strategy [13]

Table 2: Interview Questions

I. FOUNDATION LAYER
F.1.1. Where is the website content coming from in general? Who supplies it?
F.1.2. Is there the need for the information presented in a new or different way? E.g. in terms of Colours? Text? Style? Language? Tone of voice?
F.2.1. Could the same content be used in different parts of this website?
F.3.1. Who are your key audiences and which of them do you target?
F.3.2. Is the website content published amended to the audiences' needs and preferences?
F.4.1. How do you use the taxonomy? How do you categorise and label a new piece of content when it is received? Or is it someone else's decision?
F.5.1. When a new piece of content is created, is it tracked?

II. TECHNOLOGY LAYER
T.1.1. Does the university have a content management system (CMS)? In your personal opinion, what is the purpose of this system and how is it used?
T.1.2. Do you think the system is suitable for this purpose? Do you think the system could be improved? If so, how?
T.1.3. Does the CMS require any external support, or it is fully managed internally?
T.1.4. How many people have access to the system? Which persons from which departments can view/edit content? Do all of them have the same access?
T.1.5. Does this system require specialist/ technical knowledge from creative roles/parties involved? i.e. those users who create content (IT specialists)
T.1.6. Is there a content inventory? If it is automatic and provided as a part of the service offer/provision, which fields does it include, please list
T.2.1. How is it decided which technical requirements are needed for a new piece of content? i.e. moving text, flashing images, etc.
T.2.2. How is navigation decided and set up? Whose responsibility is it? Is it piloted on anyone prior to going live?
T.2.3. Do you use coding? Please give more details
T.3.1. How is the Search Engine Optimisation managed? Internally or by external organisation? Do you receive any keywords suggestions for it from content creators, marketing or anywhere else?

II. TECHNOLOGY LAYER *contd*
T.4.1. Is it a centralised online-publishing approach at this university or are the materials uploaded/ amended by a number of users?
T.4.2. Is there a particular procedure for submitting a piece of content for publishing on the university's external website?
T.4.3. Do you check with any users at all prior to publishing it online? Do you need an official authorisation before you publish?
T.4.4. If/when any changes are made online, do you need to keep any other parties informed? Is it officially documented?
T.4.5. Do you ever check archived online material from the website? Is archiving easily accessed and easily searched through?
T.5.1. Could the online content be analysed using any analytical tools?
T.5.2. What analytical parameters are used when a piece of content is being analysed? What is measured?
T.5.3. Does your team do any reporting, related to the main website? What parameters and aims does it include/cover?
T.5.4. If website content is evaluated, does the university have any internal or external benchmarks for a success of website content measurement and evaluation?

III. ROLES LAYER
R.1.1. So, which roles do you have from the following roles and responsibilities in your institution (with which access to the CMS)? • *Content creator;* •*Advisers/specialist;* • *Authoriser;* • *Governor;* • *Reviewer;* • *Analyser;* • External agencies role/access to the CM system?
R.1.2. If this university employs an external marketing agency, what is its role in relation to content creation and management?
R.1.3. Do you ever require specialist advice for a new piece of content? What kind of content/ advice? How do you manage this? Please provide examples, if possible
R.2.1. Who creates/supplies the website content?
R.3.1. Does anyone else need to see/authorise it prior to publishing?
R.4.1. Is it your responsibility to govern (amend/ review) a piece of content after publication or is it some else's?
R.4.2. If any updates are required for existing content, how is it managed?
R.5.1. Who is responsible for the content reporting from the main website? Does anyone review the outcomes?

IV. MARKETING LAYER
M.1.1. What content marketing does the university use?
M.1.2. Could there be a piece of content which is published in all channels? How is it selected for this purpose? And if it is published, does it happen simultaneously or at other appropriate/ suitable times?
M.2.1. Do you use customer profiles? How many? How? Where do they come from? How often?
M.2.2. Modern users appear more technologically savvy and their requirements from the UK HEI and HEI's website are much higher and possibly different. • Would you experience these factors or not? • Do you think the university reflects the market changes and if so, how?
M.2.3. Do you do any research on the website evaluation or development? If so, which methods do you normally use? And what is being evaluated?
M.2.4. Do you involve any users/audience in the online content creation? If so, how is it managed? Not the content created by them, but the content created together with the university
M.2.5. Do you involve any external or internal influencers for the target audiences? How significant do you think this is?
M.3.1. Does anyone do any usability tests or user experience evaluation for the external university's websites? Do you do any research on the: • Digital user experience, •Website evaluation and/or development?
M.3.2. Would you (or your team) evaluate user journey(s)?
M.4.1. What would you expect from a good piece of content?
M.4.2. What would you expect from a good image?
M.4.3. In your opinion, does any piece of content need to lead to an action?
M.5.1. Would any entertaining factors on the website be considered when content is created or evaluated? Would that be relevant/ appropriate?
M.5.2. How significant would interactive content be for users, in your opinion? What do you see as interactive content/image?

V. STRATEGIC LAYER
S.1.1. What could be the reasons for content creation?
S.2.1. Does the university have a content calendar? If so, how is the content calendar formed? And who contributes to it?
S.2.2. How big is the team contributing to the university's content calendar? How do you ensure the calendar is updated?
S.2.3. Do you take into account the university's academic calendar? Or any other calendars? E.g. UK national, international, school/college calendars?
S.2.4. Would there be repeated topics throughout the academic year?
S.2.5. Would there be any topics reflecting recent events? National/international news, e.g. political, economic, cultural, educational any other? Or is it covered via the other content marketing?
S.2.6. Are there any particular topics which would create a particular interest for the university at a particular time? Or are there any expected themes for online publications?
S.3.1. When you receive a new piece of content, which style/ content/ guidelines parameters do you amend? What basis do you use for this decision? Do you use a guideline or something to ensure it matches the university's standards and requirements?
S.3.2. Is the website content being evaluated either overall or one-by-one/page-by-page at any time?
S.3.3. How often (if ever) is a website content audit conducted apart from those cases when the software system has to be replaced?
S.3.4. Would you evaluate the created (or requested) piece of content on its overall suitability for the university website? Does anyone else do this?
S.4.1. Is a new piece of content ever passed to or comes from other online communications? E.g. e-Marketing campaigns? Social Media, other university's websites, etc. How appropriate would you find this?
S.4.2. Is it required to consider a content lifecycle for every new piece of content, or it is managed organically? I.e. it is created and lasts for a stated period only, before being archived.
S.5.1. Does any content come from users? If so, are there any regular contributors? Who would they be?
S.5.2. Do you know the reasons for these contributors' participation in the online content creation? Have these been officially researched?
S.5.3. Are there any incentive schemes to maintain their enthusiasm?
Additional question: What is Content Strategy?

The **FOUNDATION layer** suggested that the content creation proved to have been highly developed at this HEI, as the content origin indicated full participation from all the departments, nurtured by the External Relations department. This also proved to have some established communications between the team creating marketing content and the rest of the university providing the other, although the content planning seemed to require more development. The organisation clearly identified several key audiences to target, out of which the prospective full-time home/UK undergraduate students were the main target audience. The teams recognised the need to adapt digital content to the needs and preferences of this audience.

The respondents also noticed the obvious changes on the HE market, reflecting the other fields in the modern lives of teenagers, such as the requirements for shorter and cleaner designs, leading towards the movement of minimalism. The movement became popular in the UK and Europe in various aspects of life. This way, modern prospective students required this minimalistic approach in social media and websites. Though there was a dissonance in the responses where some respondents stated that the modern target audience preferred bright colours, while the others did not agree with this statement. This evidently indicated the need for the actual research to identify the truth. Young individuals also seemed to prefer shorter videos and needed to access this information at any time from any available device. Modern young people not only become technologically knowledgeable, but also require Higher Education Institutions to be at the heart of the technological advances, using this technology to provide the entertainment, in their interests. Thus, the HEI had changed its tone of voice in its approach to this audience to being confident, obtaining a new software for the free-of-clutter website design and ensuring much shorter writing style. The decision for content presentation in this new way, nonetheless, was suggested and made by the external Marketing Agency. The HEI professionals also have not yet achieved the availability of the desired VR and videos online. The only virtual reality designs used by the institution were the ones featuring some university's premises (lecturing rooms, cafeteria, sports halls and accommodation). There were some videos, though far from enough to at least represent every course offered by the institution. In terms of the repeated information, when required, the HEI had professionally managed to achieve this, avoiding unnecessary duplication and ensuring everything was entered once and correctly, linked via the keyword tagging.

The process of labelling the products/services (mainly for courses) was not the responsibility of the Content and Production, but the Digital Marketing team, who selected the most appropriate categories. The categories were agreed between the external Marketing Agency and the Digital Marketing team. Within the team, the taxonomy was decided by the person adding the content. The HEIs successfully used the URL labelling by creating individual electronic addresses for every piece of content and 'Google Analytics' and 'Google Tag Manager' programmes for tracking (mostly reviewed for particular marketing campaigns).

The **TECHNOLOGY layer** indicated the HEI using a professionally produced Content Management System. The system has been externally purchased and has largely served its purpose, it could always be improved, as could any other, though

this would require significant financial investment, potentially not available, as there is some evidence of shortage in resources. The system was flexible and not over-complicated for use by individuals with non-IT backgrounds. The CMS offered an automatically created inventory and was externally supported by the system supplier. One of the respondents, however, suggested using the in-house specialists to create student and staff sections within the Content Management System for the external website, rather than purchasing an "off-the-shelf" CMS. This indicated that, at the time, the HEI did not grow their own in-house system support specialists which again could be explained by the lack of investment in the area. Nonetheless, there was an indication of intention towards the improvement of the situation in future, as the company at the time had its own developers, thus achieving the success of not relying heavily on the external party.

In terms of the navigation/IA and technical requirements to content, this research indicated that there were two methods of dealing with the new content by the HEI. Any major changes to the delivery of the content required the team's discussion and thorough evaluation of the planned content. This method not only required technical prerequisites to content, but also building new 'widgets', making the amendments to the wireframe of the existing web design, and planning for the necessary components for the section, thus avoiding duplication. The team used strict brand guidelines to adhere to during their discussion on the potential location and formatting. If a new piece of content was not a major project, the amendments were actioned with no further discussions. In any case, the team identified if the content required any development and then prepared a user story for it, successfully using a story-telling approach. Then the team also outlined any technical requirements to this piece of content. The majority of the SEO content management for this organisation had been managed in-house/internally by the Digital Marketing team, whilst an external Marketing Agency was used for a small part of the website data, keyword research and for the new campaigns. Internally, the keywords and the suggestions for search optimisation of the website content came from the Content Production, the Digital Marketing and the Marketing teams. The university had been using a centralised approach. The Content Production, the Digital Marketing and the Marketing teams evaluated each piece of content for the quality and the use of branding prior to publication. The respondents stated that the process was informal; this, however, was dependent on the actual type of content. If the content was a large project, then it was definitely formal and involved a large amount of paperwork and templates. The processes and procedures were also not straightforward and exceedingly confusing, as there were quite a number of options revealed during the process. There was no official authorisation required for any changes made to the website online, where a third party was involved. The archived content was accessible although not used by other teams, apart from PR and Communications. This could possibly be explained by the impractical search available at the time. Archiving permissions were also in the process of removal, though the content was accessible, if required.
Regrettably, piloting was not actually used for evaluation of the digital content. The digital content at the HEI was measured and analysed in a number of ways, using various software/programmes. The Digital Marketing and the Content and

Production teams used 'Google Analytics' metrics to analyse the social media accessible from the main website, e.g. views and 'likes' on a 'YouTube' channel. The team also applied 'Siteimprove' multinational software for creation cloud-based tools and services for website governance to ensure quality assurance. Various analytical parameters evaluated the performance of the digital data, such as CTR (Appendix 1), social engagement, 'YouTube' analytics, the number of page visits/views, impressions, ORC, bounce rates, the time spent on a page/dwell time, CPC, the number of unsubscribers and the engagement levels. The data was mostly supplied by 'Google Analytics'. The Digital Marketing team used basic HTML coding, building pages to improve the appearance using CMS, and specifically created a dashboard based on the 'Google Data Studio' to identify the traffic origin, the audience and visited pages. The teams used reports extracted by Digital Marketing Executive on a regular basis and shared with the other teams within the department. The evaluation was based on the personas, identified in advance and using external benchmarks only. The HEI used a centralised system, allowing simultaneous content creation by a number of persons with limited access and further need for approval before publication.

In the **ROLES layer**, the researchers attempted to identify the standard industry roles within the institution related to content (Table 3). Thus, the HEI had *Content creators* preparing the initial content (academics, students, service professionals and content editors); most of whom obtained subject knowledge with no access to CMS unless trained. This group was providing content via email to the Digital Marketing team for approval and publication. *Content Advisers* (or subject specialists) did not normally have the access to CMS and would have been contacted (if not being the content creators themselves) by the authorisers and/or content creators additionally for their field expertise. The *Authoriser* was the Digital Marketing team, responsible for editing and publishing any new or amended website content. The *Governor* was either the person responsible for content creation (i.e. the Content and Production team with full CMS access) or a person from the relevant department, requesting the change (either via the CMS or via email to the Digital Marketing team). The content *Reviewer* for website content was any content auditor. The Digital Marketing team was responsible for content audit which was not feasibly achievable at the time of the interviews due to overwhelming workloads and staff shortage. The *Analyser* role was performed by the Digital Marketing Executive, who requested monthly analytical reports, reviewed them for their content performance and reported back to their management with recommendations. Finally, the external Marketing Agency did not have access to CMS, as it was not participating in the process of content creation. The agency, nonetheless, advised the teams on SEO and the content optimisation.

Table 3. Digital content roles at a Higher Education Institution

CONTENT ROLES	ACCESS TO CMS	CONTENT RESPONSIBILITY AND EXAMPLES
Content creator	No access	The person who is actually writing/ creating content. **Example:** An academic, service specialist or student, dependent on the content
Adviser/ specialist	No access	Field/industry/service specialist, occasionally contacted by content editor. **Example:** An academic field expert, service professional or student, dependent on the content
Authoriser	Advanced access	The content approver when it is created, amended and submitted for approval prior to publishing. **Example:** The Digital Marketing team
Governor	Page access	Content editor after publication, i.e. updating the existing published content on the selective web pages. **Example:** A person(s) responsible for updating particular/ selected page(s), e.g. the Content and Production team website
Reviewer	Advanced access	Only active/ relevant, if the university conducts regular Content Audit (currently on the ad hoc basis). **Example:** The Digital Marketing team
Analyser	Advanced access	Website performance reviewer. **Example:** The Digital Marketing Executive
Marketing agency	No access	No participation in the content creation, only advice on SEO and the content optimisation

The **MARKETING layer** in turn indicated the overall approach to content, which was 'create once – share everywhere', saving on duplicating effort. The content was shared on social media, the blog and via email marketing. Though the process had not necessarily been followed by everyone. The main focus for the digital content selection was acknowledged to be Student Recruitment. The Content and Production team stated that they looked at the reasons for the content creation (e.g. recruitment) and scheduled its release accordingly, based on "their" research; however, there was no such research, apart from the above mentioned, conducted by the Marketing Agency. The university used profiles of the personas, originally built for the new website. These personas were suggested by the external Marketing Agency, who conducted the research. The Digital Marketing team recognised that the profiles would have to be changed at some point.

All the participants agreed with the suggestion that modern users are becoming more technologically savvy, and their requirements from the UK HEI and HEI's website were much higher and potentially different. The Content and Production team, although recognising that the market changes had impacted on the way things were presented on the website, stated that this was managed by the Digital Marketing team, who only informed them on the changes affecting the relevant content. The HEI recognised the need to reflect these market changes (shorter styles in text and

video, minimalism overall, increase in the expectations from technology, personalised content), particularly the need to provide access for any device. The HEI professionals also recognised the profound necessity for pilot testing with the target audience. The Content and Production team insisted on having a Content Strategy "to address modern movements" with the professional assistance of Content Strategists, although none was actually in place. The Marketing team also highlighted the need to build trust via positive emotional reaction, not 'pushing' the content, as the users are aware of marketing techniques. The content had to be relevant and engaging and to appear to bring value to the digital user's perspective. This could have been achieved by taking the position of the market leader with free professional online advice provided and no obligations. The respondents stated that, apart from the research made by the external Marketing Agency, based on a small sample of participants, for two major requests – a new website and a new brand image – there was none conducted in the website evaluation and development. The HEI had actually conducted several Focus Groups, representing various stakeholders, where, regrettably, the actual main users were not invited. The issue is that the research was only planned and conducted for the new content. There was no indication for the existing content being assessed, despite the intentions. There was currently no co-creation with the user, i.e. the content created together with HEI. The researchers identified several groups, namely: former students, employees and active/existing students as internal influencers. The Marketing team also had just started to use one external influencer (appointed only a year ago), who came from the social media.

The Content and Production and the Digital Marketing teams only reported that their teams were involved in usability and user experience for the external website. The Content and Production team informed that the testing was conducted in two cases: (1) if there were new website elements introduced, or (2) if it was an area of the website considered as requiring a review. An example could have been a review of a course page. The team also reported that the evaluation could be both: (i) based on the results of the website report and (ii) conducted on an ad hoc basis. The information had mostly been collected during the Open Days, using iPads. Apart from the actual evaluation of the website, the team was also testing the accessibility of the content and any links on a number of devices (within their team only).

Although the tests were conducted on iPads, most enquiries were received from the desk/personal computers and mobiles, in equal percentage. Visits from tablets to the website were not as popular. Despite the continuous popularity of the PCs, the Digital Marketing team's professionals recognised that the digital/website content had to be mobile-optimised, with the growing number of mobile users accessing the HEI website via these devices. Some respondents expressed their concern about the actual content on the website, i.e. over-thinking and over-engineering it, using unfamiliar lexicon for potential students. The user journeys for various users were designed by the Digital Marketing team, using 'Card sorting' techniques. Further evaluating message and content, the respondents agreed that they expected the following from a good piece of content: keeping user's attention, engaging conversation, supporting the recruitment of the university, being relevant and

appealing to the targeted user, bringing value/benefit, being well written (a good story), well presented (reasonably short, having a great headline with a trigger to attract the digital reader) and well formatted (no mistakes). The most significant was the point that the content should make the reader act on it. There was an indication of significant growth in the higher expectations from the website images, having both – amateur and professional pictures, being relevant and reflecting ethnicities, as well as the growth of the necessity to have videos and VR online. Regretfully, HEI professionals recognised that images were often overlooked, despite their significance in added value, particularly for visual persons.

Opinions on the entertaining factors were divided. Some stated that HEIs should neither consider any entertaining factors when content is created for a website, nor should they evaluate the website for these factors. The others considered them as being useful when relevant and not distracting from the main purpose of the visit. The HEI was using GIFs (i.e. the Graphics Interchange Format is a bitmap image) for the Marketing campaigns. The Digital Marketing team suggested that having entertaining factors was expected by the users, if the institution was offering particular courses, e.g. Web Design degrees; though the entertainment should be limited, as not all users like them. Surprisingly, the examples as they were understood by the team, were notoriously unpopular pop-ups, disrupting the user journey. The technical requirements for this type of content invited growing own in-house specialists. There was also some concern expressed in using entertaining factors, e.g. the incapability of some devices to cope and potential slow delivery. It is worth mentioning that the youngest team member, as well as the PR and Communications representative, had the opposite opinion wishing to have these entertaining items on the website. The other professionals, however, stated that a carousel of images, often placed by HEIs on the top of the home page, was merely used to display the information that was requested and there was nowhere else to put it. This was not acknowledged as being professional. The respondents saw interactive content as something that students can get control over in order to get results, e.g. opinion polls, voting tools and competitions. These also were expressions of emotions, making jokes, etc., anything different and memorable. Only one of the participants suggested that it would be useful to ask the actual users to identify their attitude regarding having interactive content on the HEI website.

The **STRATEGIC layer** revealed the main reason for content creation - Student Recruitment, e.g. the application process, deadlines, related to university's reputation and research, success stories, student experience and currently running events. The main idea was to get user attention, stimulate their engagement and encourage the decision-making process to apply for studies. Apart from the Content and Production team, every other respondent assumed that this was merely this team's responsibility to create, use and contribute to this content calendar. In reality, the teams had their own targets and calendars, which included the events related to the recruitment cycle (e.g. key deadlines, pre-Clearing and Clearing); seasonal (e.g. celebrating New Year), religious (Christmas, Hanukkah, Diwali and other nationalities key celebration dates) and Internationally acknowledged event

calendars (e.g. Valentine's Day and Halloween). Some of the individual teams also had calendars for their business partners and marketing campaigns. There was still a suggestion of having one combined calendar, as it required scheduling (not random publishing); although, the researchers had already been informed about the previous unsuccessful attempt which did not last longer than several months, as the teams found it too overwhelming to manage, having too many entries/events in one place. One of the most successful and original digital projects in the calendar was designed and published at regular intervals throughout the UCAS year (52 weeks) with the view to gradually prepare prospective students for higher education overall, not necessarily to that university. This project received one of the prestigious awards on the best use of content.

The answers to the question on any repeated topics throughout the academic year indicated clear inconsistency of knowledge. The teams reported on using recent events, such as national and international news, mentioning political (e.g. 'Brexit'), industrial (developments in obesity or ecology) and health related (e.g. 'Mental Health Awareness Week') events. In terms of any particular topics at particular time included UCAS and Recruitment cycles, the Academic Calendar, any significant changes in industries (e.g. ecology) and reputation related at the time. Closer to Clearing period, there were also topics related to the student experiences at university, namely 'What life is like at uni' and/or topics related to accommodation.

Further evaluation of the brand image and the tone of voice to identify if any amendments were required as to content, i.e. style/content/guidelines revealed indicated polar-opposite ways in dealing with the content. Some of the respondents stated that they did not receive particular guidelines/parameters to follow; while others followed strict university regulations for content creation (including the requirements for images), namely the university's house style, i.e. 'Marketing guidelines' created to cover style, branding, tone of voice, the story, a strategic university plan, the way this content was read and the flow, encouraging engagement with the reader. Overall, the teams attempted to provide an ethical approach to the digital users, not misleading and being transparent. According to the responses, there was no regular content evaluation, unless it was done by the individual/school to whom this piece of content belonged or if the Digital Marketing Executive noticed overly negative content performance. The team though used specialist software to identify any broken links and similar quality assurance. Despite not having a regular Content Audit (or any at the time), the institution had gone through the impressively thorough project when it evaluated content in preparation for the new website two years ago. There were at least two issues with this approach: (i) financial difficulty in affording this process (i.e. Content Audit) on a regular basis due to the cost of the new software; and (ii) the time it took to accomplish this project.

The researchers received three completely different answers from the Content and Production team when asked if anyone was checking the messages provided by every piece of content as overall suitable for this website. One stated that no one was responsible for doing this. The other responded that only some of it would be

viewed from this angle. The last participant from the team stated that everything is and should be relevant. The latter opinion was supported by the Digital Marketing which also provided examples of questioning the appropriateness of the content provided for publishing. It was interesting that the Content and Production Manager, acting as the Content Strategist, was actually responsible for the strategy, evaluating all produced digital content and advising if the content was right (or not) overall. This person, nevertheless, never mentioned their responsibility at this point, even though they listed it when asked to describe their position at university. The issue of the overall suitability of content was also vital for the PR and Communications team, due to the university's reputation. Although the content could have been shared among the various digital locations (such as: the website, email campaigns and on social media), there was obvious differentiation in the purpose of the created/published online content. This way, all the content was divided and could be going one way from the main website to other online communications, and rarely the other way, back to the website, mostly due to its inappropriateness. The researchers identified that the HEI did not consider a content lifecycle for every new piece of content, but managed the content organically, i.e. it was created to last for a stated period only, prior to being archived. Surprisingly, a number of respondents associated Content Lifecycle with the Content Audit. The content was presented for one generalised audience (from students to their parents/guardians) with, at its best, planned dates for publishing online and archiving and no other considerations. There was some evidence for the content reuse of materials from previous years.

The teams stated that the main contributors for the website content were academics and reported not having a huge amount of User Generated Content (from students) on the website. The only student contributors were those commissioned to write blogs for the website. The university had only one external blogger, who was getting paid for their participation, promoting the institution via social media. Overall, the participants supported the idea of higher student involvement and the development of the culture for User Generated Content, implying only current students, not external audience. In reality, however, no real action had been undertaken to develop the UGC. The reasons for content contribution could only be assumed to be related to the participants in need of online publishing experience, those who enjoyed the online engagement and those who desired to share their personal experience, acting as student ambassadors. There was no research undertaken to identify the reasons, even though the team undoubtedly acknowledged the significance of the UGC for an HEI in having authentic and credible messages for prospective students. Furthermore, some HEI practitioners held the opinion that there was no need for this; while others, on the contrary, stated that it was important, as it allowed communicating with prospective students in their own language. Although the practitioners realised that some content contributors were volunteers, providing content for free, it was also mentioned that some incentives were used, such as: food/drink vouchers, online shopping vouchers, free gym memberships or even paid student jobs. It became evident that the institution was actively working on creation of in-house student influencers.

5.0 Conclusion

Overall, the conducted research indicated a number of issues relating to the dealings and attitudes of digital content creation and management. The HEI, for instance, unsuccessfully developed internal communications, even within one department, as the respondents were partially (or even fully) unaware of the responsibilities and/or activities of other teams. This way, the Content and Production Editor from the Content and Production team was working exceptionally closely with the Digital Marketing team; this made the person more aware of the true dealings with digital content in the other teams. Regrettably, despite the expert market position from the awarded project, placing the HEI on a much higher level than its competitors, the institution hardly conducted any research with the target audience as to the basic preferences, UGC and interests through to the clear requirements needed for the educational website and interactive content, entertaining the digital user. There was neither a content calendar, nor a real content strategy in place. It is worth mentioning that the researchers enquired about the content strategy in December 2018 and were advised that it was expected shortly; while, when approached the Content and Production team in February 2019, the Manager of the team stated that there was no need for it.

Finally, despite the professionalism indicated in the digital marketing activity for the institution, the question clarifying the definition of Content Strategy did not return any decent responses, except one from the Digital Marketing team, who indicated that ,in their opinion, content was everything and a Content Strategy stipulated the key events, the ways to promote these events and the channels in which it could be achieved.

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Appendix 1. Glossary of terms

CTR (click-through rate)	The number of clicks received by the ad divided by the number of times this ad is shown, i.e. clicks ÷ impressions = CTR.
CPC (cost per conversion)	The average amount a company have been charged for a conversion from this ad (calculated by dividing the total cost of conversions by the total number of conversions).
ORC (open rate clicks)	The number of unique clicks and unique opens. This number indicates the effectiveness and the level of interest of an email message. It could also be called CTOR (The click to open rate).
Social engagement	The process of communicating (engaging) in an online community, taken place on individual social media platforms or in blogs, forums and third-party review sites.
Page views	A visit to a page on the website. If the user navigates to a different page and then returns to the original page, this will count as another page view.
Page visits	A visit is defined as a sequence of consecutive page views without a 30-minute break and contains one (or more) page views.
Impressions	The number of times the ad is shown on a search result page or other site on the 'Google Network'.
'YouTube' analytics	A selection of digital analytical metrics, evaluating the performance of particular channels or single videos published on this network.
Bounce rates	The percentage of visitors to a particular website who navigate away from the site after viewing only one page.
Dwell time	The time spent on a website page.
Unsubscribe rate	The percentage of users who have opted-out from the mailing list after an email campaign. It impacts email deliverability, so a large number of unsubscribers leads to negative consequences from email service providers, e.g. 'Gmail', 'Yahoo' and 'Outlook'.
Social media engagement levels	A common metric for evaluating social media performance which does not necessarily translate to sales.
Shares in social media	The action of broadcasting web content on a social media network by social media users to other audiences, i.e. individuals or groups.
Likes in social media	The action of approval with a post on social media by a social media user.
Comments in social media	A comment is a response that is often provided by a registered user as an answer or reaction to a blog post or message on a social network.

Enhancing the Quality of the Teaching and Learning Process Through Implementation of E-Learning Tools

Case study of Armenian State Pedagogical University

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Abstract

Information technology (IT) developments brought forth new challenges for traditional higher education universities, that is to prepare academic staff to teach online courses implementing modern technology.

This study describes the University environment that focuses on online teaching and learning. We discuss the case of the Armenian State Pedagogical University Kh. Abovyan (ASPU) that has transformed the education process from traditional to online using Google Classroom. We also assess the effectiveness of Google Classroom implementation for online education at ASPU. Students from the Education Management programme took part in this study. Results confirm that the transition to the online form of education went successfully, and the four-year experience helped the university to smoothly move to distance learning during the COVID-19 pandemic. Findings show that a well - designed strategy and suggested activities to mitigate risks can direct the university to support students to achieve programme learning outcomes through online course offerings.

Keywords: online education, distance learning, virtual teaching, COVID-19, strategy.

1.0 Introduction

In accordance with the European integration policy of the Armenian educational system and participation in the Bologna Process, obliges institutions to make digitalization as one of the priorities of the field. Therefore, the integration of digital skills into teaching and learning activities is required. Several activities have been carried out since 2010. Mainly the Government of Armenia took several measures to implement the provision of online courses and distance learning for higher and postgraduate professional education. ASPU became one of the leaders

in the realization of this programme and worked hard trying to find various solutions.

There are many studies on integrating technology in the teaching and learning process that focuses on enabling students to achieve the desired learning objectives of the educational programme [1]. Technology has gained importance in all stages of education by increasing student engagement to obtain the desired learning objectives [2, 3]. Over the past twenty years, a rather common critique of teaching has emerged in many research publications and policy documents [4]. The COVID-19 crisis also highlighted that education needs reform to better train teachers in new methods of education delivery [5]. In many higher education institutions, the move to distance learning has been an opportunity to expand flexible learning modalities [6].

Distance education is not a new concept. As Christner indicates, distance education was known as far back as the mid-19th century when it was referred to as “correspondence courses” [7]. However, the examination of e-learning literature shows mixed reports on how traditional higher education institutions make the transition to becoming hybrid institutions that offer both face-to-face and online courses [8,9,10]. Student access issues lead to the reasons how institutions offer online courses and programmes [11]. A range of measures has also been developed to assess student readiness for online learning [12,13].

During the pandemic to help students complete their term successfully, different universities have introduced various solutions by shifting to online teaching via Google Classroom and Google Meet, Remind, Zoom, Slack and other platforms. [14]. In this hard period Microsoft, Google, Zoom, and Slack companies offer many of the features of their products for free to educational institutions. Online libraries, TV broadcasts, guidelines, resources, video lectures, online channels were introduced also.

To evaluate the functionality of Google Classroom as a Learning Management System (LMS) Espinosa, Estira, and Ventayen conducted research [15]. The study found that collaborative learning through assignments was an effective tool to enhance student engagement. The conducted research results by Liu and Chuang regarding the use of Google Classroom with the integration of peer tutor mechanism also had a positive perception [16].

After the evaluation of the results of numerous studies, the ASPU administration decided to implement Google Classroom as an e-platform for learning and teaching. Therefore, by the decision of the Academic Council, the Department of "Education Electronic Management" was formed to coordinate the process. The contract with Google was signed in 2015, afterwards, in 2016 the Google classroom platform was introduced to students and academic staff.
Summarizing the ASPU experience and stakeholders’ opinion we prepare SWOT Matrix Table 1.

Table 1. SWOT Matrix: ASPU experience and stakeholders' opinion.

STRENGTHS	**WEAKNESSES**
• Google Classroom: ✓ Connects instructors with students. ✓ Makes it easy to create a class and invite learners. ✓ Helps instructors to distribute assignments. ✓ Facilitates communications between instructors and students. ✓ Allows students to see assignments, documents and class materials in one place. • Upon setting an assignment, students get a notification email. All assignments stay on the stream and can't be deleted by students. • Teachers can see who has and has not completed the task. • With the help of this online tool, teachers can receive feedback, track the progress of students, save time and paper.	• No support for external files or services, lack of automated quizzes and tests, and a lack of live chats that can aid in feedback. • Some teachers are less enthused; either they find this "digital lecturing" difficult to use and they don't want to try anything new. We also have few teachers that they resist any change that University brings in. • Google Classroom lacks a fully-fledged grade book and editing of assignments once they are released.
OPPORTUNITIES	**THREATS**
• The Google Classroom app, linked with Google Drive, Gmail and Google Calendar is helping to produce and to store assignments, to share learning material and to assist student/teacher and student/student interactions. • Within a class communication of assignments set and notifications are arranged in a stream like most social media sites work. • With just one email address and one password students (and teachers) can log into all Google apps. • Students can upload work directly from their computers, tablets or phones, including pictures and video files. • Teachers and students can work anywhere and anytime on any device.	• Specific problem of Google Classroom generally focuses on concern for students' privacy and Google's use of student data. • Some students do not have an internet connection at home. This problem needed to be dealt with sensitively; it was often linked with financial issues. • Many students from regions do not have computers, tablets or modern phones.

2.0 Background

The mission of ASPU is to provide students with an outstanding learning experience and support them in achieving academic success. The University is extending its commitment even further by implementing modern e-learning tools for students to master essential academic skills, practice intellectual integrity, and research ethics. To achieve this top priority goal the university is committed to improve teaching and learning by implementing modern e-learning tools. Therefore, new technologies, e-learning teaching, and studying tools should be used.

Several reforms have been implemented by the Armenian Government in the area of education management which has increased the autonomy and responsibility of educational institutions and has created favourable conditions for an effective dialogue between the education system and employers. However, there are still a lot of problems on the way of transition to an efficient management system.

In this case, we need to design an intellectually and professionally challenging programme that will become recognized in the professional formation by preparing managers for higher education.
Education Management programme at ASPU has been developed within the framework of the Tempus Mahatma project in 2013 (Master in Higher Education Management: Developing Leaders for Managing Educational Transformation).

This project aimed to promote the transformation of higher education management in Armenia and Georgia through the introduction of a master's programme in higher education management. The program offers an opportunity to become an educational leader by developing management and leadership skills. Looking into the future, some of the most important skills that employers will be looking for will be digital skills deeply intertwined with digital learning. Therefore, we integrated modern technological tools into this educational program with the aim to prepare specialists/ leaders in education management who will also have digital skills and will be able to take responsibility in times of crisis.

3.0 Methodology and Data Collection

A study was conducted using the survey method. The survey questionnaire aimed to discover the Education Management programme main stakeholders' satisfaction from different aspects of the teaching and learning process for the two periods: after two years of implementation of the Google classroom in 2018 and in May of 2020.
The questionnaire was filled in by the students, academic staff of Education Management programme and employers (randomly selected educational leaders from the universities, schools and private education institutions) to find out how they evaluate the teaching and learning process overall and the effectiveness of the used platform. It was an anonymous survey.

The information gathered at the study and the participants' personal identities were kept confidential. The results of the study appeared as group results. It is worth to mention that participation in this study was voluntary (25 responses received from students,15 responses from academic staff, 35 responses from employers in 2018 and 23 responses received from students,15 responses from academic staff, 37 responses from employers in 2020).

The survey participants (academic staff and employers) were between 26-50 years old. Only 8 of them were over 50 years old. In 2018 three people out of 50 who participated in the survey had from 0-3 years of working experience, 6 people had from 3-6 years of experience, 14 people had from 6-10 years of experience, and 27 people had more than 10 years of experience.

In 2020 the survey participants were generally between 26-60 years old. Five people out of 50 who participated in the survey had from 0-3 years of working experience, 7 people had from 3-6 years of experience, 14 people had from 6-10 years of experience, and 25 people had more than 10 years of experience.

After analyzing all the responses we can state that all participants are sure that implementing classroom technology in pedagogical university is more essential and needed because it can help to prepare a generation for the future with digital skills.

4.0 Findings and Discussion

This study collected data by distributing the survey to the targeted participants using Google forms. The collected data were analyzed using frequencies, percent of total responses, and correlations.

The steps in analysing the data in this study were as followed.

1. Review of online learning by implementing Google Classroom.
2. Preparation and distribution of the questionnaire to Education Management programme students batch 2018 and 2020.
3. Collection and analysis of the data from the questionnaire into a statistical package.
4. The explanation of the main findings by the help of the charts.

The main findings are analysed by looking at the whole average score from the highest to the lowest result. A high score indicates that the stakeholders are satisfied with Google Classroom and it is useful and efficient as an active learning tool. A low score indicates that the stakeholders are not satisfied and are not interested in using the Google Classroom platform. The variables are measured on a 10-point scale ranging from 1 (strongly disagree) to 10 (strongly agree).

The following statements are shown in the questionnaire: methods of assessment, curriculum relevance to the workforce demand, international cooperation, employment counseling, students' readiness to work online, teachers' readiness to work online, accessibility of teaching staff.

Results are presented graphically in Figure 1. According to the conducted study organized in 2018 readiness of students to work online is 7.1 and for lecturers, this indicator is 7.5.

According to the results, all aspects are highly evaluated and there are just a few variables with lower means. The main risk was associated with “Assessment methods” (6.1), “Curriculum relevance to the workforce demand” (6.7), “Employment counselling” (5.9).

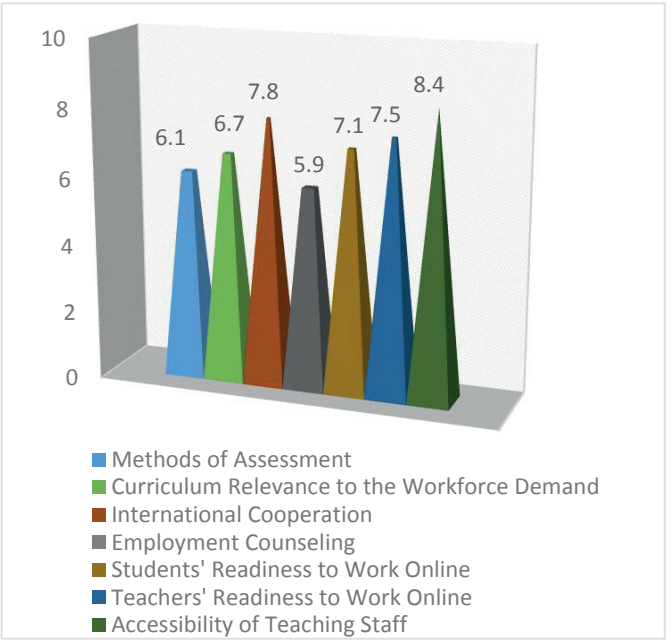

Figure 1. Stakeholders’ satisfaction from different aspects of the teaching and learning process in 2018.

The university administrators tried to manage the situation by acknowledging the risks. A high percentage of students had an intermediate level of e-literacy and digital information skills, so training was required, as well as the availability of a handbook how to navigate in the course site was required. Therefore, the

administrative and technical staff of the university organized training for students and also for the academic staff in order to support the efficient functioning of academic programmes by the usage of Google Classroom resources.
University management staff together with the Quality assurance office prepared a work plan taking into consideration the peculiarities of each specialization and scheduled the main activities;

- All lecturers teaching different courses at the university took part in the training, for which the teaching packages of the courses were developed and implemented, and online platforms were formed in order to organize further work with the students.
- A meeting-discussion on the Google Classroom system, with the participation of the University stakeholders, was organized regularly. Actually, the discussion of May 2018 was noteworthy, during which the lecturers and students objectively revealed the non-objectivity of some indicators of the assessment system.

Over the next two years, in cooperation with the internal and external stakeholders, ways were found to resolve them and thus to improve the assessment mechanism.
In order to address the risks, the following is suggested:

- understand what is required to become a successful online learner and teacher,
- study the needs of the teacher and raise the effectiveness of training in compliance with the current requirements,
- ensure methodological assistance in e-learning,
- define how students will be evaluated,
- prepare a guide for the appropriate interaction and communication including the rules of netiquette, including answers of frequently asked questions and place basic information about navigation in the course site.
- regularly organize training.

Changes and adjustments have been made to improve the curriculum in relevance to the workforce demand. The revised major areas are as follows:

- The course content of the "Information Computer Technologies for Professional Purposes" has been redesigned in accordance with the recent tendencies and current requirements of the field.
- The academic hours for research courses and for "Professional practical placement" have been added.
- The academic hours for the "Respective research work and research-based internship" have been divided into the corresponding components and equally split up for all the semesters.
- A new subject "Educational Organization and Administration" was added in the programme aimed to develop students' managerial skills.

Owing to the improvements of the e-learning system today the University can carry out even pedagogical practice (internships) online and to get employers counseling. Considering that many challenges could arise during the process of online

pedagogical practice, the work of the groups and leading specialists were planned in detail encouraging the cooperative and creative atmosphere in the groups.
With the support of the leading specialists, an online study of educational needs and opportunities to improve the process of online education in line with the current realities have been conducted in May 2020 (Figure 2).
The questionnaires were filled in by the stakeholders of the Higher Education Management programme in ASPU. Therefore, the online survey using Google forms were conducted, and at the end of the internship, the ASPU organized a practice-based defense through the Google Meet.

At the meeting, the stakeholders highlighted the important achievements that they have reached implementing the Google Classroom electronic platform. Significantly are improved the learning conditions, assessment mechanism, and total teaching and learning process, including, lecturer-student interaction in terms of the allocation and distribution of educational materials.

The following statements are shown in the questionnaire: quality of learning activity, internship, research activities, readiness to work online, usefulness of the Google classroom and Google Meet for communication and social interaction, employment counselling, international cooperation, teaching staff accessibility, overall satisfaction with Google Classroom, library and online resources (Figure 2.).

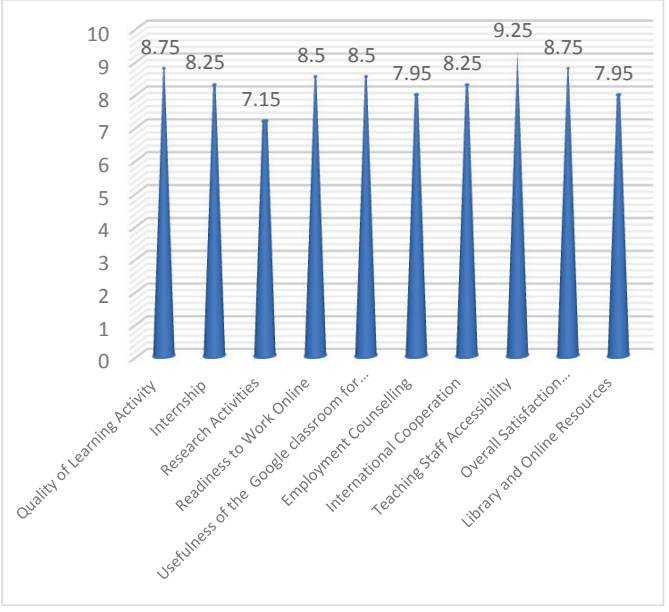

Figure 2. Results from the survey conducted in 2020.

In the chart above the average score of the overall satisfaction with Google Classroom and the quality of learning activity is the highest-8.75. Therefore, we can state that the developed strategy and operational actives related to the enhancement of the quality of teaching and learning via the implementation of Google Classroom as a learning tool helped the University to achieve its priority goal.

Based on the result of the questionnaire answered by respondents, the average score of the usefulness of Google Classroom for communication and interaction is also the highest. Respondents do not find any difficulties and feel comfortable using Google Classroom as a learning tool.

To sum up, the survey result conducted in 2020 shows that most of the stakeholders agree that Google Classroom is effective and easy to use. This result is like to the result of (2018) i.e. participants agree that they do not find any difficulties in operating Google Classroom and Google Classroom is easy to use as a learning tool.

5.0 Conclusions and Recommendations

The conclusion is based on the research findings and on the importance of e-learning in higher institutions, as well as on the stakeholders' responses on the effectiveness of Google Classroom implementation at ASPU.

The overall results show that Google Classroom is useful and helpful for the ASPU stakeholders and they are satisfied with Google Classroom tools. It enhances the student-teacher relationship and provides students with a means of interactions among themselves.

During the last 4 years, the university administration continuously organized training for the academic staff and students on the implementation of Google classroom. The practical implementation of the gained knowledge, internship organized online, students' examination scores, reduced risks as a result of organized activities during the implementation of the Google classroom, regular reports during the rectorate meetings stated that the quality of teaching and learning process within the framework of Google platform implementing its online tools were beneficial for stakeholders.

The survey main results (the average highest results related to the usefulness of the Google classroom and Google Meet for communication and social interaction, overall satisfaction with Google Classroom) also confirm that the transition to the online form of education went successful and effective. The above-mentioned activities and results are the main fundamentals of the four-year experience which helped the university to smoothly move to distance learning during the COVID-19 pandemic.

The study makes the following recommendations:

- E-learning platform should be used at all levels of educational programmes.
- The University academic bodies should enforce the adoption of the e-learning platform in addition to conventional teaching mode.
- Lecturers should be encouraged to implement interaction methods during the learning and teaching process, to expand the usage of electronic tools. They should pay more attention to students' practical work, help them to prepare assignments, and provide feedback, as a result, students will better understand the course.
- The suggested way that students properly use Google Classroom can make learning better, more engaging, and more student-centered.
- The employers should suggest ways to use Google Classroom for social interaction, be more enthusiastic in providing consultations via Google Classroom, and in organization online internship at educational institutions and quality assurance departments.

6.0 The Further Activities

Summarizing the ASPU experience we can state that the University managed to smoothly move to distance learning during the COVID-19 pandemic owing to its four-year experience in online teaching and learning through the Google Classroom.

Further activities are directed to strengthen the aspects related to Employment Counselling. It is also important to acknowledge that now workforce demand is multifunctional. Graduates are sure that developing language and digital skills they can have progress as specialists. The university's new strategic plan for the 2021—2025 period and developed operational plans include directions for the realization of such kind of conviction.

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Refining the Teaching of Programming

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Abstract

This paper considers issues around the teaching of programming, a critical yet challenging part of the computing education at all levels. This paper begins by outlining some of the key concerns around computing education – from secondary school, through further education, and in higher education. The paper describes some of the practical problems with teaching programming, through two case studies that identify some of the difficulties in learning to program. The case studies outline some approaches to supporting and scaffolding the learning of programming, with programming tutors and more specialized programming environments. The paper considers ways in which novice programmer behaviour can be tracked by appropriate technologies, e.g. via tools such as source control, or through additions to a development environment). Whilst this is within the context of English education, many issues are common elsewhere, and the paper provides some suggestions on addressing these problems. The paper concludes with some suggestions on ways to adapt and use these approaches in the teaching of programming.

Keywords: Computer Programming Education; Computer Science Education, Human Computer Interaction.

1.0 Introduction

Computer Science education in the U.K. has experienced a number of challenges and shifts as it has developed since the 1970's. The evolution and growth of computing as a defined academic discipline, alongside the increased - and growing - presence of computing in people's lives, has seen a developing focus on computing and increasing numbers of students [1]. Concerns throughout the decade after the turn of the millennium – where a focus on IT and ICT was identified as stifling student interest and thereby student numbers - saw renewed investment [2], and the reboot of Computing education in 2017 [3]. A key shift was a move away from applications of computing – as had typically been the case in IT and ICT – towards the underlying computational thinking, programming and scientific underpinnings that are recognized as Computer Science [4]. A key focus for the new course being the need to design and create software. This paper considers some of the issues in the support for the pipeline of talent, as illustrated in Figure 1.

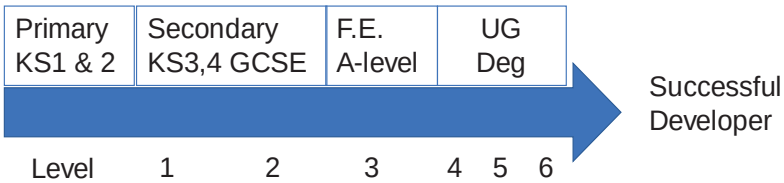

Figure 1: The talent pipeline for Computer Science

1.1 Maintaining the flow

The increased focus on technical aspects of computer science – whilst welcome in many respects – creates new issues and potential issues with the supply of students from the early levels, as well as issues in maintaining them (retention). This raises two key questions: firstly, how well it can be supported at schools and within Further Education. Secondly, how far this should and in effect has become an assumed – if not actual – pre-requisite for higher study?

As mentioned, one of the key issues is this provision and support for the new computing curriculum through the early stages of education (Key Stages 1 to 4 in the U.K.,) along with the challenge of supporting teachers and pupils where they are following the formal qualifications (level 2 GCSEs, and level 3 A-levels and BTeC qualifications) in Computer Science and Software Development. As illustrated in

Table 1 and Table 2, which shows that at GCSE (typically age 16), Computing has one of the worst pass rates, at second from last in 2018, and fourth from last in 2019, indicating that support in the classroom is needed.

Table 1: OFQAL data of lowest GCSE subjects for a grade 4 and above pass in 2018

Subject (GCSE)	**Pass Rate (4 and above)**
Mathematics	59.7%
Computing	61.4%
English language	62%
Food preparation and nutrition	62.3%
History	63.8%

National initiatives – such as the National Centre for Computing Education [5] – offer one route to support teachers, and universities can support this. Another route is the related Computing at School initiative and the associated hubs [6], which can also benefit from university involvement. This paper considers more direct options for departments, through schemes such as the Undergraduate Ambassador Scheme [7].

Table 2: OFQAL data of lowest GCSE subjects for a grade 4 and above pass in 2019

Subject (GCSE)	**Pass Rate (4 and above)**
Engineering	50.6%
Mathematics	59.6%
English language	61.8%
Computing	62.6%
Social science subjects	62.9%

As the number of students entering computing courses is increasing, so too is the range of these students in terms of their computing background, creating new tensions. This is illustrated at A-level, where the pass rate for Computer Science mirrors that at GCSE, as in Table 3, which shows that ICT and Computing (including Computer Science) perform poorly, lying in the bottom 5 subjects. So there are potential gains by ensuring that A-level teachers can also get support in the classroom in terms of making Computer Science a popular choice at school, and that students achieve the grades to want to and to be able to progress on to university.

Table 3: A-level pass rates - lowest 5 disciplines 2018

Subject	**%Pass**
ICT	54.7%
General studies	54.8%
Critical thinking	57.7%
Computing	61.7%
Physical education	67.3%

1.2 Early leaks

Following from the previous section, the shift in school level computing, from IT focused to CS focused – is causing a capacity challenge, with a lag whilst teachers are reskilled or new teachers trained. A variety of initiatives are being rolled out, including support and incentives for new computing trainee teachers such as significant bursaries [8]. From a university perspective, a more direct mechanism, that can support the local communities and also recruitment into the discipline, is the Undergraduate Ambassador Scheme. Established in 2003 - when it initially focused on science and mathematics education – the UAS has included computing for several years. The model espoused through this scheme is for computing programmes to include one or more modules that support – and award credit - for students going out in to schools and colleges to assist in the delivery of computing. This can be at any level – and as noted in the introduction – with computing now appearing at all Key Stages, the need is present across the educational spectrum. There are resources to aid the student participants in appreciating their identity as role models, as well as practical advice about things like lesson observation, approaches to learning and teaching at school, and how to plan and deliver their own classes.

A typical approach is for students to spend one day a week in a specific placement (primary school, secondary school or college), where they provide support in the provision of IT/computing, whilst also gaining experience which may encourage them into future careers in teaching. Working with local schools, the University of Hull now regularly has 8 to 12 students working in primary, secondary and sixth form environments for extended periods. Some of the special projects have involved the university students organizing trips to computing related sites – including the university itself. The success of this approach can be further seen in the students who have gone on to full teacher training pathways, and now host the next generation of undergraduate ambassadors, as well as the positive feedback from teachers who go on to take ambassadors over several years.

1.3 Later leakage

The availability of Computer Science at A-level has led to a perception that it is a prerequisite for studying at University. However, this is not typically specified by universities, and many students do not have a formal computing background. The proportions of these are shifting somewhat – empirical data from Hull show around 60% of applicants to Computer Science having some form of advanced (level 4) computer science or directly related qualification. So far this has not had an impact on recruitment to Computer Science degrees, with computing related courses remaining one of the most popular ones. However, the growth in student numbers, combined with the difficulties experienced at school and college is creating two separate challenges.

Firstly, the increase in numbers means that the size of cohorts is varying widely, with 300 within a programme or module not uncommon – creating the "North of 300" challenge [9]. Secondly, with an increasing proportion of these students arriving into University Computer Science courses with level 3 qualifications of a widely varied nature, the challenge here becomes that of managing a diverse cohort – allowing for differentiation in activity and attainment, based on differing backgrounds – as well as ensuring the dropout rate is managed. One indication of the problems associated with this is the relative poor performance of computing in terms of attainment (see

Table 1) and retention (Computer Science typically has one of the highest dropout rates [10]).

Table 4: Degree outcomes: good degrees 2018

Subject	Good degrees%
Education	71%
Computer science	71%
Architecture, building & planning	71%
Business & administrative studies	70%
Agriculture & related subjects	67%

Empirical evidence from experience is that the skill of programming is often a key barrier for students, and the approach considered in this paper is how to use more flexible and informed approaches to the teaching of programming can improve student experience.

3 Introductory Programming

3.1 Block based programming

One approach to programming is to use specialized environments to teach programming, rather than general purpose IDEs. By reducing the complexity of an IDE, the novice can focus on the core programming concepts; thus, students can avoid being side-tracked by the environment, and can instead focus on the core programming concepts, e.g. the formal analysis of the program via a data-flow analysis, and relating this back to a known library of programs (correct and buggy).

Another approach is the use of Block Based Visual Programming languages such as Scratch [11], and Crumble [12], providing simplified environments within which to teach computational thinking and programming. However, whilst the environment avoids barriers with syntax, it can still be difficult for a tutor to monitor and support a diverse class. The approach described here is to log the

learners' activities – through their interactions with the programming environment - and to use these to identify areas for development and support.

Research carried out by Cargill in 2018 [13] considered if the competence of a novice programmer can be reliably linked to measurable coding characteristics, in a way that can be automatically captured and analysed. The reason for doing this was to support improvements in efficiency of teachers when they are teaching novices to program, i.e. where their 'learner support' is best targeted. This research used the 'Crumble' software and hardware platform. This low cost computer platform includes components such as lights ('sparkles'), motors, sensors and switches enabling a variety of project based activities. The programming is done offline, and therefore can be carried out in remote locations lacking internet access. In common with other block coding systems, Crumble includes families of instructions covering loops, operations and I/O etc. The Crumble platform consists of two elements: the programming editor and the microcontroller editor.

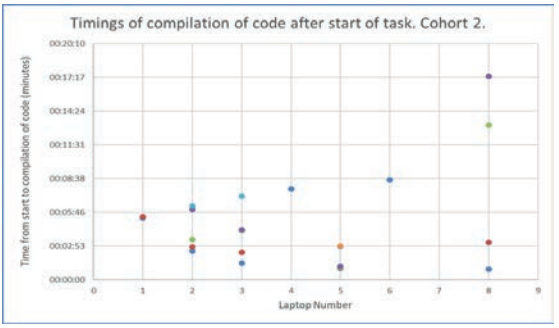

Figure 2: Compilation attempts versus time

Data was captured via XML logs of the interactions with the Crumble IDE during workshops, where the teachers were given a variety of specific programming challenges, and their interaction with the programming environment was logged to allow for post-activity analysis. The analysis of the data identified user errors, poor practice and considered possible correlations between these, and users' self-assessed levels of competence and the effectiveness of their final code. Further analysis looked at the speed and completeness of the code as it was developed. Figure 3shows visualisations of two participants programs – the more complex pattern in the second picture showing a greater variety in the programming constructs used. This illustrates the potential in using visualisations to identify specific students who would benefit from an intervention.

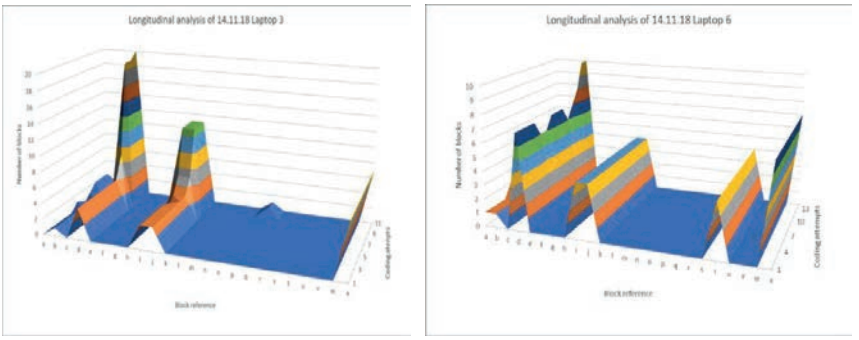

Figure 3: Visualisations of the programming activity from the XML logs

Furthermore, the analysis of the data captured on compilation attempts versus time (Figure 2), determined that the two characteristics most consistently shared by the more competent programmers was the longer time gaps between their code tests and the extent to which their code was built up initially before testing took place. This offers more effective ways to support the teachers as they develop their own programming skills, ready for them to begin delivery in the school setting.

3.1 Text based programming within a bespoke tutor environment

Student engagement is seen as increasingly valuable in measuring student study and improving success, and in particular, in avoiding drop-out i.e. improving retention, which is recognized challenge for Computer Science. However, measuring engagement through extrinsic attendance monitoring systems is not always effective; students may engage with the extrinsically motivated engagement monitoring system without engaging with the intended learning activities, with little correlation between engagement and attainment [14]. Additionally - with increasing class sizes - traditional assessment methods involving a large practical coursework are increasingly problematic. Further, there is a perception that students are becoming overburdened with a disproportionate amount of work at the end of a module, and little opportunity to catch up should a student fall behind. These contextual issues are further compounded by the range of backgrounds, from advanced level formal computer science, through informal (self-taught) programming, to complete novice.

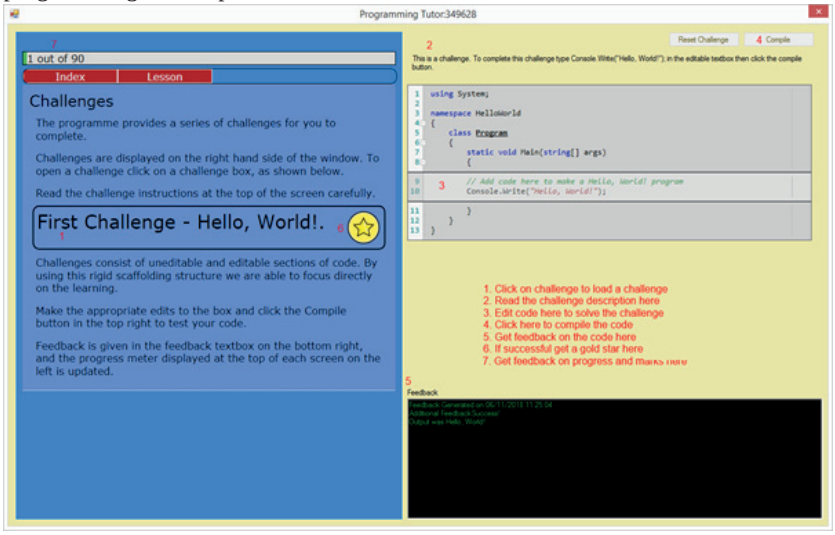

Figure 4: a bespoke programming tutor environment

For this case study, a programming tutor application was designed to address these issues – offering a series of 90 programming based problems that are marked automatically, can be attempted any number of times and carry 30% of the marks of the module, partially replacing a large programming coursework. To complement this, students took two exams each worth 30% of the module marks – one an open book examination in which students wrote code to solve basic programming problems – the results of which were automatically marked – and a second closed book exam that tested student's understanding of syntax, and their comprehension of a large piece of code written by the lecturer that they had already seen. The remaining 10% was offered for student's performance in two smaller examinations of a similar form to the final examinations. Students were able to attempt each of the mock examinations up to three times in their own time.

Problems set within the programming tutor were all accompanied by some explanatory text and a section of editable code surrounded by two sections of un-editable code. Problems typically moved from high scaffolding to low scaffolding, and problem design was inspired by similar tutoring systems [15], [16], [17].

For example, initially in a description of conditional operations students might be presented with a conditional written in the second un-editable code section and would only be asked to assign values to variables such that a particular branch of the conditional statements be reached. This is a problem with high scaffolding. Subsequent problems would have increasingly less structure – for example debugging an existing editable conditional statement, or writing their own conditional statements. Students have the ability to run the code within the programming tutor and examine the output for a number of test cases. When a student's solution results in an incorrect output students are given feedback of any compilation errors, or of the test cases which failed. When a problem results in the correct output students are rewarded explicit feedback with a golden star icon for that problem, and a progress bar is filled, adding further gamified layer of extrinsic motivation [18].

One advantage of the use of a programming tutor is that it enables engagement with the tutor to be monitored. This has a number of advantages over and above monitoring attendance as a proxy for engagement. The first is that engagement with learning activities is being utilized, rather than engagement with an extrinsic monitoring system that is not well aligned to learning activities. The second is that when students are struggling with a specific area, it is possible to collect data concerning what they are struggling with, and target assistance accordingly. Finally a fine resolution tool such as a programming tutor ensures significant coverage of basic concepts – for example it is possible to ensure exposure to several methods that achieve the same result e.g. different types of looping structures.

Data gathered from the programming tutor in an introductory first year programming course showed the relationship between the average number of engagements students made with the tutor and their overall module mark (attainment). An engagement would include opening or closing the software, and attempting to compile code. Whilst it is difficult to draw any concrete conclusions at this stage it is certainly possible to identify students who are not engaged at all, or who are engaged, but are struggling – creating a large number of engagements whilst not achieving well overall. This type of environment – similar to the Crumble extension in the previous section – offers the potential to identify "stoppers" and "movers" based on their behaviours as they work within the Programming Tutor [19].

5 Conclusions

In conclusion, there are several different contexts and issues are relevant to the pipeline of Computer Science graduates, from the early education stages, through primary and secondary and into pre-university, and then finally the changing context within which undergraduate learning activity now takes place. With computing an increasingly vital contributor to the economy, the need for sufficient well-qualified students is already out-stripping demand. Universities have a key role to play, in terms of supporting schools in their delivery of the national curriculum, across all key stages and in the formal qualifications – as well as in ensuring that the transition to university level study is successful.

Issues include the nature of the students themselves, and what they consider to be the norm around them. Early intervention – through schemes such as the Undergraduate Ambassador scheme – can aid in the initial supply to the pipeline. However, the difficulties that student face in learning to program – and the challenges of supporting that for teachers at all levels (from primary through to university), means that technology is needed to support teachers. The growing opportunities to monitor, analyse and focus support for learners as they are developing their programming skills is apparent from complete novices through to those learning more advanced concepts. With suitable programming environments – learning focused IDEs or additions to more general purpose IDEs – there are new opportunities to supporting students in focusing on the key aspects of computational and algorithmic thinking, ensuring the flow of students within this pipeline. Interaction tracking – whether simple source control, or more meaningful – but potentially labour intensive – code analysis, can offer ways to improve the learning process and the outcomes for students.

The two case studies illustrate ways in which the teaching of block-based (visual) programming, or more traditional text based programming – can be aided with suitable monitoring and reporting mechanisms, to help identify students in need of intervention by the human teacher.

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A Case Study of Learners' Use of Formative E-Assessment

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Abstract

Formative assessment is an integral part of the learning process. When learners share this responsibility with their teacher, it contributes to their empowerment and to the transparency of the evaluation process. In this case study report, we discuss the use of digital Multiple-Choice Questions (MCQs) to support formative assessment and the empowerment of learners. We conducted a survey at the end of an undergraduate university course, for which exercises done in class were also made available in digital form on the university's Learning Management System (LMS). Our expectation was that students would go online before a class to test their prior knowledge of the topic, and that they would go online again after the class to conduct a self-assessment of their new knowledge acquisition. However, results of the survey reveal that for many students, the digital MCQs are essentially seen as an aid to prepare for the end-of-term summative evaluation.

Keywords: Formative Assessment, Self-Evaluation, Empowerment of Learners, MCQs, Technology H5P

1.0 Formative Assessment and the Empowerment of Learners

What is assessment? All forms of assessment aim to collect data, based on which judgments can be made. An assessment is said to be valid when the data collected provide a clear picture of the competence of the learner; an assessment is said to be reliable if a learner is assessed in the same way during two passes of the same test; and the third key concept for assessment is feasibility. These three concepts, common to all forms of assessment, are complementary. Another dimension of assessment is that of objectivity (or lack of it). There is a distinction between an

assessment made by an examiner's judgment, which is typically subjective, and the Multiple-Choice Question (MCQ) type of assessment, which is objective. Research has shown that both assessment formats, objective and subjective, are valuable in measuring student learning. Both can be used to measure educational achievement, the ability to apply principles, to think critically and to solve problems; however, there are situations where one is more suitable than the other [1].

Finally, responsibility for assessment is not the teacher's exclusive responsibility. Learners share this responsibility when they are asked to formulate or discuss their own assessment criteria. This process of shared responsibility contributes to the empowerment of learners and to the transparency of the evaluation process [2, 3].

Assessment may be summative, formative, or diagnostic. Summative assessment reflects the paradigm of “Learning for Assessment”, whilst diagnostic and formative assessments reflect the paradigm of “Assessment for Learning”. Formative assessment is an integral part of the learning process [4, 5]. It is mostly about information exchange and cooperation: teachers show students where they believe learning should be headed; and students show teachers where their understanding is deep, shallow, or stalled [6]. In [7] a key argument in favour of formative and self-assessment is that students are already assessing their own work and generating their own feedback and that higher education should build on this ability. Indeed, even the most effective teachers can't do students' learning for them: effective teaching is about creating opportunities that maximise the chances learning will happen, and that typically includes formative assessment [6].

For assessment to have truly formative effects, tutors and students must be appropriating both social and technological resources in learning situations and must be engaging with both to learn how to take control over learning experiences [8]. According to [9], to empower students, the focus of assessment needs to shift from a teacher-guided to a student-guided process, and ultimately involves having the students assess and make decisions about themselves and their learning.

The concept of learner’s empowerment refers to the ability to learn, to define and to validate one's learning objectives [10]. Being an autonomous learner means knowing how to plan and organise learning, how to define objectives and determine the path to reach these objectives while adopting a reflexive attitude. The educational strategy and methods put in place should allow the learners to acquire not only knowledge and skills, but also learning strategies that include self-evaluation [11]. Self-evaluation is a factor of motivation and awareness, that helps learners to recognize their strengths and weaknesses, and better manage their learning [12].

The trend, whether as a result of thoughtful forward planning, or more recently under the sudden constraint of campus closures, is to move teaching online. This move includes assessment. E-assessment, often in the form of online tests such as digital MCQs, has come to serve as a catalyst for a change towards more formative assessment [13], and is seen as a means to engage students in asynchronous

activities that foster active learning [14]. In [15] the impact of formative e-assessment on the students' behavioural commitment is analysed, based on the digital traces of the students' work, and shows that students positively committed themselves to take the online tests. Interestingly, in this study, the digital traces left by the students allowed to follow and evaluate the students' learning efforts and process as much as their results.

In the next section, we review the pros and cons of MCQs in general, and of digital MCQs in particular, as instruments for e-assessment.

2.0 MCQs and E-Assessment

Although there are many different types of testing tools available for assessing learning, MCQs are universal and the most used form of testing. MCQs were born of the desire to automate assessment and save the teacher's time. They are used in high stakes exams to assess year end learning, as a quick method to assess daily learning, and at educational institutions with large class sizes [1]. There are numerous guidelines for producing effective MCQs [16, 17]. For example, an important study presented in [18] introduces a set of 31 guidelines for the construction of effective MCQs.

In the study presented in [19] the numerous advantages of MCQs are listed, such as their possible use with diverse contents; their ability to measure a wide variety of educational and learning outcomes; their possible adaptation to various levels of cognitive skills; their usefulness for assessing large classes; the automatic correction and grading, and for the statistical analyses that can be easily carried out; and their objectivity and useful format for comparisons over time. Concerning the limitations of MCQ tests, the same study concludes that MCQs may be difficult to construct for higher levels of cognitive skills; that they require written skills from the teachers, so that the questions are clear; they also require reading skills from the students, in order to correctly interpret the questions; they fail to measure some types of learning outcomes, such as the ability to communicate; it is often difficult to find good distractors (the non-correct choices); and some students might be tempted to guess the answers.

Some educators are reluctant to use MCQs because they hold the belief that MCQs are best used for measuring lower-level objectives or the simple recall of facts. However, several studies have demonstrated that well-constructed MCQs have the capacity to measure higher-level thinking such as comprehension, analysis and cognitive reasoning [19, 20].

MCQs are not only a well-established form of testing, they are well suited to digital technology because, in their simplest and most common form, they do not require sophisticated data processing. According to [13], among five categories of tasks in e-assessment (close-ended questions, i.e. MCQs or matching questions;

open-ended questions; portfolios; products, e.g. computer programs; and discussion between students), MCQs are the most frequently used form of testing.

In [17] it is shown that adapting assessment techniques to current technological advancements allows for effective pedagogical practices, learning processes, and student engagement. Digital technology opens new possibilities, both in terms of preparing the MCQs and of correcting them, which makes digital MCQs a more sophisticated and versatile assessment instrument than their paper version [21]. For example, the digital version of MCQs makes it possible to choose and vary the questions and proposed answers from databases prepared in advance or available online. The order of the propositions can be changed dynamically in order to decrease the memorisation effects as well as students' elimination strategies. Some MCQs can adapt the level of the questions to the learner's performance.

Digital MCQs can provide immediate feedback to the learners. When there is a random number of correct propositions for a given question, taking incorrect choices into account in the feedback is easier with technology, for example negative points can be attributed in case of non-selection of a good choice, and if an incorrect choice has been selected. Weighted notation is also possible, where some propositions are worth more points than others. Such scoring strategies, which help to refine the judgement and reduce the reliance on chance by learners, are more difficult to implement without digital technology. The results can also be memorised by the system, which is then able to propose again later the exercises that were not completed successfully (i.e. "Time-Spaced Learning").

Digital technology also makes it possible to use MCQs as a means of pooling responses in real time, via a voting application which collects responses and allows them to be shared in class to fuel discussion between learners and with the teacher.

As a self-evaluation instrument, digital MCQs have many advantages: feedback is immediate; the machine is tireless and can vary the offer of questions and exercises while allowing the learners to work at their own pace; the machine is not intimidating and remains neutral; and it allows to compare oneself with other learners.

Digital MCQs have their limits though: impossibility to foresee in advance all the answers which could be judged correct, and often lack of explanations in the feedback given. Indeed, unless supported by very sophisticated algorithms, digital MCQs are still limited in their remediation capacity. Ideally, errors should not only be corrected but also analysed and explained, and errors should sometimes be accepted as "transitional" and ignored. However, despite their current limits, the study presented in [22] confirms that e-assessment with MCQs is reliable in any degree program course, although it also says that MCQs should preferably be combined with another kind of assessment, such as a problem-based group project, which is effective in developing competencies and skills that MCQs are not.

MCQs have a long history but understanding student attitudes to online tests and the level of impact they have on learners' empowerment is still the subject of ongoing research. According to [23], formative assessment only benefits students who are motivated to achieve high performance. The few studies which investigated student and staff perceptions of online tests generally revealed a positive attitude towards MCQs by both staff and students (e.g. [24, 25, 26]). The reasons for students' positive attitudes towards online tests are varied but seemed to be mostly linked to the perceived easiness of MCQs; some students liked the idea of multiple attempts and feedback; other students thought that having a choice of answers in MCQs assisted their memory and thinking process; and the convenience of being able to take online tests anywhere was also a favourable factor for students [23].

In the rest of the paper, we report the results of a case study we conducted to try and understand the spontaneous usage students did of online tests in the absence of specific teacher's guidance. This case study was conducted in China during the Autumn semester of 2019.

3.0 Case Study: How Do Learners Use Digital MCQs?

During the 2019 fall semester (pre-COVID 19), various online learning activities, including many digital MCQs, were proposed to the students of a new course on "Multimedia Fundamentals". The module was a semester long course for 3rd year undergraduate engineering students, offered in English, on one of the transnational programmes between the School of Electronic Engineering and Computer Science at Queen Mary University of London and the International School at the Beijing University of Posts and Telecommunication (BUPT).The class was rather large since it included 180 students. Most of the exercises done in class were also made available in digital format on the Moodle university online learning platform. In class, students had the choice of doing the exercises alone or with their peer(s), on paper or on their phone, tablet or laptop through the digital platform. All course content, including the online tests, was made available to students at least one week before the corresponding class, so students had the possibility of attempting the online exercises and activities before attending class. Although no formal requirement was made for students to use this material, it was made available to them so they could decide what use they wanted to make of it (a kind of blended active learning experience, proposed as a self-evaluation and empowerment tool).

Our initial hypothesis was that students would go online before a class to prepare for it and to test their prior knowledge of the topic, and that they would go online again after the class to conduct a self-evaluation of their new knowledge acquisition. It has been shown previously that in addition to providing the benefits associated with blended learning, online interactive activities provide the opportunity for instructors to teach using active learning methods for delivery, with activities that

can be undertaken both in-class, and pre-/post-class [27]. Integration of interactive digital content within course material provides opportunities for learners to think critically about what they are being taught and supports the flexibility students are requesting by extending their learning environment [28].

The online learning activities, mostly in the form of digital MCQs, have been developed using the H5P technology [29], which facilitates the easy creation of rich HTML5 content. Learners receive comprehensive, automatic feedback and their engagement with the activities can be tracked. Figure 1 shows what H5P MCQs look like. They can be embedded in interactive videos or in course presentations, as is the case of the example in Figure 1. A course presentation is a set of slides, and in this case each slide contained an MCQ. The behaviour of the MCQ, how feedback is provided and how grades are recorded can be set up for each question. In the example shown in Figure 1, a wrong answer has been chosen, indicated in pink, while the right answer appears highlighted in green. The student does not get a mark but is given the opportunity to attempt the MCQ again. This is only one possible behaviour.

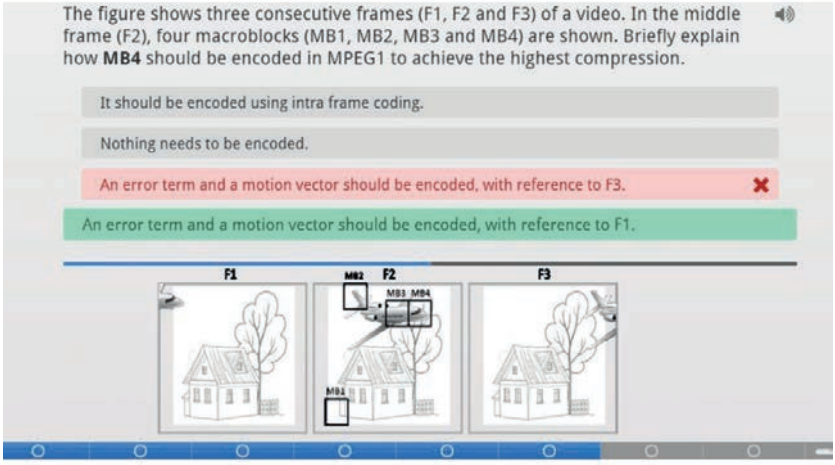

Figure 1: Example of an H5P MCQ.

In addition to the H5P based exercises, the Mentimeter voting application [30] was used in class to share the results of the digital MCQs, and two Flash-based applications were also proposed for practice. One of these, called the “colour converter” allowed students to set a colour using one colour model (e.g. RGB) and observe corresponding values in other colour models (CMYK and HSV). Another application allowed students to experiment interactively with the various steps involved in the JPEG compression standard (e.g. colour conversion, chroma-subsampling, DCT transform, quantisation and zigzag scanning). All these tools

(H5P, Mentimeter and the two Flash-based applications) were made freely available and regularly integrated in the learning activities held in class.

In order to understand the use students made of these digital online activities and in which ways they had appropriated them, a survey was launched in December 2019. 88 students answered the short survey (at least partially), and a group discussion with eight students was also subsequently organised.

3.1 Do Leaners Find Online Testing Useful?

To the question "do you find the digital activities useful in your studies?", on a scale from 0 to 5, the H5P digital MCQs score the highest at 4.4 on average, very close to "extremely useful" (See Figure 2). The polling system, quite surprisingly, doesn't score as high, maybe revealing that students do not value much having the possibility to share their answers with others.

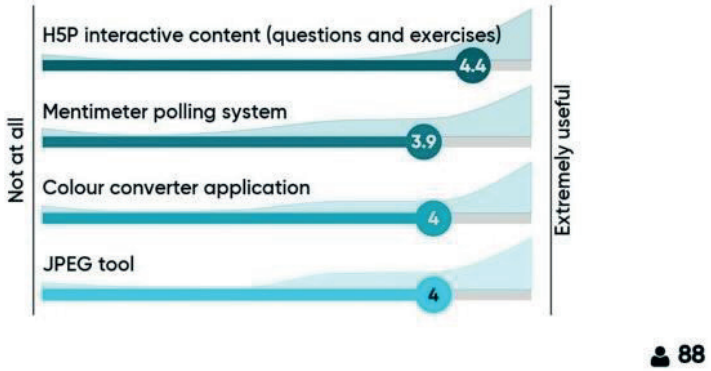

Figure 2: (Q1) Do you find the following tools useful in your studies? (88 respondents)

3.2 How Often Are Learners Using Online Testing?

To the question "how often are you using the digital activities?", still on a scale from 0 to 5, the H5P digital MCQs still score the highest at 4.2, fairly close to "very often" (see Figure 3).

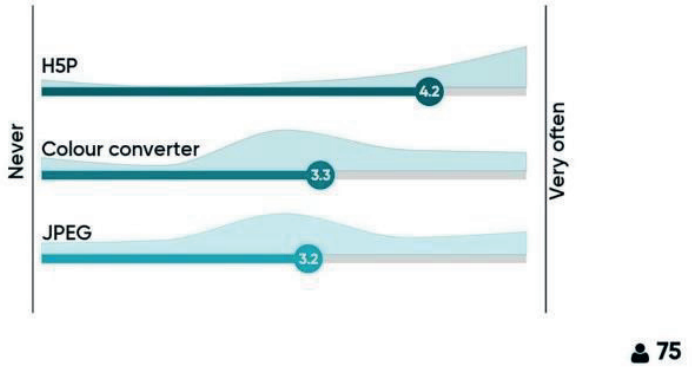

Figure 3: (Q2) How often are you using the digital activities? (75 respondents)

3.3 When Are Learners Using the Digital MCQs?

The third question was asking about when students were using the digital MCQs. There is a great diversity in their answers, but main use of the MCQs is after class (65 answers in total), followed by during the lecture (44 in total), and finally before the lecture (23 in total) (see Figure 4).

The highest combination of use is during and after lecture (23 answers); followed by only after the lecture (20 answers); and then before, during and after lecture in third position (17 answers).

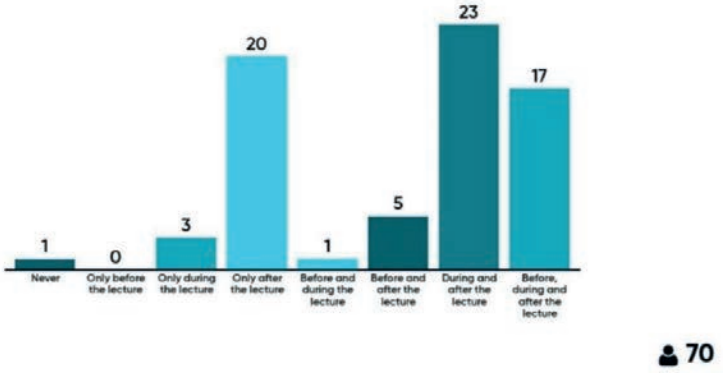

Figure 4: (Q3) When are you using the digital MCQs? (70 respondents)

3.4 What Are Learners Using the Digital MCQs for?

There is also a certain diversity in "the why" students used the digital MCQs: to revise after a class is the first choice for a majority of students, followed by to prepare for a marked test, then to get some practice, to deepen my understanding, and last in the students' reasons for using the MCQs is to prepare for a class (see Figure 5).

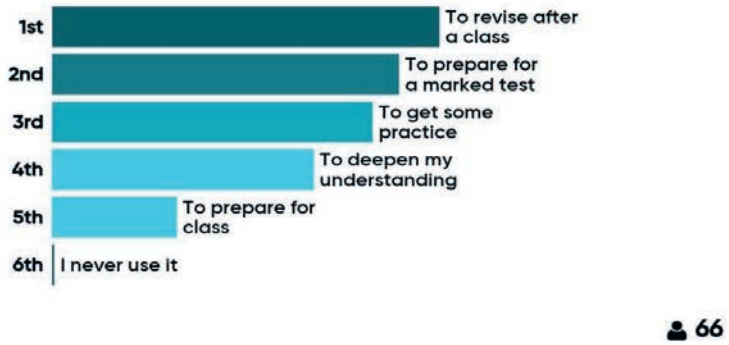

Figure 5: (Q4) What are you using the digital MCQs for? (66 respondents)

3.5 How Do Learners Access the Digital MCQs?

Finally, to the question: "how do you usually access the digital MCQs?", a large majority of students use their laptop computer (see Figure 6). This was a bit surprising as the MCQs had been especially designed to be used on small devices, limiting the use of complicated interaction styles such as drag and drops, but this proved not to be necessary.

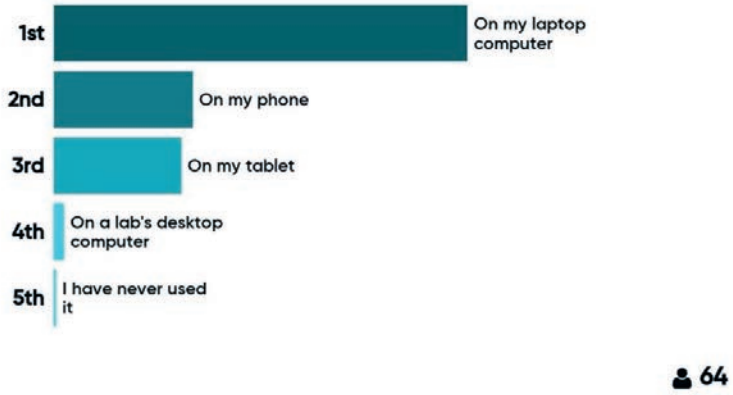

Figure 6: (Q5) How do you usually access the digital MCQs? (64 respondents)

4.0 Conclusion

The results of the survey uncovered the following: (1) there was a great diversity in "the why" the students used the online tests: to revise a topic, to prepare a summative evaluation, to train themselves, to better understand course content; (2) diversity also in “when” they used them: before, during, and/or after class; (3) and a relative diversity in “the how” they connected to the exercises: mainly on their computer, but also on their phone and tablet.

Overall, students made extensive use of the online tests and wanted the offer to be enriched. Most of them used the online MCQs after class (93% of the respondents) to revise a topic and to prepare for a marked test. All the students in the focus group expressed that they wanted the H5P exercises to be of the same type as those given in the final exam. For these students therefore the online tests were essentially seen as an aid to prepare for the end-of-term summative evaluation.

In conclusion, students seized the opportunities given to them for active learning, extensively using the digital tests offering available on the LMS and in class. However, they did not use the MCQs in the way that we intended and expected. Without guidance or discussions on when and how to use online tests, it is very likely that learners and teachers will hold different expectations. Students mainly used the digital tests as practice questions rather than self-evaluation tools and expected them to be model exercises for their final exam. Our expectation was that the students would use the online offer for self-assessment, that it would contribute to their empowerment, and that it would trigger discussions in class. However, for this to happen, the teacher must provide further guidance to the learners and set clear usage objectives and milestones, for example in the form of a “leaners-teacher contract”.

The case study was conducted on a new course, so no data is available yet to compare students’ performance with previous years. As further work we intend to examine in a longitudinal study the relationships between students’ performance and their uptake of formative e-assessment.

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Science Educators' Beliefs About Creativity

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Abstract

Creativity is valuable at all times, in all subject areas, to every individual and the society in general. Creativity can also prove to be valuable when the society undergoes extraordinary and dire conditions such as the recent global COVID-19 pandemic. It is particularly interesting to note that creativity can be developed. Nevertheless, it should not be overlooked that even though educators may potentially promote creativity they may also inhibit it in their classrooms. Thus, we decided to focus on the role of the educator to motivate and encourage creativity. This study aimed to investigate the beliefs of faculties in sciences and engineering, regarding encouraging creative thinking in their classrooms. According to the survey we conducted, the overwhelming majority of the educators perceive creativity to be valuable to the society. They also believe that they have the ability to promote creative thinking but they appear sceptical about their students' potential for creative thinking. The authors would like to conduct further research in order to: (i) understand better the standpoint of science educators in regards to creative thinking and (ii) identify similarities and differences, if any, in the beliefs of faculties of different specialties in regards to creativity.

Keywords: Creativity; Science Education; Higher Education

1.0 Introduction and Background

1.1 Defining Creativity

An early definition of creativity was referring to "the ability to make connections between previously unconnected ideas" [1]. Another definition used several years later refers to creativity as "imaginative activity fashioned so as to produce

outcomes that are both original and of value" [2]. A more recent definition which also seems to be more descriptive, refers to creativity as "the intellectual ability to make creations, inventions, and discoveries that bring novel relations, entities, and/or unexpected solutions into existence" [3]. Kampylis and Valtanen [4] have in fact collected from different sources a total of forty-two explicit definitions of the term creativity from 1950 to 2009.

1.2 Creativity in Extraordinary Situations (COVID-19)

Creativity is valuable at all times, in all subject areas, to every individual and the society in general. Creativity can also prove to be valuable when the society undergoes extraordinary and dire conditions such as the recent global COVID-19 pandemic. During such periods everyone had to some extent think "out of the box", as we hear it nowadays. What that means is think creatively! That was true for individuals, households, businesses, and the whole society. During these times we had to become creative in the use of resources for example, which given that we had several restrictions, the most important of which being the quarantine, were difficult to reach. Scientists had to think creatively and work systematically and persistently in their quest for an effective and quick examination that would trace the virus as well as an effective vaccine. Businesses had to find creative ways to reach out to their clients. Educators had to exercise creativity in delivering educational content, communicating with and assessing their students' progress as virtual education suddenly became the new norm. The challenges that all business sectors faced and the creative ways in which they approached them are already being put under the microscope in order that good practices are identified and adopted to offer a lasting effect.

1.3 Creativity and Education

Creativity is described as being domain-based [5] and it involves generating new ideas, adopting, adapting, expanding, synthesizing, separating, and improving skills and ideas in different contexts [6].

We all start out as children who are open and perceptive to new experiences, eager to learn, ready to take risks (most of us), have a high tolerance to ambiguity, are inquisitive, and above all very imaginative in every and all of our activities. In fact, when Piirto was listing the key personality attributes which contribute to creativity [7] he might as well have been describing the behaviour of young children. As we grow older, we tend to become more rigid in our ideas, short-sighted, close-minded, not willing to take risks (we do not like to be proved wrong), prone to repeat our successful actions, and we lose most of our imagination.

Creativity might be normally distributed but all persons can become more creative [8]. This is where education should step in to cultivate creative thinking in ways that this will become a lasting life-long skill which will accompany us throughout our lives. For the first time, creativity content was explicitly included in the ACM-

AIS-DPMA IS curriculum recommendations in 1995 [8]. Recently, the role of education in cultivating creativity is again emphasized by including "Creativity and Innovation" in the 21st century learning skills required for students to build a successful career. Overall, the 21st century learning skills include Learning and Thinking skills; Information and Communications Technology skills, and Life and Career skills [9].

1.4 Teachers' Perceptions About Creativity?

Being intrigued by the finding that creativity can be developed we would like to focus on the role of the educator without undermining the role of parents, businesses and the society who may also motivate and encourage creativity. Educators can be challenged in finding ways to cultivate into their students those personality attributes which will contribute to thinking creatively [7]. Care must be given to the fact that even though there is a potential for educators to promote creativity there is also a possibility of inhibiting it in their classrooms [10]. Several studies were conducted on the factors that influence an educator's commitment to students' creativity development, for example [11, 12].

"Teaching for creativity" describes forms of teaching that are intended to develop young people's creative thinking or behavior [2].

Davies, et. al., 2014 [13] list several components of teaching for creativity. These include: teacher skills and attitudes; awareness of learners' needs; flexible approaches to curriculum and lesson structure; a willingness to act as a role model; particular types of classroom interaction with pupils; the use of ICT; assessment.

Research also emphasizes the importance of a supportive school culture and the need to elicit teachers' prior conceptions of creativity in education among other things. Over the years, a few studies were conducted aiming at investigating teachers' perceptions about creativity. Kampylis, et. al., [12] have produced a listing of such studies since 1991. Some conclusions drawn from a few of these studies are the following: Fryer & Collings [14], in a study involving one thousand and twenty-eight (1028) teachers and further education lecturers from England and Wales, found that teachers have different perceptions of creativity. Westby & Dawson, [15] concluded that although educators claim to believe in creativity, their favourite students in the classroom are not the creative ones. Their justification for this finding was that teachers' main effort being to maintain order and discipline in the classroom was disrupted by the engagement of creative students in class interactions. In Kampylis, et. al., [12] the implicit theory that creativity can be developed in everybody is supported by the 84.6% of the Greek teachers and prospective teachers who participated in the study. Diakidoy & Phtiaka, [16] identified conflicts between teachers' and researchers' conceptions of creativity. On a different issue Al Jughaiman & Mowrer-Reynolds [17] found that teachers feel ill-prepared to foster creativity since creative thinking and problem solving were not part of their pre-service education programs.

1.5 Are "Science Professions" Creative?

Traditionally, we have more commonly been referring to someone as being creative in relation to some art or design output that someone has produced. Nowadays, we argue that everyone can develop his/her creative thinking skills and ideas [18] and potentially exhibit creativity. Furthermore, we extend this creativity outcome to the whole spectrum of activities and practice. "The beauty of creativity lies in its universality." stated Davia Rubenstein, et. al. [10].

However, some professions have higher levels of "creative intensity" – that is, the proportion of the workforce in creative occupations (Table 1). Based on this robust finding from research, all industries with a creative intensity above a certain "threshold" are classified as Creative Industries [19]. According to UK Government's 2001 Creative Industries Mapping Document, "Creative Industries" are "those industries which have their origin in individual creativity, skill and talent and which have a potential for wealth and job creation through the generation and exploitation of intellectual property".

Table 1 Official Statistics, Creative Industries Economic Estimates - 2015, UK Department of DCMS [19]

SIC	Description	Creative Intensity (%)
90.03	Artistic creation	91.5
74.30	Translation and interpretation activities	82.2
90.01	Performing arts	78.8
74.20	Photographic activities	77.8
60.10	Radio broadcasting	62.7
74.10	Specialised design activities	62.1
71.11	Architectural activities	61.5
70.21	Public relations and communication activities	59.3
58.14	Publishing of journals and periodicals	58.3
90.02	Support activities to performing arts	56.8
59.1	Motion picture, video and television programme activities	56.4
32.12	Manufacture of jewellery and related articles	56.2
62.01	Computer programming activities	55.8
59.20	Sound recording and music publishing activities	54.1
60.20	Television programming and broadcasting activities	53.5
73.11	Advertising agencies	50.5
58.11	Book publishing	49.9
58.13	Publishing of newspapers	48.8
73.12	Media representation	48.3
58.21	Publishing of computer games	43.1
58.29	Other software publishing	40.8
90.04	Operation of arts facilities	38.4
58.19	Other publishing activities	37.8
85.52	Cultural education	34.6
62.02	Computer consultancy activities	32.8
58.12	Publishing of directories and mailing lists	31.0
91.01	Library and archive activities	23.8
91.02	Museum activities	22.5

For those of us in the sciences (referring here to computer science, mathematics, and engineering), it is hard to accept that our role in the society might be viewed as being non-creative. It is at least comforting to see that some aspects of "IT, software and computer services" are included in the "Creative Industries". It is also important to acknowledge that a key finding in this official UK government

statistical report is that “IT, software and computer services” was the largest group, with creative employment of 825 thousand in 2013 and an increase of 117 thousand jobs (16.4%) since 2011. Additionally, the Gross Value Added (GVA) of the “IT, software and computer services” group was £35.1bn in 2013, accounting for 45.6 per cent of GVA in the Creative Industries as a whole (Figure 1). Concluding on this discussion point, it might be justifiable to state that individuals who are engaged in some particular professional activities have to intensify their creativity efforts over others who can afford to be less creative in their typical workday tasks. It remains though that since innovation is tightly coupled with creativity, creative thinking must be cultivated and encouraged into all and each one individually.

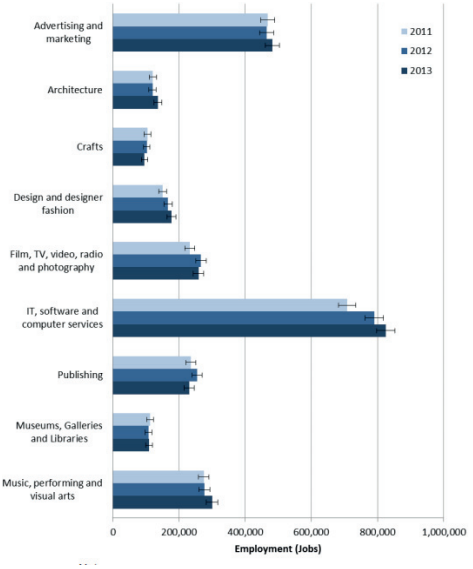


Figure 1 Official Statistics, Creative Industries Economic Estimates - 2015, UK Department of DCMS [19]

1.6 What do Science Educators Believe About Creativity?

The presently available research presents a gap in investigating the higher education level of education in relation to teaching for creativity. Also, minimum research was conducted to relate creative thinking to science education or other fields of specialization [20, 21]

Thus, the current study was initiated to investigate the beliefs of faculties in sciences and engineering regarding creativity, creative thinking and teaching for

creativity. Our study aimed at capturing science educators' beliefs in response to the following four research questions:

RQ1: "How important is creativity for the society in general?"

RQ2: "What is the potential for science students to become more creative?"

RQ3: "What do you believe about your ability to promote student creativity?"

RQ4: "How do you perceive the role of your educational environment in relation to creativity teaching?"

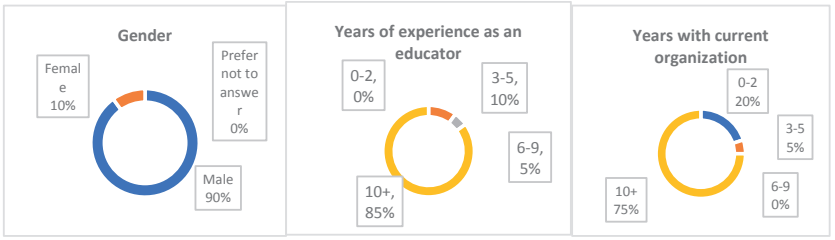
2.0 Method

2.1 Participants

The survey population consisted of 32 science faculties (all ranks) in the Department of Computer Science, which includes Mathematics, and the Department of Engineering, both in the School of Sciences and Engineering in a specific higher education institution. Those who completed the survey and finally formed the sample totalled to 20 faculties (N=20). The participation in the study was on a voluntary basis. The majority of the participants (90%) were male; this is consistent with the representation of male faculties in the two participating departments (90.6%). Also, the majority of the participants had more than 10 years of experience as educators (85%) and more than 10 years of service in the specific HEI (75%). The summarized demographic information of the participants is shown in Table 2 and Figures 2-4.

Table 2 Demographic information

N=20	#	%
Sex:		
Female	2	10
Male	18	90
Prefer not to answer	0	0
Years of experience as an educator:		
0-2	0	0
3-5	2	10
6-9	1	5
10+	17	85
Years with current organization:		
0-2	4	20
3-5	1	5
6-9	0	0
10+	15	75



Figures 2-4 Graphical representation of demographic information

2.2 Research Instrument

The research instrument was an anonymous online questionnaire. Besides demographics, the research instrument included 43 items all listed in one table with no grouping and with the items investing the four research questions being mixed up in the questionnaire. All of the items were evaluated on a five-point (from Strongly Disagree to Strongly Agree") Likert scale. The basis for the research instrument were the Teaching for Creativity Scales of Davia Rubestein, et. al. [10] from which all items were adopted with no or only minor changes. Though the instrument originally included 43 items, some items (7) were later on deleted by the developers of the tool to improve scale reliability. These items are therefore not presented in the subsequent analysis of the survey.

2.3 Data Gathering Procedure

Faculties in computer science, mathematics and engineering were invited to participate in the study during the fall of 2019 by a personalized email in which the QR code and the link to take the survey were distributed. The questionnaire could be answered in about 5-10 minutes.

3.0 Research Findings

In this section, the research findings in relation to the four research questions are presented. Only selected items are discussed while all of the quantitative data appear in Tables 3-6 and the accompanying Figures 5, 6, 7 and 8.

3.1 Research Question 1

The first research question was investigating the beliefs of science educators regarding the importance of creativity for the society in general. The topic was investigated by ten items in the survey.

Overall, science faculty believe that creativity has great value for the society. The greatest majority of them, "Strongly Agreed" or "Agreed" with almost all of the items which were examining their beliefs about the value of creativity for the society.

Item 4: Without new and creative ideas, our country will be left behind and *Item 9: Innovative ideas can move society forward* are two items which received full support (Agree or Strongly Agree) by all of the participants.

Only two items present ambiguous results. These are: *Item 3: I believe thinking creatively is the most important skill for students to learn.* For this item, the majority, being 53% of the educators were not sure either that they agree or that they disagree. For *Item 5: Creativity can save lives*, 23% stated their disagreement.

Table 3 Research Question 1 - Societal Value

	Strongly Disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly Agree (%)
1 When individuals approach problems in unique ways, they add to humanity's knowledge of the world.	6	0	12	41	41
2 Inventive thoughts are necessary for growth in any field of study.	0	0	12	29	59
3 I believe thinking creatively is the most important skill for students to learn.	7	7	53	20	13
4 Without new and creative ideas, our country will be left behind.	0	0	0	36	64
5 Creativity can save lives.	0	23	8	54	15
6 If there were more creative people, more problems would be solved.	0	0	6	44	50
7 New ideas must be generated to enact positive change.	0	0	6	50	44
8 We really need creative people.	0	0	6	44	50
9 Innovative ideas can move society forward.	0	0	0	63	38
10 Old problems can be solved with new ideas.	0	0	27	53	20

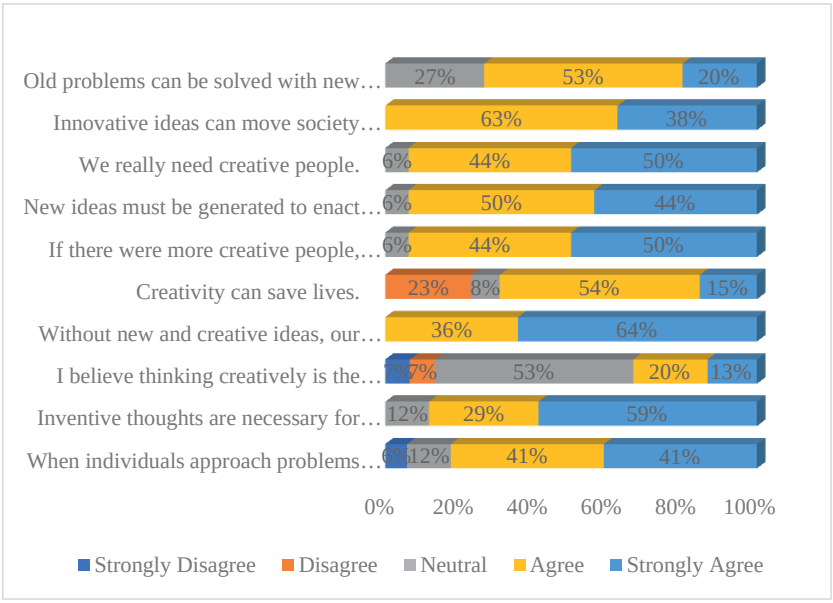


Figure 5 Research Question 1 - Societal Value

3.2 Research Question 2

The second research question was investigating the beliefs of science educators regarding the potential for science students to become more creative. This topic was investigated by six items in the survey.

Table 4 Research Question 2 - Student Potential

	Strongly Disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly Agree (%)
1. All students can develop original ideas.	18	29	24	29	0
2. Creativity is an ability that all students possess.	0	29	35	29	6
3. All students can grow in their creative problem-solving skills.	0	6	25	69	0
4. All students can contribute innovative thoughts to a discussion.	0	38	13	44	6
5. All students can learn to produce something innovative.	7	13	27	47	7
6. All students have the potential to change the world with their creative ideas.	13	25	44	13	6

The beliefs of science faculty members regarding their students' potential for creativity are not clearly positive.

As many as 69% of the science faculty believe that students can develop their problem-solving skills (*Item 3*) and 47% believe in *Item 5*: All students can learn to produce something innovative. Nevertheless, the faculty are not sure about *Item 2: Creativity is an ability that all students possess*, since those who stated their agreement with this statement are as many as those who disagree with it (29%).

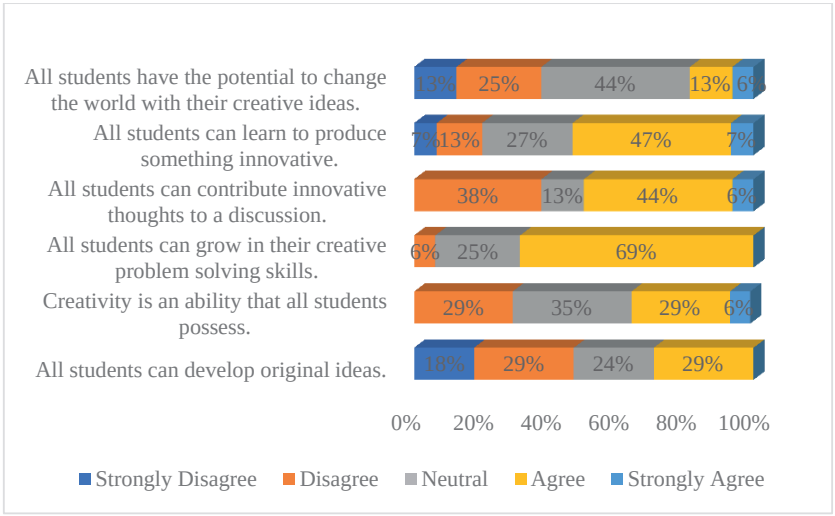


Figure 6 Research Question 2 - Student Potential

3.3 Research Question 3

The third research question was looking into the science educators' beliefs about their own ability to promote student creativity. The topic was investigated by thirteen items in the survey.

Science educators definitely believe in their ability to promote their students' creativity. With percentages as high as 94% of science educators stating their agreement with *Item 1*: I am capable of helping students to become more flexible in their thinking and the lowest of 53% of the same group stating that "Teaching creative problem solving is one of my strengths." (*Item 13*), the conclusion in regards to educators' self-efficacy is clear.

Table 5 Research Question 3: Educator Self-Efficacy

	Strongly Disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly Agree (%)
1. I am capable of helping students to become more flexible in their thinking.	0	0	6	41	53
2. I am capable of enhancing my students' abilities to take meaningful academic risks.	0	0	29	65	6
3. I am capable of fostering creative problem solving in my classroom.	0	0	13	67	20
4. Teaching creative thinking is one of my strengths.	0	0	33	67	0
5. I am capable of increasing my students' abilities to create unique solutions.	0	0	29	65	6
6. I am capable of developing a classroom atmosphere that welcomes imagination.	0	0	25	69	6
7. I am capable of promoting flexible thinking.	0	0	19	75	6
8. I am capable of helping my students to see the world from new perspectives.	6	0	31	56	6
9. I am capable of teaching my students to find connections in seemingly unconnected ideas.	0	0	40	60	0
10. I have helped many students to become more creative.	0	0	31	63	6
11. I am capable of increasing the quantity of original thoughts my students have.	0	0	38	50	13
12. I am capable of helping students to elaborate on their own unique ideas.	0	7	21	57	14
13. Teaching creative problem solving is one of my strengths.	0	7	40	40	13

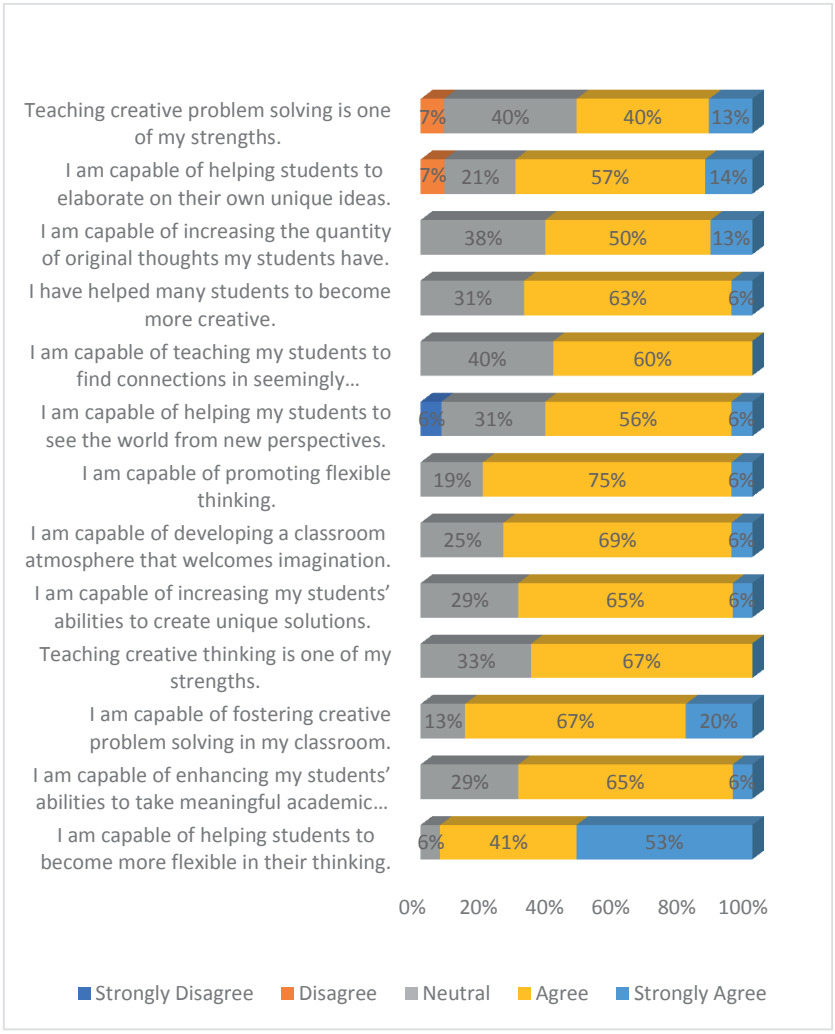


Figure 7 Research Question 3: Educator Self-Efficacy

3.4 Research Question 4

The fourth and last research question looked into the role of the educational environment, being the HEI, in relation to creativity teaching. The items which were considered examined the offering of professional development aimed at fostering creative thinking, the encouragement and support of the institution towards its faculty, etc. The topic was investigated by seven items in the survey.

Most of the science educators who participated in the study reported that they are not sure about the contribution of the institution towards encouraging creative thinking.

The very high percentage of 69% of the faculty were not sure about the value that the university places on the development of student creativity (*Item 6*).

Table 6 Research Question 4: Environmental Encouragement

	Strongly Disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly Agree (%)
1. My university provides professional development that stresses the fostering of creative thinking in the classroom.	6	24	35	35	0
2. Teaching creative thinking would not be frowned upon in my university.	0	19	38	25	19
3. My university's priorities include teaching students to think creatively.	13	27	33	27	0
4. My administration encourages me to foster innovative thinking in my students.	18	29	41	6	6
5. My university encourages teachers to produce independent thinkers.	6	6	53	29	6
6. My university environment places great value on the development of student creativity.	6	6	69	13	6
7. It is a priority in my university to increase students' inventiveness.	19	31	31	13	6

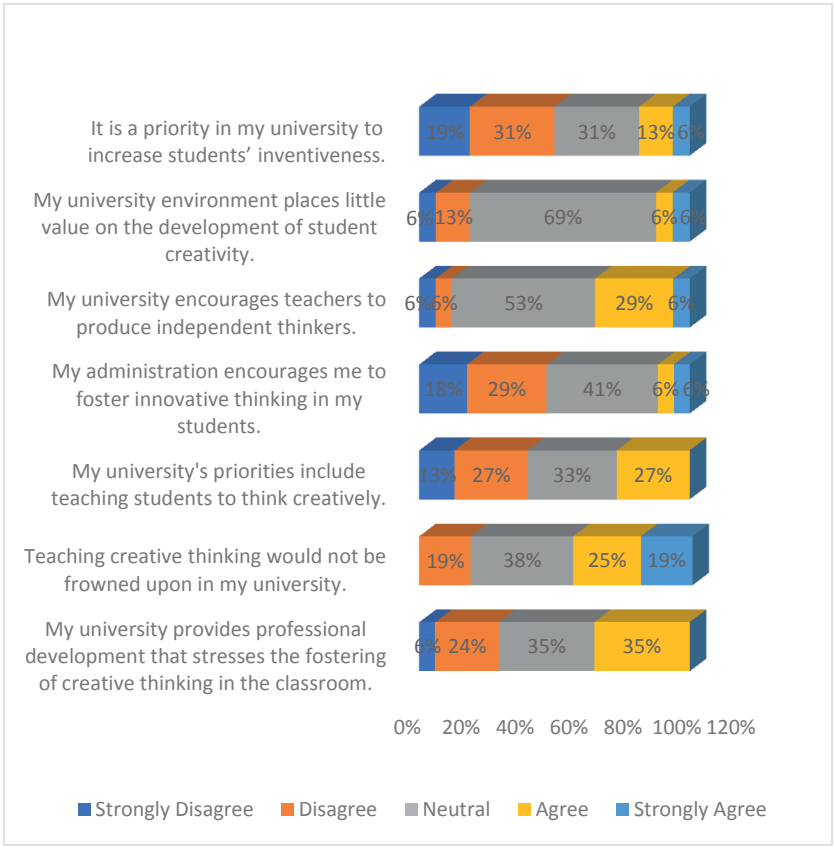


Figure 8 Research Question 4: Environmental Encouragement

4.0 Overall Results and Comparison

The overwhelming majority of the science faculty members who participated in this study, all 84% of them, support by stating their strong agreement (42%) or agreement (42%), that creativity has great value for the society (Figure 9).

This result is in accordance with other studies such as the Kampylis, Berki, & Saariluoma study of 2009 [12] where the majority of the teachers supported that creativity is a key factor for personal, social, and economic progress. Also, in the Davia Rubestein et. al. study of 2013 [10], participating teachers stated their belief that creativity is extremely valuable for society.

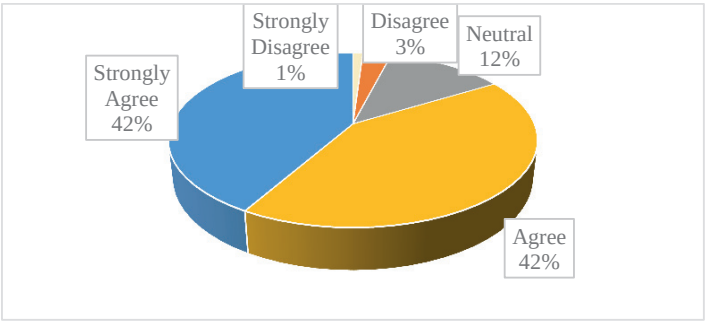


Figure 9 Overall Creativity Value for the Society

Overall, the perceptions of science faculty about their students' potential for creativity are not clearly positive. As many as 35% of them believe in student creativity, 34% keep a neutral stance and 31% do not believe in student creativity (Figure 10).

Different studies present different results in relation to this research point. In Kampylis, Berki, & Saariluoma, 2009 [12] more than 80% of their teachers/participants thought that creativity can be developed in any person while on the other hand about half of the teachers believed that only a few students are creative. Similarly, in Davia Rubestein et. al., 2013 [10], the majority of the teachers felt that most students could grow in their creativity. Diakidoy and Kanari, 1999 [22] reported that 75.5% of their participants believed that creativity is not a characteristic of all people.

The present result regarding the students' potential for creative thinking may be seen as an obstacle in promoting student creativity. That is because according to research, teachers' doubts about the students' potential for creativity may be the biggest hindrance to creativity development [23, 24].

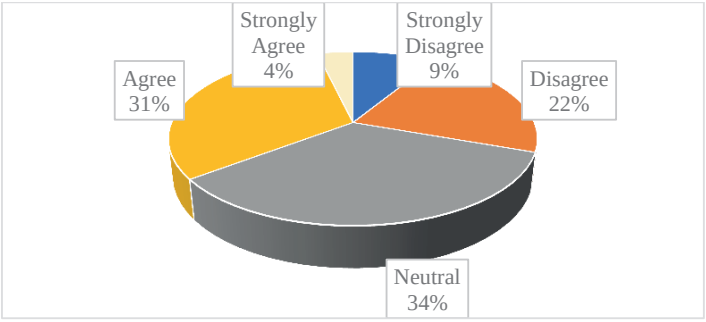


Figure 10 Overall Students' Potential for Creativity

The science faculty of the Departments of Computer Science and Engineering definitely feel confident that they have the ability to promote their students' creativity (Figure 11).

In Davia Rubestein et. al., 2013 [10], the developers of the Teaching for Creativity Scales, found a high correlation between the teachers' beliefs regarding societal value, student potential, and teacher self-efficacy. This conclusion is not supported by the present study in which, as it has already been presented, the science educators believe in the value of creativity for the society, believe in their ability to promote creative thinking but are not sure about the students' potential regarding creative thinking.

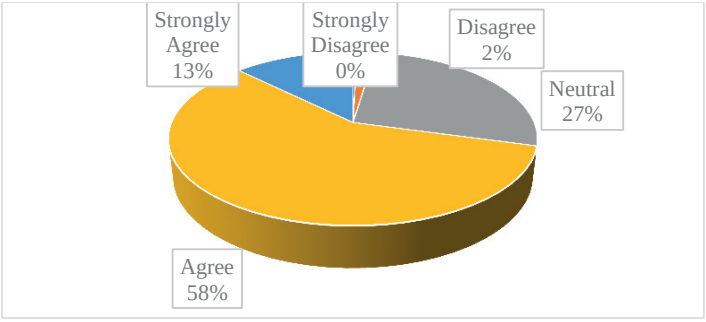


Figure 11 Overall Educators' Ability to Promote Creativity

Lastly, in regards to all seven items used to evaluate the HEI's standpoint towards creativity, 43% of the science faculty were neutral which can be perceived as being unsure about the investigated items (Figure 12).

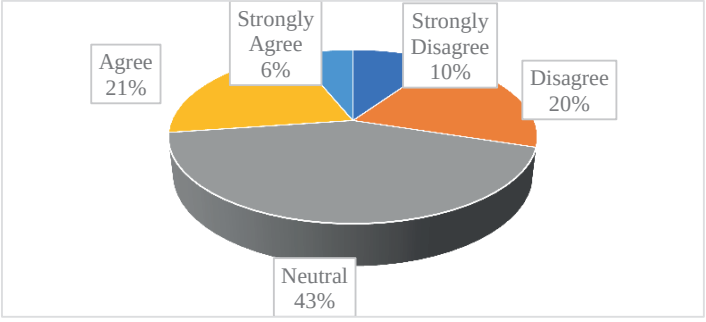


Figure 12 Environment's Encouragement for Creative Thinking

5.0 Further Research and Concluding Remarks

The concluding remarks of the study are the following:

- A high majority (84%) of science educators believe that creativity has great value for the society.
- A rather low percentage (35%) of science faculty believe that students have the potential to become creative.
- Science educators believe in their ability to cultivate student creativity (67%).
- Science faculty are divided and unsure about the environment's active support for creative thinking.

The importance of creative thinking to society is immense and as such creativity has been and is still being investigated. The present study can be expanded to consider more faculty members from the same and other disciplines and look for similarities and differences in the perceptions of faculty regarding issues of creativity based on their disciplines. The study would also benefit from some qualitative data that might be facilitated via some interviews with faculty members as these will give some insight regarding the perceptions of faculty members.

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Software Tools to Support On-line and Distance Education

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Abstract

The paper considers the use of digital, on-line technologies and interactive educational software for distance education in primary and secondary schools and at universities too. A prerequisite for the effective use of digital technologies in schools is that teachers have access to the necessary technical equipment, technologies, fast internet and have sufficient digital literacy and competence to use them. The same is assumed on the learners' part in terms of their technical and technological equipment as well as their competencies and skills in the use of digital technologies. The article also reports on how teachers in the Czech and Slovak Republic managed distance learning during the Coronavirus (COVID-19) pandemic.

Keywords: Educational software, digital technology, on-line technologies, on-line education, distance education.

1.0 Introduction

An effective use of digital technologies is undoubtedly an important condition both for the implementation of quality education and for the smooth school management, whether in administrative work or in communication with the public, especially with parents. Generally, the development shows that the influence of technology on the teaching process can no longer be overlooked and it is apparent that a good pedagogue needs to transfer his professional skills acquired elsewhere to the use of technology, when necessary [1]. Technology affects the world, people's thinking, learning goals, methods, forms, principles, the learning environment and the used didactic tools, technology needs to be used effectively and efficiently [2], [6]. Pupils need to be guided in the use of technology to help their personal growth and to achieve life goals not only in the case of children with

natural development, but also in the case of children from socially disadvantaged background and children with certain disabilities [2].

The "Digital Education Strategy", called Digital Literacy, is currently being implemented. With it comes a change in the existing State Educational Programs (in Slovak Republic) and Framework Educational Programs (in Czech Republic) and the Teacher's Standard. The efforts in the European institutions to create a systematic description of the digital skills competences that teachers should be equipped with began only a few years ago. It has become increasingly clear that in a converging Europe, a common terminology needed to be used. The result of these efforts is the framework of digital competencies of DigCompEd teachers. DigCompEdu is the output of the long-term research activities of the Joint Research Center of the European Commission.

The rigorous test of the use of digital technologies by teachers and students for online and distance teaching/learning was the COVID-19 period. During the period, schools in the Czech and Slovak Republic were completely closed. All schools switched to online teaching. Pupils, students and teachers had to use their devices - computers, laptops, tablets and mobile phones. There was a significant improvement in the use of digital technologies in teaching for both teachers and pupils.

2.0 On-line and Distance Teaching at Schools

The period of the Coronavirus' outbreak was an unprecedented situation for teachers and pupils alike. All of the schools had to solve the problem at once. There were a lot of questions to be answered and many issues that needed to be addressed. How to continue teaching? Which resources to use? Which environment, enabling distance learning and teaching to use? How to make pupils actively involved in the educational process? Will pupils/students have access to the necessary technical equipment and technologies? Will online teaching/learning work on mobile phones, tablets, computers or laptops? Teachers and school principals had to ask these and many similar questions. Each school chose its own strategy and further procedure. Unfortunately, there was no immediate assistance from the Ministry of Education. Schools and their teachers expected methodological guidance and help from their superiors - but since they did not receive it immediately, they had to deal with it themselves. From the beginning of April, the Czech School Inspectorate began to investigate the situation in schools. It provided information on online teaching by telephone contact from the school principal and asked him 10 standard questions to map the situation.

- How does the communication between teachers, pupils/students and their parents look like?
- What is the digital support for distance education in your school?
- How do distance learning methods inspire you?
- How do teachers cooperate in distance education?

- How is it possible to motivate and involve pupils in distance education?
- How can teachers use available digital technologies?
- What forms of support for digital distance learning technology do you use?
- How does the communication between teachers and students look like? (what applications / platforms they use, etc.
- How do teachers organize the content for distance education? (what online resources do they use, etc.)
- How do teachers evaluate pupils' participation and performance in distance education?

Based on the results of the monitoring, they hoped to successfully manage the situation. Data collection and evaluation took quite a long time and the results obtained no longer reflected the then-current situation. The limited scope of the article does not allow the survey and its results to be analyzed and statistically evaluated in detail.

Perhaps soon, the Ministry of Education, Youth and Sports will issue a handbook with options for what schools can do in the field of online teaching, which platforms they can use, etc., based on the experience of schools.

Due to the fact that at the time of writing this article we did not have the results of the school inspection survey, we carried out our own survey among primary and secondary school teachers. We sent out several electronic questionnaires with 14 questions to map the situation in school education during a pandemic. 10 of them concerned the situation of distance learning. These questions were:

1. How did you communicate and what tools did you use to communicate with pupils/students?
2. How did the school management support you? How did the school principals support you?
3. What software support have you used/are you using? (LMS, school information system, etc.)
4. What didactic applications did you use/are you using? (Electronic textbooks, educational websites, educational video etc.)
5. What learning materials did you create and distribute?
6. Was/is this (online and distance) teaching method difficult for you?
7. In your opinion, was it necessary to close the school during the pandemic?
8. What solution do you think would be ideal?
9. List the positive solutions that your schools have adopted (your school has accepted)!
10. Name the negatives that the adopted solutions brought!

The other 4 questions were focused on the identification and inclusion of the teacher (in the evaluation) who completed the questionnaire. They concerned qualifications, the length of teaching experience, the type of school he/she worked at. The answers to the last few questions allowed the respondent to provide information that they considered important and it was not possible to complete it in the previous part of the questionnaire. The results of the survey were very similar in both countries – in the Slovak and Czech Republic.

There were no explicit rules in the individual planning of online learning and teaching and coordination was often lacking. To provide an example, what happened was that the same group of pupils/students was to take part in two online activities at the same time. Another shortcoming was that teachers, due to the lack of guidance, did not act uniformly and started using different platforms.

The first weeks were, of course, the most difficult because most teachers used different platforms to share content of topics and study materials with pupils/students. The teachers had, in many cases, incredible support from the school and various technical issues were resolved. Still, it was quite challenging for pupils and students as well as teachers to use different platforms for different subjects. That is why at the end of the first period (in many cases, after the first week) teachers and management of schools had a meeting where they agreed on one platform that all teachers would use. In most cases, it was Microsoft Teams. The meetings addressed the issue of training teachers how to use the tool. Many schools organized the training on their own, others were assisted by external lecturers. During mentioned training, the teachers were instructed on how to use this platform, how to create teams/groups, how to start a video call, how to invite individual students etc. However, a problem that soon became apparent was the limitation of this platform, which is the fact that the maximum number of participants in a video call is 20 participants - which would be a problem if a class were bigger. Schools have solved this problem in various ways, for example, with the support of parents or sponsors, they have purchased a suitable platform for distance education. (For example license for Cisco Webex - which is an application similar to Zoom - which was used mainly in the first grade of primary schools.)

The MS-Team is still mainly used for subjects and classes where the number of students in a group was up to 20 students as it was closest to the students and there was no need for additional downloading of various other applications.

The standard teaching and learning at home was also supported by television with special educational programs. The daily broadcasting of teaching programs on the Slovak Television channel was extended to 100 minutes with an emphasis on pupils with special educational needs. A new platform for distance education was created in the form of website www.ucimenadialku.sk (we teach remotely). The website provided a lot of materials not only for teachers, pupils and students, but also for parents. There were a lot of materials for education as well as other relevant information about the situation. Various solutions were sought to make

this easier for both parents and teachers. The Minister of Education addressed an open invitation to parents and teachers to communicate with each other and attempt to help each other.

In the following sections, we will briefly describe some of the options that appeared most often in the answers of respondents.

3.0 On-line Learning Options

Online teaching at schools was implemented in different platforms. Teachers had to manage teaching, training and testing at the same time. Schools mostly used and still use:

- Microsoft office 365 - Teams (tutorial) and Forms (for testing)
- Google - Google Classroom (tutorial) and EduPage (for testing)
- Zoom – for teaching.
- Webex – for teaching.

3.1 Microsoft Office 365 – Teams

The Microsoft company offers Office 365 for free to all schools. Once a school is listed in the school register, they can get free access by being verified, and schools make extensive use of this offer. (The same is true in both republics). Accounts have been set up for all teachers and pupils. The teachers divided their pupils/students into groups according to classes. All students and teachers had their work e-mail. Word, Excel, PowerPoint are free, which is a great advantage in teaching, as all students and teachers could work in the same latest version of applications. OneDrive provides 5 TB of storage. There are also Forms for creating quizzes or tests. The most important part of online teaching is Teams. In Teams, teachers or students can create their own teams. Teacher can insert team members and are able to communicate with each other. Moreover, for communication they can use both a chat and a call.

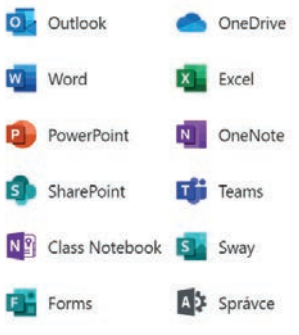

Figure 1: Office 365 applications

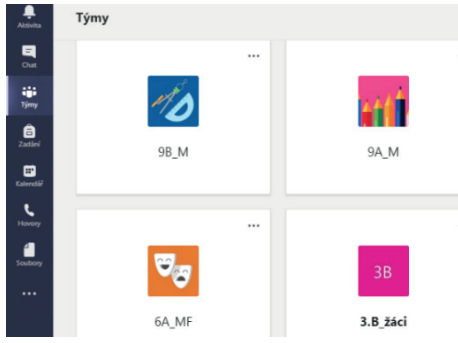

Figure 2. Teams - working groups

3.2 Microsoft Office 365 - Teams and SMART Notebook

Various interactive whiteboards are used in schools in the Czech and Slovak Republic. One of them is the Smart Board from Smart Notebook software. Connecting pupils' mobile phones, tablets, laptops, or computers during online lessons with an interactive whiteboard and the Smart Notebook program proved to be very effective. Teachers can use the interactive whiteboard to explain topics of teaching, to practice and use various activities. An important advantage of this form of teaching is that it is possible to store links to various websites in the presentation, which saves teacher's time the next time they need it. However, the preparations for the lecture with this program can be time-consuming. Creating a proper explanation of the material, usually using various graphs and tables, can take a few hours. But the prepared lessons can be used several times or in parallel classes.

The use of Smart Lab cloud activities takes less time to prepare and the efficiency during the lecture is immense. To practice these Smart Lab cloud activities various devices - computers, laptops, tablets and pupils' mobile phones were used. The prepared activities work on all devices at the same time without any problems. All these cloud activities - which are marked with a symbol "connect devices", can be run on a computer, laptop, tablet or a mobile phone. Pupils connect to activities using the HELLOSMART.COM website and the teacher's ID. The teacher sees (on the screen) the connected student devices. The teacher starts the activity for the pupils and the pupils work independently on their activities individually, at their own pace. After completing the exercise, they receive an immediate feedback on their performance. These activities include several types of tasks:

Fill in the blanks – pupils/students drag words or numbers into the blanks. These activities support deduction, composition and memory training.

Rotate – flashcards - trains memory and expands vocabulary.

Bring yourself together! – making the right pairs. A pairing activity develops the ability to recognize and discover the relationships and connections between objects and phenomena. Thus, it trains memory and develops students' creativity. Teachers make great use of this activity in classes.

Sorting – pupils/students sort items in order to learn about comparison, deduction, sequence, and arrangement. It is, again, a very often used activity.

Super sorting – pupils/students sort items into two categories. This activity teaches classification and grouping. A very often used activity.

Monster Quiz – a progressive quiz with multiple choice questions and *true – false questions*. Pupils/students work in teams on designated devices. It is a very popular activity among pupils/students and can be run on tablets, mobile phones or computers. Pupils are grouped based on a random selection of computers. Each

student responds at their own pace and the points for the team add up. The answers are evaluated immediately, and they see the correct answers and the solution explanation.

Response 2 – pupils/students answer multiple-choice questions, voting/opinion questions, short-answer questions, and true – false questions. This type of task is very beneficial for testing and it is used often with this intention. We can also use it to quickly repeat the curriculum anonymously. At the end of the test, pupils/students will see a quick evaluation of the test – which questions they answered correctly, which incorrectly, which were not answered and the final evaluation. All these answers are recorded in a table that the teacher can save. The tests can be created quickly and corrected/checked the answers/solutions immediately. The teacher only saves the results of the test to their own computer (Fig. 3). We can again perform this activity using mobile phones, computers or tablets.

Student	Grade	# Correct	# Incorrect
MICHAL	100%	20	0
Marek	40%	8	12
Martin	20%	4	16
Michal	25%	5	15
Tomas O	60%	12	8
Viki	90%	18	2

Figure 3. Teacher's environment - Response 2 – table with results of learners

Get involved – pupils/students use their devices to send their contributions or pictures or to brainstorm ideas. After solving all the tasks of all pupils/students, the teacher can sort through the questions and tasks with the pupils/students and communicate the correct solution, including the procedure.

Figure 4. Monster Quiz – the teacher screen

The most popular activity for young learners is the *Monster Quiz*. Pupils are registered for the activity and the teacher or competitors choose how many groups they will be divided into. Each participant solves their questions individually on their device and the points are added to the team's score. Pupils see questions on their devices, the teacher sees the teams and their success in solving, see. Figure 4.

The second most popular activity is testing through *Response 2*. The great advantage of quizzes and tests is that teachers are monitoring activities and actions of pupils/students on their screen (how fast the pupils answer, how many tasks they have already completed etc.). Upon completion of the test, the learner immediately knows the correct answers and their success in the test.

3.3 Other Educational Software Tools for Didactic Application creation

There are several software tools that allow for an easy interactive creation of didactic applications. Moreover, many creative and erudite teachers have created and are continuously creating their own applications. Some of them used digital educational technologies in the form of full-time teaching even before the pandemic. They used electronic textbooks, freely available educational portals and websites in their teaching. Others created own educational portals, which they provided to other teachers for free use. Many professionally (or semi-professionally) created portals are also available. For example: Infovek, Planet of Knowledge, IT Academy, Simulations and others, which are mostly the results of national projects.

Educational software can increase the quality of the teaching process and motivate learners to learn in a visually appealing and interactive environment. It can be used to present the curriculum, to practice and consolidate knowledge and to test the acquired knowledge. It is suitable for learners of any age and can be used in all phases of the teaching process as well as for an individual study. In that case, however, it must be adapted to the needs of learners and respect their individual needs. If we want to create a quality didactic software, we cannot omit didactic principles, applicable standards and procedures [12] [17] [18]. For the creation of such a software, the following procedure is recommended:

1. collect and select more materials related to the topic and plan the programming environment;
2. choose the most suitable material and design for the given application;
3. choose effective and suitable implementation tools for the creation of the educational software;
4. verify the software not only by the author (programmer), but also by users (teachers) from practice;
5. practically use the created software and use feedback to improve it.

The creative process has an iterative character and the author often returns to the previous steps to refine, supply and improve the product. The didactic software application is developed according to the known software life cycle. Based on feedback from users, it is improved, and refined until the basic concept itself is outdated, or no longer effective or reliable [11].

The European Standard for Teachers in the key competencies of a teacher includes not only the ability to work with available didactic software and educational applications, but also the ability to create own didactic software. Knowledge of programming and software development, deep subject knowledge of the creator and the learning process is assumed [1] [3] [4].

Teachers of non-informatics and computer science subjects can also create interactive educational software without programming skills in environments that facilitate and support such activities. This can include tools for creating didactic presentations PowerPoint, Prezi, Hot Potatoes, Canva etc., which enable interactive, intuitive creation of applications even in the case of a little erudite teacher [9] [10]. When creating a presentation in the PowerPoint environment, we usually use a linear procedure and a linear structure of the subject matter presentation. So we create a sequence of images, from the first (title) to the last. Even with the limited capabilities of this software, an experienced user can create a very impressive application that overcomes even the natural linear structure and connects smaller "information" units into the necessary structure.

The Prezi environment directly offers the creation of a structured presentation, i.e. the arrangement of the presented knowledge into a logical structure. There are more paths in the structure and only the start and end point is clear. Not only do we move from left to right, but we can go back easier and faster, zoom in on the details. We can move the presentation from the first point to the last or go to any point of the presentation. This non-linear procedure is in many cases more suitable, for both the creator and the learner as it is more visually appealing and for the presentation of knowledge more illustrative. It supports the systematization of knowledge into an organic unit. In some cases, however, it is more appropriate to use a linear procedure, if required by the logic of the presented knowledge.

4.0 Projects Focused on Modernization and Digitization of Education in Slovakia

The state authorities, state organizations and Ministry of Education try to support the process of electronization and informatisation of primary and secondary schools. Computers, informatics and information technologies are not only the subject of modern state study programs but have become a universal tool and technology for teaching. Several projects have been prepared and implemented during the recent years in primary and secondary schools, some of which will be mentioned. All projects have been aimed at improving teaching, but not all of them

have fulfilled the expectations of teachers and pupils. The most important Slovak national projects and initiatives that have been oriented towards electronization, modernization and digitization of education were: Infovek, Infovek2, Planet of Knowledge, Digi-School, Digital Teaching Content within Reach, IT Academy etc. These projects are devoted directly to digital education. On the portals or websites of these projects there are a lot of educational applications in form of electronic text-books, on-line courses, digital teaching materials suitable also for distance learning and distance education.

5.0 Conclusion

In conclusion, we can evaluate that the use of modern online educational technologies in distance learning during the pandemic has confirmed their importance and usefulness for crisis management. Many digital technologies, information and communication systems that teachers had at their disposal and that were not (or only rarely) used have now become imperative and their application a necessity. Teachers who used those tools without problems managed the situation. Those who had ignored it before were forced to use them - "they learned on the go", "they learned by doing and using"[13].

Most, however, considered distance learning to be time consuming. Teachers described the preparation of electronic learning materials, online assignments, tests and examinations as extremely demanding and burdensome. Schools, teachers and even pupils were not prepared for this kind of teaching. Based on the personal experience of teachers (survey respondents), it could be concluded that there was a lack of organization and discipline. Teachers overestimated the situation, assigned many tasks, expected students not to cheat and to prepare constantly. On the other hand, students had a mindset of being on a vacation, therefore, they had to be chased to work together. The ideal solution would be for the school to have developed not only a plan for how to proceed in such a situation, but also to be equipped with the necessary technologies and to use them to increase the effectiveness of teaching is a common matter and an internal need. However, at the time when we were surprised by the spread of the COVID-19 virus, no one could provide such a solution, and everyone tried to solve this in their own way. However, information literacy and the necessary digital competences on both sides - teachers and pupils/students - were lacking the most.

Definitely, the situation in education during the Coronavirus (COVID-19) pandemic in Slovakia and the Czech Republic can be concisely characterized and expressed in several points:

- Schools were completely closed and all schools implemented online teaching;
- Lack of experience of some of the teachers to create online material or give on-line courses;
- No central technical support for teachers, pupils and students;

- Students had to use their own devices - computers, laptops, tablets and mobile phones.
- Many pupils did not have the necessary equipment at home or Internet connection;
- BYOD (Bring your own device) - student devices used in primary school teaching - brings a great new experience with the use of the students‘ own devices in teaching.
- Many students (the youngest) do not have enough digital skills and parental support was needed in lower grades;
- Parents of pupils and students (maybe even society and government) understand that teaching is not so easy and that it requires a certain pedagogical mastery.
- The use and incorporation of these technologies into teaching brings new possibilities.
- Students get new skills and develop other activities in which they increase their digital literacy, learn to critically assess various information sources, create multimedia works, etc.
- However, they must respect ethical standards and safety rules.
- Preserve the rights of the minor (right to self-image, data protection, etc.)
- Lots of organizational, planning an unnecessary time consuming bureaucratic work for teachers (so they did not have enough time to devote to the preparation of the lesson).

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PBGL Framework: Personality-Based Gamification in Learning

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Abstract

According to literature review, it is defined that students in the Higher Education context are not motivated or engaged enough to form a deep connection with a subject matter of their choice and trigger deep learning. Sudden attendance drops, poor performance on specified marked artefacts or even a complete shift of attention are getting higher. These matters raise the need of a modern teaching technique such as Gamification.

Gamification helps the academics to turn something otherwise dull to an interesting and fun learning experience, tailored to the student's needs. However, there is no design framework that provides a roadmap for academics new to this technique, and this makes it hard to implement, as it requires further CPD investment and proper planning. However, Gamification does provide a lot of game elements and mechanics that can be used within a class directly as an out-of-the-box solution, but there is a risk that this may overshadow the learning experience in favour of a game.

The main goal of this paper is to formulate a path that an academic can follow, based on the plethora of game elements available, providing suggestions and tools that can be used directly within the context, in order to ensure that this motivates to all learning types of students, just like in every game where different aspects are better suited for different types of players.

Consequently, in this theoretical paper we propose a design gamification framework which is based on a pyramid consisting of the Game Elements at the bottom of the Pyramid, the Player Archetypes and the motivational model of the Self-determination

Theory on top, in order to evolve students in a gamified classroom environment in Higher education.

Keywords: Gamification, SDT, Game Elements, Player Archetypes, Bartle's Taxonomy

1.0 Introduction

Learning in Higher Education is a goal driven social activity that depends on motivational factors and experience and leads to long-term changes in behaviour potential. Motivating adult learners in continuous and interactive studying is considered as a crucial part in learning process and in distance learning.

According to the literature review, it is observed that learners nowadays face learning process as another acquisition rather than its real substance, in other words they develop a "consumer" attitude towards learning content [15]. Consequently, learning designers and lecturers should take into consideration the accomplishment of an effective instructional design, in order an enhancement of cognitive processing and encouragement of positive engagement to be achieved.

Consequently, motivation plays an important role to the learning process, as drop out numbers are getting high year to year. This raises the need of a modern teaching technique such as "Gamification". Educators often uses games and game-like environments to attract learner attention during the instructional process. Bartle described the act "gamifying" an online system as "turning something not a game into a game" [13].

While research emphasizes the importance of keeping player types in consideration in gamification design [13], only a few studies in the literature focus on these different player types, based on the motivation theories. The problem nowadays consists of academics implementing gamification in their classes. This is known by examining some of the recent case studies involving gamification that had mixed or negative results [5][11][13]. Gamification requires an additional step before being used in class in order to improve its effectiveness and be more enjoyable to a wider student cohort, and that is what we are trying to achieve with Personality-Based Gamification in Learning (PBGL) framework.

PBGL is a framework that attempts to map out the relationships between Gamification Game Elements (which we are using in-class to motivate our students) with Bartle's Taxonomy of Player Archetypes (as each student belongs in a different archetype, meaning specific elements tend to motivate them more than others). Finally, we are finishing the framework with linking both Bartle's Taxonomy and each game element with each component of Self-Determination Theory by Ryan and Deci [2]. Consequently, it is easier for academics to know which elements are linked to which component as well as which archetype is

motivated by which component, and that will provide a framework that academics can use to determine which elements may appeal more to their cohorts.

However, this will not be used on its own, as students will also be required to take the Bartle test, according to which an instructor will be able to identify the given archetype of their cohorts. This will then pave the way for which game elements would have the highest impact in that cohort's motivation.

2.0 Gamification and Game Elements

Gamification is the use of game elements in a non-game environment to engage someone in an activity [9]. This applies in many contexts, such as enterprise, advertising and marketing, education, as well as health and fitness and many more. Furthermore, it should not be confused with game-based learning, an instructional technique that has the learner or user play a game and learning happens as the game is played out.

Game-based learning requires the use of an established game context, such as a video game, while gamification is more abstract and can be applied conceptually on a multitude of scenarios which can include but are not limited to video games.

Conveniently enough, gamification itself is broken down into two different categories according to Kapp: Structural and Content gamification [9]. Structural Gamification is about the structure of a unit and gamifies the framework and rules of the unit. Content gamification on the other hand, gamifies the learning content of a unit, including class activities and assessment.

Gamification on any context is achieved by incorporating components from game contexts directly into the non-game context at hand. These components are called game elements. For the purposes of this paper we will be providing a list of the most used elements in gamified contexts based on other relevant research.

Game Element	Description
Avatars	Use of a virtual character in a 3D or imaginary environment.
Award System	The use of awards that can be acquired through achievement, activity completion or by spending accumulated resources.
Badges / Achievements	Also known as achievements, they are awarded on completing certain activities. Used to demonstrate mastery.
Challenge	The element of challenge is a harder variant of an activity or assessment or a part challenging enough to be enjoyed by some students.

Choice	Choices are used as possible options regarding a learning activity, creating the feeling of autonomy.
Collaboration	Achieved through teamwork and group-based activities.
Competition	We can foster competition with activities that pit students or teams against each other using metrics such as time, accuracy, or degree of mastery over given activities.
Feedback	Refers to the degree and richness of feedback received on any given student action within the gamified environment.
Leaderboard	Leaderboards are displaying students given a ranking which is often based on accumulation of resources or points. Used to foster competition.
Levels	Levels can indicate degrees of challenge and progression.
Personalization	An element which allows students to freely express themselves.
Point System	Points can be used as a valuable resource, which can be linked to leaderboards, or even grades, accumulated through successful completion of activities.
Progression	The element of progression focuses on progress bars and visual indicators of how close one is to their goal. Students are more motivated if they know how much more they need to do to fully complete a given activity.
Quests and Goals	A way to thematically dress up given activities and categorize them as main and optional activities. Students are able to pick up certain quests and complete them to progress through a story.
Gifting and Trading	An element that fosters collaboration, where students can help each other out. Resources are more meaningful.
Roleplay	An advanced element where students take the role of a given actor and enact in a given scenario that takes place in the imaginary narrative of the gamified system, rather than just a single session.
Social Status	The acquisition of bragging rights and feeling of accomplishment & dominance over others.

Story	A game element that brings a non-gamified system to life, sugar-coating the learning experience and making it more interesting as there is now a plot to follow.
Time	The element of time adds pressure on given activities, making them more challenging.
Unlockables	Unlockables are giving students purpose as certain activities or resources become available upon satisfying a condition.

3.0 Self-Determination Theory

Motivation plays a core role in the learning process and teachers should be constantly keeping it at high levels or improving it. The Motivation Theories are grouped by two groups, which are the Theories of Need and the Process Theories [12]. The first group involves Maslow's hierarchy of needs (1970), based on which, human behaviour is driven by their needs with the goal of achieving self-completeness.

In order to design a gamified system, it is essential to take into account motivation theories that lead to design an engaging content based on the human needs. Motivation has been divided into extrinsic and intrinsic motivation. Based on the few empirical researches, it seems that when students were given money [3], performance awards or other rewards, their interest levels were high, but when they stopped receiving rewards, they lost their interest for the process [3].

In the world of video games and gamification, motivation has a different approach. Players play a game, because they want it, as it gives them FUN. This means that players do not play mostly to earn extrinsic rewards, such as money or grades, but they are intrinsically motivated, which drive us to use game elements into the learning process, in order to increase students' motivation.

According to Werbach and Hunter [14] one Motivational Theory suits best to Gamification, which is the Self-Determination Theory (SDT) [3], as games are perfect illustrations of it [14]. On the contrast of behaviourists theories, which state that people are driven by extrinsic motivation, the SDT presents the satisfaction of their basic internal needs, in order for people to evolve in their environment. The three basic needs are the following:

1. Competence: the effectiveness of my actions in my current environment.

2. Autonomy: the internal need to be responsible for your own meaningful choices

3. Relatedness: the social involvement and the relation with others [2].

Although games promote extrinsic motivation through points and rewards in a context of competition with other players, players of the famous MMORPG genre belong to a viral community, in order to be related with others. Moreover, the urge

to accomplish a mission and win the game describes the need of competence. Since they are responsible for their decisions during the game, it makes them to feel autonomous and make meaningful choices.

3.1 Self-Determination Theory and Game Elements

As the most important aspect of games is the "Fun" factor which is not countable, even though in gamification there should be quantifiable metrics through tools, which track the user's progress and motivation during the process.

In order to succeed that, game designers use a variety of game elements, such as leaderboards, badges, progress bars and rankings. The game elements are small parts that form a game, and specifically in gamification systems, the most broadly used game elements are points, badges and leaderboards, which are also known as "The PBL Triad" [14]. However, an instructional designer needs to go through the process of selection of the game elements and techniques that cultivate both extrinsic and intrinsic motivation, as research about motivation has already shown that leaderboards or badges can demotivate the learners in an extensive way [2].

Besides, implementing a gamified learning framework based on SDT, the selection of game elements should align to the three needs (Autonomy, Competence, and Relatedness). Based on the literature review [10], each variable can be aligned with the Game elements as shown (Fig. 1).

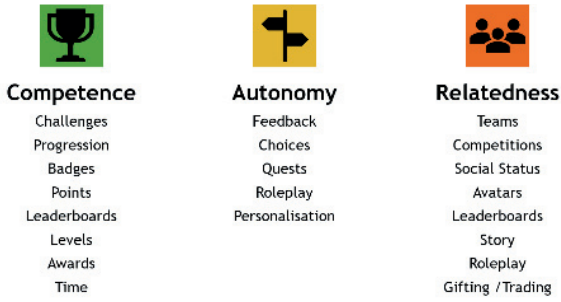

Figure 1 - Association of SDT and Game Elements

As we can see from the graph, the game elements to increase the Competence are the use of challenges, progression bars, badges, points, leaderboards, levels, awards and time, which promote competition between students.

Autonomy can be achieved by the immediate feedback through feedback loops, allowing them to make meaningful choices, giving those quests and create a personalised environment, where students have their own role.

On the other hand, Relatedness promote collaboration between teams, competitions, leaderboards, ranking and display of social status, as well as roleplaying, avatars, storytelling and trading or gifting. The use of these game elements allow students to create relationships and be related with others.

Consequently, mapping out the game elements with the three needs of SDT leads to the active engagement of the learners in the learning process and the increase of their motivational levels.

4.0 Bartle's Taxonomy and Player Archetypes

According to Richard Bartle, every player can be categorized into four different archetypes [1], which define which gameplay elements suit them best, as well as their individual playstyle. This categorization is known as Bartle's Taxonomy. This Taxonomy categorizes players based on two dimensions, the first being Action and Interaction and the second being Players and Environment (Fig. 2). As such, four quadrants are generated from these dimensions and the following four player archetypes emerge:

Killers: They act on other players. They enjoy competition, employing strategies, wit and/or reflexes to 'beat' other players in a given gaming context. They usually kill other in-game personas of other players during PvP (Player vs Player) matches on online battlegrounds, however they can also be healers who keep certain personas alive. They act on another persona either way. Since killers enjoy causing mayhem, they can be also seen as the risk-takers who enjoy the thrills of the moment.

Achievers: They act on the environment. They are players that generally aim to 'beat' the game in every aspect it can provide. They furthermore enjoy the feeling of security, and "safe but long" routes to a treasure chest, as they are not risk-takers. Achievers always aim to get all possible rewards, collect every possible resource, unlock all possible bonuses, and all that towards 100% completion of any game they are playing. They look into ways to figure out the best or most secure strategy in a given problem and will aim to have better accuracy, focus and speed on certain tasks than other players.

Explorers: They interact with the environment. Explorers enjoy the game as an experience itself and are driven by their curiosity to discover every nook and cranny in a given world, experience the game's story and lore, immerse themselves into the environment and make meaningful choices in a game context. They really enjoy figuring out solutions to problems on their own and mapping out all the game's mechanics and rules in their own mind map.

Socializers: They interact with other players. The game context acts as a backdrop as the meaningful event that takes place is socializing with other people.

Socializers enjoy collaboration and teamwork, have excellent coordination skills and really enjoy the human factor within any game, much more than the game itself. Their main goal is not to beat the game, but to formulate long-lasting friendships, strong communities and understanding other people is more important than understanding the game mechanics.

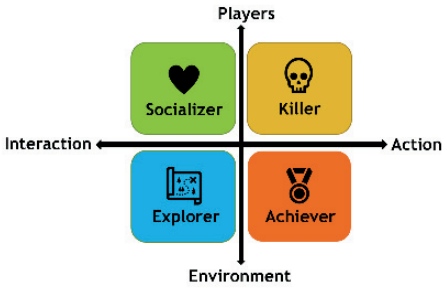

Figure 2 - Player Archetypes

While Bartle's Taxonomy is used to categorize players into four distinct archetypes, the same rules apply when we attempt to categorize the students into the different archetypes. Students are players themselves. Consequently, once we define the type of player our student is, we can accommodate his learning style into our professional practice and improve his learning experience.

Killers are students who enjoy taking risks and can live with the idea that you start over with nothing, since being killed in online multiplayer games and losing your progress is a common notion all "killer" archetypes are in terms with. Furthermore, Killers won't mind being wrong or making mistakes. They enjoy trial-and-error.

Achievers are students that exclusively go for the highest mark possible. They can reverse engineer a given unit and figure out exactly what bits and pieces are important in a given assessment brief and what to submit in a summative assessment for maximum marks. They will attempt to figure out loopholes and exploits in a unit to get maximum marks and achieve the best performance with as less content and work as possible. But once the best possible mark is achieved they will stop there.

Explorers on the other hand, will enjoy the learning process. They won't pay as much attention to getting the most marks from a unit but would rather squeeze out all information that's relevant to them from a unit. These are the most likely students to do all the work for a unit but won't care as much for the mark or submitting on time. Learning is more important to them than a mark.

Socializers within a learning context can be students who enjoy communication, collaboration, coordination and teamwork. These students enjoy partaking in groupwork activities and even managing a team themselves. Socializers are more likely to form study groups, use social media to ask questions or help other students who are having trouble with a specific assignment.

4.1 Bartle's Taxonomy and Game Elements

In this section we will attempt to map out an association between each of the identified elements and Bartle's Taxonomy. It's imperative that each element resonates with a different player type. If we know the player types which exist within our class, then with this association we will determine which game elements will be more appealing to our students and motivate them more.

Game Element	Associated Player Archetype
Avatars	Avatars allow students to immerse in the game environment (Explorers) but also connect to other avatars (Socializers).
Award System	When it comes to awards, one type tends to gather as many as possible, and that would be Achievers.
Badges / Achievements	It's natural that Achievers are drawn to badges as that demonstrates mastery of a game or system.
Challenge	If a tougher activity makes one better than others, Killers are drawn into this element. But for those seeking to further improve themselves, this is also highly likable (Explorers).
Choice	Explorers exist and are motivated by autonomy and options.
Collaboration	When it comes to leading a group or collaborating, the soft and social skills of a Socializer overshadow all other types.
Competition	Dominance over others is a trait sought out by Killers primarily and Achievers secondarily due to their nature.
Feedback	Explorers and Killers adore feedback, as they are both driven by trial-and-error.
Leaderboard	Through leaderboards, one can demonstrate mastery, especially if it's a higher rank than others. A trait sought by the competitive Killers.

Levels	If levels indicate progression, this is favoured by Achievers, if it indicates challenge, this is favoured by Explorers.
Personalization	As this is a way to express yourself to others, this is an element which both Explorers and Socializers enjoy.
Point System	Points are linked to mastery and competence and as such motivate Killers and Achievers more than the other types.
Progression	While everyone enjoys knowing how much more work is needed towards a goal, this appeals to achievers more because they know how close they are to 100% completion.
Quests / Goals	Achievers enjoy the clear instructions given by the quests while Explorers enjoy the freedom of picking up which ones to do.
Gifting and Trading	Trading and gifting require social skills and tends to build friendship – highly favoured by socializers.
Roleplay	Being able to be someone you are not fulfils your fantasies which appeals to Explorers, and if interaction with other actors takes place, this also appeals to Socializers.
Social Status	While this is an indicator of mastery, it's a clear indicator of dominance, which is favoured by Killers.
Story	Enriching the learning content with a strong narrative adds to the enjoyment and immersion, especially to Explorers.
Time	Temporal pressure adds a degree of challenge, which Achievers may enjoy for overcoming and Killers for being able to complete a task faster than others.
Unlockables	Unlocking content means you get to explore more of it (Explorers), but also means you managed to fulfil all requirements to get it unlocked (Achievers).

Consequently, it's clear that there cannot be a direct mapping to only one of the player archetypes, and multiple game elements can appeal to more than one types. This can have a positive chain effect on motivating the right cohorts if one can identify their learning needs and tailor the learning experience to their liking.

5.0 Archetypes and SDT

This paper presents a gamification framework which maps out empirically the SDT variables with each game element. However, according to Ferro et al [6] tabulated game elements and mechanics can be used in a gamified learning environment with regards to the player. Therefore, the figure below (Fig.3) shows the game elements which align to the SDT needs, but also to the player archetypes according to the Bartle's Taxonomy.

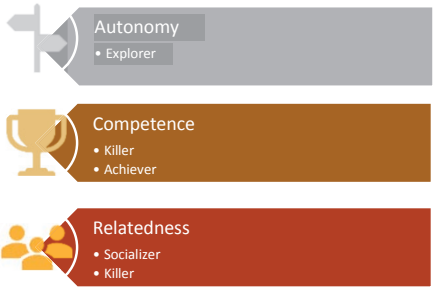

Figure 3 - Association of SDT and Player Archetypes

Associating the game elements with the SDT and Player Archetypes, we observed that some game elements are more popular to specific type of players, and as such to the specific internal need.

Explorers prefer challenges, immediate feedback, quests, roleplaying, storytelling and personalization, which are associated with the internal need of Autonomy. Besides, explorers enjoy freedom and focus on their own learning over the pre-set learning outcomes.

On the other hand, **Achievers** are driven by mastery of the course's content versus mastery over others, and such as their internal need is Competence. Besides, the most preferable game elements for achievers are challenges, progression bars, badges, awards, levels, time and unlockables.

Socialisers enjoy socializing more than any other group and are driven by the motivational force of Relatedness. They are motivated by collaboration through teams, competition, roleplaying, gifting, trading and the display of social status. Consequently, Socialisers are more likely to set up study groups or communities of practice and to share information with others without competition.

Last but not least, it seems that **Killers** find joy in competing against their peers, based on the drive of Competence, but they are also driven by Relatedness. They are motivated by points, badges, leaderboards, competition and social status. This comes to a conclusion that all the game elements can motivate different types of

players, but some of them are more popular to a specific player archetype, according to the aforementioned association between the SDT, Game Elements and Bartle's Taxonomy.

6.0 Discussion and Conclusion

Based on the links we found between elements and player archetypes some elements can appeal to more than one archetype. Further to this, to accommodate a higher number of students the archetype minorities that are identified through the Bartle test, more than one type of elements can and should be used. Obviously, this means that the student has a primary and a secondary archetype. For academics this means that it is advised to use elements that appeal to both natures of the student because the goal is to accommodate as many students as we can to improve the results.

The only one main concern and limitation of this research is that the students may not realistically answer the diagnostic questions or answer them differently, because they misunderstood the question, leading to false classifications. For that reason, we would also like to extend this system to use other similar structures, such as Brainhex [11] and Yee's theory of motivations [16].

To conclude, PBGL is a new, untested framework and requires further tinkering and case studies to be completed while using it and that is our next step. We hypothesize that given the right elements in a gamified scenario, the effects of motivation will elevate, and in order to identify this, students need to be diagnosed and classified in a given player archetype classification.

Lastly, given enough results we would like to focus on improving the validity of the diagnostics as much as possible, and thus link PBGL with other personality tests such as DiSC [17], 16PF [18], or Big Five [8].

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Identifying Gaps in Cybersecurity Teaching and Learning

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Abstract

This paper explores perceptions and expectations of privacy when using computer-mediated communication and social media. In this paper we present the results of an empirical survey into this topic and explore the pedagogic implications for the teaching of cybersecurity. The study asked undergraduate students about their habits, expectations, and beliefs about the media they use and interact with. The aim was to capture and to inform the state of the art in cybersecurity teaching through identifying students' perceptions and views on privacy, security and whose responsibility these are. The academic provision for the teaching of cyber-security is a critical contemporary requirement. To improve this teaching, it is necessary to get some idea of the necessary requirements for such a course. Based upon the results of our survey, we go on to identify some of the key issues for such courses to address.

Keywords: Cybersecurity; Computer Science education.

1.0 Introduction

Teaching cybersecurity is a timely topic, with gaps in the capacity amongst businesses to manage cybersecurity [1], with expectations for it to be included within technical computing syllabi [2]. Furthermore, it is expected that awareness of this be demonstrated by practitioners as part of their professional duty, for example in the BCS Code of Conduct [3] and the ACM Code of Ethics and Professional Conduct [4] . Whilst these codes identify the need to take responsibility for the security of others, ensuring the security of systems is a primary consideration, the evidence from practice shows potential gap here: rarely does a week go by without a press story of hacking, security breaches, data theft or cybercrime [5]. The issue effects individual users as they go about personal computer use, as well as work related business and commercial use. The problem is continually evolving as the wit of those wishing to design, implement and defend computer environments and digital networks is continually being challenged by those who would wish to outwit them. The threats can be both technological - e.g. Viruses, Ransomware, Malware, Trojans, Worms, or other Spyware that aim to secretly install themselves on your machine [6] - or human mediated e.g. Fraudsters, Cybercriminals, attention seekers, hacktivists, terrorist, or Nation-State Threats [7]. Whilst students – and staff – typically focus on technical aspects, the motivation for these comes from ethical and societal values.

In terms of types of cybersecurity attacks, CISCO [8] identify the following attack behaviours - Reconnaissance Phase (laying the ground for the future), Weaponization (e.g. Attack Vectors – Social Engineering, Phishing, Pharming, Drive-by, and Man in the Middle (MITM), Delivery (e.g. Malvertising and Malicious Attachments), and Installation Phase. Shneier [9] has argued that the solution is a holistic one that involves a golden triangle of People, Process, and Technology. With this triangle, educating users, both as preparation for and within the workplace, is a vital part of the solution. This view has been challenged [10] with the view that people are too slow and the subject too broad for the mass education of users to be successful. Instead, they advocate technology solutions based upon Big Data Security and Machine Learning. However, given the vital part that users will always play in these systems, naïve users are always liable to be the weakest link no matter how benevolent and protectionist the managed solution is. In terms of system design and implementation, the case for better educating developers and users stands. It also raises issues as to where the balance between individual rights and state protection & control are drawn.

1.1 Why teach our students about cybersecurity?

University students will go on to developing the systems, processes and providing the societal and ethical frameworks that underpin and utilize cybersecurity. With their educational and financial demographic, it could be expected that students are well aware of the issues of trust in a network economy. In this paper we explore whether such assumptions are valid, evaluating students' current perceptions through a survey on privacy and security, in an attempt to gauge the current position:

amongst both technically focused (Computing) students, and amongst a key user group, namely media and communication students.

Within the overall context of Cyber conflict and Cybersecurity there still is a need to teach end users who are expected not to merely use computer systems for their education, but also through the use of digitally networked everyday media to engage in digital citizenship and participate in public deliberations about global issues, such as democracy, the environment, health and well-being and working conditions. The need to teach individuals to cope with their online behaviours and safety has never been more acute. As Cybersecurity content becomes more pervasive, we aim here to take a look at some of the issues that should be addressed. In this context, we chose to look at privacy and from there to consider potential curriculum issues that follow. The aim being to establish a base case and to then determine the gap between contemporary awareness of the issues and levels of expertise that we would wish to instil in our graduates. Leading on from this we consider ways of moving forward from a current appreciation of cyber-security towards a future orientated cybersecurity-aware culture.

1.3 Students Perceptions of Privacy

As considered above, the students of today will go on to develop the systems, processes, and provide the societal frameworks for tomorrow. They will thus be the future major players in social media, socio-political networks, and actors in potential cyber conflict and digital activism and protest events [11], [12]. The graduates of tomorrow will be the key providers for tomorrow's systems. To evaluate students' current perceptions and awareness of cybersecurity issues, we carried out a survey on privacy and security to attempt to gauge their current knowledge and views.

1.4 Social computing, social media and the internet

One of the driving factors behind the pressing need for increased awareness of cybersecurity is the changing way we use computers and access data. In the day of the Internet of Things, where the internet encompasses computers, mobile devices, cars and all manner of other IP addressed devices – the potential for such devices to be compromised and for users to suffer is now pervading all aspects of our lives. As remarked in [13] '…physical things like smartphones, cars or human bodies and virtual things, like chat-bots or virtual assistants have been incorporated into sensing networks' that can be hacked, manipulated and hijacked). If connectivity is one issue, the way we use technology has also changed. New patterns of usage make users ever more exposed to the possibilities of cybercrime. With the rise of Social Computing – from email and chat channels through to more recent Social Media - users have never been so exposed to the potential exploitation by hackers and fraudsters. It is in this context that we carried out the work presented here

1.5 Survey focus

The survey focused on areas around privacy and security, including both online and other digitally-mediated activities (e.g. store cards). Participants were asked about how concerned they were on a number of topics. These included

- Use of social media, and the persistence of messages;
- Capture of personal data via transactions (store cards);
- Whether privacy is a right or has Surveillance and Artificial Intelligence over-taken such notions;
- With the desire to use Social Media, what has happened to Privacy;
- Are users concerned about the oversight of Government and the actions of their agencies?
- Do they engage in activities that could aid the common good? For example, have they engaged with others to improve the privacy, security and safety of other users?

The survey looked at a broad range of uses and behaviours that would be relevant to a course on cybersecurity, within the areas of privacy and security.

2.0 The Results

2.1 Demographics

A total of 109 students took part, the majority were from the 18-24-year-old range reflecting a typical undergraduate profile. This reflects the focus on the developers and users of the future. The majority of respondents were Computer Science students (83.7%), with the remainder coming from social sciences/media courses. Figure *1* provides a summary of the age profile of the students who responded to the survey.

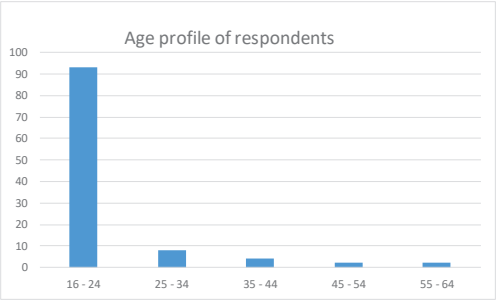

Figure 1: Age profile of respondents

Wagner [14] reports that typically less than 16% of Computer Science Graduates are Female, though the inclusion of media students helped to balance this closer to the typical profile within the IT industry. *Figure 2* summarises the gender profile of respondents.

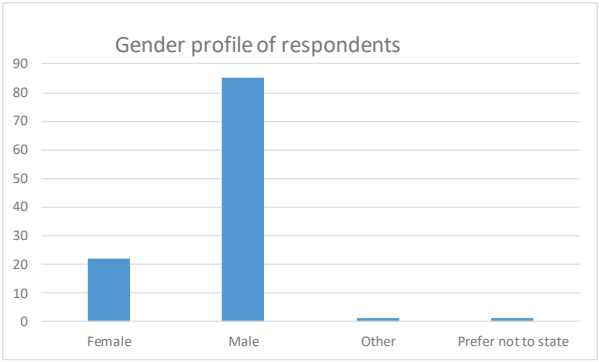

Figure 2: Gender profile of respondents.

2.2 Perceptions of Privacy

When asked about their perceptions of Social Media, as shown in Figure 3**, t**he majority are concerned about who is going to read what they have posted and use their message content. However, they are less concerned about the longevity of their message, somewhat at odds with the increasing demands for the right to be forgotten [15]. A little less than one third of students are concerned that their words online may be around for a long time and come back and damage them.

Figure 3: Concerns about social media

Figure 4 shows that nearly a third do quite routinely share the sort of personal data that can feed social hacking, though the profile from routinely sharing personal data through to keeping it secure is reassuring, in that it shows students' concerns on protecting their personal information.

Figure 4: The concept of personal privacy for students.

Figure 5 demonstrates that personal data is a commodity that many will trade for sufficient reward. The number of people willing to give up personal information if the rewards are good enough jumps up from 13% for a small reward to 27% if the reward is considered enticing enough. So people value their privacy but there is a price for it for some. This contrasts with the profile in Figure 4 where there appears a strong desire to protect personal data.

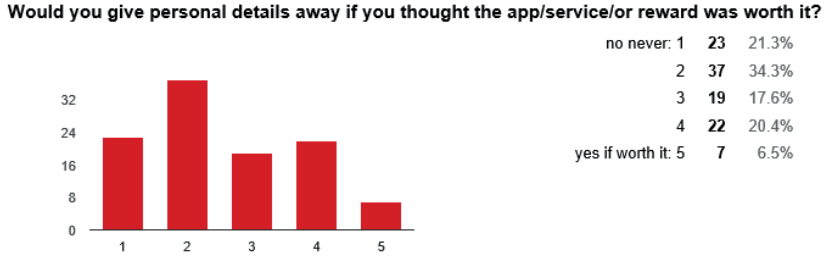

Figure 5: The worth of personal data.

For Figure 6, student were asked whether they felt "there is no difference between the rights to Privacy and Security that we hold in Normal (offline) Life to those that we have online in Social Media".

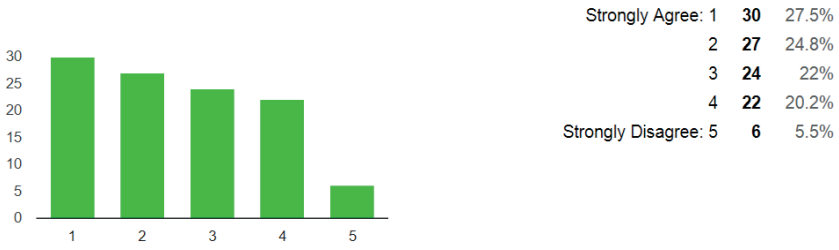

Figure 6: Real world and virtual privacy

Whilst the majority believe privacy and security issues online are similar to ones in the real world, nearly a quarter did not. Similarly, 28% perceive ethics to be different online to everyday life, proving further evidence that a significant proportion of students think that online life is new and not a reflection of everyday life. With an emphasis for many courses – especially in computing – for students to develop online portfolios and presence, the expectation to engage in social media itself is strong. So whilst many will sell data if the price is right, it is positive to see in Figure 7 how many (78%) who think that privacy is important in social media, in response to a question about "Do you think that in the modern era engagement in social media privacy is very important". This is significantly lower to a wider demographic: in a similar question at the Pew Survey of American adults [16], they say they do not wish to be observed without their approval; 88% say it is important that they not

have someone watch or listen to them without their permission (67% feel this is "very important" and 20% say it is "somewhat important").

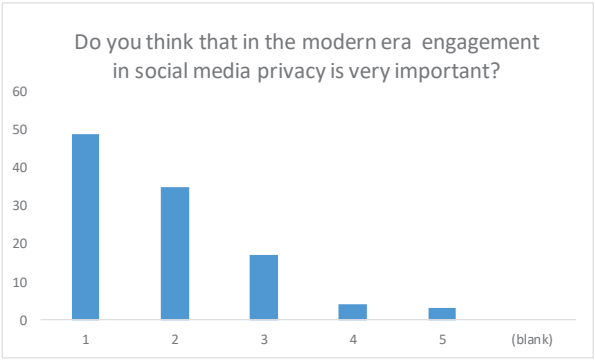

Figure 7: Ensuring privacy within social media

2.3 Security Considerations and Practice

In terms of their own behaviors, around half have multiple online identities, a little over 60% use different ID and passwords, with the other 40% not doing so (Figure *8*). Just under 50% report using tools to help protect themselves online. These figures contrast with the numbers below (section 2.4) where over 84% say they are "somewhat" to "greatly concerned" about cybersecurity. This disparity is more concerning given these are the future developers and advisors, and highlights the type of problems faced in ensuring a digitally secure society.

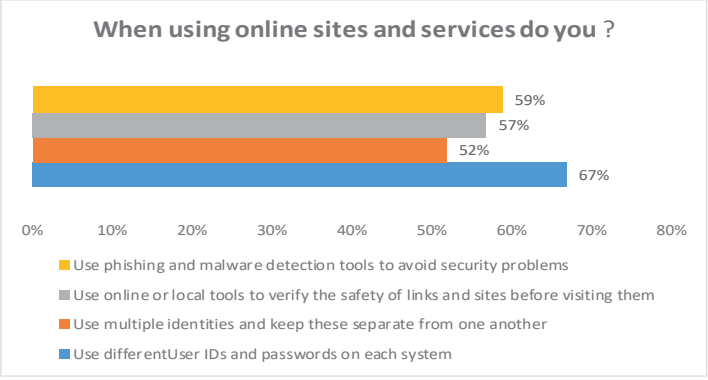

Figure 8: pro-active security behaviour

2.4 Cybercrime

From the almost normal distribution they do not appear to be overly concerned with Cybercrime when using Social Media and Social Computing, with a tenth reporting no concern (Figure. 9).

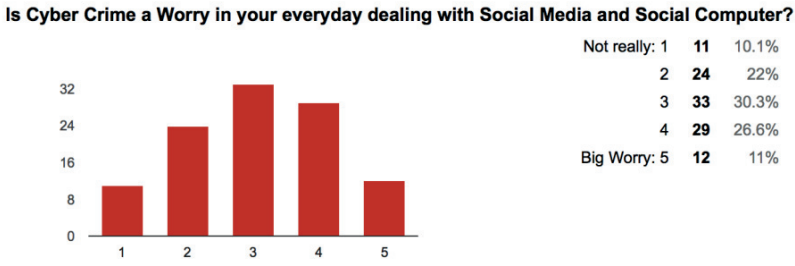

Figure. 9: Concern of cybercrime

The majority of students reported that they had not been the victim of identity theft, online or social media related crime Figure 10. Of interest some were not sure perhaps reflecting on the sometimes ambiguous nature of communications received.

Figure 10: Experience of cyber crime

With regards to being pro-active in improving their security and privacy in social media, 51% have made an effort to improve privacy in Social Media Interactions (Figure 11), meaning that 49% were neutral to indifferent about privacy. Although some claim to be very conscientious to about taking part in efforts to improve security 52.3% are at best neutral to negative about such efforts.

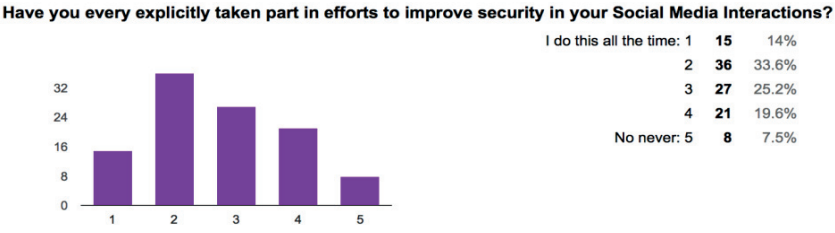

Figure 11: Pro-active security for social media

2.5 Digital Governance

On the whole, 49% worry about the role, impact, and influence of Government action and law on Social Media and Social Computing (Figure 12) when asked to what extent "Digital Governance (the role, impact, and influence of Government Action and Laws) [is] an Issue in your everyday dealing with Social Media and Social Computing". This is lower for example than the 65% of American adults, who believe there are not adequate limits on the telephone and internet data that the government collects [16].

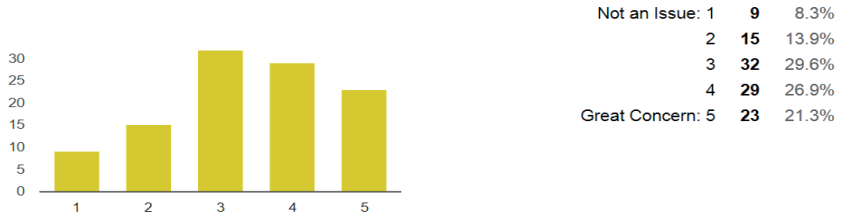

Figure 12: Concerns of digital governance

When asked about the notion of privacy as a basic right, over three quarters agree it is (Figure 13: Privacy as a right.), and this is also reflected in the interpretation of many that one way to approach this is through a privacy focussed or potentially dark web (55% agree or strongly agree).

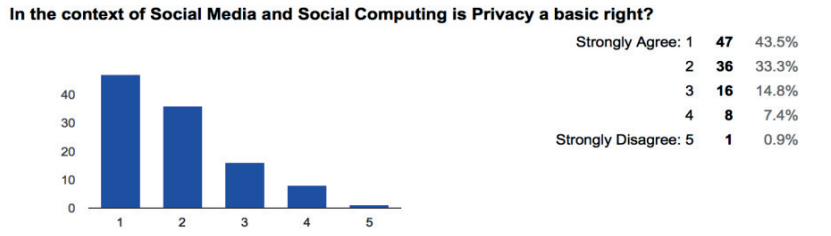

Figure 13: Privacy as a right.

3.0 The Results

In terms of student views about privacy and social media, approximately 1/3 of respondents were not concerned of other's privacy when interacting online. This reinforces the interpretation and issues above from **Figure 14**, showing the need to ensure that future developers acknowledge and respect the right to privacy in the systems they design and implement. Participants were invited to make open ended free text comments on the issues of privacy and cybersecurity, and some of the themes and issues that arose are illustrated here.

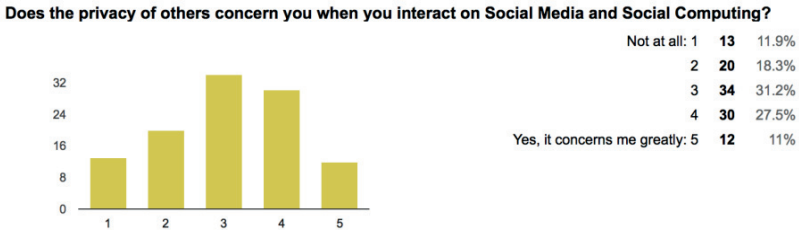

Figure 14: Privacy of others

3.1 Indifference to privacy

One of the common responses around privacy was "why do people care so much?". Equally, there was a significant view that since "there is very little privacy nowadays but it doesn't worry me personally" and it is an accepted and acceptable consequence of engaging in online media "anything related to social media has no real privacy because everything you put on social media is consequently owned by the social media site".

3.2 Inevitability

Following from the previous comments, many students felt that privacy is not possible with online lives, "it is nearly impossible to use the internet and have any level of privacy", though this is acceptable as it is so convenient "if it wasn't for the fact that it's easier and cheaper to talk to my friends over social media then I wouldn't touch it" and "I don't see any of it as being private". The acceptance of this inevitability is a common view, with participants feeling they have no control nor choice "it is possible that it [information] can be used for things that I did not intend for it to be used as, but there is little I can do apart from not revealing information on the internet about that", and that "privacy online doesn't really exist, you make a choice to put your information online for everyone to see when you sign up to social media", though with the caveat that "people need to be better educated on the consequences of this choice".

3.3 Responsibility

A common view is that it is the users fault: "People routinely publish facts about their personal life online, and then seem surprised that others can connect these and

gain a significant understanding of them", and reflecting some of the comments above "people need to realize that whatever you put on the Internet is public, and may be read by anyone" and that "people should be made aware of what is actually happening". So the focus for many participants was that the solution is in the users: educating them to avoid sharing information, on the assumption that it can (and may well be) monitored, analysed and used. As one of the participants said "Some people are overly cautious with on-line security whereas some aren't cautious enough".

Some of the participants did acknowledge responsibility on providers, "companies who harvest our personal data are acting unethically, as the only purpose for them to know my data is for their own personal gain", and "expecting privacy with social media is a dumb idea in general, but at the very least users shouldn't have to worry about being data mined". The need for understanding and responsibility were common themes "I love social media and all it can do for me. I am aware that things can come back to haunt you and I accept that".

4.0 Discussion and Conclusions

4.1 Students Perceptions

Whilst the right to privacy is clearly perceived as key to many students, the concerns about privacy and data in online interactions indicate they do not really trust their online environments. As the students acknowledge, technology is seen as a mechanism to breach privacy and data security. Furthermore, with sufficient incentive, they are willing to trade their privacy for "benefits in kind". A significant number of the students thought that privacy was effectively waved once you engage in online activity. Given the key chain nature of privacy – that your privacy can be breached if others who hold knowledge about you do not care about privacy – you are only as protected as the weakest link in your social network or your computer system: and so it is apparent that this responsibility needs to be clear to these future developers. Students claim to be greatly concerned with Privacy, Security, and Ethics, although the majority have not made explicit positive efforts in terms of privacy. They are less bothered with Cybercrime or the potential down sides of Digital Government, are not overly concerned about the privacy of others. This illustrates a disconnect between the codes of practice and professional behaviours expected of software engineers and computing professionals, and their actual views and potential practice.

4.2 Curriculum Design and Topics

Cybersecurity curricula tend to focus on technical aspects. These are of course essential, but also need to appreciate that the values and assumptions of the students may not align with effective implementation of the technical aspects. So a technical curriculum would include awareness of technical exploits e.g. using buffer overflows to overwrite local variables, stack frame return addresses or pointers to exception handlers, or dynamic issues like race condition vulnerability, but needs to also appreciate the reason that security is needed and why it is so important to the users and society. Examples of the kind of activity include understanding the need

to create secure passwords (i.e. increase the search space for those trying to break security) E.g. demonstrated by running a program to try a dictionary attack on a word based password so they appreciate how quick they are to crack However, this should be balanced with activities to understand why typical users don't appreciate that, and may choose to adopt easy passwords as a practical way to manage their accounts.

Whilst technical approaches to secure data may seem sufficient, some experience of the social engineering approaches through role playing game based approaches would also help develop students' understanding: e.g. to see how phishing and social hacking is used to target the key weak points i.e. to show how users are the weakness The different groups have clearly different needs: for many with a highly technical development focus, appreciating the ethical and societal issues can help in their analysis of requirements gathering: understanding the role of encryption and typical vulnerabilities is key. The importance of all developers taking responsibility for cybersecurity within their work could be enhanced through more explicit coverage of it within the professional codes of practice – as noted in section 1.0, whilst it is mentioned in the current code of practice "have due regard for public health, privacy, security and wellbeing of others and the environment" (section 1 of [3]), this does not emphasise the nature of it. The BCS do have a range of specific information security and Cyber Professional certificates [17], though greater emphasis in the general IT practitioner role seems lacking. The ACM [4] emphasises it more within their general code, with a full section on the design and implementation of "robust and usably secure" systems. Cybersecurity is a strong theme in the BCS course accreditation guidance, with section 2.6.4 of that code [2] addressing it, and it is explicitly identified in criteria 2.1.9 "Knowledge and understanding of information security". However, from the research in this paper, a more explicit approach to encourage cybersecurity aware behaviour and practice amongst all practitioners seems needed.

4.3 Conclusions and Future Work

Cybersecurity is sometimes perceived to be monopolised by global trusted networks (corporations, governments and NGOs). Citizens/consumers are left with limited choices and autonomy to manage and protect their online activities Technical (future) developers seem to accept the problems as inevitable and put the onus on users It is a world of hack or be hacked [18]. In such a world, there are critical ethical and political issues here of how much we need to teach students in order to create advanced cybersecurity awareness. A key competency that students need is that appreciation of the ethical context and that they do have a role and control to influence such future systems, whether they are general developers, or taking on specific cybersecurity related roles, and the inclusion of this in code of practice could be one way to ensure this.

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Virtual Laboratories and Practical STEM Education: Issues of Development and Deployments Including Benefits and Challenges

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Abstract

The use of online interactive teaching resources is becoming an integral part of modern-day educational curricula. Continuous development of resources such as interactive whiteboards, tablets and virtual laboratories help facilitate this. However, it is well acknowledged that there is a massive gap between current science, technology, engineering and mathematics (STEM) curriculum taught in primary and secondary education within the United Kingdom and the resources offered by present virtual laboratories. In particular, evidence of this gap is seen within STEM related education due to the lack of practical hands on experimentation. This paper seeks to report on the provision and research work being undertaken to meet the needs of students and institutions at both the primary and secondary levels of education. We investigate and discuss the current benefits, limitations and challenges associated with current virtual laboratories offered across the world through collaboration with schools and parents. Focusing on some of these, we report on a project undertaken to develop an open source virtual laboratory that will aim to meet current curriculum requirements while providing hands on experience that is found to be lacking in most cases within current provision. This success of this virtual laboratory is determined through implementation and use in different educational environments, identifying and addressing some of the challenges met in the process of development and deployment. In conclusion, we note that based on level of interest and use of these resources coupled with the move by everyone one everywhere to working and learning in online (virtual and

augmented) environments. It is important for learners, institutions and policy makers to avail of and invest in research aimed at improving these virtual experimentation resources for positive learning experience, enhanced knowledge and development of a highly skilled workforce for the future. This also has the potential to build upon and improve current education resources provision and sustainability in society.

Keywords: Virtual Laboratory, Education, STEM, Internet, Society

1.0 Introduction

Originating in the early 1990's the acronym STEM was derived from the educational subjects consisting of Science, Technology, Engineering and Mathematics. Historically, STEM education has consisted of vast amounts of practical experimentation due to the nature of its content. The practical aspect of STEM is integral as students gain theoretical knowledge within the classroom but are only truly able to grasp and apply this knowledge through practical experience [1]. The application of theoretical and practical teachings allows students to benefit from enhanced cognitive and collaborative skills [2]. Traditionally, practical experimentation within education consisted of students using physical apparatus to achieve a set purpose outlined within the Gatsby good practical science report [3]. However, developments within technology have now provided the ability for the conduction of practical experimentation through online means such as virtual laboratories. The aim of these virtual laboratories is to provide students with all the benefits of practical experimentation. In addition, the use of virtual laboratories looks to respond to the increase in E-learning that is being adopted across all subjects. E-Learning is defined as technology based learning where all material is delivered via electronic means across a computer network [4]. This emergence in E-Learning is attributed to the benefits it offers in terms of cost, engagement and flexibility. This paper will aim to discuss the current issues associated within the development and deployment of virtual laboratories for educational e-learning purposes. This will include both the benefits and challenges that are currently understood. To fulfil this aim, this paper will consist of the following objectives:

- Examine and discuss the current benefits, limitations and challenges associated with current virtual laboratories
- Report on a project undertaken within Ulster University to develop an open source virtual laboratory that aims to improve upon problem areas within current virtual laboratory implementation.

Each of these objectives are fulfilled through collaboration with schools and parents

2.0 Background

Virtual laboratories are described as 'one where the student interacts with an experiment or activity which is intrinsically remote from the student or has no

immediate physical reality' [5]. These laboratories have been developed through the underlying concepts associated with the internet of things and computer engineering. When developing virtual laboratories it is important firstly to understand the type of laboratory you wish to create. Typically, virtual laboratories fall into development, research or educational lab types. Development labs are focused towards enabling design and development processes to continue through answering specific questions which conform to specifications. Research laboratories focus on trying to improve upon a current body of knowledge whereas educational laboratories focus on the gaining of practical experience through the application of theoretical knowledge [6]. In order to achieve the desired type of virtual laboratory there are several development methods that can be carried out. LabView is a common development software that is used for the development of virtual laboratories [7]. LabView is a graphical based programming language that consists of three main elements. The front panel which displays the user's indicators and controls, the block which contains the code for the laboratory and the icon which displays a visual representation of the virtual laboratory [8]. LabView is a popular choice for the development of virtual laboratories due to its ability to satisfy experiments from a wide range of categories such as test, measurement and data acquisition. Furthermore, LabView virtual laboratories can be continuously updated to allow for further improvements and developments. Unity 3D is another method used for the development of virtual laboratories. Unity 3D is a cross platform and game development software that is supported by both Mac OSX and Windows. The development of virtual laboratories through the use of Unity 3D consists of many areas which can be seen within Figure 1 [9].

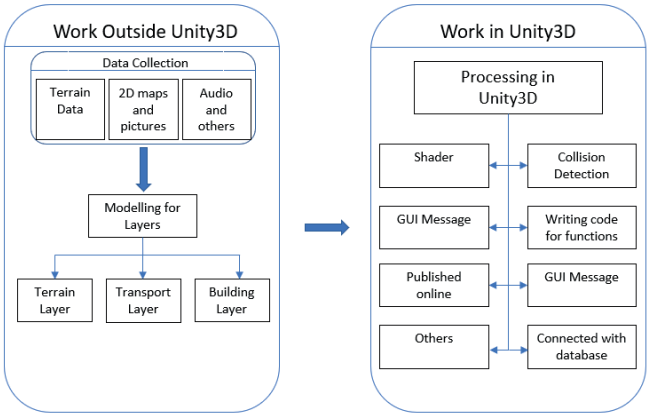

Figure 1. Areas of work involved within Unity 3D development of virtual laboratories [9]

Virtual laboratories are employed within many industries including education, healthcare and space. Within education, Labster, PraxiLabs 3D and Virtual Physical Laboratory are some of the most common virtual laboratory software packages. Labster is a commercial virtual laboratory software that offers

simulations within the areas of biology, chemistry and physics. It offers these simulations by providing users with immersive 3D universes, storytelling and scoring systems. It is currently used by top institutions worldwide which include Harvard University and Imperial College London [10]. PraxiLabs 3D is a three dimensional virtual laboratory that aims to offer accessible, usable and affordable biology chemistry and physics virtual laboratories to students and institutions [11]. Virtual Physical Laboratory is a physics based software package that offers over 370 simulations across 32 topic categories. These simulations align with the current GCSE and A-level United Kingdom specifications and are endorsed by the National Physical Laboratory, Cambridge International examinations and the Institute of Physics [12].

3.0 Methodology

This section will discuss three techniques employed to satisfy the objectives within this report. These techniques take the form of online surveys, virtual laboratory workshops and Google analytics tracking of the open source virtual laboratory developed within Ulster university.

3.1 Surveys

The development of surveys allows for data collection regarding current benefits, limitations and challenges associated with current virtual laboratories. This is achieved by ensuring survey questions are specific to the objectives and by selecting correct question types to allow validation rules to take effect. Surveys are developed using online cloud based survey development tools such as esurv.org. The use of online development tools enables electronic distribution, automated data collection and storage of data in one central hub. Two surveys will be developed, each targeted at different audiences. The first survey will be targeted solely at teachers whereas the second survey will be targeted at parents. Questions will differ between surveys, but they will follow a universal format. This format will consist of two stages. The first stage will look to gather information regarding the survey participant. This will include gender, location and age. The second stage will target questions to collect data in regard to current benefits, limitations and challenges associated with current virtual laboratories. Distribution will take the form of an unique URL and QR code attached to each survey. The URL of each survey can be seen on:

https://eSurv.org?u=Teachers_Survey

https://eSurv.org?u=Parents_Survey1

A data collection period of one week will be allowed for each survey.

3.2 Implementation Workshop

The use of an implementation workshop will aim to assess the benefit of virtual laboratories on student performance. This workshop will make use of the plotting and reaction times virtual laboratories within the Virtual Physical Laboratory. This

workshop will follow a format that consists of three stages. The first stage of the workshop looks to introduce the students to the plotting and reaction times topics. This includes providing a tailor made hand out which consists of an example question, four theoretical questions and four Virtual Physical Laboratory enabled questions. The second stage will involve students completing the four theoretical questions. Once these have been completed then stage three can commence. Stage 3 will involve providing the students with an overview of the Virtual Physical Laboratory. The students will then use the appropriate virtual laboratories to complete the four Virtual Physical Laboratory enabled questions. To complete this stage students will then be given time to ask questions. To ensure the implementation workshop remains fair and consistent, all questions asked are of equal difficulty.

3.3 Google Analytics

Google analytics is an analytics service that enables the tracking and reporting of website traffic. This will be used within the project to provide data in regard to several parameters surrounding the open source virtual laboratory developed within Ulster University. This virtual laboratory can be found using the link below.

http://sciencelabulsteruniversity.us-east-2.elasticbeanstalk.com/

The tracking of website traffic using Google analytics is conducted through the use of an embedded tracking code. This tracking code is provided by Google analytics and can be seen below in Figure 2.

```
<!-- Global site tag (gtag.js) - Google Analytics -->
<script async src="https://www.googletagmanager.com/gtag/j
<script>
  window.dataLayer = window.dataLayer || [];
  function gtag(){dataLayer.push(arguments);}
  gtag('js', new Date());

  gtag('config', 'UA-162805471-1');
</script>
```

Figure 2. Tracking code provided by Google Analytics

This tracking code is unique and must be inserted within each webpage of the virtual laboratory. Next reports and goals must be set up to track the various parameters required. Within Google analytics, reports are automatically generated and updated every 24 hours at midnight. However, Goals require individual set up. To assess the impact of a virtual laboratory it is important to understand how many users are completing the different virtual laboratories. The goals within this case are submission goals and these must be individually created for each laboratory. Similarly to the reports, these goals will update every 24 hours at midnight. Google analytics will be used over a period of 5 days starting on Wednesday 8th and finishing on Sunday 12th April.

4.0 Results and Discussion

This section will present the results gathered from the surveys, implementation workshop and Google analytics tracking.

4.1 Survey Results

Surveys were distributed extensively and completed by 158 respondents. These respondents consisted of 128 parents and 30 teachers. Survey respondents consisted of different genders, ages and locations to ensure the survey was reliable. In addition, all questions that aimed to satisfy the objectives have come from analysis of previous literature to ensure validity.

Table 1. Survey respondents who have or haven't heard of virtual laboratories

Have you ever heard of the term 'Virtual Laboratory'?	Respondents Answers
Yes	34
No	124

Table 1 shows the number of survey respondents who have or haven't heard of the term virtual laboratory before. This question looked to assess the current knowledge of virtual laboratories amongst parents and teachers. It can be seen from this Table that 78% of the survey respondents have never heard of the term before. This high percentage shows that there is a clear lack of knowledge surrounding virtual laboratories amongst parents and teachers. To build upon this result it is important to determine from which sources the 22% of survey respondents who had heard of the term before from where they had heard it.

Table 2 (on next page) shows the current methods of exposure currently providing information regarding virtual laboratories. It can be seen from this table that social media is providing the most exposure however this exposure is still relatively small. The lack of exposure that can be seen from all these methods could be a reason why there is a lack of current knowledge as identified within Table 1. To combat this it is important to build upon the current sources of exposure whilst also trying to identify new methods of exposure. The current lack of knowledge and exposure associated with virtual laboratories is a current challenge that needs further work to be solved. This further work should include determining all reasons as to why there is a current lack of knowledge and exposure of virtual laboratories. Reasons could include lack of governing standards surrounding the development of virtual laboratories, school funding, comparability between current virtual laboratories and teaching specifications, lack of time within the school day and insufficient training being provided to both parents and teachers.

Table 2. Sources from which respondents have heard of the term 'virtual laboratories'

If so, where have you heard this before?	Respondents Answers
Social Media	14
Television	2
Newspapers	0
Word of mouth	4
Search Engines	6
School talks	7
Friends	7
Conferences	4
Skipped Questions	114

4.2 Implementation Workshop

The implementation workshop was conducted with a group of 25 mixed ability students within St Colmcilles Claudy. The results displayed below in tables 3 and 4 show the marks students have achieved within the handouts provided. To assess the benefit that virtual laboratories has on student performances comparisons will be made in reference to the percentage of students who have achieved full marks with and without the use of the virtual laboratories. This comparison will be made across both the plotting and reaction times handouts.

Table 3 (next page) displays the results achieved by students within the plotting handout. It can be seen from these results that there is a 24% increase in students achieving full marks through the use of a virtual laboratory.

Table 3. Results from the plotting handout used within St Colmcilles Claudy

Number of correct answers	Without use of Virtual physical laboratory	With Virtual physical laboratory
4	14	20
3	4	3
2	5	2
1	2	0
0	0	0

Table 4. Results from the reaction times handout used within St Colmcilles Claudy

Number of correct answers	Without use of Virtual physical laboratory	With Virtual physical laboratory
4	11	22
3	8	3
2	3	0
1	3	0
0	0	0

Table 4 displays the results achieved by students within the reaction times handout. From these results it can be seen that there is a 44% increase in students achieving full marks through the use of a virtual laboratory. Across both topics it can be determined that students were on average 34% more likely to achieve full marks across both topics. These results prove that the use of virtual laboratories have a positive impact on student performance. Benefits with virtual laboratories extend beyond academic performance. The first of these benefits include multi user access. This benefit evolves around the ability for multiple students to access the same equipment at the one time. Next, System configuration is extremely flexible and easily reconfigured. This involves the changing of parameters which often cannot be done with physical equipment. The third benefit is the ability to see unseen phenomena that is present within many STEM experiments. Unseen

phenomena are undetectable to the human eye however it can be picked up by the virtual laboratories. This helps with student understanding as they can visually see all aspects of an experiment. The last benefit is cost savings. Virtual laboratories allow educational institutions to conduct experiments with high quality equipment. These types of experiments are usually not feasible for educational institutions who are under budget restraints. It can be said that virtual laboratories have a variety of benefits in addition to student performance [13].

4.3 Google analytics

Google analytics was used to provide results in regard to users, users locations, completed laboratories and operating systems. These results have all been taken from the open source virtual laboratory developed within Ulster University.

Table 5. Users per day visiting the open source virtual laboratory

Date	Users
Wednesday 8th April	79
Thursday 9th April	206
Friday 10th April	242
Saturday 11th April	117
Sunday 12th April	108
Total	724

Table 5 displays the number of users who have visited the virtual laboratory over the 5 day analysis period. It can be seen that a total of 724 users have entered the virtual laboratory which equates to an average of 145 users per day. An interesting point that must be noted is that each of these users would have accessed the virtual laboratory within a home environment. This can be said as the coronavirus forced the closure of educational institutions before the 5 day analysis period. The importance with this point is the ability that the virtual laboratory can be accessed online from home which is not always possible with current virtual laboratories such as Virtual Physical Laboratory. Also assumptions can be made with the results seen within Table 1. Findings with Table 1 demonstrated that 78% of survey respondents had never heard of the term virtual laboratory before. If this finding is applied to Table 5 then it would mean that 564 of the 724 users would have never heard of virtual laboratories before. This open source virtual laboratory would have helped improve the current knowledge that has been lacking in relation to virtual laboratories.

Table 6. Locations of users who have visited the open source virtual laboratory

Country of origin	Users
United Kingdom	453
United States	78
Ireland	60
Russia	24
United Arab Emirates	23
Netherlands	17
Poland	16
Germany	11
France	8
Turkey	7

Table 6 displays results in relation to the locations of the users who have used the open source virtual laboratory. This table only displays the top 10 countries in regard to total users. In total the open source virtual laboratory has been accessed within 26 countries across the globe and in each continent apart from Africa. This result shows the ability of the open source virtual laboratory to be accessed globally through its URL. This is a major benefit which makes the sharing of virtual laboratories simple and accessible for anyone with an active internet connection. It is estimated that currently 59% of the global population are active internet users [14].

Table 7 displays the number of virtual laboratories that have been completed. It can be seen from Table 7 that over the 5 day analysis period a total of 126 virtual laboratories were completed with Wave speed being the most popular. It can be said that on average 1 in 6 users are completing a virtual laboratory.

Table 7. Number of times each laboratory has been completed

Virtual Laboratory	Number of times completed
Wave speed	38
Velocities	36
Forces	26
Power	26
Total	126

Table 8. Operating systems of each user

Operating system	Users
Windows	435
Android	235
iOS	43
Macintosh	10
Linux	1

The final parameter measured using Google analytics is the operating systems used by each of the virtual laboratories users. Table 8 displays each of these operating systems. From Table 8 it can be seen that Windows is the most popular operating system. The most important point that must be noted from these results is the use of Android and iOS operating systems. These are mobile operating systems demonstrating the ability for the virtual laboratory to be accessed using both pc and mobile devices such as tablets and smartphones. This eradicates the limitation faced by some current virtual laboratories which can only be accessed through personal computers. From each of the results obtained from Google analytics it can be said that the open source virtual laboratory developed within Ulster University has been a success. This success stems from the improvement of problem areas outlined previously within this discussion. Firstly, this virtual laboratory has been accessed by a large number of users which helps improve the lack of knowledge that was outlined within Table 1. Secondly, this virtual laboratory has been

accessed within a variety of countries through online means which is helping improve the lack of exposure that was observed within Table 2. Thirdly, this virtual laboratory has proven that it can be accessed through both pc and mobile devices. This enables it to be utilised by users who have limited access to technological devices.

5.0 Conclusion

This paper presents data collected through three different techniques which include surveys, implementation workshops and Google analytic tracking. These techniques aimed to satisfy the two objectives listed within the introduction of this paper. Results obtained from the survey data has outlined two main challenges currently faced by virtual laboratories. These challenges are the lack of knowledge and exposure associated with current virtual laboratories. This section also presents reasons as to why virtual laboratories are currently facing these challenges. These reasons include factors which cannot be controlled by virtual laboratory developers such as school funding.

It is imperative that developers collaborate with the relevant authorities to combat these factors. It is also important that future work is conducted to try increase knowledge and exposure of current and future virtual laboratories. Results obtained from the implementation workshop demonstrated the ability virtual laboratories have of improving student performance across two topics. This section also outlined benefits that aren't associated around academic performance. This shows the multiple benefits in different areas that are associated with virtual laboratories. Results obtained from Google analytics reported on the open source virtual laboratory developed within Ulster University.

These results helped demonstrate the success that this laboratory had on improving upon the problem areas outlined within the results which included challenges and benefits. Results regarding the number of users, locations and completed laboratories have shown its ability to improve upon the lack of knowledge and exposure that is currently associated with virtual laboratories. Whereas results regarding each users operating system have shown the ability to access the virtual laboratory through various means such as tablet, personal computer or mobile devices. This improves upon the limitation spoken about previously which mentioned how some current virtual laboratories can only be accessed through a personal computer only. The analysis conducted within this project has provided a foundation which indicates where future work would be beneficial.

This work will focus around continuously improving upon the challenges and limitations mentioned by furthering the techniques used within the methodology. In conclusion, the work presented within this report has satisfied its initial objectives to therefore help improve current literature surrounding virtual laboratories.

Table 9. Brief summary of benefits and challenges

Benefits	Challenges
Improvement in student performance.	Lack of knowledge associated with virtual laboratories amongst parents and teachers.
Virtual laboratories allow multi user access. This type of access is not available within practical laboratories.	Lack of exposure of virtual laboratories through common means such as social networking, search engines and conferences.
System configuration is flexible.	
Unseen phenomena are detectable to the user.	
Costs savings in comparison to practical laboratories.	

6.0 Acknowledgement

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An Educational Augmented Reality Application for Improving Knowledge Acquisition

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Abstract

Advances in Information and Communication Technology (ICT) and the digitalisation of everyday life have drastically influenced the way 21st century students access information and knowledge. As students are significantly affected by the digital era, they are constantly handling digital information, they seek to be directly connected, they require prompt responses and social interaction and they prefer learning based on experiences. Therefore, students are pursuing more interesting, entertaining, motivating and engaging learning experiences. Consequently, new educational needs and requirements have arisen. Augmented reality is a contemporary and real-time interactive technology which can be used in educational settings to cope with these new needs and meet these new requirements. More specifically, augmented reality offers new ways of interacting with both the physical and digital world in real time by providing prompt access to rapidly flowing information which becomes meaningful and ‘‘alive’’ as it is embedded in the appropriate spatial and time framework. Particularly, this study briefly goes over 21st century students’ new needs and requirements for more interactive and engaging learning experiences and presents the augmented reality technology. Additionally, it examines the effects of augmented reality when used in educational settings.

Moreover, the main aims and the concept of our prototype educational augmented reality application as well as the potentials it offers to students are described. Finally, after going over the concept and the features of the augmented reality application as well as the educational needs and challenges that it aims to meet, conclusions and suggestions for future research and studies are given.

Keywords: Augmented reality, Educational technology, Virtual learning environments, Computer mediated learning, Human computer interaction, Education.

1.0 Introduction

It is beyond any doubt that Information and Communication Technology (ICT) advances and life digitalisation in the 21st century have brought about many changes to the way modern students have access to information and knowledge by providing them diverse contemporary and unconventional means and learning methods compared to previous generations.

Modern students grow up with ICT and as a result, they are more accustomed to digital media and multi-tasking. Moreover, they handle digital information daily and have prompt access to a wide variety of rapidly flowing, constantly increasing and dynamically changing digital information from various sources [1, 2, 3]. Hence, their learning is influenced by the digital era and is attained in the background during daily occurrences [4]. More specifically, as students mature and form their personalities in flexible communities, they request prompt responses, seek to be directly connected, require social interaction, opt for experience-based learning, require direct and continuous interactions with digital content, prefer inductive reasoning and have excellent visual literacy skills [5, 6, 7]. It is apparent and understandable that modern students become disengaged, uninterested in and less willing to follow conventional educational systems and approaches, as their way of thinking, their perception of efficient learning, as well as their educational needs and requirements have drastically changed [8].

The causal connection between society and education has created new social perceptions which lead to the need for redefining educational processes with a view to further enhancing students' cognitive and social-emotional skills and promoting their wellbeing. In this context, learning will be more multi-disciplinary, flexible, engaging and interactive and it will be promoted through experiential and participatory teaching methods [8]. In addition, learning will be student-centred and will respond to modern learning requirements, contemporary global market demands and the need for lifelong learning.

Augmented reality is an innovative and rapidly growing technology which is all the more applied in the field of education providing significant pedagogical benefits [9]. This interactive technology combines the real environment with digital information, creating, thus, new learning experiences, new methods of knowledge acquisition and generalisation through an active and interrelated learning process. Augmented reality attempts to change the way we see, comprehend, learn and interact with both the physical and digital world. When applied in education in a student-centred manner, augmented reality can create interactive learning environments, engaging experiences, as well as collaborative learning activities. Additionally, it is a powerful educational tool which satisfies and fulfils students' new needs and requirements, provides novel teaching and learning methods and aims at enhancing the overall educational process.

In this study, we briefly go over students' new needs and requirements for more interactive and engaging learning experiences and we analyse the augmented reality technology (Section 2). We examine the effects of augmented reality when it is used in educational settings (Section 3). Furthermore, we describe the main aims and the concept of our prototype educational augmented reality application, as well as the potentials it offers to students (Section 4). Finally, after discussing the concept and the features of our application as well as the educational needs and challenges that it aims to meet (Section 5), conclusions and suggestions for future research and studies are given (Section 6).

2.0 Augmented Reality

The term augmented reality refers to technological applications of computer units which enrich and reform users' physical environment by incorporating virtual content and digital data (e.g. information, images, sounds, videos, interactive objects etc.) in the real world, as users perceive it through their senses, creating, thus, a Mixed Reality (MR) in which both physical and virtual objects co-exist and are presented together in a unified depiction [10, 11, 12, 13, 14]. Augmented reality consists of a set of technologies and devices which enhance the way users perceive the real world by reinforcing the physical world with digital information and bridging the gap between real and virtual environments, thus allowing users to move in a hybrid environment without constraints [15].

The definition of this innovative technology varies and given the rapid development of technologies and technological systems which augmented reality applications exploit, it would be inappropriate to limit the definition to specific technologies [16]. Moreover, the term augmented reality should not be defined restrictedly but broadly as it could be applied to any technology that dynamically blends real and virtual information in a meaningful way [16, 17]. Nonetheless, a commonly accepted definition was provided by Azuma [18] in which he described augmented reality as a real-time interactive technology which combines real with virtual objects and incorporates them in the real world and enables users to see and

interact with digitally generated objects which are projected into the physical environment. Moreover, in a subsequent study, Azuma et al. [19] defined the potential of interaction between and among users, real and virtual objects and the combination and harmonisation of real and virtual objects within the physical environment in real time as the main features of augmented reality. These characteristics allow spatial and time information correlation and display it within the physical world as a three dimensional overlay in real time.

All in all, augmented reality is considered a modern and rapidly developing technology whose novel applications are increasingly implemented in various application domains and in everyday life. Augmented reality offers users new ways to interact with both physical and digital environments in real time, as well as smart solutions to facilitate everyday life and daily tasks. Additionally, it defines new ways for users to communicate and get informed by providing them with virtual information and content regarding the direct and indirect environment that they are not able to detect promptly through their senses [20]. More specifically, information becomes meaningful and "alive" through augmented reality as it is embedded in the appropriate spatial and time framework.

3.0 Augmented Reality in Education

When rapid technological advances are combined with pedagogical principles, a wide range of changes in education is brought about and new opportunities for quality teaching and learning experiences are created.

Augmented reality, when applied in education, contributes to more effective learning as it transforms the conventional model of learning and offers new opportunities for the creation of engaging, collaborative and interactive learning environments rendering learning more realistic, authentic, interesting and entertaining. Hence, it helps develop immersive interfaces and learning experiences which foster situated learning which is a powerful pedagogical approach [21]. Moreover, according to Dunleavy and Dede [22], augmented reality is a cognitive tool and a pedagogical approach which is fully "*aligned with situated and constructivist learning theory and facilitates participatory and metacognitive learning processes*".

Augmented reality aims at forming multimodal learning environments which promote active interaction with the subject, create motivating and engaging experiences, support empirical learning through actions and facilitate effective approach of visualising and interacting with abstract concepts in a multi-sensory manner [23, 24, 25, 26, 27, 28]. Furthermore, educational augmented reality applications provide personalised and ubiquitous learning while simultaneously reinforce and promote collaborative and student-centred learning [29].

4.0 Augmented Reality Educational Application

Our prototype educational augmented reality application was designed with a view to improving the overall learning process, offering students interactive learning environments and providing them with useful dynamic information in a user-friendly way. More specifically, the application involved primary education pupils (aged 6 to 12) and focused on the augmentation of their educational books, hence usability, learnability, fun, interactivity, accessibility and simplicity were selected as the main attributes for its design and development.

As our educational augmented reality application focuses on pupils of young age, it was necessary for us to understand their perspectives so as to design, customise and develop the application according to their needs and requirements. Thus, we opted to utilize a co-designing approach. According to Druin [30], students' involvement in the designing process facilitates the understanding of their needs and requirements and can influence the final result in a positive and creative way. Moreover, in their study, Alhumaidan et al. [31] highlighted the positive impact that co-designing with students has on designing collaborative learning experiences when utilising augmented reality. Hence, with a view to attaining better and more conclusive end results, as well as customised and personalised learning experiences, we utilised cooperative inquiry, which is a co-design approach suitable for pupils of young age [32], and involved pupils, students, teachers, educators and developers in the overall design process.

For the development of this specific augmented reality application, Vuforia Software Development Kit (SDK), Android Studio Integrated Development Environment (IDE) and Unity Editor were utilised. Particularly, the application recognises and distinguishes each page of the book and as a result it provides customised information regarding the content of each page. It is worth noting that the application recognises the pages of the book without requiring any further fiducial markers or any teachers' or pupils' intervention. Moreover, in order for our application to be more accessible to pupils, we minimised the need for specialised equipment as well as the need for specific software requirements so that pupils can enjoy multimodal learning environments simply even by using low-end mobile phones or tablets.

Focusing on pupils of younger age and mainly aiming at enhancing their engagement and active participation, improving their understanding of the concepts and subjects being taught, as well as reinforcing the overall education process, this prototype application, as it is depicted in Figure 1, offers them the potential to:

- listen to the recorded reading of the text;
- watch educational videos regarding the context and the concepts being taught;
- interact with fully interactive three dimensional (3D) virtual objects;

- navigate to relevant and educative websites;
- view additional images and information on the specific topic.

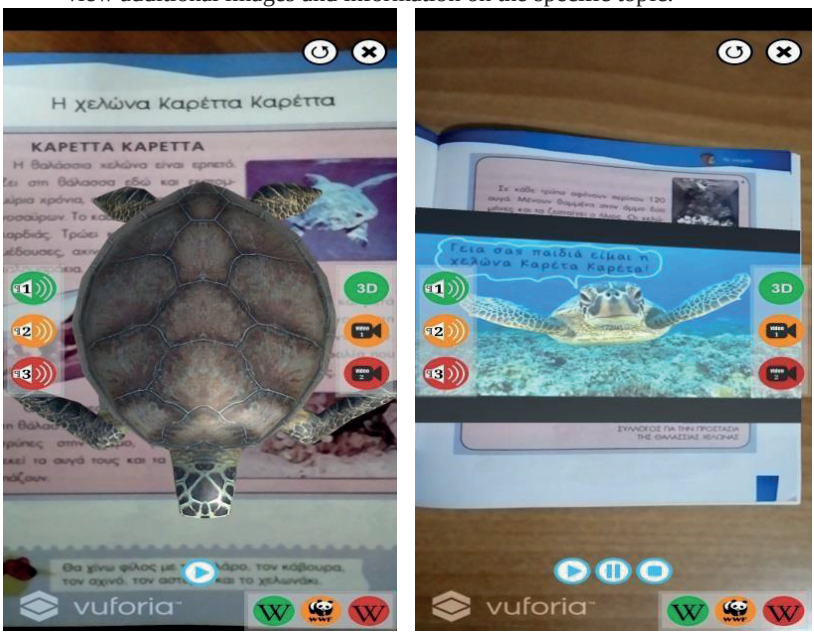

Figure 1: Educational augmented reality application.

5.0 Discussion

Due to the fact that students need to search, decode, manage and evaluate information on a daily basis, critical thinking is regarded as one of the most important soft skills of the 21st century. In that view and with the aim of making the learning experience more engaging, motivating and interactive and enhancing students' critical thinking, we developed a prototype augmented reality application which focused on first grade Greek pupils and the subject of Greek language. In order to make the application more accessible, we chose the chapter "The turtle Careta - Careta" from the book which is included in the curriculum and first grade pupils are familiar with because it was regarded to be an informative, useful and interesting topic and of high significance for our environment. Hence, we based our work on the texts and images of the existing book.

Additionally, the specific chapter is overwhelmed with information that pupils cannot visualise and comprehend without having any previous experience or knowledge of the topic. In this chapter, pupils must read out loud and comprehend the text and then answer relevant questions. During the developing process, we noticed that young pupils focused more on reading the text correctly without

making any mistakes rather than comprehend its context. Consequently, they could neither remember the information that they had just gone over nor spot the critical information.
Augmented reality facilitates the interaction between real and virtual objects and maximises students' learning experience when used in educational settings [33]. In addition, augmented reality enables students to collaborate and communicate with their peers in real-time mixed reality environments. Therefore, we focused on increasing students' engagement and motivation and improving their critical thinking, knowledge acquisition and management through our prototype augmented reality application. The application enriches the learning experience through educational videos, voice recorded text by teachers, interactive virtual objects, additional images and information on the specific topic as well as links to specific student-centred educational websites. Through the use of educational videos, pupils can familiarise themselves with the topic and better comprehend it. By listening to the recorded text readings by educators, pupils will be able to learn to read better as the reading will not be influenced and altered by external factors which happen during the teaching process. Hence, no matter how many times pupils listen to the text, the way it is read will be steady and the colour of the voice will remain the same. By interacting with virtual objects, pupils will better understand the topic as the relevant and fully interactive information will be presented to them in real time and in 3D. By following the provided links, pupils will also be able to find additional information in order to comprehend the topic better. As a result, the overall learning experience becomes more informative, engaging and interesting.

It is worth noting that the pupils who participated in the development process found the application intriguing, entertaining and imaginative. Additionally, the educators and teachers quoted that the application was easy to learn and use and that they noticed that pupils were more motivated and engaged in learning activities when using the prototype augmented reality application. All in all, the teaching and learning experience was more interactive, communicative and engrossing for both teachers and pupils.

6.0 Conclusion and Future work

With a view to enhancing students' learning experience and increasing their engagement and motivation as well as improving their knowledge acquisition we presented our prototype augmented reality application. Particularly, we briefly went over the augmented reality technology as well as its use in educational settings. Furthermore, we presented our prototype application and its use cases and we examined its main features and the educational needs and requirements that it aims to meet.

Future work will focus on improving the current application and implementing it in educational settings to evaluate its effectiveness and the way it affects the overall

learning experience. Moreover, qualitative and quantitative studies in cross-cultural settings will be carried out in order to better comprehend how pupils, students, educators, teachers and parents assess the use of augmented reality in education.

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Applying a Five Levels Framework of Lifelong Learning to e-Learning by the Wider Public

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Abstract

The paper describes the levels and methods of developing new skills during the pandemic of COVID-19, and the main challenges and advantages that occurred when trying to learn this way and identifying popular topics and to what level the learning was undertaken. The paper discusses applying five levels to e-Learning by the wider public during these difficult times, from increasing general interest to gaining qualifications and learning new skills.

Keywords: Updating-skills, e-Learning, new-skills, wellbeing, COVID-19

1.0 Introduction

The pandemic in 2020 has had a major global impact on so many people regardless of age or country, this included many schools and universities having to change from face-to-face education to e-Learning, and the changes in the lifestyle were more widespread. This current study takes into account different groups of learners

and the tools for accessing the resources for online learning. Considering the challenges, several factors are considered and responses included the different areas of study both before and during the COVID-19 pandemic lockdown. Frequency of use and the various activities for which the internet was used were also evaluated, and the perceived advantages and challenges of the new learning styles are considered.

Those employed in the medical and care sectors had dramatically increased workloads and were sometimes being asked to live for extended periods at the places of employment to minimise risks of infection. Other workers in key areas continued working but under increased difficult conditions. Many employees were encouraged or required to work from home. This created problems of lack of suitable space and constant disruptions, particularly if the home was shared with children that had to be taught from home.

In many cases a "lockdown" was in place, so the families had to remain in their homes, being allowed only to leave for essential shopping and for medical care. In the UK, many people live in flats or small houses with no or very limited gardens, so providing little opportunity for children in particular to use up their natural energy. The lockdown caused stress and mental strain for many people due to the isolation. The restrictions were lifted to allow people to leave their home for one hour per day for exercise, but this had to be close to their home.

These restrictions lasted many months resulting in the development of different lifestyles. Entertainment now had to be home based using the radio, television or the Internet or social media Apps on mobile or tablets. Meetings, both related to employment or those with friends and families, had to be undertaken remotely using systems such as Skype and Zoom, GoToWebinar, GoToMeeting and many more, which for many involved learning new skills and ways of communication. Social meetings including practices and performances by choirs and musicians were conducted remotely.

2.0 Developing Levels of Skills

During these months many staff were "laid off" by their employers, some with a percentage of their salary, such as with the English "Furlough" scheme where the reduced salary was paid partly by the Government for a limited period. Others employees were asked to take a pay cut whereas some were made redundant.

During the lockdown many started developing or expanding different interests, driven possibly by boredom or having the time to invest in new or existing interests or ambitions Some develop new skills to help their wellbeing, due to the strain of the pandemic, of isolation during the lockdown period. Others were concerned that they may have to look for different jobs, following the epidemic which led to the opportunity to enhance or develop new skills and to update their CVs, as in the Figure 1.

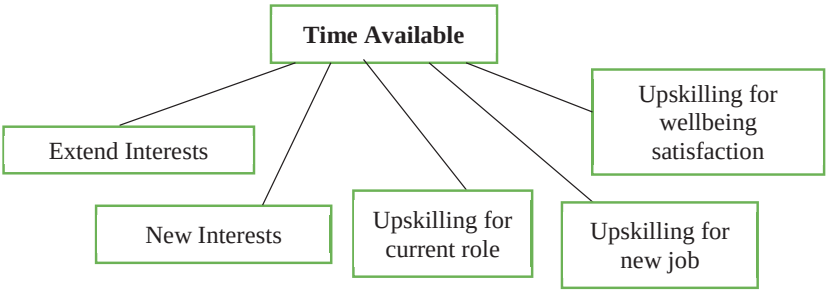

Figure 1: Utilising available time

It was felt there was a need to investigate the levels and methods of developing these new skills during the pandemic by the wider public. It was thought that learning could be considered at 5 levels similar to the five levels of Continuous Professional Development [1,2] previously developed by the authors.

These five levels of learning new skills during the pandemic could be:

- level 1- learning for general interest
- level 2 - on-line meetings of more technical basis
- level 3 - series of remote technical presentations
- level 4 - more intense training courses to improve or learn particular skills
- level 5 - courses leading to qualifications

Typical examples of these levels could be:
Level 1- learning from TV, Internet etc on topics such as cooking, sewing, drawing, appreciation of art or music

Level 2 – webinars such as ZOOM meetings arranged by the BCS Specialist Groups and Branches, usually lasting one hour, often of more technical basis, or those organised on week during the lockdown by the Bournemouth Natural History and Science Society meetings, that ranged from local history, astronomy, to ocean pollution.

Level 3 - series of remote technical presentations, examples of which being the series of related presentations, by Tom Gilb HonFBCS , each of 3 or 2 hours duration, organised by the BCS SPA (Software Practice Advancement) and the Quality Specialist Groups,

Level 4 - more intense training courses to improve particular skills such as the one to three full day training sessions by Tom Gilb HonFBCS, organised by the BCS Quality Specialist Group, and MOOCs (Massive Open On-line Courses) with no or self-assessment such as the FutureLearn [3] Agile course, Getting Started With Agile and Design Thinking of four weekly sessions of four hours, and that of the

Coursera [4] eight week course of four hours per week, both of which courses also involved additional study.

Level 5 - courses leading to qualifications, such as leading to BCS certificates, an MBA (Master of Business Administration), or music grades, whether with free courses or with payment.

3.0 Investigating Skills Achieved

Research was undertaken using both quantitative and qualitative methods. Following pilot surveys, SurveyMonkey was used for the questionnaires whereas interviews were conducted remotely via the telephone, Skype or the internet. Participants were located mainly in the UK and in Africa. Open ended questions were used to identify additional the "best" and "worst" aspects of remote learning during the lock down period.

The investigations were made to try to understand how people used the radio, television and internet to increase their skills, their previous use of the technology, the types of technology that were used such as email, Zoom etc, the main challenges and advantages that occurred trying to learn this way and what where the most popular different topics and to what level was the learning undertaken, including gaining qualifications.

3.1 Quantitative Results

There were 57 responses to the online questionnaire of which 34 came from the UK and 13 from Kenya, of which 21% were self-employed, 46% were employed and 18% unemployed, with the remainder being students. A variety of different technologies were used in the learning process by the respondents to the questionnaires (Table 1). The main change was in the decreased use of the shared desk top computers, presumably as more people worked from home.

Table 1: Equipment used to access learning

Equipment used to access learning	Prior to Lockdown %	During Lockdown %
Desktop computer, personal	96	71
Desktop computer, shared	71	43
Laptop, personal	83	86
Laptop, shared	62	62
Mobile Phone, personal	81	81
Smart Phone	90	86
Radio	67	78
Television	73	73

The responses concerning the usage of particular software during the lockdown was seen to be as expected with high usage of email and Zoom, particularly as Zoom was used widely by those working from home (Table 2), and as a limited version was made available at no cost from the start of the lockdown period. This was thought to be particularly relevant for level 2 and above.

Table 2: Frequency of use for more technical purposes
During lockdown (as a percent of returns)

Usage of software	**Never used**	**Light**	**Regularly**	**Heavy**
Email	0	9	23	68
Zoom	16	29	26	29
Skype	43	32	18	7
Microsoft Teams	31	33	18	18
Google	7	9	27	57
Facebook2	50	15	20	15
House Party	88	6	4	2
Whatsapp	12	14	36	38

The range of topics used for self-study, which was mainly at level 1 and 2, and the extent that these were used during the lockdown generated a few surprises (Table 3) The implications from much of the media was that gardening, wildlife, cooking and baking would have been most popular.

Table 3: Topics followed during lockdown (as a percent of returns)

Topic	**None**	**Occasional**	**Regularly**	**Heavy usage**
Nature and wildlife	55	25	14	6
Gardening	43	41	10	6
Cooking	29	41	30	0
Baking	57	29	12	4
Sewing	90	10	0	0
Understanding art	48	31	11	10
Drawing and painting	70	18	6	6
Craft	60	34	0	6
DIY	43	31	18	8
Singing	65	19	10	6
Music - playing / learning	20	22	34	24
Dance	58	32	6	4
Exercise	20	46	24	10
Religion and spiritual themes	43	23	23	11
News	12	12	42	34

The use of webinars during the lockdown period (Table 4) for more serious learning was felt to be more relevant to level 3 and above.

Table 4: Purpose of using the Internet
during lockdown for more serious learning (as a percent of returns)

Purpose of the software	Never used	Light	Regularly	Heavy
Used for webinars	24	31	24	21
Used for attending remote events	20	40	24	16

Figure 2 shows the indications for level 4 of those studying but not for qualifications,
where the online courses leading to certification relates to level 5

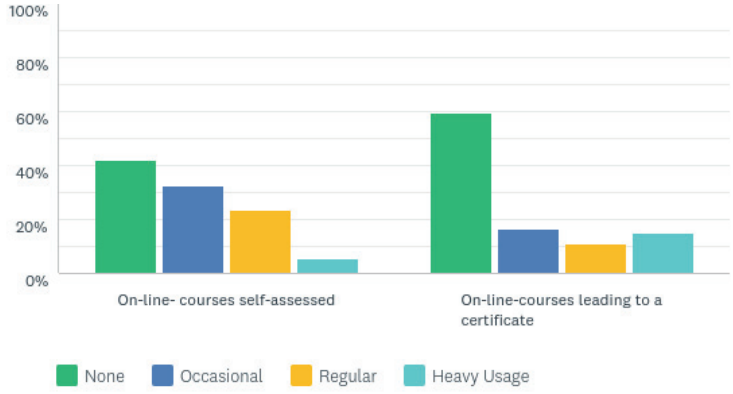

Figure 2: Courses possibly leading to qualifications

3.2 Qualitative Results

Thirty three Interviews were undertaken mainly via telephone, Skype and Zoom. Twenty of those interviewed were between the age of fifteen and sixty five from Egypt. It was found that the younger ones were particularly interested in using the internet technology to see their friends face-to-face and using social media such as WhatsApp, Instagram and Facebook, while the more mature interviewees from this group were worried about the virus and its effect on the world.

The remaining interviewees were based in the UK. There was a much larger percentage of those undertaking level 1 and level 2 learning, particularly with the use of Zoom and one interviewee followed hair and beauty sessions.

Five people undertook the Tom Gilb seminars at level 3, and two undertook art course at level 4, while one completed an MBA in Artificial Intelligence, which was at level 5.

4.0 Advantages and Challenges

There was found to be several advantages identified from both the qualitative and quantitative investigations. Many felt that they had had the time to develop new skills, new interests and sometimes new friendships. Some experienced, with this remote form of learning, that they developed an understanding of self-directed learning such as via webinars and MOOCs. The confidence in using Zoom at level 1 and running Zoom sessions at level 2, to meet face-to-face with family and friends, was often cited as an advantage, and these were expected to be utilised long after the end of the pandemic.

In addition to developing new interests and skills, some identified moving to new aims such as obtaining professional Fellowship grades or becoming Chartered. The writing of articles and of conference papers, sometimes for the first time, was made more achievable for some due to the enforced lockdown and access to the internet. These activities enabled CVs to be not only kept up-to-date but sometimes enhanced in different directions, such as acting as an unpaid remote tutor in basic computing skills for charities. These actions in turn could assist in retaining or obtaining new and possibly different employment.

The challenges of learning remotely were dependent, in part, on location. The results of the survey (Figure 3) identified as major issues suitable space and time, possibly when working from home or supervising the online education and entertainment for small children, impacted on free time.

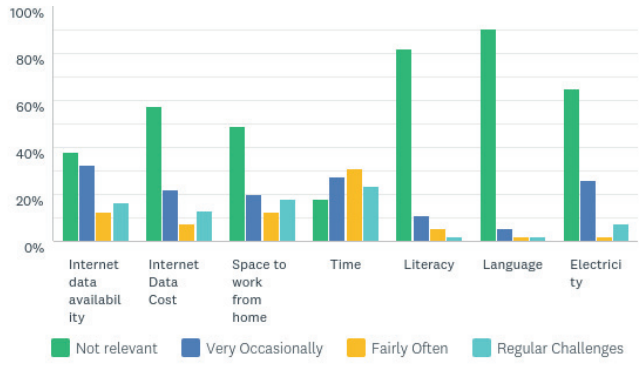

Figure 3: Main Challenges

The access and cost for online learning was identified by some elderly groups in the UK as major problems. The views obtained from many based in Africa [5] included issues of lack or loss of power, instability of the Internet, speed and expensive cost of internet access, lack of suitable software and hardware, and the lack of prior experience of e-learning by the teachers pupils and general population. Comparing the perceived best and worst aspects of the new learning styles, it is noted that while the application of these levels in the UK seems to have progressed well, a more difficult situation is reported for learners in Africa.

5.0 Improvement for e-Learning in the Future

The response to the open-ended questions on ways to improve online learning in the future reflected in a similar way as the problems experienced between those in Africa and those in the UK

5.1 Views from Africa

Direct quotes from the survey included the need for:
"faster internet access", "more reliable broadband", "online support with learning", "short webinars of less than 1-hour" , "repeat webinars where time slots are inaccessible", "recording the webinars to re-listen or if missed", "clearer brighter images", "improved screen saving", "better content coverage", "the cost including removal of VAT on ebooks", and "guidance and training on using online tools for teachers and learners".

Other longer comments included:

- "we found ourselves right at the deep end from the very start and took some time to catch up",
- "better microphone particularly as some students did not have suitable microphones",
- "what is needed (eg on zoom) is some way of having more people able to speak/ interrupt / interact at the same time or in short sequence - this is normally done by gesture/ body language when you are all in the same room"
- "devising right legislation, mastering support and Investment in and devising Innovative means of enhancing the learning for individuals and organisations in the country",
- "government support of BBC to offer education (like the old days, BBC Micro, Open University etc)",

5.2 Views from the UK

Direct quotes from the survey included included the need for:
"provision for child protection in platforms", "create a greater range of ways to engage in the learning", "affordability of Wi-Fi connectivity", "more reliable electricity", "power backup", "time management, have smaller groups for intense

courses", "reduce the cost of data", "everyone needs a decent broadband and equipment", "developing and maintaining online library resources for personal and public use, faster broadband", "interactive as well as passive content", "reliable broadband", "use of breakout rooms during webinars of over one hour", "mix live sessions with recorded", "increase awareness about online platforms", and "training on the use of platform for efficiency".

Other longer comments included:

- "a mean of telling the presenter to speed up or slow down and increase the volume",
- "one should be notified in case power is about to go",
- "recognise students at different stages in learning",
- "school curriculum adjustment to support online team project work rather than rote learning",
- "seek ways of minimising background noise during live interaction",

Also a particularly interesting comment included - "less work which would allow more time to learn".

6.0 Looking Back from the Future

The response to the open-ended question that when things are back to normal after this pandemic what would you feel that you would like to maintain from this learning experience. There was a difference in the views, not between Africa and the UK, but between the academics and the learners.

6.1 Views from the Academics

Direct quotes from the survey included included the need for:
"proper investment in material that supports online work", "continuing having dialogue online with parents so they can access the students work" (particularly relevant for schools), and "restructuring courses for online delivery".

Some comments were

- "I'll aim for blended approach to make the most of both",
- "restructuring courses for online delivery",
- "some lessons could be recorded so students can go through them when they wanted",
- "continuing giving varied assignments using the platforms we have become accustomed to" ,

6.2 Views from the Learners

Those that participated in the learning process had slightly different views
Direct quotes from the survey included included the need for:
"spending less time moving around and doing more things on line", "flexible working from home", "business travel becomes the exception rather than the normal", "family meetings with distant relations" and "self pacing".

Longer comments included

- "Use it more since I saw the advantages",
- "use of zoom is now widely spread so it will be used in the future"
- "I will continue to use online access for things like National Theatre performance",
- "stay a member of an international virtual choir",
- "there are more opportunities to learn online than I thought ",
- "I'll try and continue to set aside time for my own learning",
- "Allocate and fixed time for more online learning"

There does seem to be some very positive potential long term benefits of this enforces style of learning, at least for some people

7.0 Conclusion

The change in learning patterns for all students from primary to higher education and the production of suitable materials by the teachers and lecturers has been achieved in a remarkably limited time, that prior to the pandemic could not have been visualised.

The new skills learnt by all, in such a very short time, could be expected to be utilised at least in part in the future, particularly in maintaining connections with geographically remote friends and family and also in developing research on a more global scale. The working from home at least for many for part of the week could be seen in the future to be of benefit to both employers and employees, both financially, on transport costs and reduced office space, in addition to improved lifestyles but we should not forget about the consequences of this on the mental health and the wellbeing of people

In conclusion, the pandemic has enhanced the speed of change and brought the concept of e-learning to a wider population. Those from less affluent geographic locations, especially in rural areas, have often experienced more problems, but it is hoped that future developments of technology and the reduction of costs could address in the future this digital divide.

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Online Learning in Kenyan Public Universities: Effectiveness and Challenges

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Abstract

The COVID-19 pandemic has had an enormous global impact on the higher education sector. As a result, universities around the world have been forced to design responses swiftly. Kenyan universities have also been greatly affected by the pandemic and have moved towards online learning as face to face learning has been shut down in order to contain the spread of Coronavirus. Unlike the developed world that has increasingly embraced online learning, in Africa this is not the case. The aim of this paper is to explore the effectiveness and challenges facing online learning in Kenyan public universities. The paper answers two questions: What is the effectiveness of online learning in Kenyan public universities? What are the online learning challenges experienced in Kenyan public universities? The study adopts a desktop study design where secondary data will be obtained from various current peer reviewed Journal articles including World Bank and UNESCO reports. This paper provides recommendations that may be adopted in order to reinvigorate online learning and ensure it is successfully utilized in public universities in Kenya.

Keywords: Challenges, Effectiveness, Online learning, Public Universities

1.0 Introduction

According to a recent report [1] more than 1 billion and 575 million students in approximately 188 countries around the world have been affected by the closure of schools and universities as a result of the preventive measures taken by countries against the spread of COVID-19. Krishnakumar and Rana [2] posited that social

distancing, self-isolation and prohibition of persons from assembling in large numbers had been confirmed by researchers as the main measures to combat spread of COVID-19. Due to isolation, the use of technology has been considered the most appropriate alternative to keep educational systems functional in many parts of the world during this period. COVID-19 has provided us with the opportunity to adopt online learning as education systems need to be abreast with the rapid emergence of new technologies, thus making it a necessity in higher learning institutions in Kenya and the world over. According to Houlden and Veletsianos [3] many scholars were skeptical on whether higher education was actually prepared for the digital era in regards to learning. There have been increased stress and anxiety levels amongst teachers around the world due to the requests to shift to online learning [4]. Tamrat and Teferra [5] posited that shifting to online learning was not a simple task especially in a continent that had only 24% of the total population having access to the internet, where there's poor connectivity, unreasonably high costs and also frequent power interruptions.

Online learning/ e-learning is the learning that is facilitated and supported with the help of information and communications technology (ICT) through the internet. Unlike the developed world that has increasingly embraced e-learning, in Africa this is not the case. In Africa, e-learning adoption had been slow due to few scholars being familiar with online teaching [6]. Further, as evidenced in Ugandan higher learning institutions, absence of internet connection, technical incompetency and negative attitudes have limited e-learning adoption [7]. Kenyan scholars have identified inadequate training as well as heavy workloads as the key reasons for reading materials being uploaded to e-learning platforms rather than having actual audio visual online teaching [8]. Studies have advocated for adequate funds, policy as well as infrastructure as they are the key pillars for attainment of e-learning success [9,10].

Most public universities in Kenya have blended online learning with face to face learning and as such have lagged behind in its full implementation [11]. Public universities such as University of Nairobi, Kenyatta University, Jomo Kenyatta University of Agriculture and Technology and Moi University have online learning platforms however they are experiencing certain challenges in the use of the platform [12].

1.1 Statement of the Problem

The Coronavirus 2019 pandemic has created enormous challenges for the higher education community. UNHCR [13] estimated that 91% of students enrolled in formal education had been affected. Subsequently, higher learning institutions have been forced to shift from face to face learning to online learning to contain the spread of the virus. In Africa Online learning uptake has been slow [6]. According to Tarus [11] and Mutisya and Makokha [14], implementation of e-learning is still at the infancy stage in most Kenyan public universities due to many challenges related to implementation. Empirical studies have highlighted certain deficiencies for instance poor online teaching infrastructure, inexperienced faculty members,

resistance, information gap, financial constraints and so forth [15, 16, 14, 17, 18]. The present situation demands for urgent action by public universities to ensure continuity of student education, despite the limitations experienced. Making a transition to online learning is not only an extremely difficult exercise but also highly complex for education systems though it has become necessary [1, 19]. Thus the study intends to examine the effectiveness and challenges of administering online learning in Kenyan public universities.

2.0 Literature Review

Mayeku and Odera [16] carried out a study on policy guidelines and quality assurance challenges in Kenya public universities' distance learning and affirmed lack of funds, use of outdated facilities, lack of proper infrastructure inadequate expertise in production of these materials, poor teaching/learning practices as the main challenges cutting across the sampled universities.

A study conducted in two Kenyan public universities by Nyerere, Gravenir and Mse [18] pointed out inadequate skills, scarce electronic content, poor internet connectivity, limited accessibility to computers, students with limited computer literacy amongst students and frequent electricity blackouts as some of the reasons for why students were reluctant to enroll in online classes in Kenya. Touray, Salminen and Mursu [20] identified ICT barriers that affected developing countries such as socio-cultural, infrastructural factors, political including leadership, legal and regulatory factors.

Oyo and Kalema [21] focused on MOOCS in higher education in Africa and confirmed existence of certain challenges for instance lack of preparedness for digital Education by instructors, insufficient electronic content that's locally developed, low Internet connectivity, inadequate accessibility to computers, computer illiteracy of those joining higher education and also frequent electricity blackouts.

A study was carried out by Tarus and Gichoya [22] on preconditions required for implementing e-learning successfully in Kenyan universities. Findings indicated several critical success factors such as technological components which entail availability of computers including other e-learning devices, network connection, Internet bandwidth and also learning management system that is reliable Organizational components which comprise of e-learning policies that are relevant and operational, adequate financial allocation, stakeholder sensitization as well as training on e-learning and top management support. Lastly Pedagogical components consisted of learners being supported and motivated by their e-learning instructors; learner and teacher capacity building on e-learning pedagogy including on development of quality content.

A study conducted on barriers and opportunities affecting e-learning implementation in public universities in Iraq found that low internet bandwidth,

insufficient financial support, inadequate programs for training, lack of adequate technical support, inadequate ICT infrastructure, lack of clear policies and objectives [23] .

Sun and Chen [24] carried out a study on the effective practice of online education. The authors established that its effectiveness is anchored on availability of course content that's well designed, presence of interaction that's highly motivated between the instructors and learners, availability of well-prepared as well as fully-supported instructors; developing a sense of online learning community and rapidly embracing technological advancement.

A study was done in Kenyan public universities on their e-learning status by Makokha and Mutisya [25]. Findings indicated that e-learning was still in its infancy stage. Further the study confirmed that the universities lacked e-learning policies, e-learning was used by a few lecturers and students, just a few courses were actually offered online, most of the online uploaded modules as represented by 87% were basically lecture notes rather than being interactive and that the universities lacked ICT infrastructure and technical skills. The study recommended for universities to collaborate with private sectors so as to improve their ICT infrastructure, build their capacity and also standardize the e-learning programs within the country.

Hadullo, Oboko and Omwenga [26] carried out a study to identify the quality factors in regards to e-learning system at JKUAT in Kenya and ascertained course design, course support, social support, administrative support, course assessment, learner characteristics, instructor characteristics and institutional factors as the factors that determine e-learning systems.

3.0 Methodology

The study adopted desktop approach where secondary data was obtained from analysis and synthesis of empirical studies secured from articles in peer reviewed Journals including World Bank and UNESCO reports.

4.0 Findings and Discussion

4.1 Effectiveness of Online Learning

Studies have ascertained that online learning is effective. Shifting to remote learning has been assessed as being a good opportunity for teachers and also students to become more creative and even innovative [27]. Rudestam and Schoenholtz [28] posited that online learning could encourage developing of a more detailed and even more sophisticated understanding. Puthe [29] pointed out benefits of open and distance learning such as the ability of one to access information 24 hours, availability of upto date information, ability to learn at one's own pace, availability of customized courses and cost effectiveness.

Online learning provides enormous opportunities for assessment that can take into account numerous technologies which are not prone to the technological limitations experienced in a face-to-face environment and presentation modes [30, 31, 32, 33].

Takalani [34] postulated that e-learning encouraged learners to not only be responsible for their learning but also it built self-knowledge including self-confidence. Similar sentiments were echoed by Matuga [35] who contended that e learning enabled students to engage in planning, monitoring and even evaluating their individual behavior, cognition and also learning strategies. Thus the teacher/instructor only plays a minimal role of facilitating learning.

Other researchers have stated that e-learning succeeds since it encourages student learning subsequently leading to higher level of student engagement [36, 37, 38, 39, 40].

According to Trakru and Jha [40] use of e-learning enabled students to understand concepts, improved their problem solving including calculation skills, and also their computer operational skills. Adopting ICT usage in schools can increase the level of collaborative, active including lifelong learning, enhance students' motivation, increase information accessibility and also shared working resources, can deepen understanding and can assist students to not only think but also communicate in a creative manner [41]. It therefore fosters group interaction by the collaborations involved and self-learning.

From the foregoing it is clear that online learning enhances student creativeness and innovation, fosters deeper understanding of concepts, propels students motivation to learning thus engaging students more, encourages collaborative learning and self-learning as well. Thus universities should adopt online learning,

4.2 Challenges facing Online Learning

As deduced from the empirical literature several challenges have been noted. The challenges are discussed below:

4.2.1 Poor Lecturer Attitude and Perception

The main players who should ensure effective ICT integrated learning implementation are the professors, lecturers and also teaching assistants [42, 43, 44]. It is thus critical that they hold the right attitude as well as perceptions in regards to ICT for them to be able to effectively integrate technology in teaching. Similar sentiments have been espoused by Khan, Hasan and Clement [41] who established that teachers should have a positive attitude towards technology if want to succeed in using it in their classes. Tarus, Gichoya and Muumbo [12] confirmed that lecturers lacked interest and were less committed to adopt online learning.

4.2.2 Lack of Infrastructure

Lack of infrastructure to support online learning process is a challenge. Studies have confirmed lack of infrastructure as a serious challenge [23, 45, 11, 12, 14]. Infrastructure which entails computers, network, internet connectivity and also computer labs have been found to be inadequate thus not being able to support high student numbers who intend to access online learning in public universities. However there's consensus that in the past few years majority of the public universities have made considerable progress to strengthen their ICT including online-learning infrastructure [12]. Berhanu [46] posited that e-learning developments were threatened by introducing it without acknowledging the shift in paradigm, laying the needed ICT infrastructure as well as having the efficient support mechanism.

4.2.3 Poor Student Attitude and Perception

Students are expected to have the right attitude and perceive online learning positively for it to be effective. If students view online learning negatively then they may be reluctant to adopt it [14]. Students' perceptions as well aspirations need to be taken into consideration since it directly impacts on their learning space and also style [43, 47, 48, 49].

4.2.4 Takes more time and increases faculty workload

Several authors agreed that web-based courses require more time and effort on the part of faculty in comparison with classroom courses of comparable size, content and credit [50, 51, 53]. As faculty become more involved with online methods, the workload tends to increase as many interactions with students become one-on-one interaction. Tarus, Gichoya and Muumbo [12] were assertive that creation of e-content took a longer time, therefore impeding e-learning implementation in public universities. Other studies have also indicated that e-learning took more time for academics in comparison to traditional classroom teaching [54, 32, 56]. Mutisya and Makokha [14] contended that heavy lecturer workload and insufficient interaction time affected e- learning adoption.

Some researchers stated that academics need to continuously be present on the online discussion boards for them to control the discussions going on, provide answers and also feedback so as to ensure that the students do not detach from the course they are undertaking [56, 57, 58]. Moreover, Keengwe and Kidd [59] concurred, that online learning was more labor intensive since grading the papers and responding to questions required a lot of time.

4.2.5 Inadequate Finances

Financial constraint is a major obstacle hindering successful implementation of online learning in Kenyan Universities. Despite the fact that Kenyan public universities have made annual budgetary allocations to ensure implementation of e learning, it has been evident that the allocations are actually inadequate for

carrying out all critical e-learning activities such as staff training, maintenance, e-content development, acquiring Internet bandwidth and also e-learning infrastructure development [23, 60, 61, 12]. Universities in Kenya spent on average only 0.5% of their total recurrent expenditures on Internet bandwidth [9]. Opondo and Boit [61] were assertive that the process of developing digital learning in public universities was complex and expensive.

4.2.6. Student Inaccessibility

For online learning to be successful the students should be able to access it otherwise it would fail. Students can only engage in online learning if they have laptops, computers, android phones or even tablets. Considering COVID-19 pandemic World Bank reiterated that majority of the students would have great difficulty in accessing online learning, more so those staying in areas that have poor Internet connection and are subjected to several other challenges [19]. The student ratio of those having their own computers for every 100 students was 3:8 which was actually considered very low thus being a challenge [9]. Similarly, Mutisya and Makokha [14] observed that over 70% of the students did not have laptops due to the high cost of acquiring it thus making it difficult to access online learning.

4.2.7 Lack of Technological Skills

Engaging in online learning requires knowledge of technological skills. Studies have confirmed lack of required technical skills as an obstacle to effective online learning implementation [23, 32, 55, 60, 14, 62, 61, 21, 12]. Both online learning and online content development requires great skills hence inadequate technological skills of those involved may hamper its progress.

4.2.8 Staff readiness

For online learning to be effective lecturers should be ready. Yunus [63] asserted that there should be adequate training as well as support in ICT including pedagogy before ICT could be effectively integrated. Vrasidas [64] posited that as much as institutions may have had the necessary ICT facilities, there may be some other issues for instance inadequate time for preparation for lessons including unsupportive curriculum design. Sun and Chen [24] pointed out staff readiness as a prerequisite for effective adoption of online learning.

4.2.9 Insufficient Internet Connectivity/ Low coverage of internet

Insufficient internet connectivity is also a matter of concern. The main reason for poor internet connectivity in public universities is the high cost of bandwidth which is actually prohibitive [23, 14, 12, 62]. If internet is slow it hinders effectiveness of online learning as not much learning can go on. As such internet quality was found to be critical in influencing e- learning adoption and usage [65, 66].

4.2.10 Poor Remuneration for developing e-learning modules:

Module development is resource intensive thus requiring lecturers to be rewarded adequately for it. Most universities have paid lecturers an amount which they felt

was not proportionate to the effort required in the developing an e-module. Studies [14, 12] have cited instructors and administrators low motivation as a challenge hindering effective e learning implementation. Thus recognition through adequate remuneration may motivate instructors to effectively engage in online learning.

4.2.11 Lack of Student Preparedness

Students need to be prepared for them to effectively undertake the online courses. El-Mansour [45] reiterated that traditional undergraduates were actually not well prepared in dealing with online learning. Further regarding the students earlier educational experiences they had not been exposed to cope with the autonomy as well as responsibility involving online instruction

4.2.12 Resistance by Lecturers

Some faculty members have resisted online learning due to lack of support from the institution and lack of training on the technical skills required [67]. Persons having limited knowledge in ICT have come up with unfounded lies regarding online and blended learning [68]. Some administrations have argued and discussed on what should to be done, while others have already ventured into online learning. Studies in the education field have confirmed that resistance to change occurred highly within groups lacking interest in change were abstaining from cooperation, and wished to continue maintaining their status quo [15].

4.2.13 Lack of protection for the developed E-modules and lack of information on Copyright

A study by Mutisya and Makokha [14] found that e-materials developed by lecturers were not in any way protected thus could be used by anyone for teaching and also for publishing. Thus lecturers may not willingly develop e modules for fear of their materials being used without their permission. Additionally another challenge relates to lack of knowledge of copy right issues when using materials from the internet [45] subsequently leading to liabilities.

4.2.14 Inadequate and poor quality E-content

Inadequate e-content may hinder the effective e learning process. Tarus and Gichoya [22] contended that having quality content bolsters successful implementation of e learning. A recent study [26] confirmed that students were dissatisfied with the course structure and its organization, inadequacy of content and absence of relevant examples.

4.2.15 Lack of clear policy

Lastly, lack of clear policy on online learning is also another daunting issue. From their studies, [16, 61, 62] found that there was lack of a clear and coherent policy for ODL at the national level. Absence of a clear policy on e-learning hinders its effective implementation [23, 12].

5.0 Conclusion and contribution of the study

Online learning has become a necessity due to emergence of COVID 19. The study concludes that online learning is effective in terms of enhancing creativeness and innovativeness, its cost effective, it propels student engagement and also increases students' motivation. However the study also highlights some challenges that may be experienced such as poor lecturer and student attitude and perceptions, inadequate finances, increased workload, poor infrastructure, insufficient internet connectivity, inadequate technical skills amongst many others. If public universities want to succeed in online learning they need to consider its effectiveness and challenges. The benefits of online learning greatly outweighs its challenges hence deliberations need to be made in order to reinvigorate online learning in public universities in the wake of COVID 19 pandemic. This study contributes to the body of knowledge by providing useful insights on the effectiveness and challenges facing online learning in public universities. The findings may be used to not only improve educational initiatives by policy makers but also to assist public universities to improve their online learning programmes.

6.0 Recommendations

It is vital for public universities to understand the challenges facing online learning if they wish to obtain a successful online learning outcome. E-learning solutions should be consistent with a country's human factors and contextual factors [69]. Thus the study makes the following recommendations:

- Lecturers and students should embrace use of technology as well as technological gadgets to accelerate learning more so during these exceptional times. Public universities should engage in developing a comprehensive plan and also have a follow-up scheme so as to ensure that both academics and students are making good use of the digital platforms.

- There is need to empower the technical users such as the system administrators, programmers web designers and database administrators.

- A well thought out and thorough training on online learning skills should be conducted for both lecturers and students since it is imperative in order to achieve a remarkable implementation of online learning. The training should be practical and not just an overview resulting to lecturers and students being able to confidently use the systems put in place. Lecturers should be trained on curricula development, content development, modes of interacting with students and assessment of assignments and exams. Crawford-Ferre and Weist [32| underscores the importance of online faculty having professional development and adequate professional training relating to online design and also instructions.

- Public universities should have the basic infrastructure for online learning to be effective. Large infrastructural investment is required if ICT is to

succeed [70]. Moreover, there should be a reliable network infrastructure that can handle several users at the same time without interruptions.

- Devising new ways to support and motivate the teaching staff for developing e-content for instance by giving additional credit points to staff while being promoted, monetary incentives and other non-monetary incentives.

- Public universities can also lay emphasis on the use of online learning tools which are compatible with several devices such as tablets, laptops including smartphones as they are largely available to students.

- Formulation of suitable and operational online learning policies to direct Kenyan public universities towards attaining effective implementation of online learning.

- Lecturers should review their courses constantly to ascertain that content is updated and relevant. Quality course content that's suitable to learners knowledge and abilities should be developed by instructors in order to bolster learners satisfaction [71]. Rich and relevant e content should continuously be incorporated in online learning courses as this may accentuate academic self-efficacy.

- Public universities should engage in collaborations as well as partnerships with other well accomplished online learning partners so as to acquire the best practices in the spheres of e-content and infrastructure development including workshops on online learning. This may bolster online learning implementation and reduce resource duplication.

- Making it mandatory for every student to possess a laptop when joining the university. Universities could partner with some of the leading computer manufacturers and actually negotiate for less costly ways of acquiring laptops and computers by its students.

- The government as well as universities should make online learning a priority and avail more funds for development purposes such as ICT infrastructure improvement, training and research.

- Lecturers and students should be encouraged to have a positive attitude towards online learning so that they may wholly embrace it as the new normal especially during these tough times of the COVID 19 pandemic. Jung (2017) noted that both intrinsic and extrinsic learner motivation were necessary to enhance learners' success in online learning.

- Public universities should create autonomous online learning centers that have flexible management, skilled personnel and flexible delivery systems

that have the capability to respond promptly to unavoidable educational ICT innovations.

- Public universities should actively enhance awareness on the benefits of online learning to both students and lecturers so as to reduce resistance.

- In order to avoid infringing copyright laws, teaching staff should be enlightened on the copyright laws. This may save them from liabilities that may arise.

- Finally, public universities should build on collaborative networks in order to solve the challenges facing online learning. The networks may include policy makers, online learning sponsors, educators and telecommunication network service providers. Public universities may enter agreements with telecommunication network service providers so that they may provide bandwidth for free or at a cheaper rate.

These highlighted recommendations if taken into account would allow public universities to create not only an interactive but also an enjoyable learning experience for both lecturers and students in the midst COVID-19 pandemic.

7.0 Suggestions for Future Research

The study only utilized desktop approach and as such it provides a solid platform for further in-depth research regarding the subject matter. Future studies on the subject matter should utilize quantitative approach. A comparative study may be conducted to compare effectiveness and challenges facing online learning in private and public universities in Kenya and the world over.

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eLearning in Kenya during Lockdown:

Case Study Comparing District, National and Private School Experience

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Abstract

The corona virus pandemic has had a massive impact on education in Kenya particularly in rural and low-income schools which generally experience greater disadvantages. Over forty percent of Kenyans live in absolute poverty and a sizeable portion of the population are at risk of entering this category [1]. The COVID19 pandemic will push this at-risk segment of the population into poverty as well as increase the levels of poverty of those already within this the bracket. This case study's outlook considers the existing inequalities within the country. It exposes challenges and solutions that are present in sections the country, but remain inaccessible to groups mainly due to marginalisation and lack of institutional structures to equitably disseminate learning opportunities. In a sense, the solutions would have to consider the needs beyond mere resources[2]. To truly support eLearning, realistic assessments of communities and individual deprivations and circumstances need to be considered.

As a response to the pandemic and school shutdown, the ministry of education rolled out eLearning content on platforms through the Kenya Institute for Curriculum Development (KICD)[3]. These include radio, TV and online lessons. They also produced digital content in DVDs and CDs for commercial purposes. Due to the levels of poverty, only a very small percentage of students can

access these eLessons. Lack of access to electricity and technology is common in most homes. Even when the technology is present, the cost of internet data is prohibitive [4, 5, 6]. Other pressing needs including food, water and healthcare often take precedence in these circumstances. Security of electronics and self is also lacking in deprived neighbourhoods.

The cases below outline how these inequalities and deprivations impact various schools. The study concludes with suggestions for solutions based on these experiences.

Keywords: eLearning, Inequality, Poverty, COVID19, education policy

1.0 Public District School Kenya

Kapkoi Central Girls is situated in rural western Kenya. It's a public district school for girls. It operates as both a day and boarding school. The majority of the students come from very humble backgrounds and can hardly afford two meals a day. In a community characterised by such disadvantage and poverty, nestled in a farming area, some students are forced to work as casual labourers even during term time to add to their families' income. Delayed entry into schooling for children means that most learners start school when they are older than the normal six years or below. Some start school as late as when they are 10 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 e-Learning.

Prior to lockdown, traditional methods were being used to teach including lectures, demonstrations, explanations etc. There is only one computer in the school. Interaction with ICT was minimal as there is marginal ICT integration apart from sections in maths and chemistry. The teacher uses the camera on the computer to display the experiments on to the white boards installed in all the classroom which reduces overcrowding around the demonstration. These whiteboards are a novelty among schools in the area. Leaners find these sessions exciting and stimulating. These experiences are however rare as not all the teachers especially those in other subjects neither have the capacity nor are they interested in the utilisation of eLearning. They mostly only use the computer for exam results analysis.

During lockdown, there is hardly any e-Learning taking place, a situation that is experienced by schools throughout the district. In Kapkoi Girls school, the earlier weeks had one of the teachers attempt to teach maths and business studies. Only two students responded as most learners cannot access smartphones and even when they can, data bundles are expensive. Most homes also lack access to electricity. The educational material offered for these classes was also limited to basic revision material. These needed to be simplified so as to be delivered through WhatsApp as this was necessary for the pending exams. After insisting that exams would be held 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. As soon as the ministry scraped the annual exams, the motivation to

teach and learn all but died. Other schools with students with more means exhibit only a slight deviation from this lacklustre engagement with eLearning.

2.0 Public National School Kenya

This case demonstrates the experience of students in the exam year of high school at a national level girls public school. Filomena is 18 and is to sit her final year exams later this year. eLearning during the lockdown was an attempt that happened within the first month of the lockdown. Two subject teachers, history and biology provided online classes using Zoom and Microsoft Teams. A few students attended the classes but there seemed to be no real reprimand for non-attendance. The student were thus demoralised and gave up attendance due to the general lack of quorum, continuity or assessment. There was hardly any follow up or serious impetus to engage, manage and monitor attendance. The lack of continuity especially due to connectivity issues left those making attempts to undertake eLearning experience gaps in their learning. Some felt they could not catch up and without schools monitoring, they stopped attending altogether. The teachers and the institution failed to query the lack of attendance or offer encouragement for those experiencing difficulty in understanding or accessing the eLearning platforms. Celestino is 17 years old and also in a public school. His teachers have not initiated e-Learning, though he claims some teachers from other classes have.

This trend is echoed as common for other neighbourhood student in similar schools. Parents seem to play no role or have no expectations even within these circumstances when student are under their care for the duration of the lockdown.

2.1 Public School B

A second student Emma also in a similar school has a slightly different experience as her school delivers some level of eLearning lessons. The preferred platform is Zoom where they mostly manage just over 50% attendance. Emma was in boarding school in Nairobi but after schools were shut down due to the pandemic she was forced to go back to her rural home. She comes from a low-income household where they have no access to electricity. She is forced to travel ten kilometres to a friend's house to access electricity. She is the recipient of a programme arranged by the alumni association to donate laptops and mobile phones. Without this she would otherwise have no access to eLearning.

Her father supports her by buying her bundles of data and airtime. Both her parent's schooling is basic, lacking computer literacy and therefore lack the capacity to offer significant academic support when she is at home. Among her friends, only one has access to e-Learning. Being from a national school, her village has high expectations from her and rely on her to offer support to other students laying undue burden on her time.

Together with the academic expectation she is also required to do her portion of housework putting further strain on her time and capacity. She however feels that continuity is necessary and will be and will be an advantage over the others currently loosing on learning. Teachers will repeat the lessons when schools resume which will be a recap for her.

3.0 Teacher Experience: Private school in Kenya

Clementine, a teacher in an international school shares her experiences of online teaching. She teaches art and design which is very skills based. She therefore deliberately set tasks for students to do away from computers so that they have off-screen time. Prior to lock down, she very rarely used email to communicate with students and as a rule teachers were not allowed to engage with students on social media. Now she often sends feedback to students by email and the students share images of their work in groups on WhatsApp.

Her school has operated a virtual learning platform for the past six years. This platform was mostly used to give information to students including posting curriculum overviews, resources and homework. However, many of the students rarely engaged with it, preferring she writes homework on the white boards. Before the pandemic she had no experience of teaching virtually. One morning, the staff was introduced to Microsoft Teams, the next day, teachers were at home and expected to use this platform to deliver eLearning.

There are however pros and cons in her experience of eLearning. The positives include being able to continue with the syllabus, and being able to work from home where she gets coffee more regularly. In her case, teaching continued seamlessly despite lockdown so that students did not lose learning. She finds that eLearning works well for teaching and assessment in many subjects. The negative aspects include not being able to see students as they work. Being an art teacher requires that one engages one-on-one with her students. Many fail to send images of their work, either because they didn't have the means to do so or because they simply hadn't done it. Most art assessment is done through verbal feedback and this is really difficult when one cannot see the work. Demos can be done online but it does not help her subject where she needs to see students exploring and experiencing their processes using different art materials.

In order to enhance the system, she suggests that what could be done if more time had been available to prepare for the e-learning includes better training for staff. General strategies for online teaching and in her specific case in computer graphics, animation and digital editing would enhance her capacity to teach online art and design. This experience has definitely made her appreciate the art room more. She believes there is definitely a place for online teaching and learning in many subjects depending on the situation. However, for creative skills, there is no substitute for hands on exploration. It has also made her realise how much intuition is involved in teaching. When a student is physically in front of a teacher, teachers are able to instantly tell what they are going through, their challenges and their understandings and to address these immediately. This is the 'human interaction' which is missing from online teaching. It is an intuitive capacity to instruct which is difficult to capture when online teaching but can be enhanced with time and training.

The various experiences outlined expose the inequality and deprivation experienced differently by the various portions of the population, all within one country. The fact that a segment continue to learn almost seamlessly whilst the

rest, the larger segment lack access to this will exacerbate existing inequalities. The next section summarises and offers some suggestions based on the cases.

Table 1 shows the authors' perspective on aspects of eLearning in the various school settings

Table 1: eLearning in the various school settings

IT integration for eLearning	Public District	Public National	Private School
Prior ICT experience and use teachers	No	Basic	Yes
Prior ICT experience and use students	No	basic	Yes
ICT training for eLearning	No	Basic	Basic but is experience enough
Students access equipment	Hardly	Mixed	Generally positive
Access to data	No	Mixed	Generally positive
Space and Time	None	Mixed	Generally positive
Support from parents	None	Mixed	Generally positive
Security	Mixed	Mixed	Generally Positive
Peer to peer support	None	Mixed	Generally positive
Policy support	Undersupplied	Mixed	Self-organised

4.0 Conclusion

The experience gleaned is that e-Learning is interesting, breaks monotony, allows the learners to work alone, collaborate with peers and be creative. However, this capacity is only enjoyed by the few who can afford it. Inequalities highlighted include private versus public schools, rural versus urban, higher income versus low income families exhibiting differences to access [7, 8].

Several factors emerge as the cause for low or no eLearning. The first is lack of resources among populations with high level of deprivation, a glaring reason for the lack of eLearning engagement. Livelihoods requirements take precedence over technology when basic requirements cannot be met. Deprivation is also the cause of insecurity, lack of motivation from both teachers and students. Cooperation with families is necessary to ensure entry into schooling at the right age is encouraged. This will enable interest and desire to complete ones education. The second is lack of an institutional and government led process that creates more equitable access. The government has long recognised the need for an ICT agenda for education. Indeed, one of the promises of the current government was to have every student

possess an iPad. This has not materialised. The lack of an institution led approach also means training and access is unavailable for teachers.

The third is the nationwide attitude towards learning is based on simply excelling in exams and not so much on learning to attain practical lifelong skills that last a lifetime. Exams postponement let to the altogether folding of any attempts at eLearning among local public schools. As a country this led to learning loss for a vast majority of the students [9]. The focus on exams and rote learning simply to pass exams has shown its consequences which include the lack of interest in teaching and learning not only within schools but also exhibited in parents' low expectations. This being a nationwide attitude is detrimental to learning and fails to use education as a tool to enable a diversity of skills, many of which can be used to enrich lives rather than simply focusing on passing exams.

A curriculum review as well as a more equitable, state driven approach to improve eLearning would be beneficial. Closing the inequality gap would help schools such as Kapkoi Girls get opportunities and motivation both for the students and teachers to enable them participate fully in technology use rather than experience the helplessness of being left behind.

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COVID-19: Impact on E-Learning, Capabilities for Development and Digital Citizenship in Emerging Economies

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Abstract

The global COVID-19 pandemic has had a paralysing impact and shock on all aspects of life. Education has been particularly affected. Due to lockdown and social distancing requirements, the previously tentative and seldom applied remote learning and working patterns have had to be rapidly implemented for continuity in education, work and life. Online interactions have taken such a hold that platforms such as Zoom, Microsoft Teams and Skype have seen extremely rapid increase in usage. As socio-economic challenges tend to impact poor and emerging economies more sometimes even decimating any gains on their path out of poverty, COVID-19 has had a massive impact on education, a key welfare need, and together with this digital citizenship. Digital citizenship refers to the society's use of relevant technology not only to improve their lives but its use in economic opportunities and engagement in political participation. It requires that both the opportunities and rights of all citizens are ensured at present and in the future. High poverty levels in emerging economies requires that the extent of deprivation in light of this new digitised world and what it means for capabilities expansion is interrogated. Health infrastructure is deficient and a large share of the economy are informal which means disruptions in welfare particularly food and health is a constant threat to households livelihoods.

Using emerging literature on the impact of Covid19, this paper will outline the challenges the pandemic poses on eLearning, their impact on capabilities especially education and therefore to digital citizenship. It will outline, based on findings, ICT and other relevant policy directions that would contribute to eLearning in emerging economies. Promotion of capabilities, effective use of resources such as outside learning arrangements and innovative hybrid methods emerge as areas for future exploration. This is a challenge as millions of students lack access to both technology and low-tech solutions in vital areas of their education and thus future livelihoods in a more digitised world.

Key Words: ICT policy, e-learning, capability approach, education, development

1.0 Introduction

It is impossible to escape news of COVID-19's impact on learning globally. Examples of this are the UK's exam results shambles and the United States equally shambolic quest to reopen schools. ICT and knowledge systems have been shoved into the limelight with unexpected speed [1]. In Kenya, following the national shutdown in March, schools and colleges closed disrupting over 17 million school going learners [2]. With an economy characterised by informality, high reliance on tourism which is now curtailed, a small public sector and tax revenue base, a limited fiscal space and precarious access to international and financial markets, the threat to welfare provision for marginalised sections of the population is urgent[3]. Additionally, in some cases high prevalence of in-country unrest, violent riots or civil wars and with growing inequality means that the need to address the challenges that the pandemic poses are critical [4].

Global economies have ground to a halt in this homogenous, unprecedented, exogenous pandemic causing governments to blow the dust off their Keynesian principles to try to offset the downturn[5]. The net effect will be huge debts, low potential growth and poor people becoming even poorer [6, 7]. The economic Impact is set to cause havoc globally with many countries being thrown into recession. The rising numbers of death and infections leaves the question of recovery unanswered even for developed countries claim authors like Barua [8]. In terms of economic shock, Barua adds, if the disease is rapidly contained, growths could fall at 1% but if not, which means it lasts up to or beyond 18 months, then the fall will be 4% and estimated low levels projected to persist for decades. The virus together with other existing factors expose the disadvantages that citizens suffer within and between countries calling on the digital age for engagement with digital citizenship.

Countries rescue packages for businesses and citizens survival have been designed and implemented with workers furloughed or required to work from home. In emerging economies, lockdowns were also broadly applied but with less generous incentives [5, 7]. In most cases, due to unemployment and informality of employment being the norm, there is no security or rescuing whatsoever for large swathes of the population, as is the case in Kenya [5]. The unprecedented nature of the impact of the pandemic has shocked institutions and systems. A look at the economic shock, its impact on poverty and inequalities create the backdrop that illustrates COVID-19's's effects on eLearning and consequently digital citizenship. The initial hope that warm weather will save developing countries from the ravages of the COVID-19 pandemic have not been realised as the number of infection increase globally [9]. Fragile health systems as well as the lack of testing capacity can explain the low numbers in developing countries. In Nairobi an estimated 4 million people live in urban slums which is nearly 70 % of the city's population [1]. The prevailing economic neoliberal paradigm has led to uneven growth, inequality and growing poverty calling for alternative measures, the case for the capability approach. As Austrian [9] states, for developing countries, if the virus was allowed to spread, the large populations in slum areas, coupled with poor capacity for surveillance and control, ongoing misinformation on preventative behaviours and treatment, the result would be devastating.

Kenya's Vision 2030, the strategic plan of an aspiring emerging economy has ICT development as one of its key pillars [10]. Enabling ICTs for eLearning was particularly pertinent for competitive higher education attainment in light of the

promotion of tertiary institutions into fully fledged universities in 2013[11]. To achieve this, forms of Technology-enhanced Learning (TEL) which encompass eLearning, Blended Learning, and using Massive Open Online Courses (MOOCs) are all part of this drive [11]. However, as eLearning is being pushed to address the increase in demand, dissemination challenges including the economic and infrastructural realms have affected this progress particularly in low income areas [12, 13]. There is also the generally increased vulnerability and insecurity at an individual level as low-income citizens have a higher risk of COVID-19 transmission due to lack housing, water, sanitation and food [14, 15]. Overcrowded conditions make social distancing and quarantining measures impossible. Higher population densities, informal dwellings, and when available sharing of sanitation between multiple households is common. Additionally, mostly household have multigenerational members with high levels of social mixing and exchange [2]. The residences are transient and dwellers have higher mortality rates and vulnerability to economic shocks as most dwellers are informally employed [16,17, 1, 4]. Slums have accelerated epidemics and outbreak in the past [17]. Disadvantage, marginalisation and inequality existed prior to the pandemic but is bound to exacerbate as a result of the pandemic [18]. An increase in poverty and inequality means that the prevailing informality in livelihood options has a direct negative impact on eLearning.

In the next sections, the paper introduces the capability approach (CA) as a theory through which the push towards eLearning can realise a sustainable and broad impact on education by first and foremost ensuring citizens capabilities as opportunities and functionings are enabled [19, 20]. This is followed by an overview of the challenges of eLearning in Kenya which are outlined as the shocks brought on by the pandemic on the economy, communities, families and individuals. These have a direct effect on the delivery of education as a welfare need and consequentially eLearning and digital citizenship. It concludes by illustrating what a capability approach led policy and education environment would mean for those facing disadvantages during the pandemic as well as possible policy directions.

2.0 Capability Approach

The challenges to eLearning brought on as a result of the pandemic and the potential to overcome the paralysing effects of the pandemic when analysed through Amartya Sen's capability approach (CA) reveal failings in prevailing systems and offer ideas for remedy [21, 22, 23, 24, 25]. The CA is based on the critique of traditional economics' tendency and dependency on resource or opulence based (income or commodity command) approaches or utilitarian (happiness, desire fulfilment) approaches to determining human wellbeing [20]. The term 'capabilities' according to Sen [19] refers to trained potential including skills, aptitudes and abilities that reflect real opportunities that a person has to live a life they have a reason to value [26, 27]. Capabilities are concerned with the expansion of freedom as the primary end and principle means of development. The centrality of individual agency and the primacy of participation form the key principles of the CA [28]. The CA has gained prominence especially in research and practice of human development in areas of poverty alleviation, gender equality, education and democracy[29].

The capability approach's main constitutes are functioning and capabilities. Functionings are the 'beings' and 'doings' of a person, whereas capabilities are the various combinations of functionings that a person can harness and consider necessary to live their lives [30]. Functionings are thus constitutive of well-being, referring to achievements and fulfilled expectations while capabilities are the

person's freedom to achieve well-being. The capability approach is therefore not only concerned with functioning but with overall capabilities. As Sen [19] explains, the capability approach tackles both the means and ends as opposed to other approaches whose focus is on resources. This divergence can be illustrated in the fact that other factors affect the conversion of resources into wellbeing outcomes namely their capabilities. People's generation of capabilities from goods and services is determined by conversion factors which could be personal, social or environmental characteristics [31, 32, 34, 35, 36]. The considerations of interpersonal variations between individuals are a key components that the CA has above other theories, to explicitly differentiate different spaces of inequality. What particular inequalities exist when outlined can answer the question "inequality of what?"[33]. Poverty is thus the deprivation of basic capabilities and not simply the lowness of income, which is considered to be of mere instrumental importance. Agency is also important to realise substantive individual freedom. Agency is "what a person is free to do and achieve in pursuit of whatever goals he or she regards as important" [19]. The individual is an agent and not a patient whose malady is the absence of wellbeing but one capable of realising what they consider important. Substantive freedom includes wellbeing freedom and agency freedom, the former referring to what constitutes wellbeing while that later refers to what it takes to bring about achievements that one values and attempts to develop. The centrality of agency is a key departing point for Sen's and Nussbaum's ideas of CA[19, 34, 35, 36]. Nussbaum [34, 35] developed a list of basic capabilities while Sen [19] insists that ideas of and weightings of capabilities should be defined by the individual. CA has thrived and has been applied in empirical studies [20] including in ICT and social studies. For example, Madon [37] adopts the CA to e-Governance in Kerala India but goes beyond expenditure, infrastructure, access and skills, she targets the value the ICTs have to enable individual functioning hence their benefits. Other examples include research in computer ethics through the lens of CA [37, 38] and the application of CA to examine social exclusion is brought about by ICT in society resulting in inequalities in different spaces [39] and in this authors such as Klein's choice framework as a way to operationalise CA to development. Its concepts are well suited to analyse eLearning and digital citizenship in emerging economies [31, 40]. Ideally all capabilities should be developed concurrently based on agency freedom.

Applying this to eLearning in Kenya, requires that remedial ideas are not simply resource or utility based but include what the individual considers to be important as well as offers opportunities for capability expansion. As capabilities are mutually exclusive, for example Sen's[19] instrumental capabilities, it means that all the capabilities ideally should be developed concurrently. The focus on the economy cannot be promoted at the expense of democracy or security as is the case in development discourse, for instance, as both affect overall capabilities and functionings. With Nussbaum's list[34], some direction of minimum levels of wellbeing below which life is unbearable can be mapped out through effective policy making.

3.0 eLearning in Kenya

The Kenyan government ministry of education's ICT and education's policies when challenges by the pandemic has failed to ensure learning continuity [2]. When the schools closed in March 2020, the government presented an optimistic stance stating how prepared schools were for the transition to online learning which was not the case [41]. Remote learning is a countrywide challenge but marginalised groups are yet again destined to further marginalisation if they lose the capacity to be educated whilst their better-off counterparts continue learning,

therefore widening the inequality gap and the digital divide broadly [42] as well as the gender digital divide [43]. Overall, parents are dissatisfied with the quality and level of eLearning as the implementation of eLearning for the public schools that attempted to engage was rapid and fraught with 'learning on the job' lacking in prior training, engagement and commitment [41]. In July 2020, Kenya made an about-turn and declared that apart from universities, all schools and tertiary institutions will remain closed until 2021. This means learning loss of two-thirds of a year for the whole country [44]. Nearly 18 million school going students as well as several million university students are out of learning at even the suboptimal levels they had accessed prior to the pandemic [1]. A typology to evaluate challenges include four categories that conceptualise the "TIPEC" framework, Technology (T), Individual (I), Pedagogy (P), and Enabling Conditions (EC). This highlights the key concepts hindering e-learning implementation and delivery by depicting a broadened overview of the Kenyan case [45, 46]. The next section is an overview of factors which impact eLearning. These include transitionary examinations, content development, informality of livelihoods, prevalence of boarding school systems and how this affects housing, nutrition, gender disparity and the general poverty and inequality.

Examinations play a critical role in the annual education cycle in Kenya. The transition from primary to secondary and school or secondary school to university is based on examination which explains the ministry for education was reluctant to postpone the exams [47]. But when the extent of the unpreparedness and lack of broad institutional infrastructure to equitably deliver online learning emerged, exams were postponed. This was a necessary step given the circumstances but due to the countries education structure that bases all succession on grades, schools and students had no incentive whatsoever to pursue any learning[47]. Kenyan public education system can be accused of promoting mere schooling as opposed to learning which contributes to learning poverty [9]. Learning poverty is the percentage of over 10-year-olds lacking literacy skill which given the current trajectory can be 50% by 2030. There needs to be investment in the capacity of all students and not simply focus on curriculum syllabus delivery to reduce learning poverty. The push for eLearning is necessary as Kenya is signed up to realising key Sustainable Development Goals SDGs [49, 50]. Investing in learning as opposed to mere schooling requires that skills taught are useful in the global market to develop appropriate human capital says Huma Waheed, the World Bank's senior education specialist [48] and would require appropriate, accessible and effective content.

Among the key issues is the challenge to create effective content and to make it accessible [51]. Previously, radio learning had been created to supplement normal teaching as complementary to taught content which means limitations in scope and content was not a key concern[51]. The ministry of education has implied that schools have moved to online learning citing TV, radio, ed-tech apps, mobile phones and computers as options for learning [44]. The underlying assumption is that there is access to some or all of these modes which is not the case for a vast majority of the population[44]. It therefore means that the ministry of education electronic and digital lessons called 'out of class learning' offer no learning to large swathes of students. These designed programmes are now being implemented by Kenya Institute of Curriculum Development(KICD) on radio, computer and smartphone but are not well advertised besides which learning is mostly halted with the shutting of institutions [44]. Conscious that millions of students are excluded from virtual learning, a low-tech strategy was sought[1, 41]. Low income and informality are factors which contribute to the lack of traction when it comes to capacity to access content.

Informality of employment is common with over 70% of the population engaged in the informal sector [52]. Informality means at times business operate in the shadows which mean they can escape taxes but on the other hand it means that they forsake security for income and benefits. Firms are small, owners are less educated, employees less well-trained creating barriers towards formality [17]. Characterised by a hand to mouth system, COVID-19 has nudged some businesses into closure [8]. This means that large swathes of the population are in precarious livelihood situations where increasingly they are forced to take risks to make ends meet.

Job retention schemes, unemployment benefits and business loans are not applicable or widespread in developing countries [8]. The large share of informal workers and those in small and medium enterprises SMES means that a large share of jobs cannot be done from home [53, 54, 55]. Gottleib et al., [53] argue that incapacity to work from home in developing countries due to social distancing policies affects the share of employment of what can be done at home. This disadvantage determines economic outcomes during and after the pandemic[53]. The share of jobs which can be done from home relate directly to a countries income [52, 54]. In urban centres, the value is 20% in poor countries and 40% in more affluent areas. Educational attainment, formality of employment and household wealth determine whether or not one works from home and exposes the vulnerabilities of various working groups [54]. Resulting reduced livelihoods options and poverty have a direct impact on resources for eLearning, lack of capacity to support eLearning as working from home is not an option.

As is the case elsewhere, it is implied that learners are being supervised by parents and guardians but amidst extreme poverty and lack of recourses, this supervision is applicable to only 20% of the learning population whose parents are able to work from home [53]. For the vast majority whose parents and guardians cannot work for home the layers of disadvantage begin to establish themselves quite brutally [51]. Additionally, parents as informal workers are ill equipped to assist with eLearning as they mostly have lower literacy levels, it follows that both the e-Platforms and content are unfamiliar to them thus the skills to disseminate information are solely the forte of the teacher [52]. In more marginalised areas such as among the nomadic tribes and deprived rural and urban areas, both children and parents have given up on educational together. Having structures previously relied on such as boarding schools and teachers to oversee learning, most low income household are in perpetual holiday mode complete with games, household chores and farming, and oblivious to the implications of learning loss [41].

Kenyans prefer to take their children to boarding schools where they are assured of security, health and freedom from hunger [47, 56]. With the schools shutdown, the students are back in their homes, where in low income areas they lack resources, live in cramped households, face hunger and nutrition deficiency, increased gender disparity, and general disadvantages due to poverty and lack of sufficient welfare provision. Housing among the more disadvantaged is characterised by overcrowding and single room facilities. Space in the household is either shared or non-existent.

Nutrition as a consequence of school closures is critical especially for students who rely on school feeding programmes as the main source of nutrition [57]. The growing cost of living and the pandemic had the potential to challenge existing livelihoods but school closures have increased household burdens. The need for food takes precedence over others such as online learning [14]. Poverty and lack of technological resources means most families cannot afford technology, both hardware and software. They sometimes do not have access to electricity and even if they do, frequent power blackouts are the norm [56]. The cost of data to access

online material is high as they have to rely on pay-as-you-go data bundles which ironically, item-for-item is costlier in developing countries [47]. To mitigate this disadvantage, some of the tactics used include having to share mobile smart phones between family members which is cumbersome and the parent, the ' breadwinner's' requirement takes precedence. There are also tensions with privacy and unsupervised internet access[47]. Issues such as chores, unsuitable working spaces and unruly siblings are also a distraction which students now have to deal with[58].

Gender disparities are also playing out with girl students experiencing further marginalisation and disadvantage[59]. The school closures coincidence with planting season in rural areas and has also meant that girls particularly are required to perform, together with households tasks, other duties like faming and caring for other family members to cushion the families' income [14] They are also at risk of crisis like female genital mutilation, early pregnancy, early marriage which will mean the likelihood of school dropout post COVID-19 [2, 56]

The globally inequality, the poverty gap between and within countries is growing as the neoliberal economic trend if left to guide global economy [60]. Differences exist at the very basic level we have access to toilet roll, or more seriously access to healthcare which now a lack of means life or death should one contract Covid19. This is exemplified in the social vulnerability and susceptibility to Corona Virus among black people due to racial inequality in both the UK and America [4, 61, 62]. Due to differences in developmental states, between and within countries, Kenya exhibits this unequal manifestation as only a small proportion of the population is capable of working from home and therefore embracing e-solutions, the vast majority is unable to participate [24, 2]. The politics and other factors not withstanding eLearning has been shoved into prominence globally, carrying with it all the attendant inequalities and with it the digital divide [11, 43]. In terms of the rural urban divide, 44% of the urban population have access to the internet compared to 17% in rural areas [48, 49]. Additionally, gaps in basic digital skills still limit wider usage and application of digital tools, and services creating gaps in advanced digital skills which limits business development. Reports claim that 93.4% public primary schools are now covered by the Digital Learning Programs but secondary schools are lagging in access to connectivity. The present curriculum does not offer digital skills as a stand-alone compulsory course [48]. The next section considers this limitations to delivering eLearning and how this impacts capabilities and digital citizenship.

4.0 Education and Digital Citizenship and Capabilities

Learning and technology poverty has dire repercussions the obvious one being that learning loss results, in both the short and longer term, has a negative impact on the economy [63]. Literacy as a foundational skill is not only a prerequisite for active participation in society but also the gateway to all other learning outcomes [49]. Education is not only a capability but one that also consist of intersecting constitutive and overlapping capabilities [25]. Capabilities focus on enabling functioning and agency as key to capability attainment which leads to development thus getting rid of unfreedoms ensures development. As capabilities are mutually enhancing enhanced capabilities increases capabilities elsewhere and vice versa [19]. Sen's instrumental freedoms and Nussbaum's list of Capabilities provide starting points in the establishment of capabilities [19, 34, 35].

One can have functionings but still have significant gaps in their lives and this is where the concept of capability comes in. For example, the quality and quantity of

education can either support or limit ones potential. Just as much as lacking employment opportunities even when one is educated thereby limiting agency despite education attainment is equally debilitating. It hinges on the opportunity and potential to exercise ones agency. The outlined challenges in accessing eLearning which include the narrow reliance on transitionary examinations, pedagogically deficient and inaccessible eLearning content, informality of livelihoods, prevalence of boarding school systems and how this affects housing and nutrition, gender disparity, poverty and inequality only begin to reveal gaps in capabilities. These play a role in limiting to what extent one is able to access their agency to convert opportunities into functionings and capabilities.

As capabilities are mutually enhancing, the argument is that all aspects of eLearning must be considered for students to benefit from engagement and learning fully and equally. In the new increasingly globally digitised and connected world, technological aspects that impact all of life are exponentially growing thus harnessing of this develops different levels of opportunities to ascertain ones freedom. Sen[19] integrates the securing of inter-personal and intra-personal freedoms which directly links individual agency and social arrangements an example being policies in hand that create employment opportunities for all citizens. The high percentage of informality in Kenya's employment pattern is a result of policies prescription in previous years narrow based on economic development, personal incomes and GDP. They fail to create an understanding of barriers in society that hinder personal agency and development. The capability approach is in opposition to this. Basic income for example is redistributive without recognition [20, 26]. Even with an increase in income, the cost of other resources, the cost of welfare including nutrition and health, poor housing, or lack of reliable electricity and in the case of eLearning, lack of capacity for parents of guardians to offer supervision would still contribute to learning loss.

The role parents in technology and virtual learning or other remote systems requires that parents need step up roles their roles [34]. Parents in low income areas are incapable of working from home, exhibit diminished capabilities and are unable to exercise agency where needed a situation that can be remedied through lifelong learning policies. These can be diminished if opportunities are lacking leading to what Nussbaum identifies and labels adapted preferences[35, 34]. These are situations where our subjective preferences and choices are shaped and informed or deformed by society and public policy thereby forcing agents to lower their aspirations locking them in undermined unequal situations [35]. Inequality in social and political contexts both in redistribution and recognition leads to unequal chances and unequal capacities to choose which mean limited agency for marginalised groups. Therefore, a person's relative advantage is enhanced by enabling public and policy environments as is the case with accessing citizenship in our new digital world. The role of parents in technology virtual learning or other remote systems parents need to step up roles. Parents in low income areas incapable of working from home exhibit diminished capabilities and are unable to exercise agency where needed. This is a situation that can be remedied through lifelong learning policies. These can be diminished if opportunities are lacking leading to what Nussbaum [35, 34] identifies and labels adapted preferences as situations where our subjective preferences and choices are shaped and informed or deformed by society and public policy thereby forcing agents to lower their aspirations.

In developing countries, poverty, inequality and unemployment create political and economic risks which are amplified when capabilities and freedoms are curtailed [64]. The results of this are insecurity and powerlessness which then culminates in emigration, social unrest and in some cases political upheaval[50].

These it is argued were the precondition for movements such as the Arab spring as well as behind the current migrant situations from various countries in and post conflict or simply economic migrants. In developed countries, it is estimated that less than 43% of the citizens trust their governments[48]. This has implications on regime stability and economic development. The resulting low voter turnout in these countries means democratic deficits which demand a new paradigm for more inclusive stakeholders and citizens [48, 49, 50]. Rising citizen's aspirations, mistrusts and discontent with government as well as general apathy are contemporary challenges in governing modern nations which demand that, in step with rapid innovations, governments are adaptive and competent [65]. Innovations in Information communication technologies (ICT) have had unprecedented impact on every sector of society resulting in hope for better lives globally [64]. Due to e business revolutions governments attempt similar principles to enhance efficiency and effectiveness. The focus has however leant more on the business role and information systems of government at the expense of democracy.

The argument is that governments engagement with IT should facilitate democratic processes that involves deliberation and co- production together with the sharing and delivery of better public services [65]. The need for deliberation and co-production requires agency and participation which a capabilities informed approach would enable. Scholars propose a democratic e-Governance system which includes a multidimensional evaluation model that encompasses information systems, business, public administration and democratic theory which also advocating for citizens engagement beyond mere acceptance[64]. This views citizens as active agents in governance, agency as mentioned previously is a core component of the capability approach.

5.0 Conclusion

The policies and structures that affect technology including pedagogy and enabling conditions and the individual's capacity in this paper outlined as capabilities are outlined in previous sections. How these manifest in Kenya highlight the key concepts hindering e-learning implementation and delivery [45, 46]

The capability approach is in tension with the current iteration of neoliberalism whose growth centred principles continues to reproduce poverty and inequality, therefore putting forward the need to look at alternative ways. The COVID-19 pandemic has exposed weaknesses in learning especially in emerging economies where large swathes of the population are at risk of being on the disadvantaged end of the digital divide. More than ever, the role of education as impacting all the other capabilities cannot be overemphasised. The use of Social media as well as the government use of radio, TV or SMS as the most prevalent and trusted had those with less literacy at a disadvantage. This has implications for digital citizenship exercising agency, and participating citizens need to have the capacity to engage via technological platforms when negotiating and co-creating this new terrain.

Capabilities should span a life time says Sen [19]and so should a key capability such as education. During the pandemic the complete breakdown of the education system reveals the governments lack of capacity for continued learning. Like many countries, Kenya's policy makers face challenges to restart learning. These can include innovations in learning in external spaces as well as hybrid learning systems to challenge issues such as lack of resources, overcrowding, lack teacher training and lack of motivation. The successful realisation of this vision requires appropriate policy guidelines, a minimum level of available digital infrastructure and associated human capacity as guided by the capability approach [11, 51]

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Challenges of Rapid Migration to Fully Virtual Education in the Age of the Corona Virus Pandemic: Experiences from Across the World

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[4] International Hellenic University, Greece
[5] Vaasa University, Finland
[6] Queen Mary University London, UK
[7] National Kapodistrian University, Greece
[8] University of West London, UK
[9] University College, Dublin, Ireland
[10] Limerick Institute of Technology, Ireland
[11] Alex Ekwueme Federal University, Nigeria
[12] University of Nicosia, Cyprus
[13] Aristotle University, Greece
[14] Armenian State Pedagogical University, Armenia
[15] Southampton Solent University, UK
[16] British Computer Society, UK
[17] University of Bihac, Bosnia-Herzegovina
[18] University of Copenhagen, Denmark
[19] University of Sri Jayewardenepura, Sri Lanka
[20] State Institute of Livadia and Larnaca, Cyprus
[21] University in Trnava, Slovak Republic
[22] Tsireio Gymnasium, Thekleio Gymnasium, Latsia State Inst., Cyprus
[23] IES Francisco Tomás y Valiente, Fuenmayor Spain
[24] School San Fernando, Constantina (Seville), Andalusia, Spain.
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Abstract

The social disruption caused by the sudden eruption of the Corona Virus pandemic has shaken the whole world, influencing all levels of education immensely. Notwithstanding there was a lack of preparedness for this global public health emergency which continues to affect all aspects of work and life. The problem is, naturally, multifaceted, fast evolving and complex, affecting everyone, threatening our well-being, the global economy, the environment and all societal and cultural norms and our everyday activities. In a recent UNESCO report it is noted that nearly a billion and a quarter (which is 67,7 % of the total number) of learners have been affected by the Corona Virus pandemic worldwide.

The education sector at all levels has been one of the hardest hit sectors particularly as the academic/school year was in full swing. The impact of the pandemic is widespread, representing a health hazard worldwide. Being such, it profoundly affects society as a whole, and its members that are, in particular, i) individuals (the learners, their parents, educators, support staff), ii) schools, training organisations, pedagogical institutions and education systems, iii) quickly transformed policies, methods and pedagogies to serve the newly appeared needs of the latter.

Lengthy developments of such scale usually take years of consultation, strategic planning and implementation. In addition to raising awareness across the population of the dangers of the virus transmission and instigating total lockdown, it has been necessary to develop mechanisms for continuing the delivery of education as well as demanding mechanisms for assuring the quality of the educational experience and educational results. There is often scepticism about securing quality standards in such a fast moving situation. Often in the recent past, the perception was that courses and degrees leading to an award are inferior if the course modules (and sometimes its assessment components) were wholly online.

Over the last three decades most Higher Education institutions developed both considerable infrastructure and knowhow enabling distance mode delivery schools (Primary and Secondary) had hardly any necessary infrastructure nor adequate knowhow for enabling virtual education . In addition, community education and various training providers were mainly delivered face-to-face and that had to either stop altogether or rapidly convert materials, exercises and tests for online delivery and testing. A high degree of flexibility and commitment was demanded of all involved and particularly from the educators, who

undertook to produce new educational materials in order to provide online support to pupils and students.

Apart from the delivery mode of education, which is serving for certificated programmes, it is essential to ensure that learners' needs are thoroughly and continuously addressed and are efficiently supported throughout the Coronavirus or any other future lockdown. The latter can be originated by various causes and reasons that vary in nature, such as natural or socio-economical. *Readiness, thus, in addition to preparedness,* is the primary key question and solution when it comes to quality education for any lockdown. In most countries, the compulsory primary and secondary education sectors have been facing a more difficult challenge than that faced by Higher Education. The poor or in many cases non-existent technological infrastructure and low technological expertise of the teachers, instructors and parents, make the delivery of virtual education difficult or even impossible. The latter, coupled with phenomena such as social exclusion and digital divide where thousands of households do not have adequate access to broadband Internet, Wi-Fi infrastructure and personal computers hamper the promising and strenuous virtual solutions.

The shockwaves of the sudden demands on all sectors of society and on individuals required rapid decisions and actions. We will not attempt to answer the question "Why was the world unprepared for the onslaught of the Coronavirus pandemic" but need to ascertain the level of preparedness and readiness particularly of the education sector, to effect the required rapid transition. We aimed to identify the challenges, and problems faced by the educators and their institutions. Through first-hand experiences we also identify best practices and solutions reached. Thus we constructed a questionnaire to gather our own responses but also experiences from colleagues and members of our environment, family, friends, and colleagues. This paper reports the first-hand experiences and knowledge of 33 co-authors from 27 institutions and from 13 different countries from Europe, Asia, and Africa. The communication technologies and development platforms used are identified; the challenges faced as well as solutions and best practices are reported. The findings are consolidated into the four areas explored i.e. Development Platforms, Communications Technologies, Challenges/Problems and Solutions/Best Practices. The conclusion summarises the findings into emerging themes and similarities. Reflections on the lasting impact of the effect of Coronavirus on education, limitations of study, and indications of future work complete the paper.

Keywords: virtual education, rapid conversion, COVID-19 pandemic, preparedness, readiness.

1.0 Introduction

As most higher education institutions have had experience gained in the transition from traditional (face to face) to blended and traditional or blended to virtual there are issues and challenges faced by both the institution and learners in the provision of effective support systems for online delivery. The strains between online provision, multi-site learning and keeping geographical links with the main campus has taken centre stage.

While past and recent reports indicate that most Higher Education Institutions such as those considered by Valtanen et al., 2011) [1] had considerable experience and infrastructure enabling distance mode delivery, secondary and primary schools had minimal -if any- technological infrastructure and staff knowhow to enable virtual education.

Assessment is likely the most disrupted aspect of the student experience. The push to alternative formats, replacing exams or adopting proctoring systems without proper consultations and evaluation of options was a major challenge.

In this time of the COVID-19 pandemic, learners expect an omnipresent learning experience across a range of media and digital channels using innovative modes and methodologies of learning. In order to confront these pinch-points, Higher Education Institutions must now embrace the concept of the Digital Campus and Digital Learning more than ever before through:

- Innovative delivery: using a range of learning methods and learning supports
- The ability to earn and learn by maximising the capacity for a student to engage in their digital learning environment synchronously, asynchronously, online, face to face, or via a blended array of these
- The global classroom: allowing students to interact without physical or geographic borders,
- The digital library: enabling self-directed learning through access to a limitless portal of learning resources.

While most higher education institutions had considerable experience and infrastructure enabling distance mode delivery, secondary and primary schools had minimal if any technological infrastructure and know-how to enable virtual education. In addition, community education and training was mainly delivered face-to-face and that had to either stop altogether or rapidly convert materials, exercises and tests for online delivery and testing. A high degree of agility and commitment was demanded of all involved and particularly from the educators who undertook to produce materials and provide online support to pupils and students.

Apart from the delivery of education for certificated programmes, it is necessary to ensure that learners are supported throughout the lockdown. The primary and

secondary education sectors have been facing a more difficult challenge than that faced by Higher Education. The poor or non-existent technological infrastructure and poor know-how of educators, as well as the digital divide where many households do not have adequate access to Internet and computers make the delivery of virtual education difficult or even impossible.

Delivery in the higher education sector (particularly in the northern hemisphere) seems to have been organised into two stages. The first stage was the inevitable 'dive' into online delivery. The second stage appears to focus on (a) learning from the lessons of the urgent transformation of the institutions into online education providers, (b) planning delivery for the autumn and winter of 2020/21 in uncertain circumstances in relation to the intentions of the students to return or defer. Lessons learnt from the rapid migration predictably vary across the sector but there are key areas that the universities need to focus on to succeed in future endeavours: scalability of online delivery, appropriate mix of online and blended, a 'toolbox' of technologies to support online classrooms and design of assessments to support strategic missions and not disadvantage students.

In order to be relevant and to survive, Higher Education Institutions (HEIs) must promote a flexible model of education that includes blended and online programmes. HEI's must realise the importance of the online digital campus in supporting the potential growth to reach a wider cohort of students, supporting lifelong learning and the knowledge economy. It is also important to take cognisance of the information and digital literacies of the learning community. Personal ability and capability must be supported by the technology and not vice versa.

The primary and secondary sector faced more serious problems as they needed to migrate from the face-to-face model to a virtual model in a few days when such conversions usually take months or even years.

In section 2 the research design, methodology, method and research instruments are provided. Section 3 presents the contributions from the fourteen (14) countries where the co-authors work.

Section 4 shows the identified commonalities and differences as well as the solutions reached and best practices.

Section 5 outlines the main findings of selected related published research reports (covering the period between March and April 2020 – coinciding with the period of writing this paper).

Section 6 is the conclusion which includes projections on future required actions and indications of further work.

2.0 Research Design: Methodology, Method, and Instrument

2.1 Research Methodology

Action research is also known as contextual action research, participatory research or collaborative inquiry. The co-authors who are actively involved in education are dealing with a real situation which they are required to address through co-operation and sharing experiences and knowledge. This cooperation aims to understand the problems, engage in problem solving and obtaining results in /co-learning and shared solutions [2,3,4] proposed an Action Research Model which was adapted (Figure 1) for this collaborative inquiry.

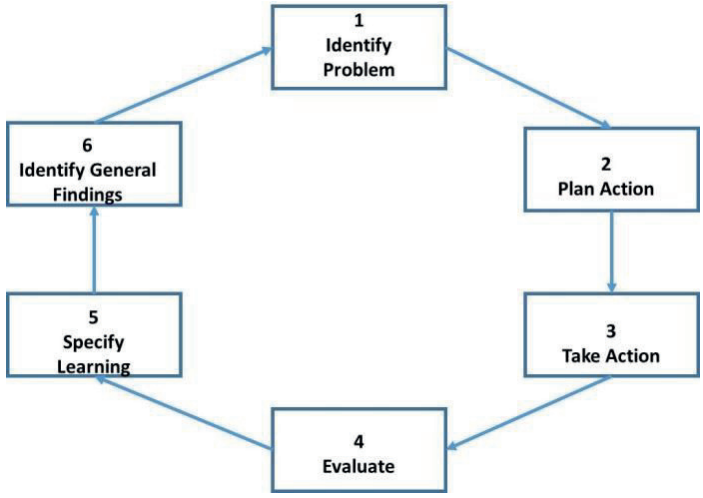

Figure 1: Action Research Model (adapted from [4]

Step 1: Identify Problem - Rapid migration to a fully virtual Model due to the eruption of the pandemic
Step 2 Plan Action -Design a questionnaire to collect responses from respondents from different countries
Step 3: Take Action- Distribute questionnaire and collect responses and additional input from team of researchers (co-authors)
Step 4: Evaluate contributions based on first-hand experience
Step 5: Specify learning achieved
Step 6: Identify general findings

2.3 Research Method and Research Instrument

It was decided to use the survey research method in order to collect information about many variables. According to Galliers (1992) [5] "*The use of surveys permits a researcher to study more variables at one time than is typically possible in laboratory or field experiments, whilst data can be collected about real world environments*."

The principles advocated by Pfleeger and Kitchenham [6] for constructing questionnaires were considered for the construction of the survey instrument. We included some closed questions which aimed to capture demographic information about the respondents themselves and their involvement in the rapid transition from the status quo to fully virtual education. Open questions aimed to provide an opportunity to respondents (in this case the authors) to share their experiences in free text format. The survey aimed to identify practices employed and first hand experiences with the view of identifying similarities and good practices for sharing among all co-authors, their respective institutions and perhaps further afield. The questionnaire aimed to gather responses regarding the five issues that King et al. [7] revealed when they reported the approach and problems encountered during the effort to convert the University of South Australia's (UniSA) distance education programmes to online delivery mode. They identified and reported on the following challenges:

- concepts and paradigms - tension in Australia between the paradigms of on-campus and off-campus (distance) delivery;
- capabilities of staff and students to use online modes of teaching and learning effectively;
- resources for online teaching and learning including access to appropriate equipment and networks, training, development and support;
- the 'objects' that needed to be available to students and staff to facilitate online authoring of, and interaction with, teaching and learning resources;
- managing the implementation and maintenance of online modes, including, for example, planning processes, changing work practices and re-skilling of staff, and changing organisational structures.

Most respondents completed the questionnaire. Some respondents were contacted and, in order to speed matters up, were prompted with the questionnaire questions over the phone by the researchers who recorded the responses.

3. Reports and Opinions from Across the World

3.1 Rationale for presentation of reports in country sequence

Contributions by the co-authors are clustered by country (alphabetically). A similar style of presentation is employed in multi-country reports such as the one

employed by Horton in 2013 [8] in the UNESCO publication *Overview of information literacy resources worldwide*.

Our paper has been co-authored by a 33 academics and/or industrial training experts, from 27 institutions, who live and work in 13different countries mainly from Europe but also from the Middle East, Asia and Africa.

The co-authors hold different positions ranging from Researchers and PhD Scholars, Teachers, Tutors, Lecturers, Senior Lecturers, Assistant Professors, Associate Professors, Professors, Heads of Department, heads of Section, Technical Support, and Librarians. Also the co-authors specialise in diverse fields namely Classics, Computing, Computer Science, Biology, Botany, Dentistry, Education, Engineering, Languages, Law, Library Science and Technical Support.

In several cases only one co-author contributed from a participating country. However, even for those countries like Greece, Cyprus and the UK where more co-authors contributed it is not necessarily possible to generalise for the whole country. The authors presented their own personal experience but they also provided information about their institutions and commented on the general climate in their sector and sometimes across sectors from each respective country. Sharing experiences from across so many countries and so many specialisms as well as levels of responsibility, provides the basis of understanding the general climate, but also forms the basis for further investigations and possibly collaborative actions. In addition, some contributions came from the primary and secondary education sectors as well as from further education, community education, special needs education and industrial training experts.

All co-authors reported their first-hand experiences (detailed in the body of the paper) during the rapid transition from the status quo at the time (traditional or hybrid model) to a fully virtual model. In addition to reporting their own experiences co-authors provided details of how their institutions and their respective governments handled the rapid transition from delivering traditional and/or hybrid education to either partially or fully virtual education. In several cases they also provided a general view of what has been taking place across their respective countries and what preparatory steps are being taken for the 2020-2021 academic session.

3.2 Armenia

Contributed by Professor Rita Gevorgyan, Armenian State Pedagogic University, Yerevan, Armenia

The crisis caused by the spread of COVID-19 pandemic has become a challenge worldwide and also for the Armenian education system. Today, the world is facing not only a health crisis but also a serious educational crisis and the situation was such that it was not possible foreducation to continue in the format previously

employed. It was necessary to solve this problem very quickly and to ensure the continuity of education with alternative approaches.

Under such circumstances the educational process at the Armenian State Pedagogical University after Kh. Abovian (ASPU), including pedagogical practice and all exams, are conducted online by the use of the Google Classroom platform.
At the ASPU the graduation examinations of the bachelor's and master's degree programmes started on May 25 and about 2,334 graduates of the full and part-time system took the examinations via distance learning using the Google Classroom platform.
ASPU started to use the Google classroom platform 4 years ago, so the existing experience made it possible to carry out the final graduation examinations effectively and easily.

The examination questionnaires for each course were posted on the official website of the university, the faculties compiled the schedule of consultations and provided them to the students. We can highlight that as the examinations were recorded with the help of the Google Meet tool, according to the graduation procedure, the exams were transparent and objective.
We would like to stress that ASPU has had sufficient resources for e-learning since 2016, on the basis of which the university has moved smoothly to distance learning during the COVID-19 pandemic.

During the previous four years the University has been periodically organising training for the academic staff to develop their skills and abilities to work in the Google Classroom platform. About 700 lecturers teaching different courses at the university took part in the training, as a result of which the teaching packages of the courses were developed and implemented, and online platforms were formed in order to organise further work with the students.

A meeting-discussion on the Google Classroom system, with the participation of the University stakeholders wasorganisedregularly. During the meetings, stakeholders highlighted the important achievements from the implementation of Google Classroom electronic platform that significantly improvethe learning conditions, assessment mechanism, and total teaching and learning process, including, lecturer-student interaction in terms of the allocation and distribution of educational materials.

Actually the discussion of May 2018 was noteworthy, during which the lecturers and students objectively revealed the non-objectivity of some indicators of the assessment system, the huge number of assignments, and conditioned by them the workload of students and academic staff. Over the next two years, in cooperation with the internal and external stakeholders, ways were found to resolve them and thus to improve the system.

Owing to the improvements of the system and developed guidelines, today the university is able to carry out even pedagogical practice (internships) online.

Considering that many challenges could arise in the process of online pedagogical practice, the work of the groups and the leading specialists were planned in detail encouraging the cooperative and creative atmosphere in the groups.

With the support of the leading specialists, the students conducted an online study of educational needs and opportunities to improve the process of online education in line with current realities. Therefore the online surveys using Google forms were conducted, and at the end of the internship by using Google Meet, the ASPU organised a practice-based defense. Finally, according to the opinion of all ASPU stakeholders, we can statethat Google Classroom promotes learning efficiency and ensures the further development of the university.

In this rapidly-changing environment, adaptability skills are essential to navigate effectively through this pandemic. Looking into the future, some of the most important skills that employers will be looking for will be digital skills deeply intertwined with digital learning. These skills need to be learned at school and University and of course updated over time.

The pandemic crisis showed what could be done with technology in the education system and at the same time highlighted those situations where only face-to-face interaction is needed. Therefore we need to better integrate technology into education and prepare specialists who will be able to take responsibility in times of crisis.

3.3 Bosnia-Herzegovina

Contributed by Dr Associate Professor Ratko Knezevic, ESL / Academic English and Professor Amela Colic, School of Law, University of Bihac

Unlike the established offline curriculum that was in use prior to the COVID pandemic situation, the University of Bihac faced the need to convert the courses from both traditional and hybrid mode to fully virtual. Previous experience of University of Bihac staff in offering distance mode courses provided by the incoming professors from the partner universities before the pandemic who delivered online lecturing in various subjects, helped facilitate an easier transformation from offline to online campus.

There were some tensions between on-campus and off-campus provision. The term “Open learning” or “Openness” were ambiguous; will the off-campus provision affect content, quality, the relationship between education and training, the relationship between teachers and taught as well as equity and access in off-campus provision?. 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. For the next academic year 2020/2021 it is necessary to provide the same online conditions for the students participating in the incoming mobility [9].
The staff had the capabilities to produce materials and use online modes of teaching. By using the online applications and processes (web-based learning, computers' supported learning, virtual classroom and platforms for online learning) we were able to continue the education process without any obstacles and emphasizing that all different fields of research were successfully covered. In certain fields (science and medicine) the practical parts of education such as laboratory works were done in face to face way.

Resources for online teaching and learning including access to appropriate equipment and networks, training, development and support were available. The objects that needed to be available to students and staff to facilitate online authoring of, and interaction with, teaching and learning resources were also made available.

The University library is a separate institution covered by the County Ministry of Education, same as the University. Due to the fact that the library staff did not have the skills and capabilities to provide the dynamic online library services required in the situation the university teaching staff had to find alternative ways of ensuring students had access to the appropriate literature and resources to support their studies.

The University of Bihac started with online education as soon as the situation became dangerous for students and staff, even before the state was locked down. University management staff made a working plan at the level of faculties and the education programmes proceeded accordingly as per the already made schedule. The students and staff were skilled and capable to deliver or acquire the content due to high level of information literacy skills acquired. Although the staff were experienced in online delivery methods due to opportunities for exchange of experience with many incoming professors' from abroad and participation in international online meetings and conferences, there was a need to switch from the offline campus to the online one entirely. Any obstacles faced while the online campus functioned were resolved accordingly. Out of 15 work weeks in the academic plan for 2019/2020 scheduled for offline delivery 14 of them were conducted through online means. In order to facilitate the students to acquire the content the academic plan was amended giving the students a week off to prepare for the exams. By respecting the restrictive instructions imposed by the authorities that led to easement of restrictive measures, the University of Bihac was allowed by the respective Ministry of Education to perform the students' examination in face to face manner.

The staff in charge of Quality assurance at the University were involved more than usual due to the fact that this year the university had to meet the requirements for its re-accreditation. The university department for students and their issues together with the Quality assurance office created a questionnaire related to evaluation of

the online campus. All students were given an opportunity to evaluate every subject and teacher individually in an anonymous way.

The students were allowed to fill up the questionnaire by the end of the last examination term in October 2020 due to the fact that they were given a two week longer period than usual to be evaluated. The whole academic calendar was adjusted to the pandemic situation challenges and as such approved during one of many e-sessions that the university Senate did. That is why the results of the questionnaire will be known at a later stage and they can form an excellent base for a further research to be done. The questionnaire is still available at the students' info service and the Quality assurance Office collects the responses that will be published at the end of the academic year 2019/2020. Due to the pandemic situation the University of Bihac created an e-presentation of the study programmes offered for graduated High schools' students which provided them with more information about each one through filling a questionnaire and each question they made was answered appropriately.

The University staff are well aware that the pandemic situation is neither predictable nor a short-term one. That is why the University management is engaged in searching for long-term solutions. Although the offline campus with interactive relations between the teachers and students is a preferable way of lecturing offering a richer education experience there is a reasonable need for maximum effort to develop the best approaches in online methods of teaching. Despite all obstacles caused by the pandemic situation there were positive impacts also such as exchange of experience and working within a multinational environment. The existing online teaching platforms were successful as a first response to the pandemic situation. However there is a need to work on their development and upgrade them in order to make the transfer of knowledge effective and curriculum acquirement efficient. That is where the international co-operation between the academicians, librarians and all other involved in the teaching process should focus.

3.4 Cyprus

3.4.1. Contributed by Dr Andreas Savva, Associate Professor, Department of Computer Science, School of Sciences and Engineering, University of Nicosia

I have been involved in converting courses from traditional or hybrid to virtual, but much more work is necessary to state that the conversion was 'full'.

The institution was already offering distance mode courses in all areas before the pandemic. There are no tensions between on-campus and off-campus provision. The staff have capabilities to produce materials and use online modes of teaching.

The institution has a large separate department for Distance Learning (DL support. The staff are trained to assist lecturers in developing DL programmes.

Resources for online teaching and learning including access to appropriate equipment and networks, training, development and support are available. All educators took a 36-hour (one semester, 3-hours a week) training offered by the DL department. Adequate 'objects' were available to students and staff to facilitate online authoring of, and interaction with, teaching and learning.

After taking the training course I converted all courses myself without any assistance from the staff even though I believe that there are still many things I need to learn. Difficulties were observed in the explanation of the material using examples traditionally solved on the board. To solve this, I have created step-by-step animations to present them (was not an easy task). Of course, problems have arisen in the invigilation of examinations and this is something for which I still do not know which the best practice is.

Online teaching is not a new mode of delivery for most (if not all) universities. Universities around the globe invested a lot in offering DL programmes. Special departments supporting DL were created and faculty members were taking intensive training on DL tools. Yet, in this quick transition due to the epidemic, academics who have never taught online, offered courses during the last semester that have not been devised in this way.

Now, the epidemic will change all that. Faculty have already begun preparing lectures to deliver online. All institutions, if they haven't done it before, will be offering training sessions to faculty members on how to use online learning platforms and other tools. Online delivery of courses will be used either as the only delivery mode or as an add-on to face-to-face teaching.

In Cyprus, the Higher Education accreditation body was until recently very strict at accrediting DL programmes. The major concern was the assessment criteria and methods and usually academic programmes were only given accreditation if the final examination was taken by the students in person in some approved examination centre.

The transition from face-to-face teaching to online delivery has a serious impact on assessments and evaluation. Due to the epidemic and following the approval of the Higher Education accreditation body, most universities have promoted flexible ways of assessment and allowed their faculty to decide on the type of assessment and evaluation they would consider most suitable to use for their courses. Although technology has been used extensively to support teaching and learning, on-line examinations especially for courses designed for face-to-face teaching, is a challenging task. Assessment and evaluation methods must change in order to fit the online mode. It is particularly difficult to monitor the students and thus ensure that they will not behave inappropriately during an online exam. It is

also possible that the performance of the students during an online exam might be affected by other external factors such as the internet speed or connection.

This epidemic has definitely changed the way in which we perceive education. Even though in the future we will still be offering courses in a face-to-face mode or online mode or even a combination, one thing is for sure: Education will not be the same again!

3.4.2. Contributed by Dr Vasso Stylianou, Assistant Professor, BSc CS Program Coordinator, Department of Computer Science, School of Sciences and Engineering, University of Nicosia.

I have personally been involved in converting courses from traditional and hybrid to fully virtual mode. The University of Nicosia has been offering distance mode courses in many different areas, both at Bachelor and Master level within all Schools, i.e. Business, Education, Humanities & Social Sciences, Law, Sciences and Engineering, for several years before the pandemic.

The faculty have capabilities to produce materials and use online modes of teaching. Such activities and the necessary skills have been promoted by the university and are supported by a number of units which operate within the university such as the Distance Learning Unit (DLU) with specially trained IT support assistants, the Pedagogical Support Unit (PSU), the e-learning Pedagogical Support Unit (ePSU) and the Technology Enhanced Learning Center (TELC).

Most resources necessary for online teaching and learning were available as several distance learning (DL) programmes were already running at the university. Some last-minute training was necessary as not everyone was involved in these DL programmes.

The university uses Moodle LMS. The delivery of online synchronous classes was done using WebEx. Lectures were also recorded enabling additional asynchronous learning. Most of the courses of the CS program were already set-up in Moodle with a plethora of material offered to the students. Thus, both the faculty and the students had access to Moodle. But since many programmes were not offered in DL mode WebEx meetings were not common practice. Overall, the material available to students through Moodle ranged from non-existing for some courses to only the basic lecture material being available for other courses, to all course activities being supported with posted material on the Moodle platform.

The new mode of operation doubled the work load of faculty. Amongst other necessary tasks, meetings had to be planned for each lecture; lecture recordings needed to be traced as these were sometimes delayed or not becoming available to students as they should be; the communication with the students was intensified and the load of emails and other messages coming from students was continuous and required immediate attention and response; the delivery of course material had

to be thought over and diversified as the whiteboard was not available for use and the delivery of practical courses had to be adapted to new mode of lecturing. Lastly, but very importantly, most assessment activities had to be re-planned. Also the way in which the students would be examined needed serious consideration. This was probably the most difficult, demanding and time-consuming task.

3.4.3 Contributed by Ms Annita Zirki, Computer Teacher, State Institute of Livadia and Larnaca, Cyprus.

I was personally involved in converting courses from traditional or hybrid to fully virtual. The institutions where I teach did not offer distance mode courses before the pandemic. I am not aware of any tensions between on-campus and off-campus provision. Many members of staff do not have the necessary knowledge and skills for teaching online.

My students are between 10 and 15 years old. The online lessons for computers at the state institutes were not compulsory. We used Zoom and Viber. I used testware software to help my students solve tests similar to the ECDL exam.

The online lessons were not as efficient as the ones in the classroom. Sometimes students pretended to be in the classroom but they were not. For the virtual learning to be successful both teachers and students must be equipped with the necessary software and hardware. They must get trained to use the online platforms.

The Ministry of Education offered online seminars, handouts and videos to the teachers showing them how to use the various platforms like Teams, Zoom. The Ministry also offered tablets to a lot of students that come from poor families. They offered free office 365 licences to students and teachers. They used the platform Microsoft teams. I personally used Zoom.

Although I produced materials and exercises many of the students did not respond on many occasions. Extra effort was necessary to involve the parents so that the students engage with this new process.

I was not involved in the managing the implementation and maintenance of online modes, including, for example, planning processes, changing work practices and reskilling of staff, and changing organisational structures carried out. There was no consultation with the teachers by the management.

3.4.4 Contributed by Ms Georgia Lambrou, English Language Teacher, Tsireio Gymnasium, Thekleio Gymnasium, Latsia State Inst., Further Studies, Cyprus

The transition from the traditional class into the virtual was so sudden, and violent in a way, that no one believed that it would work. We started with uploading work sheets for revision on the school website for several weeks, but it was practically hard to work. A lot of the students did not have access to the Internet, and since it was not obligatory to respond they ignored our attempts. What is more, a lot of teachers did not know how to use the Internet and some did not have an e-mail address. For one of the Gymnasiums (age group 12-15) I worked at, I had to upload work for all the grades though I only taught the first, because my colleague, who is now retired, could not use the Internet.

This kind of asynchronous learning was hard for both myself and the students. What I did was to upload revision material and wait for their responses via email. A small number of students responded, and I confess I was relieved because it was really hard to read their answers on the screen, take notes on a paper, and send feedback to each one of them via email.

As far as the Ministry of Education is concerned, they reacted to the crisis really fast, by providing us with the Teams platform. At first, they said that only the courses with end-year exams would be taught in Teams, and the rest should continue with the asynchronous method. The teachers acted upon this directive, and, a few weeks later, all courses were taught online.

Before the online lessons started, there had been online training sessions of at least two hours by the IT teachers, and a new time schedule had been given by the schools. The time provided for each lesson was thirty minutes. Gymnasiums had four lessons with five minute intervals from 7.45 to 10.00 a.m., and Lyceums (age group 15-18) from 10.15 a.m. to 12.30 p.m. The difference in time was convenient for families who had more than one child and only one device to access the net.
It must be noted that before the beginning of the online lessons, the Ministry was consulted by all the bodies concerned with children's rights and they asked the parents' written permission to allow their children use Teams. I, myself, was reprimanded for using Messenger with one of my afternoon classes without the parents' concession before the online lessons for the Institutes of Further Education began. However, the majority of the teachers, especially in the Lyceum found it more convenient to 'unofficially' use Zoom. I found my morning school students too young to use a platform other than Teams; it would change the flow of the schedule and confuse them.

As far as my work is concerned, I would say that my previous experience with social media really helped me with the platform. Though no material for English was provided by the Ministry, the electronic version of our course book was really helpful. In the traditional classroom I mostly use it for listening, but for these first steps as a virtual teacher I used a book-centred approach to control both my work

and the students' attention. I had only worked for less than three weeks with the online lessons and though I teach for more than twenty years, I was nervous before my lessons. I would wake up early, have breakfast, even get dressed though no one could see me; the cameras were locked by the Ministry!

During the online lessons, most of the students were inactive not because the lesson was book-centred, most of the activities demand their oral response, but because they felt that they could hide themselves. Connecting to the lesson was obligatory, but they would give responses like "we are still in our pyjamas" and "we haven't had breakfast yet". Some others would interfere with any kind of sound effects, but I could check whose microphone was unlocked and name was in a purple circle so I could reprimand them.

As the days went by, however, some students realised that this is a language lesson and that oral production (speaking) is important and so they became very talkative Another thing that it must be noted, is that when the school opened some of my students brought their homework and/or projects printed. I think this was because they needed help to scan or upload their work and unfortunately most of the work I gave them was in pdf form.

As colleagues, the English language teachers cooperate in the same extent we had cooperated before the lockdown, the syllabus was normally coordinated and though we were told that we did not need to continue with new material, none of us hesitated to go on new material.

It seems that the virtual learning is here to stay. The Minister announced that virtual learning will definitely support but not replace the traditional classroom, and the truth is that our accounts in Teams are still active.

Also, since Cyprus is a small country, it is easy for the schools to provide poorer students with both tablets and Internet connection, which they found from different sources (the Ministry, their budget, donors). In my opinion, it cannot replace the traditional class in primary and secondary education, because the students are young and inexperienced, it is hard for them to follow the learning experience behind locked cameras, and they need to sense their teacher's physical presence.

3.5 Denmark

3.5.1 Ms Theodora Valkanou, PhD fellow, Faculty of Law, University of Copenhagen, Denmark.

I have not been personally involved with converting courses from traditional or hybrid to fully virtual. My university only occasionally offered distance mode courses before the pandemic. The University of Copenhagen, Faculty of Law has

recently directed its agenda focus towards ‘digitalisation’ with a view to keeping up with technological developments and making the legal profession relevant in the modern job market. Online teaching was not however (at least explicitly) among the priorities of the 'digitalisation' shift.

COVID-19 signified an abrupt, unprecedented crisis which posed several challenges on teaching which had to be conducted online overnight. In response to the pandemic, the University of Copenhagen e-learning consultants developed a comprehensive ‘Online and Blended Learning’ database providing guidance to tutors engaged with online teaching and familiarising them with relevant platforms and tools. In addition, employees were provided with the opportunity to consult staff of the Faculty's Research Group on Law Teaching and Learning for idea sparring and remote teaching-related assistance alike. Several seminars have also been offered to staff to smooth their transition to the new era of digital teaching. These jointly contributed to managing the implementation and maintenance of online modes, including, for example, planning processes, changing work practices and reskilling of staff, and changing organisational structures. Seminars addressing remote teaching issues are expected to take place in a more comprehensive manner as of fall 2020.

‘Objects’ that needed to be available to students and staff to facilitate online authoring of, and interaction with, teaching and learning resources *were made available to staff through the ‘Online and Blended Learning’* database, *and to students through the standard online ‘Blackboard’ platform that is used irrespective of the pandemic for teaching material and assignments.* Staff did have basic capabilities to produce materials and use online modes of teaching. In general, material that would have been used in on-campus teaching (e.g. PowerPoint slides) were used in online teaching. *However, given that most of the staff was not familiar with platforms that were to be used for online teaching, their own learning curve was rather steep.* The new mode of operation doubled the workload of faculty calling for additional effort and engagement. Amongst other duties, meetings had to be planned for each lecture, recordings needed to be followed up as these were sometimes delayed or not becoming available to students as they should be; the communication with the students was intensified and the load of additional messages coming from the students required immediate response. As far as students are concerned, whereas their adjustment to digital platforms was fairly swift, their active engagement in online classes was minimal raising questions on the learning outcomes achieved. It is nevertheless noteworthy that students submitted an encouraging evaluation of the online teaching offered in spring 2020.

The COVID-19 pandemic speeded up a technological revolution in universities bound to take place anyway, maybe somewhat more progressively. Online teaching should not completely replace traditional modes of teaching – yet it is almost certain that it will complement them. On a positive note, online teaching has the potential to make education more widely accessible. Universities may seek the opportunity to expand the audience of students that would otherwise not be able to

be physically present in class (say part-time employees or parent-students). Having said that, physical presence as an essential aspect of training should not be undermined. It is essential that students are given the opportunity to interact and exchange ideas in a classroom setup with both fellow students and lecturers. In addition, re-skilling of staff and changing of work practices must take place gradually and with due respect to lecturers. Online teaching as a complement to traditional teaching modes can only be successful in the long-run if implemented in a progressive, organised and systematic manner taking into account a wide spectrum of opportunities and risks alike.

3.6 Finland

3.6.1 Contributed by Dr Eleni Berki, Docent, Adjunct Professor University of Jyväskylä, Finland- Involved in Software Quality Engineering/Management, and as an Industry Trainer in Private Industry.

I have not been personally involved in converting courses from traditional to fully virtual but have been personally involved in converting courses from hybrid to fully virtual. My institution offered distance mode courses before the pandemic. There were/are occasionally tensions between on-campus and off-campus provision. Almost all staff have capabilities to produce materials and use online modes of teaching.

Resources for online teaching and learning including access to appropriate equipment and networks, training, development and support were available almost always. The `objects' that needed to be available to students and staff to facilitate online authoring of, and interaction with, teaching and learning resources were made available.

Managing the implementation and maintenance of online modes, including, for example, planning processes, changing work practices and reskilling of staff, and changing organisational structures was rather efficient.

3.6.2 Contributed by Dr Juri Valtanen, Educator/Trainer, Tampere University and Private Company, Tampere, Finland.

I have not been personally involved with converting either traditional or hybrid courses into fully virtual. My institution offered distance mode courses before the pandemic. My main involvement was MSc/PhD Thesis Seminars and Supervision. There are tensions between on-campus and off-campus provision. The staff have capabilities to produce materials and use online modes of teaching were available.

The `objects' that needed to be available to students and staff to facilitate online authoring of, and interaction with, teaching and learning resources were available. Re-planning and re-designing for product/service re-distribution worldwide have been challenging due to the sudden change of work mode and time availability. Ongoing personal change and anticipation for the future is being carried out.

3.6.3 Contributed by Drs Berki and Valtanen.

3.6.3.1 Preparedness of the HE Sector in Finland.

In Finland, the Coronavirus pandemic affected the formal and non-formal education rather a lot. Participating in both formal and non-formal education and residing in Finland during Coronavirus times, we have experienced and traced various situations regarding the readiness and preparedness of the particular sectors to face the challenges raised by the pandemic's consequences. Being also union members we evidenced the experiences of other colleagues, learners, trainers and trainees. To tackle the pandemic and its consequences the academic trade unions inform their members on their websites, Facebook, Twitter and membership letters by email about the current situation.

There is a general agreement that the university sector has been able to maintain their teaching and other activities especially well. According to the answers given to the survey that was sent to the staff members by their professional union in May, almost all union members had been able to continue working remotely from their homes. As the Union's journal newsletter Acatiimi recently reported, the survey results showed that the Finnish academic community was able to cope with the situation exceptionally well thus far and both teaching and research staff and other staff had been able to fulfill their work duties well during the remote working time.

In our opinion the Universities were already equipped with the right communication tools and online learning platforms (e.g. Moodle) and the staff members were used to working in distance mode. However, the non formal education including professional training and the realization of training sessions in strict time limits reported that the transfer to distance mode teaching and its preparation were laborious and time consuming processes. Proficiency in the use of tools such as Zoom, Microsoft Teams, and others became a necessity.

Some Universities and training organizations have announced that they plan to continue in distance mode for the foreseeable future (Autumn 2020) and into the next academic year thus highlighting a commitment to the the new virtual mode.

Many times it has also been expressed that we are living a *new normal* and that there is no going back to the *old normal*. The Universities' Professional Unions common newsletter Acatiimi, in 2020 [10] asked: "*What is the old normal in university teaching? Meeting students in lectures, seminars, supervision meetings.*

All this has become virtual, as stipulated by the restrictions of the Coronavirus epidemic. University faculty members have shown high-level pedagogic competence, as they have managed to transform so much of their teaching to a different format, to completely different environments, in minimal time. This has, though, had its human price: working hours have not been counted." The latter is really a difficult issue to be tackled by academic trade unions in Scandinavian countries.

Further, in Finland, when all sectors face possible cuts in future funding, education and training sectors may be affected with a shortage in their employees from next year onwards.

3.6.3.2 Formal (State-organised) Education Sector and Challenges During Mar-Jun 2020,

The formal education sector in Finland managed relatively well during the corona spring time. Even though all levels of education (primary, secondary, higher) were not prepared, a level of readiness was high. Key success factors for the quick and agile transformation of learning activities from a face-to-face mode to the online mode overnight were: i) teachers' creativity and commitment, ii) technological readiness and ICT support staff and iii) parents' flexibility. In general, the Higher Education sector managed better the transformation process than the secondary and primary education sector, because of the level of students' readiness for self-directed and self-organised learning. Yet, in all levels of the formal education sector, the key challenges were not technology and how to use it but the well-being of pupils, students, teachers, managers and parents. It turned out that school (and school premises sometimes) was a much more important place for many than it was ever realized before!

3.6.3.3 Challenges in Higher Education.

In the formal Higher Education sector students are expected to show a high level of self-directed learning. That is, an independence concerning learning is a demand. However, some students were not yet mature enough to meet the high expectations of independent, self-organised learning. The spring term of the Coronavirus time clearly showed this. This observation was witnessed particularly among the first year students. It was found out that the new (e.g. first year) students suffered much more stress and felt more tiredness and loneliness than other (e.g. more experienced) students during distance and online learning activities. Also the first year students found it more challenging to create and maintain team spirit among other students during isolation. Another challenge for the same students was that they had to adapt to working long periods with the computer. Clearly, the educational jump from high school to tertiary education has been more demanding for the first year students during the corona-virus time, at the first months of 2020.

However, in the name of learning activities, the Higher Education level students' readiness to use technological platforms and devices can be considered to be higher than the pupils or students of the secondary and primary education; that alone can explain why the digi-jump was easier for them.

3.6.3.4 Challenges in Secondary and Primary Education.

Students and pupils in formal primary and secondary education sectors are expected to study many different but compulsory subjects and also choose some other subjects based on their own interests. Notably, some subjects were much more challenging to transform into online mode. Particularly challenging subjects were mathematics, physics and chemistry. Learning these subjects online turned out to be not easy for the teachers and rather difficult for the pupils and students who needed the teachers' guidance and support much more. This particular tutorial support, mainly individual-based, was challenging for teachers to implement during the given schedule. On the contrary, some subjects like sports and arts in particular, were more stress-free than mathematics, physics and chemistry, but they were also surprisingly challenging to transform into online mode. The subjects that were the easiest to transform into online mode were languages and the so called reading subjects like history, geography, biology. So one could say that there were great imbalances between different subjects regarding the degree of easiness or difficulty they exhibited while transforming them into online mode. One consequence of this was that teachers (or, more accurately, some teachers) reduced the workload of students and pupils by giving less tasks to do than normally.

Additionally, many teachers adapted their ways of applying and utilising technology such as Google Meet or Microsoft Teams, based on their ICT-skills levels. For example, some teachers used the technology in a way that demanded from pupils and students to look at the screen all the time while some other teachers made variations in the use of technology by using, for example, audio-material (as live-streaming) for a change.

A rather surprising consequence was that the instruction and studying of the school subjects from distance also affected the parents, which were, in one sense, forced to be some-kind-of-teacher/instructor, too, for their offspring. This arrangement led, at some point, to some uneasy situations when teachers received messages from parents (but also students and pupils) even during the night time. But even further, this revealed the huge differences among families' backgrounds. Clearly, some families simply had much less (or worse) learning resources to offer to their offspring. In some cases, pupils' and students' home environment was unsafe and not suitable for optimal learning because of too many distractions. In some rare cases, pupils and students simply disappeared. They did not show up during the online mode. This directly led to deep worries about the well-being of students, pupils, parents and teachers.

In summary, it turned out that the school's environment is a much more important place for pupils and students than a place to just collect study points and passing grades. The school was remembered as a place where pupils and students learn how to build socio-technical and communication skills and maintain social relationships, to exchange thoughts and ideas, to find and build own identity as active learners, and to grow and mature as a human beings. Many pupils and students were genuinely missing school.

Tools and Technologies Used:

In primary and secondary education sector

For online teaching Google Meets, Microsoft Teams

For homework tasks: Google Classroom, WhatsApp

For communication: ThatsApp an Wilma platform, Pedanet platform and phone if needed.

In the Higher Education sector: For tasks: Moodle, for communication: emails.

3.6.3.5 Challenges in Non-formal Education

The Non-formal (not State-organised) education sector of Finland did not manage so well during the Corona-virus crisis, in the first months of 2020; this sector seemed to be neither prepared nor the level of readiness was high. However, there seemed to be great contextual and organisational differences.

The main picture has been that the non-formal education sector was closed down and most of the courses were cancelled. The courses taught by Adult Education Centres (Tyovaenopiso) in their physical premises were mainly short courses lasting from one to three months, based on group activities. These courses were hobby-based as well as skill oriented such as painting, dancing, IT skills, general knowledge and languages, which are not designed to aim at any degree.

Many of the typical users-customers for these hobby-based skills courses have been retired persons who belong to Coronavirus risk groups. Many municipalities of the Finnish cities such as Turku, Tampere, Loimaa, and others around Finland closed down many of these non-formal education sector organisations. However, there were a few great exceptions, which managed to transfer short courses into online mode within a few weeks time. The city of Jyväskylä cancelled all the courses except the language courses, which became available only in online mode by voluntary teachers. It was then up to the teacher how the language course was designed and implemented. The most common resolution followed was that all the learning materials were transformed to be as a self-study material, just text-based

material with the inclusion of some videos, too. The change of the learning mode from offline to online depended on how skillful the teacher was with ICT technology.

In addition, the Adult Education Centres of the cities of Helsinki, Espoo and Vantaa made their courses available online and offered them for free during the corona spring time. The cities of Helsinki and Espoo even increased the amount of short courses because they wanted to support the learning of both those groups of people who i) had just lost their workplaces and ii) were put in isolation, that is over 70 years old people. The increased number of courses included mainly languages and information technology related short courses such as how to make own podcast, web-pages, and other. The city of Vantaa did not have enough resources to add new courses. Moreover, the cities of Helsinki, Espoo and Vantaa offered free guidance to their citizens/users/customers on how to use these online platforms and devices over the phone and through their Facebook sites as well as by Zoom. This guidance was offered for a few weeks and was for around forty (40) hours per week and the guidance/instructions were provided in five different languages. The short online courses were disseminated through YouTube channels and Facebook sites. These materials were mainly short videos.

Finally, there were also organisations of non-formal education sector that deliver professional and work-based training, which had to manage and transform their courses from offline to online mode almost overnight. These were from one to two hour info sessions and from three to six hours short courses. For example, the city of Tampere and its unit of Employment Services (TE-keskus) with various Education/Training providers and partners offered guidance and short courses for the unemployed and those under the threat of unemployment. Training sessions and seminars or short daily/weekly courses started to be offered through webinars by Microsoft Teams and Zoom. Furthermore, the Uratehdas professional organization, which is funded by several labour unions and offers short (from 4 to 6 hours) courses for highly educated unemployed or under the threat of unemployment, had to practically adapt to the new normal and change very quickly. The staff managed to transform their short courses from face to face to online webinars by using Zoom and Gotowebinar platforms almost overnight. Technology and tools used in the non-formal education sector included Zoom, Gotowebinar, Microsoft Teams, Facebook site and You Tube channel. Communication was basically handled through emails and WhatsApp or phone calls.

3.7 Greece

3.7.1 Contributed by Dr Andreas Agouropoulos, Assistant Professor, National Kapodistrian University of Athens (NKUA), Greece, School of Dentistry (Paediatric Dentistry Department).

I have personally been involved in converting courses from traditional to fully virtual. We have not been offering courses in hybrid mode in the NKUA School of Dentistry. Dentistry is a field where teaching is provided through theoretical, laboratory and clinical courses. Laboratory and clinical courses are a major part of the curriculum for the years 3-5 in our School. Furthermore, dentistry in general is a field that is considered one of the most dangerous for getting infected by Coronavirus and this applies both for the doctors and the patients. For the above reasons the School of Dentistry was one of the first that had to take precautions and was closed early to protect public health. This caused a major stress because the theoretical courses could be carried on fully virtual, as was done, but laboratory and clinical work had to pause. The transition was sudden and both faculty and students had to adjust to the new methods of teaching, although there was no time for a smooth transition. The problem was mainly for undergraduate courses and postgraduate courses attended by numerous students. Postgraduate courses with small groups were much easier to handle from both sides. The issues that arose were: platforms not able to support the attendance, internet overloading causing connection problems, access of the students to good internet connection. Nevertheless, the problems were handled and theoretical courses were held fully virtual. The new challenges will be the final exams for each course and the laboratory and clinical courses.

Although the university has allowed all types of examinations (in campus or virtual) there are some legal issues with virtual ways of examination. In the School of Dentistry the decision is to carry the examinations in campus (with all the appropriate precautions) in order to overcome possible legal matters that will hamper the examination process.

Laboratory and clinical courses had already started three weeks before submitting this exam document. This was possible because major renovations took place, mainly for the ventilation and air cleaning systems. Furthermore, the groups of students have been reduced to half, but this has caused extra working hours for the faculty and stuff which is a problem and has reduced the total time the students can practice. Added to the above is the extra cost of all the protection equipment for students and staff.

All the faculty members produced new, or adjusted the existing materials and used online modes of teaching. They responded immediately to the challenge and fully adopted virtual teaching. All courses were taught by the faculty members through the use of platforms that allowed the presence of numerous students. Since the School of Dentistry uses a platform for distribution of teaching material for the

various courses there was already the infrastructure and some experience on working with online platforms. This work was enhanced at this time and probably will be enriched further in the year to come, because the theoretical courses will be kept virtually in the following year. The NKUA made available, in a short time, different options for online teaching and learning. The training was done through written instructions and tutorial videos that were helpful. There was also support from the University helpdesk and mostly from the IT department of the School of Dentistry that helped the faculty to carry on the virtual courses.

As mentioned earlier our School had a platform where students could obtain information about different courses, education materials, schedules of classes etc. which was the only available tool for online learning. We didn't have any fully online course or examinations in the past and the above mentioned platform was used supplementary for the on-site courses.

In this semester I had two postgraduate courses in small groups of 5 students. We carried out the courses through online seminars using Skype, reading material provided through e-mails and homework in the format of small projects. Final exanimation was mandatory for one of the courses and this was done though a written essay by the students, and submitted through e-mails.

Managing the implementation and maintenance of online modes was supported sufficiently by the IT department of the School. The issue that remains and the new challenge is how to adopt the curriculum for next year, since the plan is to have a mixed learning schedule with online theoretical courses and on site laboratory and clinical ones. For the moment extra hours have been added to the staff and faculty to facilitate the division of the students in small groups in order to attend the lab and clinical courses following the safety rules and regulations. Since the Coronavirus will be present in the year (or years) to come, I strongly believe that the 3 past months was a rehearsal for a situation that will remain unchanged for some time. The special requirements of the education in dentistry call for adaptation in order to be able to continue the laboratory and clinical courses safely for students, patients, faculty and staff. The use of appropriate protective measures and special equipment will remain necessary until the pandemic is resolved. Until then the use of virtual modes of teaching will also be mandatory since this eliminates crowded classrooms that pose s danger for virus transmission.

In the long run the above could also be a significant asset for our School. The reduction of the faculty members has caused a work overload for the remaining ones. Using online teaching could be a solution to this problem and also it could be a more attractive teaching modality for the new age students that are very keen on working online. On the other hand, it could have a negative effect in building interpersonal relationship skills that are necessary to work with patients efficiently. This is a challenge that should be taken into serious consideration, because extreme use of the Internet for teaching, working, communicating etc. will affect personality and increase loneliness. Therefore, a balance between virtual teaching and physical-presence teaching will have the best outcome for all parties involved.

3.7.2 Contributed by Professor Kerstin Siakas Department of Information and Electronics Engineering, International Hellenic University, Thessaloniki, Greece, and of Production, School of Technology and Innovation, Vaasa University, Vaasa, Finland.

I have not personally been involved in converting courses from traditional or hybrid mode to fully virtual. My department (in Greece) offered distant mode in all modules of the MSc Programme 'Web-Intelligence' before the pandemic. Here I am providing results from interviews I have carried out in Greece.

HE Educator (IT) In the Spring semester 2020 all the materials/slides had to be converted to fully virtual education. Most of the educators already had their materials on-line on the Moodle platform. The experience of educators was that *"before entering the on-line mode theoretical teaching, you need to be more prepared, in particular if the teaching is recorded for further use. The educator does not have the same contact with the students. We started to use Zoom when the COVID-19 broke out, it is easy to use, but in the beginning, we had problems with the number of students. The system broke down several times. Now the university has paid more licences and it works well. Regarding practical on-line sessions and assignments, we had to find new ways of supporting the students. All students in our department had computers and internet connection so that was no problem. In other departments many students did not have needed computer equipment or Internet. Regarding the exams the educators can choose how they want to do the exams".*

Further education adult students
All courses had to be changed to on-line versions. We had not much previous experience. Very few students of the class took part in the on-line classes because a) they did not have a computer or access to the Internet, b)their children needed to use the computer for their studies simultaneously, c)they did not have the required skills.

Primary school
In the sector there was lack of experience of most of the teachers to give on-line courses. It took long time to organise how to do the teaching. In the beginning emails were sent to the pupils regarding what they should read and what exercises they should complete on their own. Many pupils did not have the necessary equipment and their parents were not able to provide them with support. Some state TV channels broadcasted materials daily to different classes and subjects.

Thoughts about the future impact and changes

I strongly believe that education in the future will be personalised, ubiquitous and pervasive. Pedagogic student-centred trends and technological developments, such

as Social Media Learning, Artificial intelligence, Gamification, Serious games, and Augmented and Virtual reality, have paved the way for this.

Research has shown that educators lag behind students in the use of technology. Today's students have grown up with computers and are native users of them. This means that educators need to be trained in the use of new technologies so that they can make the most of technology for the sake of improved learning.

3.7.3 Contributed by Professor Mary Plastira, Faculty of Classics, Aristotle University, Thessaloniki, Greece.

This INSPIRE paper is a very inspiring attempt indeed! I would like to put down some thoughts concerning the way I lived through the Coronavirus lockdown in Greece and how I managed to operate. It is a technophobic philologist who is speaking who nevertheless managed to respond to the novel teaching techniques, after I had had initial help from my daughter to set up the Skype for Business platform. To be honest the IT Support System from the Aristotle University gave detailed instructions which to my mind were so verbose, I soon gave up the effort to try by myself. Anyway between computers and myself always something goes wrong, as if they can feel (pardon me!) I do not love them. In any case, after setting up the system I was connected with Skype for Business (other applications provided were Bigblue Button, Zoom, Google Meet, and Microsoft Teams) and I could manage by myself without asking for further help. Like most members of the staff - especially those of a certain age – "I was barefooted on the thorns" , as the Greek proverb says, but I managed.

To my surprise I had an online full house with fifty students attending and no drop outs, not even at the end of the semester. As we were advised centrally not to encourage students to have their cameras on in order to avoid the system crashes, I had to lecture to empty-face windows. Still the warnings put aside, students seemed reluctant to appear on screen. Very few responded to my appeal to have at least a limited number of cameras on (four or five at the same time). If I overlook this cold feeling of speaking to a "black wall" I often experienced, I knew most of my students were there because they were active participants.

I used the chat function instead of a "blackboard". The main drawback was, due to time restraints, the inability to type using the multiple breath and stress marks when writing in lower cases in Ancient Greek. To pass the required information across I had to write in capitals. The students on their part wrote the questions they had to pose or answered to mine through the chat function as well. My explanations to their points were given orally. Given that we were not trained for this mode of teaching we managed remarkably well.

Yet, as I confided to my students, I missed a lot of the traditional teaching, even things which, if strictly judged, were not positive. Their sleepy faces and their

yawns at times (my classes were usually 8.30 to 11.00 a.m.), the seeking of clarification from the nearby student, the expressions which declared either that I had my audience hooked or bored to death, their looks of confusion…In other words I missed the human in flesh at the opposite end who looks at you and whom you look at and communicate directly both through the speech and the language of the body. Nevertheless, a sign of a more intimate positive reaction under the new circumstances should not be omitted. It is the warm "Thank you" when the session finished, which was something I seldom experienced in class.

Apart from the special subjects I had to teach, that is Homer in one class and an overview of the Ancient Greek Drama in the other, I felt the urgent need for communicating with the students beyond the strict lines of the program. I wanted to share thoughts and feelings concerning the novel experience we were all going through. So every Saturday we had our "Saturday meetings in the days of the virus" that is the name I gave. I explained that since I was not a psychologist, therefore I was unable to provide psychological advice; our topics to be discussed would be gleaned from our discipline of ancient Greek authors. The *point de repère* in our first online meeting was a passage from Plato's *Protagoras*. This gave us the opportunity to ponder on the relationship between teacher and student in the eyes of Socrates. We were puzzled by the danger the young student faces, when at his aim to conquer knowledge he (sorry for the 'he', education was mostly provided to males in Ancient Greece) listens to the authorities in the realm of science, literature, political thought, social life and behaviour and is endangered to diminish, if not to abolish, his ability to think, the autonomy, in other words of his own mind. Expanding on this point we pondered and endeavored to give an answer to the question whether each of us can really have autonomy in the days of excessive information. The following meetings focused on Ancient Greek Medicine: the Plaque in Athens in the beginning of the Peloponnesian war (430-427 B.C.) and one of its victims, little Myrtis who was unlucky to die at the age of twelve but lucky to be brought to light through excavations which revealed her beautifully preserved bones that gave us material to reconstruct her face. We also discussed divine healing, the shift to scientific Medicine with Hippocrates, the so-called father of Medicine, and last but not least women physicians.

As far as the exams are concerned some of my colleagues decided to do distant written exams through e learning but they faced problems with the connection. Students were also not happy: They complained about the duration of the exams which they considered to be insufficient, especially for open-ended questions. They also noticed that many members of the staff followed the same structure of a written paper, although the circumstances were different. There were also reports of cheating. Personally I decided to do online oral exams in groups of four, on Skype for Business again, to avoid this problem. It went smoothly and I think it gave first-year students the opportunity to taste a different type of examination to which they were not exposed before and which were much afraid of. It also gave them a chance to participate in a discussion, through which their knowledge was tested, with their fellow - students rather than a strict old-fashioned exam.

3.7.4 Contributed by Mr Errikos Siakas, IT support, Aristotle University Thessaloniki Industry Sector(s) Education, Greece.

I have not produced any materials myself but supported initiatives by certain professors in test matters. When the Coronavirus appeared all teaching staff had to quickly transfer to fully virtual teaching mode. There was no platform for this, and a majority of the teaching staff had no experience in using virtual teaching. The university has around 50.000 students and 4000-5000 teaching staff.
The IT support department had to quickly find a software platform that the teaching staff could use. The following platforms were proposed and used in chronological order:

1. **Skype for business:** A particular agreement was created with Microsoft and Google. When a huge number of students were simultaneously on-line in different courses the system did not work, was difficult to access and build a session. This solution was abandoned due to this problem.
2. **Google meet:** Videoconferencing
3. **Big Blue Button** in Moodle: This system did not work when more than 100 students partaking in one course/session
4. **Zoom**: this system was considered to be the best for virtual teaching mode due to its relatively high usability (easy to use), high portability (all kinds of computer systems, notebooks and mobile phones are compatible), good authentication and the huge number of simultaneous users it allows.

In general, the teaching staff had little experience of producing materials for on-line mode teaching. There was no training in the different approaches used. Notes were prepared to help teaching staff and students to use the software platforms. The IT support helped teaching staff and students by email, online and phone calls. The phone calls increased from approximately 70-80 phone calls/day to 250-300 phone calls per day.

Most of the teaching staff had their own equipment and network. Also, most of the students had at least a smart phone they could connect to the virtual teaching, that took place during set times. There is a possibility for the teaching staff to record the presentation for asynchronous learning for the students. This is not obligatory. Some teachers have used this possibility. Teachers also have the possibility to create smaller teams and assign tasks to the team by using break-out-rooms and to allocate responsibility to somebody (e.g. a student) for the team. Students have the right to apply to take their examination in the university. Less than 10% of the students used this possibility to apply to take their exams in a traditional way. It has not been decided yet exactly how this process will work. An unexpected phenomenon that was observed with the virtual simultaneous teaching was that more students attended the class than in traditional teaching.

The sudden transfer to virtual mode was very stressful for:

1. **Teaching staff** that had to prepare material for on-line teaching and to use technology they were not familiar with. A stress factor also was the frequent change of platform. Because of this it was decided that the teacher could use

whatever platform he/she wishes. Also, in the exams there is no formal obligatory way of carrying out the exams. Every teaching staff decided what he/she thinks is most suitable.

2. **IT support** had to decide what platform to use and to support both teaching staff and students in the use of the software platforms. During the exams the IT support staff work in shifts and during weekends. The exams run until end of July and end of August with re-examination and the new semester starting in beginning of October.

Primary and Secondary Education: WEB-EX (CISCO) is used**.** There has been a voluntary seminar for the teaching staff in the use of WEB-EX arranged by the Ministry of Education. It has not been obligatory to provide virtual teaching. Some teachers chose not to offer virtual teaching at all and others opted for a few hours per week. However, most of teachers have used some form of electronic teaching. The simplest way has been to send tasks to the pupils by emails and the pupils have to send back the completed tasks. This seems to have been the way used most. Even this has been difficult in many cases, because in particular the younger children needed help from parents or other persons in their environment. Many parents have limited knowledge of computer use and in particular if the children are young, they needed help. Also computer compatibility and lack of other equipment needed (e.g. printer or scanner) has been a problem.

Concluding I want to say that the experience in general terms has been positive. The sudden change created a high workload, and was very stressful and difficult. However, on the whole virtual learning should be an alternative for students so that they can manage their time more effectively. Also the lockdown will decrease traffic and reduce the carbon footprint.

3.7.5 Contributed by Ms Maria Panteri, School Psychologist, Special Needs Primary School of Arkalohori, Heraklion, Crete, Greece.

I have personally been involved in converting courses from traditional to fully virtual. My institution did not offer hybrid or distance mode course before the pandemic. There is great differentiation between traditional education and distance learning, mainly in terms of philosophy, but also in the way and the means of the implementation.

The staff have capabilities to produce materials and use online modes of teaching. Initially, teaching staff in Greece seemed sceptical to getting involved in distance learning, and l seemed unprepared to use online teaching methods. During the first month of the quarantine and the suspension of schools, school counsellors provided online training to teachers and information on how to produce online material for all subjects.

Resources for online teaching and learning including access to appropriate equipment and networks, training, development and support were provided. The Greek Ministry of Education provided instructions for the use of specific educational applications and platforms, to be used by the educational community (e.g. e-class, e-me, Webex . The use of network data was free so that teachers, students and parents have free access, but this happened later from the first negative reactions of those involved. In addition, the Ministry proposed to all schools to record the needs of school units and families for equipment, such as computers, in order to meet these needs by the state. However, the adverse economic conditions in the country did not favour the strengthening of schools with equipment.

The `objects' that needed to be available to students and staff to facilitate online authoring of, and interaction with, teaching and learning resources were made available as far as possible.

In terms of managing the implementation and maintenance of online modes, including, for example, planning processes, changing work practices and reskilling of staff, and changing organisational structures, there was a change in the organisational design and working practices from the start of distance training mode (mid-March) to the start of the formal operation of schools (end of May). Initially, the Ministry provided the impetus and direction to operate the teaching, especially in Secondary Education, but due to the lack of a legal framework, there were no complaints. Asynchronous forms of distance education were used extensively just like it was in primary schools.

Also a distance learning team was set up at each school, consisting of principals and IT teachers, to offer organisational assistance and technical support. In addition, it was common for computer science teachers to organize online training seminars.

As a psychologist, working in education, I had to radically change my way of work, from the traditional to the virtual mode, during the pandemic era. Face-to-face counselling and consultation sessions have been turned into online sessions, through applications, such as Skype, Webex and social networks. Of course, this experience was not easy, as it requires practicing new communication skills and adaptability.

Parents and children did not seem very familiar and willing to work systematically with this way of working with the school psychologist. As expected, greater difficulties and resistance were observed in parents and students from rural areas than in urban centres, due to the lower familiarity of the former in technological means. The same was observed with teachers in urban areas, who were more receptive to create new educational material and taking advantage of the poles of innovation provided to them by several universities and websites.

As a PhD candidate in a Spanish university, the period of pandemic also significantly influenced my communication with the university. While in the past the use of technological means such as Zoom, Moodle etc. was widely used in our communication with the professors, the suspension of the operation of universities in Spain has completely hampered our cooperation. Of course, this may have contributed to the fact that the country was hit hard by the health crisis, but the university did not seem to take advantage of the technological means and adapt to the new situation.

In conclusion, I consider that despite the fact that the changes which occurred in education were sudden and somewhat violent, this whole evolution gave the education system a new impetus to the technological development and modernisation. However, in order to establish the virtual mode of education in the Greek educational system, we need to overcome several legal obstacles, which concern the protection of the personal data of students and teachers, the issue of examinations etc.

Finally, I believe that in the near future a mixed learning plan will be adopted, trying to make full use of the traditional form of education and, in an alternative way, the virtual mode. However, with regard to special schools and students with special educational needs, things are quite different, as greater difficulties must be overcome (multiple family problems, technological illiteracy, behavioral difficulties, distraction). For now, the adoption of virtual education for students with special educational needs is further away.

3.7.6 Response from Ms Valentina Panteri, French Language Teacher

I have not been involved in converting materials from traditional of hybrid to fully virtual. Most of the staff have capabilities to produce materials and use online modes of teaching.

Resources for online teaching and learning including access to appropriate equipment and networks, training, development and support were available. Before the pandemic, I did not use any alternative modes in teaching. Generally, I think that in Greek schools, resources for distance learning programmes were not used before.

`Objects' that needed to be available to students and staff to facilitate online authoring of, and interaction with, teaching and learning resources were made available. Personally, to replace my courses remotely, I used the Webex application. In adult students, our lectures were recorded in order to be used at other times. I also had to visit several websites to get ideas and modify my teaching material appropriately.

As far as the managing the implementation and maintenance of online modes, including, for example, planning processes, changing work practices and reskilling

of staff, and changing organisational structures, there were some problems. The adoption of distance learning required more time, especially for the preparation of each lecture. Technical problems often existed, but were gradually resolved. During this period, the need to communicate with students, especially minors, was strong and distance education seemed to serve this need as well.

The transfer from the traditional form of teaching to the virtual one, for me personally was quite difficult because I did not have any prior experience. My familiarity with e-learning platforms was small and as my work is in the private sector I did not have the opportunity for formal training from the Ministry of Education, as my colleagues in public education had. Other foreign language teachers working in the private sector have had similar difficulties.

Since the teaching of a foreign language to children is based mainly on oral teaching and interaction, the use of distance learning methods has made the learning process difficult. The biggest difficulty I encountered was the examination process and assessment procedures, as children complained about it and found it difficult to follow the rules without adult supervision.

What I particularly liked about distance education was the use of techniques I had not used before, such as animations and images that I created with the Scratch program and the fact that there was more flexibility in the educational media, as I did not just use the traditional book. I soon found out that there are plenty of websites that give ideas for exercises and activities in learning a foreign language. But what puzzled me particularly was the legal framework regarding the copyright of all this material available online which I often used in my classes.

From my discussions with colleagues, both in foreign languages and other specialties, I found that a new challenge this time for teachers and parents was trying to convince the children, especially the younger ones, that the computer is now a useful tool to their education. The delimitation of computer use after teaching was even more difficult, as its use on the one hand was imposed for educational purposes and on the other hand was limited due to the dangers it poses.

In conclusion, I consider that this new condition in education will continue in the short term, as long as this epidemiological condition remains. However, I remain attached to traditional education. I believe though that Higher Education will establish this modern form of teaching more quickly.

3.8 Ireland

3.8.1 Contributed by Professor Claire McGuinness, Assistant Professor, Information & Communication Studies, University College, Dublin, Ireland.

COVID-19 restrictions imposed from March 12th in Ireland necessitated a full emergency online pivot for the remaining five teaching weeks of the 2019-2020 academic year in UCD. As with all of my colleagues, urgent measures were taken; my postgraduate module, *Information Professional as Teacher*, which is usually taught in a traditional F2F discursive style, was converted to a fully synchronous online module. All remaining lectures were held live during the usual two-hour timetable slot, via the university's virtual classroom function (Blackboard Collaborate Ultra). With a small class of 11 students, it was relatively easy to maintain engagement, using the tools in the virtual classroom. During class, students were enabled to submit written comments or questions using the inbuilt chat function, or to use their microphones to contribute verbally. Some students did choose to keep their cameras and microphones switched off; however, as instructor, I was visible on video at all times, except when screen-sharing. The class sessions were recorded for those who could not attend from home. For the remaining five weeks of the module, there was almost full attendance at the virtual class each week. Coursework was submitted online and planned in-class student presentations were replaced with recorded PowerPoint slides or written digests. However, one significant change that occurred when lockdown was announced was that we were encouraged to immediately upload all course materials to Brightspace (the institutional Learning Management System) for the remainder of the module, in case of instructor absence – this required a lot of intensive work, as our usual approach is to release materials each week.

At the time of writing (July 2020), the focus has now shifted to planning for the forthcoming Autumn trimester (2020-2021). As social distancing and some other COVID-19 restrictions are still likely to be in place, we will be unable to proceed as we normally do, although seeking to provide some form of on-campus experience for students remains a priority, particularly for incoming first years. Currently, I coordinate and teach a large first year module on digital literacy. While this module is usually taught via a blended approach (including a virtual element in the form of asynchronous online tutorials), it is certain that the weekly F2F lectures will not be able to take place in the usual way due to social distancing restrictions, i.e., with 150+ students together in a single lecture theatre. So, one likely solution is to adopt a "hybrid" approach, where lectures are delivered F2F to smaller groups of students in rotation, while simultaneously broadcast live for remote attendees, or captured for later viewing. This would mean that each student receives some F2F learning.

University College Dublin already offered several distance mode courses before the pandemic. Some individual modules in our School (Information & Communication Studies) were already delivered fully online, although just one of our full programmes is available remotely (Professional Certificate in Digital Information Management). Our School is interdisciplinary, covering a range of subject areas including Information & Communication Studies; Library & information Studies; Digital Information Management; Communication and Media, Human Computer Interaction; and Digital Policy.

During the initial rapid transition to online learning, some tensions between on-campus and off-campus provision emerged, and they continue to affect the planning process for 2020-2021.In the direct aftermath of the online pivot, academic staff expressed concern about the quality of the student learning experience in light of the sudden shift. Different approaches were taken by individual staff – some chose to pre-record asynchronous lectures, while others opted to deliver synchronous online classes via the virtual classroom in Brightspace. Staff expressed uncertainty about which approach was best and raised concerns about issues such as students' Internet connectivity, their working-from-home arrangements, their personal circumstances, and time differences in the case of international students who had returned to their home countries, including the US, China and India. Some staff felt uncomfortable with online learning and expressed the view that F2F supports better engagement and rapport with students; others, however, were very positive, and observed that quieter students, who typically choose not to speak out in F2F classes, seemed to be contributing more to the virtual classes using the chat function. The overriding issue was how to preserve an excellent learning experience for the students even though they could no longer attend campus; the university in general was committed to minimising disruption as much as possible and continuing to ensure that learning outcomes were met. Subjects with a particular need for hands-on learning (e.g., in labs, etc.) experienced significant difficulties with the online shift; however, our School was not badly affected in this respect. Some planned workplace internships for our students were cancelled; most, however, now consist of online projects. Outside of learning, there are significant concerns about how students' overall university experience will be affected by the online transition, particularly in terms of social life and the extra-curricular activities that can often be transformative in students' lives.

The capability of academic staff to produce materials and use online modes of teaching varies broadly; some are better equipped than others. A lot depends on their previous experience. Many staff members had already been using Brightspace extensively for a range of purposes, including the structured provision of online learning materials, quizzes, e-tutorials, discussions, coursework submission and some virtual classes. The university immediately made a range of supports available, including written guides, webinars and online training sessions to bring staff up to speed and these continued over the Summer. In our School, we are fortunate to be able to avail of the services of a dedicated educational technologist, who provides support and guidance, as well as direct input to instructional design.
Resources for online teaching and learning including access to appropriate equipment and networks, training, development and support were provided. The relevant units in the university, (i.e., IT Services, Teaching & Learning) were quick to offer training opportunities and supports for any staff who required them. An institutional Zoom license was rapidly purchased and made available to all staff, to enable virtual meetings and online classes for those who wished to use it.

All staff already have their own laptops, computers and peripherals. The institutional LMS, Brightspace, offers the functionality to deliver classes online,

including an option to record virtual classes, which are then made available to students who were unable to attend. As mentioned earlier, we could also avail of Zoom to host meetings, webinars and virtual classes. GSuite is also used for collaborative authoring, document-sharing, etc. Students have always used their own choice of digital technologies to support their learning activities, including social media such as WhatsApp and Facebook for group collaborations, and GDocs, OneDrive and DropBox for document-sharing and collaborative authoring. We also have School-based subscriptions to Adobe Acrobat, Poll Everywhere, SurveyMonkey and other online tools. The institution also enables staff to download a select range of licensed software apps to their personal devices for remote use.

To manage this extensive transition, planning took place at different levels: institutional, college and school, with Heads of School, College-level Vice-Presidents for Teaching & Learning, and School-level Teaching & Learning directors assuming prominent roles, with regard to communicating decisions made at upper management levels. Several working groups were set up to plan for critical and urgent issues such as moving end-of-year exams online and facilitating the institutional grade approvals process. Programme directors and individual module coordinators assumed responsibility for their own programmes and modules, in terms of the teaching and assessment approaches to be implemented.

Guidelines for both staff and students were rapidly issued, including an extensive FAQ for students covering the challenges that were likely to arise. Staff meetings at university, college and school level took place as normal, via Zoom. The ongoing uncertainty around the pandemic means that plans made now may need to change as time goes on; this has significantly affected our ability to set definitive parameters for programme delivery in 2020-2021. It is likely that much of the first trimester teaching in 2020-2021 will take place online, with a small amount of F2F teaching. Social distancing rules indicate that 2 metre separation must be maintained, thus reducing the capacity of teaching spaces. This is a major concern for programmes which are marketed as on-campus experiences and attract high numbers of international students on this basis. The true impact of COVID for the coming academic year has yet to be seen, as students may choose to defer their enrolments to the following year.

3.8.2 Contributed by Mr Jerald Cavanagh, Institute Librarian and Project Leader ERASMUS+, and Mr Padraig Kirby, Research Development and Innovation Project Officer and Project Coordinator ERASMUS+, Limerick Institute of Technology, Ireland.

For over fifteen years we have been involved in converting Library, Information Literacy and Research skills training courses and Programmes into fully virtual courses. This has involved design and implementation of innovative online resources and supports such as online Information Literacy and Research Skills Modules, courses and tutorials and involving content creation working with various specialists in the eLearning field such as Cranfield University, Epigeum and Springshare Ltd.

We have been involved in converting courses from traditional to virtual both on the institutional level- in LIT and on the international level through extensive involvement in major EU funded projects. We have been highly active on the international level in these projects and have led the development of highly innovative –e-Learning courses in the Library and Information Literacy field that have been implemented in many different regions of the world such as the Western Balkans, Russian Federation, China and Central Asia in major EU funded Library projects.

In Jerald Cavanagh's role as Institute Librarian at LIT, he has taken a central role in supporting teaching, learning and assessment in the Institute. In recent months, he has played an active role in strategic planning in the Institute in the context of the development of the Digital Campus against the background of COVID 19, and has contributed to the vision for the Technological University Digital Campus Ecosystem in Ireland.

We have been personally involved in converting Library and Information Literacy training courses and Programmes into fully virtual courses both on the institutional level in our roles as Project Leader and Project Coordinator across a number of major EU funded library projects.

LIT offered distance mode courses through our Department of Flexible Learning-course list [11] and through the LIT Quality, Teaching & Learning Department (More details about these courses to follow below). In addition, LIT Library have offered an entire suite of Online Information Literacy and Research skills courses to students and staff for many years. Our Department of Flexible Learning has offered distance mode courses in many subject areas, disciplines and departments: - Applied Social Sciences, Mechanical and Automobile Engineering, Business and Humanities, Information Technology, Electrical and Electronic Engineering, Art and Design, Marketing, Enterprise and Digital Communications, Sport, Leisure and Tourism, Built Environment, Business and Financial Services.

As dealt with below also, the Quality, Teaching and Learning Department at LIT, currently offers an array of courses for staff of the Institute through its level 9 – ten credit online course entitled *Designing and Adapting Coursework for Blended and Online Learning* which was launched this year.

As most Higher Education institutions have experienced in the transition from going from traditional to virtual, there are issues and challenges faced by both our

institution and our learners in the provision of effective support systems for open and distance courses. The tension between online provision, multi-site learning and keeping geographical links with the main campus is now a central mission. Learners now expect an omnipresent learning experience across a range of media and digital channels using innovative modes and methodologies of learning. In order to confront these tensions, LIT are now embracing the concept of the Digital Campus and Digital Learning through:

- Innovative delivery: using a range of learning methods and learning supports,
- The ability to earn and learn by maximising the capacity for a student to engage in their digital learning environment synchronously, asynchronously, online, face to face, or via a blended array of these,
- The global classroom: allowing students to interact without physical or geographic borders,
- The digital library: enabling self-directed learning through access to a limitless portal of learning resources.

LIT now support a flexible model of education that includes blended and online programmes. We realise the importance of the online digital campus in supporting the potential growth to reach a wider cohort of students, supporting lifelong learning and the knowledge economy.

The staff are expected to have the capability to use VLE's (Virtual Learning Environment's) and online modes of teaching delivery such as Microsoft Teams, Zoom, Moodle, Camtasia, Panopto, Articulate in order to produce materials and deliver teaching online.

Librarians at LIT are expected to develop online materials in the Library and Information Literacy field covering areas such as Referencing, Citation and Avoiding Plagiarism, Web Search Strategies and Tactics, Evaluating Information, Getting Published among others using Online Platforms such as LibGuides from Springshare.

In light of the current COVID-19 situation, it is likely that, much of Library training in the future will have to be prepared for online delivery, via Teams or a similar platform. In order to do this, we have allocated staff to particular areas to work on presentation (individually or in teams), to prepare content which could be delivered to our students come next September 2020 and throughout the semesters. The ideal situation would be that we have appropriate numbers of staff, knowledgeable and confident to deliver IL teaching remotely to online students in different subject areas. The content should be able to be reusable and shared and deliverable within and across all the subject disciplines.

LIT through its Quality, Teaching and Learning Department has recently launched a level 9 – ten credit online course entitled *Designing and Adapting Coursework for Blended and Online Learning.* The content of these CPD Staff Support Sessions for Blended and Online Learning is aligned with the curriculum and with

the classes being taught by the Institute. Therefore, this programme offers staff the opportunity to gain credited CPD in Teaching and Learning in the context of online learning and associated assignments and assessments. The course offers an array of CPD opportunities aimed not just at academic staff but at other staff such as librarians also, as follows:

- Learning Outcomes for Online Learning
- Online Learning Approaches
- Instructional Design for Content Development
- Designing and Storyboarding a Module
- Moodle Setup
- Creating Interactive Videos
- MS Teams: Online Classes and Assignments
- Zoom for Live Classes
- Creating Animated Video Resources using Camtasia
- Creating Learning Resources using Articulate
- Panopto for Creating Video Resources
- E-tivities for Continuous Assessment
- E-tivities for Online Assessment
- Flipped Learning Approaches
- Reflective Journals for Continuous Assessment
- Multiple Choice Quiz and the Gradebook
- Moodle Assignments using the Grading Rubrics
- Moderating Online Group

Multiple "objects" are made available to staff and students to facilitate online authoring of, and interaction with, teaching and learning resources such as Moodle, Teams, Zoom, Camtasia, Panopto, Articulate.

Over the past 30 years, librarians have spent much of their time teaching Information Literacy (IL) via IL programmes delivered in the Library. During that time they have also endeavoured to bring the Library into the physical classroom through design of these IL training programmes and their delivery by trained Subject and Engagement Librarians. The emergence of COVID 19, has led to a sudden retreat from physical interaction with students and staff into a virtual world.

Much of the Library and IL training provided by Library staff in the foreseeable future at least will have to be prepared for online delivery, via Teams or a similar platform and supported by an array of supporting IL content such as LibGuides hosted by online platforms such as Springshare.

On the level of the Institute, as can be seen from the recent launch of the level 9 – ten credit online course *Designing and Adapting Coursework for Blended and Online Learning*, the onset of COVID-19 has led to a sudden and increased need for provision of staff training and teaching resources to support Blended and

Online Learning to help both academic and support staff such as librarians to cope with a new world where teaching delivery through virtual means has become the norm.

As can be expected, strategic planning processes since the onset of COVID- have been very much focussed on the Digital Campus and state of the art digital infrastructure, ICT provisions and digital connectivity.

Higher Education Institutions must now be prepared to address the immediate educational or research needs of learners, to allow them to engage when they want and how they want. We must be there to serve the digitally enabled student and this can only be achieved through the reskilling of staff. Higher Education Institutions of the future, including LIT, must have a strong digital identity and digital infrastructure, including the appropriate equipment, hardware and software with innovative delivery, using a range of learning methods and learning supports.

3.9 Nigeria

3.91 Contributed by Dr Dili Ojukwu, Lecturer, Alex Ekwueme Federal University, Nigeria.

I have not been personally involved in converting courses from traditional or hybrid to fully virtual. I am aware that there are tensions between on-campus and off-campus provision.

Some of the staff have the capabilities to produce materials and use them in online modes of teaching. The problems however are twofold: lack of sufficient infrastructure; and level of poverty. These can be elaborated as follows:

1. **Infrastructure**: The twin issues of inconsistent power supply and lack of adequate Internet bandwidth [12]. Students who are at home find it difficult to access or participate in remote learning because the power supply to their homes is not consistent and this causes them to miss out on online activities.

Furthermore, wireless Internet connectivity in the country is neither cheap nor available in most remote villages. Even though most cities have sufficient bandwidth connectivity, the costs of acquiring the data to last for the duration of, say 2-hour online learning, is very prohibitive. Put simply, there is the prevalence of digital divide between the rural and city dwellers in the country [13].

2. **Poverty:** There is also the issue of the level of poverty in the country. A lot of students do not have the resources to acquire laptops and smart phones to enable them to participate in remote learning activities. And

even some of those who have these gadgets find it challenging paying for the data to enable them access online materials on an extended basis as there are no free wireless services in the country.

Hussain [13] emphasises "The drastic escalation of coronavirus will not only affect learning, it will compound the pre-existing education inequalities in Nigeria, with vulnerable and disadvantaged children at the receiving end. To curb the widening of the existing education inequalities, there is an onus on the Nigerian government to put in place measures to ensure continuity, inclusion and equity for all learners during this pandemic".

Similarly, the World Literacy Foundation [14] state that in Nigeria and other African countries "Children on the higher end of the socio-economic spectrum may experience less disruption to their learning because their private schools are well-equipped with ICT infrastructure and they can afford remote learning resources at home. The majority that would be left struggling are the students from vulnerable and disadvantaged backgrounds, who do not have access to computers and other devices outside school. In many cases, these children live in communities with poor or non-existent Internet connectivity and unreliable power supply. Inevitably, this digital divide will exacerbate the learning disparities among these children".

3.10 Russian Federation

3.10.1 Contributed by Galina Zamaraeva, Senior Lecturer Department of Foreign Languages for Professional Communication, and Professor Yury Panov Head of the Chemical Engineering Department, Vladimir State University Vladimir, Russian Federation.

We have personally been involved in converting courses from both the traditional and a hybrid model to fully virtual at the University. Several subject areas including Civil Engineering, Architecture, Chemical Engineering, Electrical Engineering, Automation of Engineering and Industrial Processes, Information Systems and Technology, Applied Information Science, Law, Psychology, Special Needs Education, etc. were converted. There were tensions between on-campus and off-campus provision.

The university staff have capabilities to produce materials and use online modes of teaching. There were resources for online teaching and learning including access to appropriate equipment and networks, training, development and support. However, this was not always possible when arranging laboratories. The staff were provided with on-line workshops by the university engineering or teaching staff. The staff use their own computers, laptops or/and smart phones.

The University provided the staff with some IT-platforms, such as Moodle, Webex, etc. They also use email and social networks for communicating with students and their colleagues. Not all necessary `objects' to facilitate online authoring of, and interaction with, teaching and learning resources were made available to staff and students.

The managing the implementation and maintenance of online modes, including, for example, planning processes, changing work practices and reskilling of staff, and changing organisational structures were organised from the very beginning.

As for schools, the situation was more difficult as before COVID-19 pandemic they were not involved in distant education at all (except some special on-line schools) and it is more dependent on management. There were at least two ways to turn to a new road. First.: School teachers had to convert their courses completely and turn to new modes of teaching. Lack of previous experience of distant teaching and / or IT skills, made it difficult to survive in a new educational environment. Second. They had a kind of support in terms of online courses developed by different developers. One of them is Yaclass at *yaclass.ru* providing resources in different subjects at different levels for schoolchildren, teachers and parents. Those who used this educational platform were completely satisfied with it. Another platform is Foxford at *externat.foxford.ru* which was used in combination with other tools. In Vladimir region they could also use *edo.obrazovanie33* which needs further development (users' opinion). These and other tools / platforms made the conversion easier and more successful.

The common problems were limited access to the Internet, lack of laptops or other appropriate devices We should also take into account that schoolchildren, especially at elementary and secondary school levels are not able to control their learning activities themselves and need their parents' attention and care.

Some more details on the University challenges.

Let us remember some English proverbs:

***Seeing is believing*:** Half a year ago it was difficult to believe that bad news from China could become reality all over the world. COVID-19 seemed to be something from bad science fiction rather than a real problem. It didn't take a lot of time to make us believe as we could see and feel painful results both in terms of human beings' health and life as a whole. The threat of falling ill became the first and the worst reason to feel frightened.

Bad luck never comes alone: Health problems turned out to be the source of lots of other problems, including economic, social and educational depression.

Actions speak louder than words: So to prevent illnesses and deaths of our colleagues and students we had to change our lifestyle and our mode of teaching.

At Vladimir State University we used to teach most of our students face-to-face in the University classrooms, laboratories, workshops delivering live lectures with a piece of chalk or whiteboard marker on the board, PowerPoint slides and videos on the screen, listening to our students opinions, their reading, speaking and breathing looking in their eyes, using verbal and nonverbal language.

Better safe than sorry: We had to change for virtual reality to save the people's health. But education? So we moved to virtual classrooms on different platforms. To be precise some departments provided distant courses in Law, Psychology, Special Needs Education, Automation of Engineering and Industrial Processes, Information Systems and Technology, Applied Information Science, Civil Engineering, Architecture, Chemical Engineering, Electrical Engineering, and some other fields long before this pandemic. So the staff (at least 35 – 40%) at the University had some experience in this mode of teaching using the single Moodle platform on the University Server.

With the lockdown all students had to follow their professors to virtual classrooms. But it was impossible to use one platform for about 30,000 students. So we got access to WeBex (with the University) or we could use Yandex tools or Google Classroom as well as Zoom or Skype. We also could communicate with our students via email or social networks. The University engineering and /or teaching staff arranged webinars to teach those who weren't capable to work in a new environment and produce new forms of the materials they had got used to bringing to their students. We also got an opportunity to join several webinars provided by Moscow State University.

Practice makes perfect. During these several months we learnt advantages and disadvantages of different online tools. Google Classroom is helpful in terms of saving all the materials, links and students' works, providing immediate communication with any student, monitoring the whole educational process by any part (student, teacher, administration). Designers made it accessible even for visually impaired students. The biggest disadvantage of the platform is unavailability of live communication. Zoom, Skype, even WhatsApp help overcome this disadvantage.

We also had to change the form of our teaching materials to present them online taking into account that most books from the University library are not available. Another problem we got is immaturity of some students. We have to state that some students failed to study in a new environment which seemed to be temporary and without any control.

In addition, we got a new experience in arranging exams and graduation works submission having an opportunity to make records of these academic events that could be convenient in some cases.

Measure twice, cut once: Having got some experience in distant teaching we would like to conclude with some points. Virtual classroom can provide us with

some good instruments mentioned above but it can't replace real face-to-face communication with students. We believe that education is not just about knowledge but also mentoring, sharing emotions and life experience. We hope the world will find the ways to win the struggle against COVID to bring learning, studying, teaching, mentoring back into our University classrooms.

3.10 Slovak Republic

Contributed by Professor Veronica Stoffová, University in Trnava, Slovak Republic.

I have only partially been involved in converting courses from traditional to fully virtual. My university offered some distance mode courses in Programming, Computer Science, ICT and Digital Technologies before the pandemic. There were occasionally some tensions between on-campus and off-campus provision. Many (almost all) teaching staff are able to create online courses and e-learning materials. Unfortunately, not only have they little time to do so, but when they do, they usually do it at the expense of their own free time - and not everyone is willing to do that anymore.

Resources for online teaching and learning including access to appropriate equipment and networks, training, development and support were available. Most schools used the Teams video conferencing system, or others (Cisco Webex, etc.), and used the possibilities of school information systems like EduPage. Some e-learning materials and resources for primary and secondary schools were distributed centrally, or were available and freely accessible portals. However, not all students had the necessary hardware and software for online communication.

The `objects' that needed to be available to students and staff to facilitate online authoring of, and interaction with, teaching and learning resources were made available. Everyone could freely choose from the many that suited them best.

Exact rules were not set in the individual planning of online learning/teaching and coordination was often lacking. It happened, for example, that the same pupil / student was to take part in two online activities at the same time. Some schools, especially universities, have prepared some online activities (for example, state final examinations, PhD comprehensive examinations centrally) and other activities have been prepared by teachers individually.

3.11 Spain

3.11.1 Contributed by Carlos Morales Calleja, Secondary School Teacher, IES Francisco Tomas y Valienta Fuenmayor, Spain.

I have been personally involved in converting courses from traditional to fully virtual. We did not have hybrid course before the Coronavirus. The institution did not offer distance mode courses before the pandemic. I do not believe there were/are tensions between on-campus and off-campus provision. The staff have capabilities to produce materials, and they use online modes of teaching. However, they usually do not have the time to create them because of the load of administrative and bureaucratic work. There is also a huge difference between professors as not everyone is on the same level of use of technologies or their willingness to learn and educate themselves.

There were no resources for online teaching and learning including access to appropriate equipment and networks, training, development and support. During a brief period we worked with our own means and we self-educated ourselves. We were offered an online course on distance education (MMOC) in mid-April 2020 and May 2020 but, in my opinion, it was too theoretical and impractical.

The `objects' that needed to be available to students and staff to facilitate online authoring of, and interaction with, teaching and learning resources were made available. Students who did not have computer resources or an Internet connection were provided, but the teachers were never asked about our needs.

The managing the implementation and maintenance of online modes, including, for example, planning processes, changing work practices and reskilling of staff, and changing organisational structures were chaotic because the educational authorities sent conflicting messages and were not clear with the orders. They also did not provide us with the means to make the transition and we had to improvise and find the tools ourselves.

3.11.2 Contributed by Maja Stoffová, Secondary School Teacher, Secondary School San Fernando, Constantina (Seville), Andalusia, Spain.

I have been personally involved in converting courses from traditional to fully virtual. My school did not offer hybrid or distance mode courses before the pandemic. There were tensions between on-campus and off-campus provision.

The staff have not really got capabilities to produce materials and use online modes of teaching. Digital competence of many colleagues is insufficient. Our digital skills depend on the training that everyone has wanted to do. There has not been a common training. We had to adapt at the time. Many times, we had to help each other. Not all teachers used digital material in face-to-face education, so they had to change the whole methodology. Some teachers only taught by videoconference and they did not have to change many things.

No resources for online teaching and learning including access to appropriate equipment and networks, training, development and support were made available.

All the teachers had to use our own equipment without any technical support in case of problems. We had to discover on our own the different video conferencing platforms, how they work… We have a central school system (Séneca in Andalusia) for communication with parents, for grades, communication between teachers and school management (not all teacher/parents know how to use it). There is a Moodle provided by Andalusian Education Counselling, but most teachers preferred the Google Classroom so that students do not have to use so many different platforms.

There were students who did not have appropriate equipment or an Internet connection. It took too long to solve this problem (by the school management or the Andalusian Government). There were also students who did not have enough digital competence to follow an online teaching. They handle new technologies, but only for leisure: social networks, making videos, playing games online, but not for serious work.

There was not a central decision on the `objects' that needed to be available to students and staff to facilitate online authoring of, and interaction with, teaching and learning resources.

At first, everyone could freely choose what suited him/her best, but when students complained about the diversity of platforms used, we tried to reduce them to one or two (Google Meet and Zoom for on-line classes; Google Classroom and Moodle for deposit materials, exercises and create tasks.)

At the beginning the managing the implementation and maintenance of online modes, including, for example, planning processes, changing work practices and reskilling of staff, and changing organisational structures was chaotic and stressful. Every week we received new instructions that changed the previous procedures. Students also had some problems adjusting to this new teaching system. The work of preparing classes, activities, and correction of delivered activities, etc. required more than 11 hours of daily work. In addition, we were overwhelmed by administrative work, sometimes doubled senselessly. The most problematic point was the exams. We do not have specific platforms for exams. We used Google forms or videoconference to monitor an exam and test the student knowledge. But the results showed that the students copied or had external help or students cheated in other ways during the exam, however, it was not always possible to prove this. For example, we stopped examining the theoretical contents of the subjects, but this theoretical knowledge is still part of the university entrance exam.

Every Friday we sent the list of the tasks of our subject to our students. (There was no common model to use.) They were homework for the whole week; the days in which they were going to teach by videoconference, the content to be covered, the exercises they had to do, the day and method of delivery, etc. And every Friday we had to fill out a form in Google Drive for each tutor about the incidents of the students in his/her group.

Recently, on July 6, the new instructions from the Andalusian Autonomous Government regarding the beginning of the 2020/21 academic year were published [15]. The instructions are rather vague, since they leave many decisions in the hands of the educational centres themselves.

Initially, only a face-to-face education is contemplated. The flexibility of the schedule, the creation of "coexistence groups", the distribution of the classroom, reduction of the number of teachers for a group (if possible), etc. are mentioned. They want less contact between the students.

They also talk about the creation of a specific COVID-19 commission that includes members outside the educational community (City councils, health centres) and each centre will have to create a protocol so that the teaching-learning process is developed in a safe environment. However, as usual, the document is too theoretical with some proposals that can hardly be carried out and no specific solutions are offered.

3.12 Sri Lanka

Contributed by Professor Nelum Deshappriya, Department of Botany, University of Sri Jayewardenepura, Sri Lanka.

I have been personally involved in converting courses from traditional to partially virtual (hybrid). My institution offered several External degree programmes distance mode courses before the pandemic.

There are in general some tensions between on-campus and off-campus provision. One to one and face to face delivery allows more interaction with students in terms of asking questions, consideration of their suggestions on prescribed aspects of the topic and online teaching lacks these essential features. Long periods cannot be spent on such activities due to data problems so the time that can be spent on interaction with students during a lecture is drastically restricted. Even facial expressions of the teacher and students are an essential part of the teaching learning process as it is a gauge of the level of comprehension and engagement. There have been complaints that when using the Zoom platform for lectures, students tend to join and not participate even by physically being there.

For some topics of a course unit, I used videos so that both the students and I can spend some time on the necessary points. However, the students were again concerned about the facilities and data usage as some complained that even the Zoom platform cost data for them.

Uploading material to the LMS is another option but the students prefer videos to lecture material. However, as there is a limit to the size of the files that can be uploaded that also led to problems.

Several staff have expertise in developing distance mode materials. Adequate resources for online teaching and learning including access to appropriate equipment and networks, training, development and support were available. LMS was in place. Personal knowledge/awareness about Google Classroom, Zoom platform was used during the initial stages of the pandemic. Some aspects such as using Camtasia to prepare videos were self-learnt.

The `objects' that needed to be available to students and staff to facilitate online authoring of, and interaction with, teaching and learning resources were available. However, some students indicated the unavailability of access to data etc.

Managing the implementation and maintenance of online modes, including, for example, planning processes, changing work practices and reskilling of staff, and changing organisational structures carried out was facilitated.

The Zoom platform was made available free of charge for staff and students. LMS was in place but the administration was not completely satisfactory. Some support from the university after the big crisis period was over but before that personal abilities had to be utilised. Attempts are being made to regularise the activities.

3.13 United Kingdom

3.13.1 Contributed by Professor Stylianos Hatzipanagos , Head of Graduate School University of West London.

I have led Graduate School initiatives in providing online delivery of research training and advice and support to supervisors and students. Online delivery has not been an alien concept, since the institution offered distance mode courses before the pandemic in various fields including in Education.

On the question of availability of tools that needed to be available to students and staff to facilitate online authoring of, and interaction with, teaching and learning resources were available. The university has a rather robust provision of a set of resources, including Blackboard Collaborate, Microsoft Teams, the VLE to support students, at all levels, from undergraduate to doctoral. The academic development unit is responsible for support and training of staff.

The University of West London moved its postgraduate research training online. Before remote working, research training was delivered by blended learning using a ‘flipped classroom’ approach. The blended approach required students to engage with modules from the Research Skills Master Programme produced by Epigeum before attending a related face-to-face workshop delivered by academic and research staff.

While staff and students have been working remotely, the university’s Graduate School produced weekly briefings for students to direct their learning via the

Epigeum Research Skills Master Programme. The previously face-to-face research workshops were delivered online via the university video conferencing systems. Additional support was provided through consolidation activities for students such as peer review, online surgeries and discussion boards. The move to online research training was complemented by regular online seminars where students and staff presented and discussed their research. These activities (in combination with doctoral online supervision) enabled staff and students to remain connected and also provided a way to identify students who require additional support.

As well as specific academic and pastoral support from the Graduate School team, the wider university offer for doctoral students included an ongoing counselling service, student financial and visa advice, academic support for English as a second language, academic writing development from Level 7 to Level 8 with a Royal Literary Society Fellow, and bespoke support sessions for mathematics and statistics.

There were tensions between on-campus and off-campus provision caused mainly by lack of student online communities, interaction between students at a social level and co-curricular activities that could result in lack of motivation and lack of commitment to studies and mental health issues.

In the UK, the sudden move to online learning did not allow a well thought out and consistent approach to learning design. In most cases, the universities' online learning project were divided into two stages: 1. emergency measures to support students during the pandemic in Spring 2020 and a more systematic approach of design of programmes and modules in preparation during the summer to support students from the Autumn term. The challenge has been for the sector that appropriate pedagogical models need to be deployed to underpin such developments and to achieve consistency across the broad range of modules and programmes. There is no concrete evidence so far that this is happening across the sector

3.13.2 Contributed by Dr Harjinder Rahanu, Senior Lecturer, Middlesex University London, Faculty of Engineering and Science, UK.

All courses of the Faculty of Science and Engineering have already been offered with the hybrid model. The university has campuses in London, Malta, Mauritius and Dubai. Many of our courses are offered across all campuses. London based as well as overseas based students have equal access through the VLE to all materials, including lecture notes and slides, assignment specifications, and earlier examination papers. I have been directly involved in converting courses (modules) from hybrid to fully virtual.

Most staff have capabilities to produce materials and use online modes of teaching. For those with computing and IT expertise this aspect of the conversion

to the virtual model was straight forward. For those who do not have the know-how, guides have been produced showing step by step instructions and details on how to develop and upload teaching materials and use online conferencing platforms, e.g. Adobe Connect and MS Teams to deliver lectures/labs/workshops.

Resources for online teaching and learning including access to appropriate equipment and networks, training, development and support were made available. All staff are able to use the Cloud for sharing documents, easy access to virtual learning environments. Training is available online, and Employees can also request hardware, e.g. laptops to be delivered to their home address in order to work from home.

The objects that needed to be available to students and staff to facilitate online authoring of, and interaction with, teaching and learning resources were made available.

Managing the implementation and maintenance of online modes, including, for example, planning processes, changing work practices and reskilling of staff, and changing organisational structures were carried out efficiently. The instruction to work from home was issued on a Monday and by the Wednesday of the same week; Adobe Connect was being used to deliver lectures. Training sessions were also provided for staff, not familiar with using online conferencing platforms, the same week.

Formal examinations were replaced with alternative assessments (AA) including, Open book 2 hour exam now to be completed/submitted 6 hours from release, AA (Exam replaced with individual written report). Provenance is always a concern and it was necessary to ensure consistency and quality control i.e. that all the learning outcomes for the module and degree programme were met, that approval by the Head of Department, Academic Quality Standards (AQS) and Exams teams was received.

Statistical analysis of student performance on AA provided comparable results between previous years formal examination and results from AA. No cases of academic misconduct were reported. It can be tentatively implied that the replacement assignments did not compromise the standards and rigour of the assessment regime.

3.13.3 Contributed by Dr Adam Edwards, Library Liaison Manager, Middlesex University, London, UK.

I have not personally been involved in converting courses from the traditional or hybrid model to fully virtual. However, Middlesex University has been offering distance mode hybrid courses for over 20 years starting from the former Institute for Work Based Learning (now the Work and Learning Research Centre [16] Business programmes and then within other Faculties. Most recently we have

joined in a consortium with three other universities (Canterbury Christchurch, Cumbria and Portsmouth) to run Police apprenticeships, which are run remotely, any classroom teaching taking place on police premises.

The COVID-19 pandemic has meant everyone involved in teaching is having to learn new ways of delivery very quickly. We are fortunate to have the Centre for Academic Practice Enhancement [17] to support this at Middlesex. Librarians have been learning from colleagues at the Open University (a UK university which is entirely distance learning) to ensure to model their best practice. The University is running training too, for example the recent Faculty of Science and Technology Learning and Teaching day which was devoted entirely to online learning methods and technologies.

In the early days of the pandemic (March to May 2020) we operated more or less on an emergency phase to get through the academic session and exam results. Work now is focussed on a more planned approach using Kaltura New Row for classes backed up by Zoom for one to ones. But the hardest task is re-planning the curriculum. Librarians normally teach in class with students on computers. It is very hard to replicate this online when you cannot see how students are doing. We are adopting a flipped approach [18], working on creating learning material reinforced by quizzes using iSpring Quiz software. This software has a wide variety of types of quiz (far more than Moodle or Kaltura New Row) and integrates with PowerPoint (if you purchase the full package).

Looking forward to the next academic year, the University Library is going to re-open but with services highly constrained. Books will have to be requested and collected, not taken from shelves as quarantine rules mean we have to ensure books are not touched and left for others to then touch and catch the virus. We will therefore offer a “click and collect” service modelled on supermarkets offer to drive up customers. There are also big implications for study space and how that is cleaned between users. Initially we will offer limited booking with most study spaces closed to ensure social distancing between students.

Our major Library purchasing push has been on ebooks and special collections of material in areas where print has been the preferred choice, particularly in Art and other creative subjects. The pressure is then on to find the money to do this, which for now means diverting money away from print books. Unfortunately, there is an on-going problem that not all publishers will let libraries have ebooks of key titles. They are pushing direct sales to students in the hope of boosting profits and believe that not allowing library ebooks will encourage this, perhaps forgetting students and universities are currently under huge financial pressure. Other publishers charge very high prices for library ebooks (e.g. a print law book which costs £133.50, but the eBook version is £790.00) on the basis that an ebook replaces several print copies. Librarians are therefore working with academic staff to find alternative texts we can supply, ironically then loosing sales for the publishers who are being unhelpful.

It is a very curious situation for a Librarian to be in, working from home and not working in the library they manage. Our profession is perhaps uniquely one directly associated with a specific place. 2020 is breaking that link and going forward our future is even more as "knowledge navigators" [19] in a virtual rather than physical world of information.

3.13.4 Contributed by Dr Nickos Paltalidis, Lecturer, School of Electronic Engineering and Computer Science, Queen Mary University of London, UK.

The institute offered distance mode and hybrid courses before the Corona Virus pandemic. Therefore, appropriate equipment was available but only used from colleagues who work for distance mode courses. Staffs were familiar with the use of the university's Virtual Learning Environment (BlackBoard), only for sharing teaching materials, and for communicating with the students.

During the pandemic, training sessions took place and the team had to get prepared in a short period of time. The delivery model was modified from hybrid to fully virtual for all semester B modules. This included, a) self-recording lectures (videos) for each topic using the *Q-Review platform/Echo360 Universal Capture*, b) online tutorials per teaching week using *Blackboard Collaborate*, and c) online office hours using *Blackboard Collaborate.*

In order to enhance leaning and communication under these circumstances, additional actions took place:

- The daily in-class exercises were replaced with homework exercises where the students had to submit their answers on VLE within 12 hours. Sample answers were available to the students after the submission deadline.
- The tutorials exercises were replaced with homework exercises where the students had to submit their answers on VLE before the online tutorial. Sample answers were shared and discussed with students during the online tutorials.
- Short online education videos were shared with students for further understanding of the topics.
- Smaller classes for the online tutorials were created by allocating the students into small groups
- A Discussion forum was created for each topic on VLE to enhance the communication between students and lecturers.

The team had to get familiar with new software applications in a short period of time. Some software applications were not compatible with the latest technology devices and IT support were required. Working from home, it was not the best environment to record lectures. Factors like the lack of appropriate equipment, network issues, external noise, etc. made the lecture recording a challenging task.

Traditional exams were replaced with alternative assessments. The team had a short period of time to modify the initial exam papers which already had been reviewed and approved by the external examiners. The final format of the alternative assessment was an open-book exam, which should be completed within 2 hours and be submitted within 6 hours from the exam being released. Answers should be answered by the student (individually), without consulting any other person. Students should not discuss their answers with any other person. Students could refer to textbooks, notes, and online materials to facilitate their working, if providing a direct quote, or copy a diagram or chart, the answer should cite the source.

Most staff have limited experience with open-book questions and thus it was a difficult task. Some alternative assessments were modified three to four times until the criteria was fully satisfied. Also, revision lectures were modified under the latest instructions for the alternative assessment, and additional online sessions were scheduled to inform students and to answer inquiries.

The planning process started early, before the beginning of semester B. In changing environment with a new, unexpected, and complex context, the team had to continuously evaluate the latest information, facts and best practices, and to take decisions accordingly. These requirements resulted in extra workload, time pressure, and cancelation of annual leaves.

For the near future, most of the institutions will formulate a clearer blended learning approach for online delivery. The aim is to provide a) asynchronous modes like recorded lectures, education clips, online activities, etc., and b) synchronous modes like online live streaming, group discussion, via MS Teams, Zoom, etc.

The world will not be the same after this crisis. We will not be the same after this crisis, and Higher Education institutions and Higher Education systems will not be the same after this crisis. Digital will have a role to play. It is already clear that the pandemic has created a permanent shift towards digital teaching. After the pandemic, we will come back with a much more widely shared understanding that digital tools are complements, not substitutes, for the intimacy and immediacy of face-to-face learning. Online education will be recognized as core to every school's plan for institutional resilience and academic continuity.

3.13.5 Contributed by Dr Elli Georgiadou, Visiting Researcher, Middlesex University, London, UK.

The UK has a long tradition of offering distance mode courses for both obtaining qualifications and for professional updating. The University of London started offering External Degrees in 1858. "*These courses were offered to people who*

were not able to attend the institutions in London, at university approved centre to students where the students' learning takes place outside the direct supervision of the university/college. "An external degree is offered alongside the traditional internal degree programmes for those students who can attend the University full time. The degrees were open to people in other cities, or to London based students who had attended evening classes. …..In 1865 overseas centres were approved the first being in Mauritius" [20].

The proliferation of information and communication technologies greatly increased on-line teaching and learning opportunities. Nowadays the University of London offers *"over 100 qualifications many taught using the latest technologies in distance mode and on-line"*.

In 1969 the UK Open University was established and its first student cohort started in 1971. *"The OU celebrated its 50th year in 2019. It is a fully distance mode, public research university and the largest university in the UK mainly for undergraduate education. The majority of the OU's undergraduate students are based in the United Kingdom and principally study off-campus; many of its courses can also be studied anywhere in the world……. Most of the OU students study part-time while they work."*[21].

In recent years the majority of Higher Education (HE) institutions in the UK (and across the world) offer external learning opportunities and in recent years elearning in its many forms has proliferated. Massive Open Online Courses (MOOCS) are nowadays mainstream, many (especially Professional Development, short courses and seminars) are being offered free of charge.

My first personal experience of distance mode education was my studying part-time in the early 1980's (while I was teaching full-time at a Further Education college) for a degree at the Open University (OU) UK. Materials (notes, books, assignment specifications) came by post. Technologies used were TV programmes and occasional multi-connection (about 5 students) on the telephone with a support tutor. The tutor was available for face-to-face with students once a fortnight but with geographical distances as well as work obligations (in my case I was usually timetabled to teach evening classes which clashed with the tutor availability!). I only attended a tutorial session once, and I never visited the University itself. I attended two one-week long Summer Schools which helped with the revision. Despite the difficulties it was a great opportunity to be able to study while I was working at my own place, own pace and own time. However, studying through the use of static technology often resulted in feelings of isolation which could only be overcome by the sheer determination to study for a degree.

Silvester and Berki [22] in1999 presented a study on the continuous development and improvement of Open and Distance Learning (ODL), associated technologies and materials.

In 2006, Georgiadou and Siakas [23] studied the introduction of new technologies to enable distance learning and teaching emphasising that ODL offers opportunities to learners to study at their own place, own pace and own time. As shown in Table 1 there has been a regular introduction of new technologies to facilitate distance learning and teaching over the last 60 years.

Pedagogies and solutions to the challenges as well as the need to satisfy the internal Quality Assurance requirements in addition to the requirements specified by the UK Quality Assurance Agency (QAA) evolved alongside with technologies.

Pedagogical innovations nowadays incorporate open, distance mode, lifelong, flexible, asynchronous, interactive and blended learning. Interactive technologies enable the learner to participate in group discussions and group work, obtain feedback from the teacher and fellow students promoting group identity and belonging. Assessment methods and instructor training in the use of technologies, production of materials and pedagogic aspects as well as evaluation have become mainstream.

As a Principal Lecturer at the University of North London (now London Metropolitan University) I led the development and establishment of a distance mode top up degree with the approved college Hong Kong Computer Institute in 1997. From the beginning of the negotiations (March 1997) we needed to rapidly convert the face to face delivery to a hybrid mode with materials, lecture slides, past examination papers etc. available in both hard copy and electronically (via email). Although the scale of this example is minimal compared to what happened recently because of the Corona Virus pandemic, nevertheless the challenges created by the rapid transition, from the status quo at the time, was unprecedented. We had to devise and implement a new model very quickly.

Management commitment to the project enabled the rapid development and implementation of a hybrid model whereby one of our lecturers (the enthusiastic and versatile young lecturer then - our co-author of this paper Professor Eleni Berki) joined the partner Institute in Hong Kong for an intensive 8 weeks launching a rapid start in September 1997. Apart from taking part in the planning and management decisions, I also developed online materials and taught my module to my students who were based in London and in Hong Kong.

Table 1 – Approximate Introduction of Distance Learning Technologies (Extended from [23])

	Pre-1960s	1960s	1970s	1980s	1990s	2000s	2010s	2020s
Printed Materials	S							
Audio Tapes		S						
Video Tapes		S						
TV lectures			S					
Group telephone tutorial				I				
Video conferences (bilateral)				I				
Videoconferences (multiple simultaneous links)					I			
Internet based					I			
Multimedia					I			
Computer Supported Co-operative Work					I			
Virtual Learning Environments					I			
Pedagogic Frameworks						I		
Mobile Devices						I		
Learning Communities						I		
Communities of Practice						I		
VLEs							I	
Simulations							I	
Virtual Machines (VMs)								I

Key: S= Static, I=Interactive

This rapid development was a challenge. One of our major concerns was to ensure that the experience of the London based students was comparable to that of the Hong Kong based students. This was also a strict requirement by the UK Quality Assurance Agency (QAA). In subsequent semesters and years the course continued with the hybrid mode where every module lecturer spent one week of each semester visiting the Institute and teaching the students face to face. All students (London-based and Hong Kong based) took the same examination at the same (5pm in Hong Kong and 10 am in London).

In 2001, Berki and Georgiadou [24] presented a comparative study of the results from London based students taught face-to-face, the first Hong Kong based students taught in the hybrid mode (50% face-to-face and 50% distance mode, and a cohort with 15% face-to-face and 85% distance mode). This outcome-centred evaluation of the students' performance (in the 3rd year module Information Systems Development Methodologies), at three different stages namely before web-based materials were available, during their development and after the first version was fully developed and available on the web, indicated that students studying in different modes and in different countries achieve comparable results. The comparability of the results led us to conclude that the quality of experience and the quality of performance had not been compromised.

In subsequent years and at Middlesex University, I witnessed and participated in the development and delivery of many courses (at degree and Masters level) which evolved into distance mode, hybrid courses in tandem with the introduction of new technologies and pedagogies. Hatzipanagos et al. [25] looked at the use of the Internet for online learning and the problems that web-based learning technologies pose from the various stakeholders' (developers, educators, learners, technical support, and legislators) viewpoints. Empirical evidence gained from two successful implementations (led by the University of North London and by Middlesex University London respectively) were presented.

Changes and challenges engendered in conversion from one mode of education to another are usually incremental, gradual, evolutionary and over a long period of time. The rapid conversion required this time of the Corona Virus pandemic was fundamental, all-encompassing, disruptive, and demanding. It was thus inevitable that tensions would arise. Solutions found at such short time will most probably need to be re-evaluated and improved.

3.14.6 Contributed by Emerita Professor Margaret Ross, Solent University, and EurIng Geoff Staples, BCS.

We have personally been involved in converting courses from traditional to hybrid and fully virtual courses since the late 1980s. We decided to offer as "distance learning" courses, those leading to the external BCS certificate, diploma and higher professional diploma at the level of 1st, 2nd and 3rd year degree courses [27, 28],

which we had run for several years previously as a Day-release for an intensive version lasting one year and also as evening classes over three years.

These remote lectures were the traditionally modified but extended physical lectures that were posted in envelopes to the students. This was a very slow process with photocopying, filling the envelopes and posting to all of the continents with the exception of Antarctica! The most lost envelopes that failed to arrive and needed re-sending were normally to South America. The students were also sent weekly links to relevant topical online material, and were sent weekly feedback exercises. These were sent back by the students by post or email. The externally set and marked BCS examinations were held at various centres in the UK and at various overseas locations.

We then moved gradually to electronic files which we sent to students instead of the physical envelopes. This was not popular initially with the students who felt they had problems with Internet access and the reliability of power and felt that they needed to print the files so issues of poor quality printers and the cost incurred of paper and ink were raised. We continued as this was more economic and time-efficient for the relevant lecturers and course supervisor (Margaret Ross), and we no longer needed a secretary to assist us.

A further remote only top-up honours degree course in computing, aimed at students that had completed the BCS examinations or a relevant HND (Higher National Diploma) was established [29, 30]. This could be completed in one or two years using online communications. The students had to pass both elements of assessment and closed book examination for each unit. The students were expected to travel to Southampton for the examinations, but special arrangements could be made if problems, such as with a visa application, existed then special arrangements could be made such as at a local British Embassy or Consulate. The students could have one-to-one communication with the Course Supervisor or the Tutors at pre-agreed times.

We have not been personally involved in converting courses from hybrid to fully virtual. The only hybrid course was a two year MSc Six Sigma course, with attending at weekends about every six weeks, and with regular Internet based weekly tutorials at a time convenient to the students. These were often on a Saturday or Sunday evening. The assessments were reports with presentations submitted on discs.

Solent University also offered distant mode courses BSc and hybrid MSc courses before the pandemic. There were also self- study units provided for all the students on a general study and technical skills, such as preparing CVs, covering letter for job applications, referencing, academic writing and mathematics.

The full range of business/IS computing, for the BCS and BSc courses, including programming, databases, systems analysis and design, security, project

management, ethics, user design were involved. The subject areas for the hybrid MSc Six Sigma course, of which both Margaret Ross and Geoff Staples were lecturers, included statistics, academic research and writing, ethics, and parts of the syllabuses for the Six Sigma yellow, green and black belt. These also involved various quality management tools and methods, including Quality Functions Deployment, Cost Benefit Analysis, Root Cause Analysis, statistical techniques and representations [31, 32, 33].

There were tensions initially between on-campus and off-campus provision**.** The majority of the full-time lecturing staff did not wish to be involved with then "distance learning" or hybrid courses so a number of suitable external part-time lecturers supplemented the four full-time staff, which included Geoff Staples and Margaret Ross [34]. It was felt that each remote student took a larger proportion of the lecturer's time than a comparable full-time student and many lecturers did not like the evening or weekend remote tutorial and physical sessions.

On the question regarding staff having capabilities to produce materials and use online modes of teaching it must be emphasised that in the past we developed the skills over a considerable number of years. Changes were made to modify the material taking account of the students' access to new software and hardware as well as changes in computing. In the traditional attending classes, we had been using Panopto to record explanations associated with every PowerPoint slide. This was welcomed by the students, particularly those who did not have English as their first language, and those that had hearing or sight problems and those that had missed a session [35]. The use of multi-choice questions, with hand held devices issued to each student [36] was also used in the lectures, although the time to distribute and collect back these devices was a major disadvantage. Training was provided for lecturers to use these new techniques in class and how they could be used for remote students. These training courses were regularly provided by the dedicated e-learning department of the university.

The organisation of the "distance learning" courses was arranged by the Course Supervisors in conjunction with the lecturers and, in the past, with some clerical assistants. The assessments and examinations for these "distance learning" courses were managed through the normal university processes, with internal moderation then external vetting by the External Examiners. There were the normal arrangements for these "distance learning" courses, of double marking of assessments and examinations, as with the conventional attending courses that took place. Finally, the results of the "distance learning" courses also were considered by the appropriate Examination Boards. Any changes and the annual monitoring of these "distance learning" courses were carried out under the normal University procedures.

The difference of our 40-year long experience to the experiences and challenges faced during the Corona Virus pandemic is that in the past changes happened over a period of years whilst the recent crisis demanded fundamental changes overnight.

4.0 Consolidation of Research Findings

4.1 Tabulation of findings

The main aim of this research study was to collect and share first hand experiences and opinions from educators across different countries, different specialities and different educational sectors. In the process much learning was achieved (Learning achieved being one of the stages of any Action research as shown in Figure 1).

In order to establish commonalities in practices and the use of technologies for both developing materials and for enabling communication for synchronous learning and teaching it was decided to tabulate the results (see Tables 2,3,4, and 5). It is evident that across all countries there was considerable infrastructure within the HE sector as well as experience of using VLEs prior to the Corona Virus pandemic. Although we cannot conclude that these results apply across the whole country in each case, we can see some emerging patterns.

As can be seen from **Table 2** Moodle is used by 8 out of the 14 participating countries whilst specialised development technologies, like Labster (for simulations) are used only in 1 country.

Table 3 shows the use of Communication technologies. It can be seen that Zoom (a relatively new platform) is widely used and so is Moodle and Microsoft Teams.

By far the most useful and relevant finding to the focus of the paper i.e. Challenges of rapid transition can be seen in **Tables 4a, 4b, 4c show t**he problems experienced were time pressure, extra workload, lack of resources and lack of experience (especially in the secondary and primary education sectors), no or poor access to the internet etc.

Other problems that emerged included: Library staff not skilled and capable to adapt to provide the online library services required, legal issues concerning virtual methods of examination, lack of co-ordination, unclear instructions.. Laboratory and clinical courses were cancelled.

Finally **Tables 5a, 5b, 5c** summarises best practices (solutions) reported from the different countries.

Several innovations were introduced by the educators such as the use of Labster for simulations particularly instead of actual laboratory experiments.

Difficulties were observed in the explanation of the material using examples traditionally solved on the board in the physical classroom. One professor reports: "To solve this, I have created step-by-step animations to present them (was not an easy task)."

Tables 2, 3, 4a, 4b, 4c, 5a, 5b, and 5c sumamrise the research findings. Similarities in approaches, use of development tools and communication technologies as well as problems encountered can be seen in the body of the paper but also in these tables.

5.0 Selected Related Published Research Reports: An Appraisal of their Main Focus and Findings.

A number of related research studies on the impact of Corona Virus in all levels of education have been published nationally and internationally by governmental authorities of a few countries or by institutes worldwide. We briefly refer to them next. UNESCO [37] and OECD [38] as well as a few other organisations worldwide have published online detailed reports on the impact of COVID-19 on education worldwide.

Similar research questions were asked by most of them though the focus is on different items. Common research questions: How distance learning opportunities were realised and which communication tools or learning platforms used by students during school closures?

1. What were the parents, teachers and principals' perceptions of schools/homes challenges and needs?
2. To what extent schools and teachers collaborated with the learners?
3. What were the further needs for teachers' and students' support?

Table 2: eLearning Platforms and Educational Tools										
Countries	Moodle	Blackboard	Kaltura Newrow	Labster	Google Classroom	D2L Brightspace	Microsoft Teams	Panopto	EduPage	G Suite
1. Armenia	✓				✔					
2. Bosnia-Herzegovina	✓						✔			
3. Cyprus	✔	✓	✓	✓	✓	✓	✔			
4. Denmark		✔								
5. Finland	✔				✔		✔			
6. Greece	✔									
7. Ireland	✔	✔				✔	✔	✔		✔
8. Nigeria							✔			
9. Russian Federation	✔				✔		✔			
10. Slovak Republic	✔						✔		✔	
11. Spain	✔				✔					✔
12. Sri Lanka					✔					
13. United Kingdom	✔	✔	✔	✔			✔			

Table 3: Communication Technologies													
Countries	**Moodle**	**Blackboard**	**Kaltura Newrow**	**Labster**	**Webex**	**Google Classroom**	**Zoom**	**Microsoft Teams**	**Skype**	**Big Blue Button**	**Adobe Connect**	**Whats App**	**Viber**
1. Armenia						✔							
2. Bosnia-Herzegovina							✔		✔				
3. Cyprus	✔						✔	✔					
4. Denmark		✔											
5. Finland	✔					✔	✔	✔				✔	✔
6. Greece	✔				✔				✔	✔			
7. Ireland	✔	✔					✔	✔					
8. Nigeria								✔					
9. Russian Federation	✔				✔	✔	✔	✔	✔			✔	✔
10. Slovak Republic	✔				✔		✔	✔	✔				
11. Spain	✔				✔	✔	✔				✔		
12. Sri Lanka						✔	✔						
13. United Kingdom	✔	✔	✔	✔			✔	✔			✔		

Table 4a: Tensions/Challenges/Problems									
Countries	**Time pressure**	**Extra workload**	**Lack of resources**	**Lack of experience**	**Understanding new modes of examinations**	**No prior experience**	**No or limited access to the internet**	**IT Issues**	**Other issues**
1. Armenia	✔	✔							
2. Bosnia-Herzegovina	✔	✔							Library staff was not skilled and capable to transform to provide the online services required
3. Cyprus	✔	✔			✔	✔			Difficulties were observed in the explanation of the material using examples traditionally solved on the board. “To solve this, I have created step-by-step animations to present them (was not an easy task).” Of course, problems have arisen in the invigilation of examinations.
4. Denmark	✔	✔	✔	✔		✔		✔	

Table 4b: Tensions/Challenges/Problems

Countries	Time pressure	Extra workload	Lack of resources	Lack of experience	Understanding new modes of examinations	No prior experience	No or limited access to the internet	IT Issues	Other issues
5. Finland	✔	✔							The well-being of staff and learners was a constant worry; expected self-directed learning did not fit to everyone; in terms of resources and resource-based learning there were many differences among families' socio-economic background – schooling normally equalise these differences but in the absence of schooling the amplification was inevitable; great variations were revealed regarding the easiness of a subject's online transformation mode (e.g. languages were easier than maths, physics, chemistry).

Table 4c: Tensions/Challenges/Problems									
Countries	**Time pressure**	**Extra workload**	**Lack of resources**	**Lack of experience**	**Understanding new modes of examinations**	**No prior experience**	**No or limited access to the internet**	**IT Issues**	**Other issues**
6. Greece	✔	✔	✔	✔	✔	✔		✔	Legal issues virtual ways of examination. Laboratory and clinical courses were cancelled.
7. Ireland	✔	✔				✔			
8. Nigeria		✔	✔			✔	✔		On-going university sector strikes Poor or non-existent infrastructure poverty
9. Russian Federation	✔	✔		✔	✔	✔	✔	✔	Lack of control during tests and exams
10. Slovak Republic	✔	✔		✔		✔	✔		Lack of coordination
11. Spain	✔	✔	✔	✔	✔	✔	✔		Not clear instructions Lack of coordination
12. Sri Lanka	✔	✔	✔	✔	✔	✔	✔	✔	Lack of coordination
13. United Kingdom	✔	✔	✔		✔				

Table 5a: Best Practices			
Countries	**Teaching**	**Assessment**	**Management**
1. Armenia	Teaching using Google Classroom platform	Examinations using the Google Meet tool	Online Teaching Strategy implemented four years ago
2. Bosnia-Herzegovina	Practical parts of education such as laboratory works were done in face to face way.		Legal basis to perform the whole education process online. Started with online education as soon as the situation became dangerous for students and staff, even before the state was locked down
3. Cyprus	Step-by-step animations were used to present problem solving exercises. Online synchronous classes was done using WebEx		Free equipment (hardware and software) for students coming from poor families. Of course, problems have arisen in the invigilation of examinations. To solve this, I have created step-by-step animations to present them (was not an easy task).
4. Denmark			A comprehensive database providing guidance to tutors engaged with online teaching
5. Finland	The use of Open Educational Resources; adaptation to the new reality with or without the support of technology; the availability and rich variety of new teaching and learning materials	Assessment and feedback mechanisms were differentiated towards a more personal basis e.g. through WhatsApp, phone calls, etc. Too early to categorise as but expected that teachers become more acquainted with their students and their learning conditions.	The teachers' trade unions active role in successfully communicating the collective members needs to the management; the collaboration of private and public educational providers for the availability of open/free, cost-effective learning material resources

Table 5b: Best Practices			
Countries	**Teaching**	**Assessment**	**Management**
6. Greece	Division of the students in small groups in order to attend the lab and clinical courses following the safety rules and regulations	Online oral exams in groups of four, participating in a discussion	
7. Ireland	Synchronous interactive online classes using the Virtual Classroom software, Blackboard Collaborate Ultra. Group and individual student meetings via Zoom	Take-home and open-book exams to replace traditional in-person exams	A Digital Campus with a flexible model of education that includes blended and online learning. Continuously updated FAQs for staff and students.
8. Nigeria	General Strike in Education which started before the eruption of the pandemic		

Table 5c: Best Practices			
Countries	**Teaching**	**Assessment**	**Management**
9. Russian Federation	Google Classroom, Moodle: sharing various teaching materials, monitoring, dead-lines ZOOM, Skype: live communication with the opportunity to discuss relevant issues and share Power Point presentation and any texts	Formal requirements to assessment Google Classroom: monitoring written tasks ZOOM, Skype: live communication with the opportunity to share examination materials and talk with an examinee WhatsApp, Viber: prompt availability and responds	Staff meetings, sharing experience, monitoring
10. Slovak Republic	Everyone could freely choose from the many that suited him best.		
11. Spain	A forced but quick adaptation to virtual teaching. Surprising increase in interest on the part of some students with poor results in face-to-face teaching.	Diversification of the tools used: Google Forms, monitoring written tasks using Google Meet, etc.	Online teaching from the beginning of the lockdown Provide computers and internet connection to those students who did not have them.
12. Sri Lanka	Use of Camtasia		
13. United Kingdom	Use of Labster for lab simulation Online education videos were shared with students	Alternative Assessments (comparable results)	Dedicated unit , seminars, workshops, licenses

The findings were similar especially on the following: Teachers responded with dedication to the challenge of distance learning but they also found many difficulties in socio-technical collaboration with other stakeholders groups. Additionally, many inequalities were maintained and in some cases students' mental health and learning gaps worsened. Motivation and engagement were difficult in these exceptional circumstances [39].

A number of needs became apparent and many recommendations were expressed for addressing these needs, including the following: teachers' professional development, families' socio-technical and psychological support, hygiene trainings for all, guidance for learning at home, digital competencies and the list can go on. A school Principal expressed one of these needs in the following words: "The biggest message I'm sending home is: Make sure that kids are reading at home." [40]. Particular emphasis on teachers support to master the challenges has been placed on better digi-pedagogics and teaching skills, worldwide. In the EU many Universities emphasised the strong impact of Corona Virus in international collaboration and research and teaching exchanges [41]. Along the same lines adult education organisations in Europe try to continue activities as much as possible to reach out to learners from vulnerable groups.

"One question currently unites all educational sectors in Europe: how can learning and teaching be organised during the COVID-19 pandemic in Europe, and how can marginalised groups be included? Measures to contain the outbreak forced schools, universities, adult education centres and other educational institutions to suspend all face-to-face learning offers [42]. Apparently and unfortunately, barriers to learning that have existed for learners from vulnerable groups before the pandemic are reinforced through the rules for "social distancing".

6.0 Concluding Reflections, Research Limitations and Future Work.

A pandemic is naturally a multifaceted, fast evolving and complex problem impacting on the safety of human life, well-being, the global economy, the environment, all societal and cultural norms, and everyday activities. Most of the Universities were largely prepared as they had the infrastructure and considerable prior experience of using modern technologies for hybrid delivery (combining face-to-face and on-line elements) both locally and internationally. Staff knowhow and availability of resources including technical support were already in place. Hence the rapid transition was not as painful as that experienced by the primary and secondary sectors. These sectors in all 13 participating countries faced by far the most serious challenges. Teachers were largely unprepared and parents,

especially those from the non-affluent strata of society, were unable to support the leaning of their children. Inequities, inequalities, social exclusion, the digital divide and economic deprivation in general, which existed prior to the pandemic crisis (even in countries like the UK - sixth largest economy in the world) were exacerbated and brought to the fore. Some schools and local authorities and some governments rose to the challenge and provided resources such as laptops for children whose families could not afford them.

Kress [40] in 2020 stated: "*With the news changing daily and more and more schools closing, school leaders are scrambling to address a situation for which they have no playbook: doing what they can to reassure and support students and teachers, striving to keep education going in some form during closures, and trying to process all of it themselves. They are at once improvising and relying on previously drafted disaster plans, tending to logistics and worrying about what students will eat and how they will learn.*"

Drs Berki and Valtanen (section 3.6.4.2) conclude: "In summary, it turned out that the school's environment is a much more important place for pupils and students than a place to just collect study points and passing grades. The school was remembered as a place where pupils and students learn how to build socio-technical and communication skills and maintain social relationships, to exchange thoughts and ideas, to find and build own identity as active learners, and to grow and mature as human beings. Educators as well as many pupils and students were genuinely missing school."

Evidently teaching and learning of discursive subjects (e.g. social sciences, classics, and languages) were more readily converted. More challenging is the case of practical and experimental sciences. See section 3.7.1 (by Dr Agouropoulos) for an example from Dentistry (a field teaching is provided through theoretical, laboratory and clinical courses). Simulations were used mainly for technical subjects.

Dr Adam Edwards (section 3.14. 3) shares the following thought about the future role of libraries and library scientists: "It is a very curious situation for a Librarian to be in, working from home and not working in the library they manage. Our profession is perhaps uniquely one directly associated with a specific place. 2020 is breaking that link and going forward our future is even more as "knowledge navigators" in a virtual rather than physical world of information".

PhD scholar Maria Panteri (section 3.7.5) provides the following observations. "In conclusion, I consider that despite the fact that the changes which occurred in education were sudden and somewhat violent, this whole evolution gave the education system a new impetus to the technological development and modernisation. However, in order to establish the virtual mode of education in the Greek educational system, we need to overcome several legal obstacles, which concern the protection of the personal data of students and teachers, the issue of examinations etc." Maria continues: "I believe that in the near future a mixed

learning plan will be adopted, trying to make full use of the traditional form of education and, in an alternative way, the virtual mode. However, with regard to special schools and students with special educational needs, things are quite different, as greater difficulties must be overcome (multiple family problems, technological illiteracy, behavioral difficulties, distraction). For now, the adoption of virtual education for students with special educational needs is further away".

Professor Jury Panov and Galina Zamaraeva (section 3.10.1) remind us "Virtual classroom can provide us with some good instruments ...but it can't replace real face-to-face communication with students. We believe that education is not just about knowledge but also mentoring, sharing emotions and life experience. We hope the world will find the ways to win the struggle against COVID-19 to bring learning, studying, teaching, mentoring back into our University classrooms."

Dr Nickos Paltalidis (section 3.14.4) concludes: "The world will not be the same after this crisis, we will not be the same after this crisis, and higher education institutions and higher education systems will not be the same after this crisis. Digital will have a role to play. It is already clear that the pandemic has created a permanent shift towards digital teaching. After the pandemic, we will come back with a much more widely shared understanding that digital tools are complements, not substitutes, for the intimacy and immediacy of face-to-face learning. Online education will be recognized as core to every school's plan for institutional resilience and academic continuity."

Dr Andreas Savva (section 3.4.1) also reflect :" This epidemic has definitely changed the way in which we perceive education. Even though in the future we will still be offering courses in a face-to-face mode or online mode or even a combination, one thing is for sure: Education will not be the same again!

Professor of classics Mary Plastira (see section 3.7.3.), although she did convert to new and innovative methods of teaching and examining her students, she shares an anxiety/misgiving many of us felt at this time of the sudden switch to the virtual model: " … Yet, as I confided to my students, I missed a lot of the traditional teaching, even things which, if strictly judged, were not positive. Their sleepy faces and their yawns at times (my classes were usually 8.30 to 11.00 a.m.), the seeking of clarification from the nearby student, the expressions which declared either that I had my audience hooked or bored to death, their looks of confusion…In other words I missed the human in flesh at the opposite end who looks at you and whom you look at and communicate directly both through the speech and the language of the body. Nevertheless, a sign of a more intimate positive reaction under the new circumstances should not be omitted. It is the warm "Thank you" when the session finished, which was something I seldom experienced in class".

In the same vein of thought, Dame Mary Beard (Professor of Classics at the University of Cambridge, UK, a fellow of Newnham College, and Royal Academy of Arts Professor of Ancient Literature) in the BBC Radio 4 programme *Point of View*, (June 21st 2020): "The end of university as we know it?" asks whether the

iconic university lecture might have had its day, in the aftermath of the pandemic. As she approaches retirement, (in two years from now) she recons: "*over my career I've done getting on for 2000 lectures .... I doubt I'll be doing another before I retire*." [43].

Dr Dili Ojukwu (section 3.9.1) provides a sobering reminder that while in advanced economies we are largely preoccupied with indulgent thoughts of the latest technologies, and lockdown deprivations, in countries like Nigeria the deprivation is of a totally different order of magnitude, not least the lack of sufficient infrastructure, and the unreliable access to power. "There is also the issue of the level of poverty in the country. A lot of students do not have the resources to acquire laptops and smart phones to enable them to participate in remote learning activities. And even some of those who have these gadgets find it challenging paying for the data to enable them access online materials on an extended basis as there are no free wireless services in the country." This reminder challenges us to reflect and consider our social, economic and ethical responsibilities at a global level.

Some of the rapid changes in education brought about by the Coronavirus pandemic were indeed already happening in an evolutionary manner over the last 40 years (sections 3.14.5 & 3.15.6) during which there have been considerable developments of technologies and associated pedagogic models. However, the need for a rapid transition to fully virtual education presented all stakeholders (developers, technical support, educators, learners, their families, as well as legislators) with immense challenges. The requirements of the various stakeholders, their Weltanschauungen (worldviews) and approaches are different, sometimes synergistic, sometimes conflicting. Some changes in practices and local implementations are likely to become part of the new normal. Based on our research findings presented in this paper, it is safe to observe that at least for the immediate future a hybrid model will emerge that must combine adaptability, flexibility, and agility in order to ensure preparedness and readiness to face future challenges.

In this paper, we sought to gather and share information on first hand experiences and challenges faced mainly by educators across 13 countries. The contributions from the 33 co-authors of this paper provided a snapshot which could reasonably be considered (but not necessarily generalised) across the 13 countries represented. Some good practices and solutions to the challenges are common across all 13 countries. There is considerable variability within the primary and secondary education sectors as these were the sectors least prepared and least ready to implement changes in such a short period. There were disparities in teacher knowhow and in socio-economic inequalities which were exacerbated by the onslaught of the pandemic.

We can see from the individual experiences of the co-authors what development platforms and communications technologies were used, what the major local challenges were and what practices and innovations were developed. We could see

(with our educators' eyes that students and pupils had to also quickly adapt to the new environment. However, the next step will be to seek to learn what the experiences of students were from the learners' eyes, from these same countries.

Such a rapid and somewhat violent transition was inevitably difficult, laborious and a type of culture shock. Professor Kerstin Siakas (section 3.7.2) emphasises: "I strongly believe that education in the future will be personalised, ubiquitous and pervasive. Pedagogic student-centred trends and technological developments, such as Social Media Learning, Artificial intelligence, Gamification, Serious games, and Augmented and Virtual reality, have paid the way for this. Research has shown that educators lag behind students in the use of technology. Today's students have grown up with computers and are native users of them. This means that educators need to be trained in the use of new technologies so that they can make the most of technology for the sake of improved learning."

Technologies can facilitate matters but they are not the sole answer. There was indeed lack of preparedness let alone of readiness to face the onslaught of the Coronavirus pandemic. Lack of preparedness is usually due to the perception that the risks are low. Donahue et al. [44] in 2014 cite literature which provides evidence that politicians underinvest in mitigation because the electoral payoffs are higher for bringing in disaster funding through postdisaster declarations to provide help. Finally, all stakeholders and society as a whole, indeed the whole world 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.

Ours and others' research studies have had a specific focus on certain issues that were first time-met and/or were new conditions for managing the sudden change and transfer demanded from reality to virtuality. In the desire to adapt and function well and overcoming any technical or pedagogical (or other) obstacles many other dimensions of the learners' and instructors' wellbeing were rather forgotten. For instance, there were/are not so many critical voices on people's privacy and monitoring/surveillance online [45] and the protection of their personal credentials [46] such as passwords, email addresses, usernames, photos, and the list can go on.

While the (educational) world moved online cyber-criminals also moved online. Bulling was decreased in the physical learning boundaries but increased in the cyber-world's boundaries. Phishers and other cyber-criminals [47] were more active during the Covid-19 crisis and many citizens were deceived online to give in their bank account numbers to buy effective educational software or more email space or peaceful virtual life. The worrying issue is that the cyber-criminality [48] (appears in many communication tools and e-learning platforms and many developing or developed countries' citizens do not have the technical know-how and the socio-technical competencies to recognise, for instance, phishing emails and protect themselves.

Moreover, there has been inadequate related research or research studies that do not prioritise these emerging safety issues. Unfortunately, neither state initiatives existed (to our knowledge) during the Coronavirus crisis aiming to increase public awareness. Moreover, no parallel initiatives appeared, or seem to have been planned by the governments and Ministries of Education for the students' and teachers' privacy protection and cyber-security trainings. There are still notable missing security gaps for interacting and learning online.

The parents, educators, headmasters, principals and policy makers should prioritise also on the security and not just the functionality, easiness and usability [49] of the pedagogical applications and communication tools. Researchers should also dedicate time and resources in the future to invest on this matter, as an issue of well-being in general. Security together with usability [50] as important quality properties should be required, designed, realised and tested in any piece of online educational software; and should be checked against very specific and certain quality criteria [51].

Most, and gradually all, educational institutions faced the laborious challenge of migrating from traditional face-to-face or hybrid education to fully virtual/distance/open/online delivery within an exceptionally short time. Remarkably the transition was to a large degree successful due to the dedication of the academics and the co-ordinated support provided by management and technical support staff.

Changes and challenges engendered in conversion from one mode of education to another are usually incremental, gradual, evolutionary and over a long period of time. The rapid conversion required this time of the Coronavirus pandemic was fundamental, all-encompassing, disruptive, and demanding. It was thus inevitable that tensions would arise. Decisions and solutions reached under such immense time pressure will most probably need to be re-evaluated and improved.

We have taken a snapshot of how as educators we were challenged, how we were changed and how we experienced and implemented the rapid transition from the status quo to a totally virtual pedagogic model, in future, we propose to carry out localised research to collect views and reactions from our pupils and students who lived through this unprecedented period of change in a general atmosphere of danger, fear and the need to continue their studies.

7.0 Declaration

The views and conclusions contained in this paper are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied.

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