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The Impact of Rapid Adoption of Online Assessment on Students' Performance and Perceptions: Evidence from a Distance Learning University

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Abstract: One of the most sensitive changes faced by universities due to the COVID-19 crisis was the remote assessment of student learning. This research analysed the case of a massive distance learning university that rapidly changed the final assessment (*N*=126,653 undergraduate students in 2020) from face-to-face exams to entirely online exams. The research focused on the influence of online assessment on academic performance and students' perception of the new method. Two data sources were used: the contrast of academic performance indicators (assessment, success and achievement rates, and average marks obtained) between the online examination call and the previous ones with face-to-face examinations; and a questionnaire to a sample of students (*n*=714) on their perception of the online assessment experience. The results show that all the academic performance indicators in the 28 Bachelor Degrees offered at the university increased when the final assessment method turned to online due to the pandemic crisis; and that a majority of students are more favourable to online assessment methods. The discussion places these findings in a context of rapid change, and concludes by identifying the possible implications of online assessment for student retention, organisational challenges, as well as possible further studies.

Keywords: e-learning, distance education, online exams, online assessment, students' performance

1. Introduction

The approach to learning assessment is a key aspect in the pedagogical model of higher education institutions. Therefore, universities are very cautious about moving towards digital assessment methods. Changes are usually made with appropriate timing, allocating the necessary resources and valuing their contribution to the quality of education. But the context for introducing digital innovations in universities was altered by COVID-19 (International Association of Universities, 2020; Naffi, 2020; United Nations, 2020), so at that time the transition from campus-based methods to remote teaching practices took place without having time to plan and evaluate the impact of the changes.

There is much evidence to suggest the influence of using different assessment methods —face-to-face, online or blended— on the learning cycle of higher education students (Gikandi, Morrow and Davis, 2011; Ferrell, 2013; Guerrero-Roldán and Noguera, 2018; Tawafak, et al., 2018). And therefore it is to be expected that a change in assessment format —from a face-to-face to an online method— will have some impact on students' performance.

Considering these reflections, in this paper we analyse the impact on students' performance of introducing an accelerated change in the final assessment of students in the case of a massive distance university, which moved from a face-to-face examination-based system to a fully online mode in June 2020, as a consequence of the pandemic. It is worth to notice that the only change was in the assessment system, as the courses were already taught at a distance before, and during, the pandemic. We aim to answer the following research questions:

- Research question 1 (RQ-1). Has the new online final assessment method had any influence on students' performance?
- Research question 2 (RQ-2). How has the sudden change resulting from COVID-19 influenced students' perceptions towards assessment?

In the first place, we introduce the background to the reasons that make it difficult for universities to implement digital assessment systems. We also explore the literature on the relationship between digital assessment and performance in higher education. This is followed by a case study at the *Universidad Nacional de Educación a Distancia* (National Distance Education University, UNED, Spain), where a final online assessment system was

applied due to the COVID-19. We aim to provide evidence about the impact of the rapid adoption of online assessment that can inform further reflection and decision-making about assessment methods that can be used.

2. Barriers to digital assessment in higher education

Examples of digital assessment include proctored exams, multiple-choice digital tests, virtual reality simulations, standardized tests, video performances, and digital portfolios. There is a lot of research on digital assessment, focusing on the application of some of these variants in different contexts (Vani and Gupta, 2016; Smith, 2017; Daffin and Jones, 2018; Nardi and Ranieri, 2019; Makransky, et al., 2020; Alyahya and Aldausari, 2021). In general, the results point to the integrity of remote assessment processes and a number of associated advantages (Gray and Ferrell, 2013; Timmis, et al., 2015; Okada, 2019): better engagement from students; staff can choose the timing for their assessments; students can choose when and where to undertake assessments; more efficient management of assignment submissions, marking and moderation; better storage and archiving of student attainment records; ability to improve existing "human" or solely paper-based methods of marking. But, in the case of higher education and despite the abundance of evidence, only a few universities have implemented any online assessment system. It has been mainly in the open and distance universities that most pilot tests have been implemented (Conrad, 2013; Chaudhary and Dey, 2013; Guàrdia, Crisp and Alsina, 2017; Gil-Jaurena, Domínguez and Ballesteros, 2020), while face-to-face universities are reluctant to overcome the many obstacles to digital assessment. In any case, a recent study about assessment in mega universities shows that "online assessment is reported to be applied at a 'low' level" in 4 of the 7 analyzed open universities (Karadag and Ozgur, 2020, p. 44).

There are a variety of inhibitors that explain the low presence of digital assessment in universities (Bacow, et al., 2012; ENQA, 2015). On the one hand, there are barriers on the academic side. Digital assessment practices require a very different type of educational organisation from the conventional one (Voogt, et al., 2013). They are part of a digital scheme where the educational agents must use communication tools and procedures for the delivery of learning tasks, which are very different from the usual dynamics in the classroom. There are also doubts about the academic reliability of online assessment tools, which lead to questions about the quality and validity of the assessment as a whole. These doubts have been addressed by different forms of proctored digital assessment, but they depend on sophisticated software which is difficult to implement (Langenfeld, 2020). And finally, there is a concern about the complexity involved in adapting assessment tools that are based on different software, each with its own configurations, and which do not always meet the requirements demanded by teachers to assess different types of skills and knowledge. For example, in the case of experimental science studies (Pilli and Aksu, 2013; Faber, Luyten and Visscher, 2017; Dalby and Swan, 2019), there is a concern about the delivery of tasks with mathematical formulations and which demand different time management than those of assessment tests in the field of humanities or art studies (Cheng, et al., 2013; Soffer, Kahan and Livne, 2017).

On the other hand, a second type of barrier of a regulatory and normative nature, is also mentioned in the literature. It is only recently that quality assurance agencies have paid attention to online evaluation (Appiah and Van Tonder, 2018; Foerster, Gourdin and Huertas, 2019; Quality Assurance Agency for Higher Education, 2020). Without the necessary regulatory support, it has been difficult to advance the use of online assessment methods, as in many cases instructional design is tied to specific standards (Ferrão, 2010; Stödberg, 2012; Charteris, et al., 2016).

3. Academic performance in digital assessment

As universities use more digital assessment tools, there is more research analysing their effects on student performance. The main variable to consider when analyzing performance is the control of exams and tasks that are performed remotely. This is because there are many doubts about the integrity of the online assessment processes, which are beyond the direct —physical— control of the teachers. Doubts about integrity lead to the assumption that students can cheat in exams, and as a result their performance will be higher. However, evidence indicates that, in general, students do not cheat on online tests and exams more than on face-to-face ones (Raines, et al., 2011; Ellis, 2012; Fask, Englander and Wang, 2014; Arnold, 2016; Hylton, Levy and Dringus, 2016; Chen, West and Zilles, 2017).

From there, another dimension analysed is whether control over examinations and assessment tests has any impact on student performance. Most research focuses on proctored online examinations, which are the most common way of controlling the assessment process in digitally mediated situations. But the results are

inconclusive: there is ample evidence indicating better assessment results when online exams are not proctored than when they are proctored (Milone, Cortese, et al., 2017; Alessio, et al., 2018; Daffin and Jones, 2018); while other research (Eyal, 2012; Stack, 2015; Hylton, Levy, and Dringus, 2016) indicates a high dependence on the academic conditions in which the exams are administered. Also, proctored —versus non-proctored— exams are perceived by students as more difficult and anxiety-generating, especially in the case of webcam-controlled exams (Kolski and Weible, 2018).

In addition to process control, various other uncontrolled factors that can influence student performance in digital assessment have also been analysed. For example, the influence of attitudinal (Elmehdi and Ibrahem, 2019) and anxiety-related issues (Stowell and Bennett, 2010), the impact of the exam environment (Hollister and Berenson, 2009), student procrastination (Levy and Ramim, 2012) or engagement (Bertheussen and Myrland, 2016) have been analysed.

Research results are inconclusive on whether online examinations are determinative in one way or another of student performance. Eventually, a review of the literature suggests that performance depends on classic academic variables, such as the context in which the examinations are held, the configuration of the assessment tests and how they fit into the learning design. The fact that assessment exercises are proctored does not seem to influence the grade obtained either, with results indicating different levels of performance depending also on academic variables.

4. Methodology

4.1 Research context

The main objective of the research is to determine the influence on students' performance of the change in the final assessment system at UNED, from a face-to-face to an entirely online examination system. To better understand the impact of this change on students, the research also aims to understand the influence of the speed of change, since the online assessment system was suddenly introduced as a result of the COVID-19 crisis.

Normally, the final assessment at the UNED was based on face-to-face examinations held in the study centres located in Spain (65 centres) and abroad (19 centres). The change in assessment method meant that teachers had to convert their final face-to-face examination into a digital web-based examination. To this end, the UNED offered two digital assessment systems. One of these was applied mainly to courses with a low number of students enrolled, and consisted of using the assessment facilities available in the university's learning management systems (LMS). This solution involved adapting a digital infrastructure that was already in use. The second option was a new digital assessment system on which we focused on this work. This is a proctored testing platform created by UNED in order to scale up the large number of tests that had to be taken online due to the pandemic. The number of online exams that took place in the new e-assessment proctored platform was about 188,000. Table 1 presents the characteristics of the final assessment methods before and during the pandemic. We remind that the only change was in the assessment system, as the courses were already delivered at a distance mode before the pandemic.

Table 1: Final assessment methods at UNED before and during the COVID-19 crisis

Key issues	Usual scenario	COVID scenario
Delivery of the courses.	Distance mode.	Distance mode.
Final assessment system.	Face-to-face exams. Teachers prepare exams that students take in the UNED regional centres.	Proctored online exams. A cloud-based application was designed with user access via the web. Teachers prepare exams, and students take them online from anywhere.
Type of exams.	Different types of exams can be prepared (MCQ, essay or open-ended questions, or mixed).	Different types of exams can be configured (MCQ, essay or open-ended questions, or mixed).
Time to complete exams.	The examinations were conducted synchronously. Limited response time control (maximum 2 hours, minimum 1 hour).	The examinations were conducted synchronously. Limited response time control (maximum 2 hours, average 1 hour).

Resources allowed in the exams.	Normally students cannot introduce or use any material (books, class notes) in the exam classroom.	Some teachers designed open-book online exams.
Integrity of the assessment process.	The integrity of the process was guaranteed by the exams being invigilated (by teachers and support staff from the regional centres). No electronic devices are permitted.	Integrity was ensured through control procedures that prevented students from cheating: camera shots during the exam, no copy and paste in the application, reduced time to complete the exam compared to the time available in the face-to-face mode.

To clarify and monitor (for quality assurance purposes) the academic aspects associated with the transition from an analogical to a digital assessment system on a mass scale, the university designed a protocol that included guidance for the teaching staff. The university's premise for its professors was to apply the same academic criteria established in the study guide for each course, making the least number of changes to the structure of the assessment, even though it was now online: i.e., if the original classroom exam was a multiple-choice questionnaire (MCQ) to be completed in one hour, the online assessment should be similar; if the classroom exam included a MCQ section and an essay section to be completed in 2 hours, the online exam should have the same scheme.

The transition from one system to another did not cause any organisational difficulties, although the context of the COVID-19 led to a consensus among the teaching staff that the design of the new online exams would not lead to increased difficulty. The aim was to avoid greater stress for students, considering the difficult situation associated with the pandemic.

In terms of the availability of technological infrastructures and the digital skills of students, teachers and support staff, the context of a distance university means that these needs are essentially covered. During the enrolment process, students are asked about the need for connectivity to access online learning. Similarly, teachers and support staff are trained to operate in fully online contexts.

4.2 Participants

The final online assessment system was implemented mainly at the undergraduate level —at UNED, Master's Degree studies are mostly based on continuous online assessment—, so research is focused on Bachelor's Degree students at UNED.

According to university statistics, in 2019-2020 the number of students enrolled in undergraduate studies was 126,653. In 2019-2020 UNED had a total of 158,782 students enrolled (see Table 2).

Table 2: UNED students enrolled in Bachelor Degrees and the total set (Source: UNED data centre)

Year	Undergraduate students	Total students at university
2015	143,255	190,019
2016	142,807	185,194
2017	136,791	172,319
2018	128,867	162,720
2019	129,124	163,481
2020	126,653	158,782

UNED offers 28 Bachelor Degrees, listed in Table A-B in the Appendix and also shown in figures 2, 5, 6 and 7. The number of students enrolled in each program varies, ranging from 27,510 students in the Bachelor Degree in Psychology to 477 in the Bachelor Degree in Engineering Information Technology.

4.3 Data collection methods

Two sources were used to obtain the data that meet the research questions:

1. Information from the university's Data Management Office. To respond to RQ-1, information was collected from the UNED data centre on student performance in the last six-year cycle. All data refer to

the June evaluation call, which corresponds to the second semester. The data collected were grouped according to a set of key indicators related to the academic performance of students (see Table 3).

Table 3: Key indicators of students' academic performance

Indicator	Description
1. Assessment rate (AR).	How many students took the course final assessment examinations. Increased student participation in assessment tests is positive in determining performance.
2. Success rate (SR).	How many students (of those who were assessed) passed the course. If the number of students taking the subject and passing it is high, it is positive in determining performance in that subject.
3. Achievement rate (Ar).	How many students passed the course, on total enrolment. If the number of students who pass the course (in this case in aggregate, considering all those enrolled) is high, it is positive for determining performance in that course.
4. Average mark in the course (AM).	Including the final exam and other required activities. The mark can range from 0 to 10, being 5 the pass score. A high average mark in the course indicates better performance.

2. Data from a survey addressed to enrolled students, about their perception of the rapid change in assessment methods at the university. To respond to the RQ-2, we designed a survey for the students, most of whom had participated in the final online assessment of the UNED Bachelor Degree courses, in the June call, during COVID-19. The survey included questions about previous experience with online exams, the conditions under which they took the exams, perception of the time for completing the exam, difficulty, anxiety, control/invigilation, and preferences about assessment modalities. The survey included closed questions, Likert-type questions, and an open-ended question for additional observations the students would like to express. The survey was announced in the digital spaces of the courses once the exams had finished, during the second half of June 2020. And it was also distributed in the social networks of the research team and collaborating professors. The data collected was screened for reliability: repeated answers or replies sent several times were eliminated, as well as rare cases (such as the selection of the same answer in all the questions or answers inconsistent with the questions asked). It resulted in the number of valid responses of n=714 (from 725 original replies). The sample includes students from 20 Bachelor Degrees, with a higher representation of students in the Social Sciences area. Only 4 of these respondents had not participated in the final online assessment.

5. Results

The results derive from the analysis of data from the two research data sources. Firstly, data on student performance over the past six years measure the impact of the change in assessment method during COVID-19. As described below, the analysis of these data in response to RQ-1 takes two forms: aggregating all Bachelor's Degrees and measuring the variability of performance indicators in the last six years; and disaggregating each Bachelor's Degree and performance indicators into these degrees.

The second analytical framework concerns data from the survey of Bachelor Degree students who participated in the new online assessment. In response to RQ-2, only the items referred to students' perceptions of the sudden change in the final assessment method because of the COVID-19 have been considered.

5.1 Overview: general evolution of academic performance indicators

The information in Figure 1 provides an overview of the evolution of four academic performance indicators in the cycle over the last 6 years, aggregated for all UNED Bachelor Degree courses. The data for the year 2020 correspond to the online assessment method, whereas the usual face-to-face examinations at UNED were used in the previous 5 years, from 2015 to 2019. In 2020 the academic performance of students increased in all 4 indicators by between 10% and 15%.

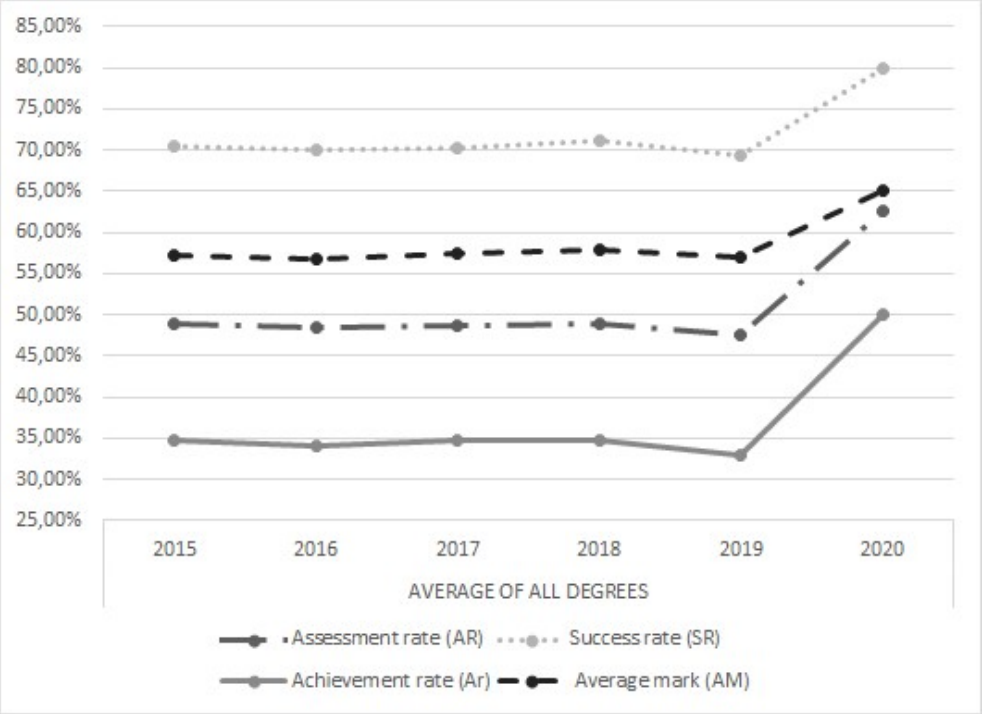

Figure 1: Evolution of academic performance indicators in UNED students. Aggregated data from all Bachelor Degree courses between 2015 and 2020 (Source: UNED Data Management Office)*

* To include all the indicators in the same figure, the value of the Average Mark (AM) has been weighted to 100% based on the information provided in table 3. So here a score of 0 points is equivalent to 0%, and a score of 10 points to 100%.

The following sections present the results by breaking down the data from the two sources mentioned. For a better understanding, the information is grouped around each performance indicator. Figures 2, 5, 6 and 7 have a similar structure: they show, for each Bachelor Degree, a line that represents the increase in each indicator, being the origin of the line on the left the average of the indicator score in years 2015 to 2019, and the end of the line on the right the indicator score in 2020. The figures highlighted in each figure reflect the increase (the difference between the two values, also available in Table A-B in the Appendix). We also performed one-way ANOVA tests on each undergraduate degree, marking with an asterisk in the corresponding figures (2, 5, 6 and 7) those degrees that show statistical significance (p<0.05) and where the null hypothesis –that there is no difference between means– is rejected.

5.2 Assessment rate (AR) results

The AR is a very relevant indicator to be considered in this study due to its relation with students' engagement in the courses. From a stable rate below 50% in the previous 5 years, in June 2020 this indicator has increased up to almost 65% (see Figure 1, and the details in Table A-B in the Appendix).

To deepen the analysis, the comparison between the value of the AR indicator during the cycle of the last 5 years in each degree —the reference value is an average of these 5 years—, when the final assessment was the face-to-face one, and the value corresponding to the same indicator in 2020, when the final assessment was online, is shown in a disaggregated way in Figure 2.

The students who have increased their assessment rate the most (24.09%) are from the Bachelor Degree in Criminology. In contrast, those who had the lowest increase in the AR are from the Bachelor Degree in Physics (8.58%). The average increase in AR for all Bachelor degrees was 14.42% (*SD*=4.02).

Coinciding with the online exams, all Bachelor Degrees experienced an increase in the student assessment rate in 2020 compared to the average of the previous 5 years. The increase was significant in 24 out of 28 degrees (85.7%). The mean increase in AR for all Bachelor Degrees was 14.42% (*SD*=4.02). The AR increased the most in

the Bachelor Degree in Criminology (24.09%; p=0.00 significant), while it increased the least in the Bachelor Degree in Physics (8.58%; p=0.39 non-significant).

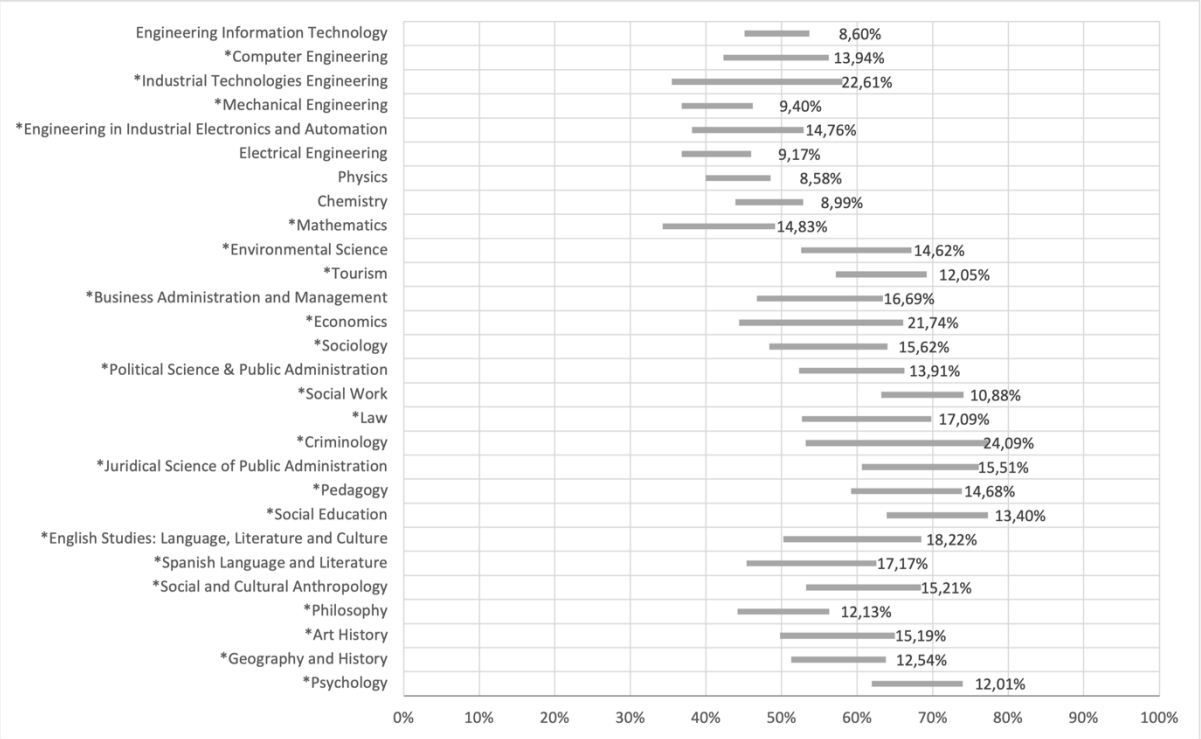

Figure 2: Assessment Rate: Average score from previous years with face-to-face exams *versus* score with online exams (Source: UNED Data Management Office)

* The difference is statistically significant (p<0.05 in one-way ANOVA)

The data from the survey on students' perceptions provide a complementary view related to the RA. Students were asked what influence the fact that the method used was online had on their decision to participate in the final assessment (Figure 3). A majority of students said it had no influence at all (64.8%), followed by those who felt encouraged to participate (24.0%), and a minority felt discouraged (11.2%). This is directly related to students' perception of online assessment, with a positive impression (predominantly "no influence" or "positive influence" responses). Eventually, this could explain in academic terms the higher participation rate in the exams. However, the possible projection of these results to other domains should consider the context of the research, as well as the possible biases of a sample composed mainly of students who took the exams and excluding those who did not, who may also have been discouraged by the new online exam format.

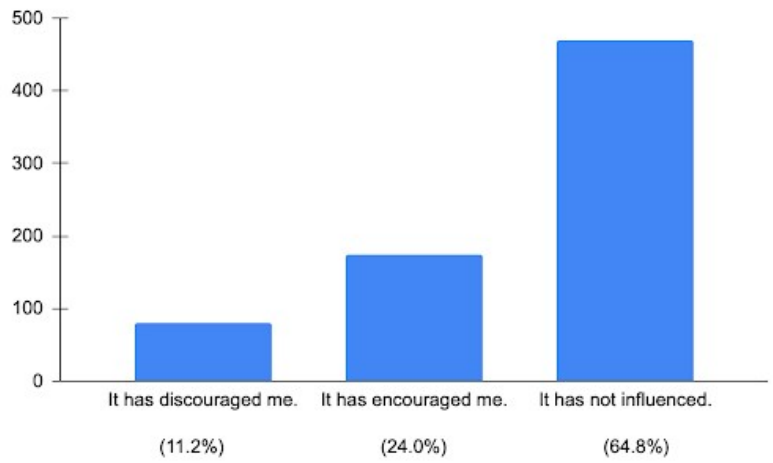

Figure 3: Data from the item: Has the fact that the exams are online influenced your decision to take them?

Figure 4 also shows the data from the survey items on students' preference between online and face-to-face exams. The majority of UNED students prefer online exams (54.3%) to face-to-face exams (39.9%), with a small percentage expressing other preferences (5.8%). Although this is significant, it should be noted that the context is that of a distance university, where there is a clear preference for digital methodologies.

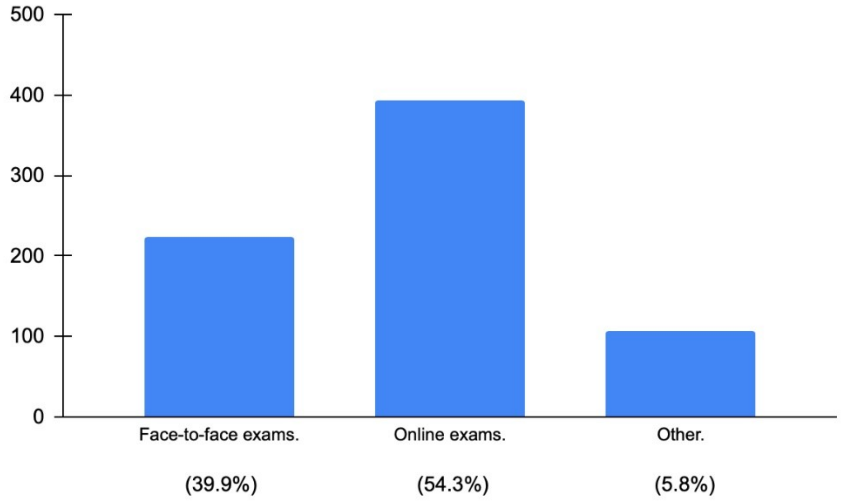

Figure 4: Data from the item: What assessment method do you prefer for taking the final exams?

5.3 Success Rate (SR) results

The SR indicator also increased with the new online assessment method (see Figure 5). The average increase in the success rate was 10.12% (*SD*=2.76). The increase was statistically significant in 10 out from the 28 Bachelor Degrees. This means that the percentage of students who passed the courses among those that were assessed was significantly higher in 35.7% of the Degrees. The Bachelor Degree with the highest increase in SR was Criminology (19.33%; *p*=0.00 significant), and the one with the lowest increase was Political Science & Public Administration (6.91%; *p*=0.30 non-significant).

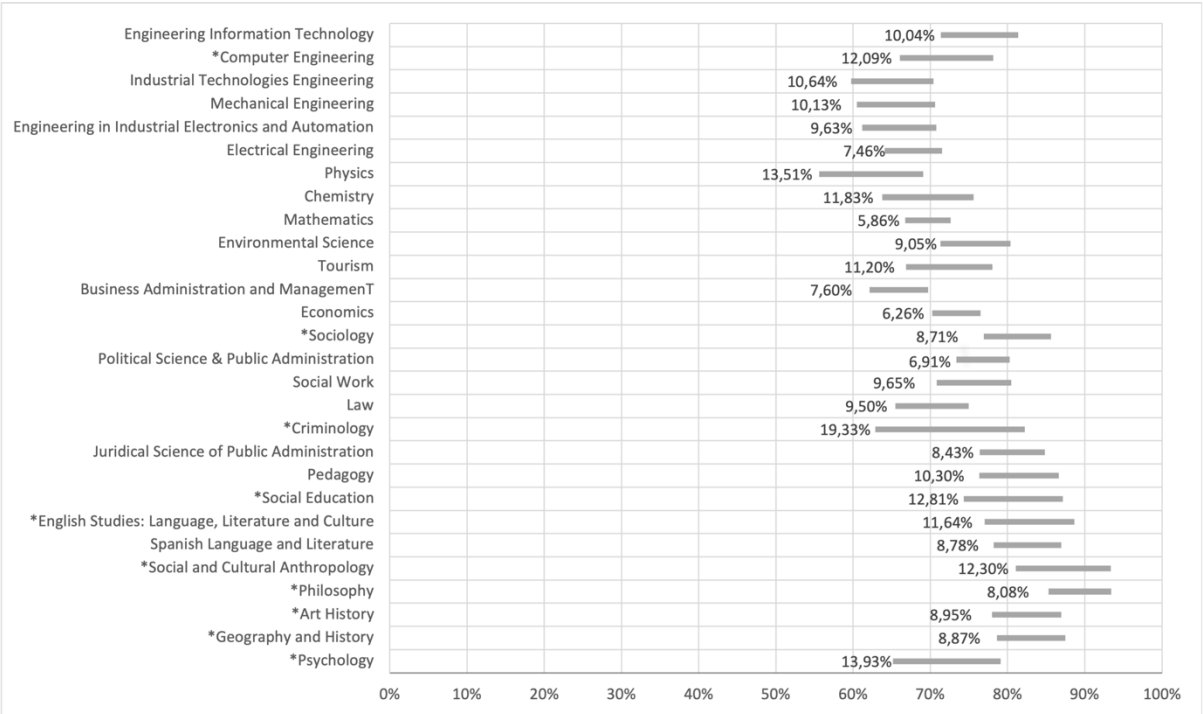

Figure 5: Success Rate: Average score from previous years with face-to-face exams *versus* score with online exams (Source: UNED Data Management Office).

* The difference is statistically significant (p<0.05 in one-way ANOVA)

5.4 Achievement Rate (Ar) results

The Ar, which derives from the previous two indicators (assessment rate and success rate), has consequently increased, as well (see Figure 6). The increase was statistically significant in 24 out from the 28 Bachelor Degrees (85.7%), and the detailed data indicate maximum increases of 30.62% (p=0.00 significant) in the Bachelor Degree in Criminology, although the highest figure is in the Bachelor Degree in Social Education with 67.54%. The lowest increases are those of the Bachelor in Engineering Information Technology with 8.40% (p=0.55 non-significant), with the Ar in that Degree in June 2020 below 50%. The average rise in Ar for all the Degrees was 16.01% (*SD*=5.67).

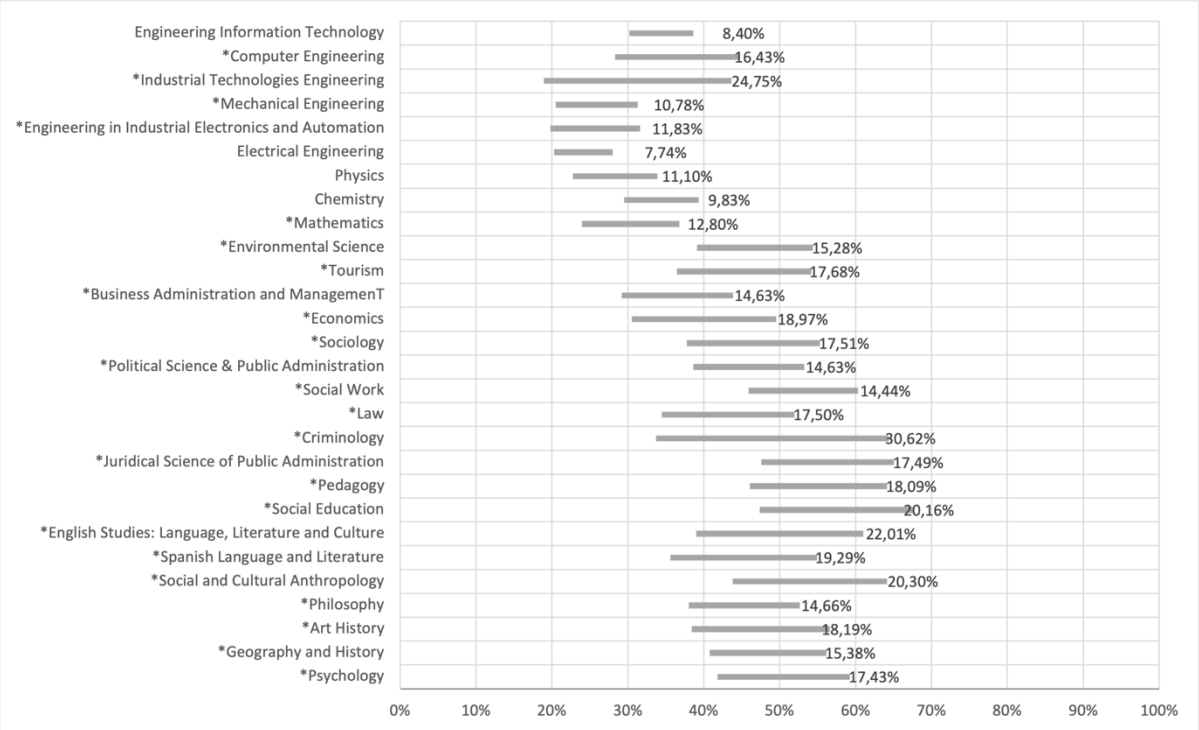

Figure 6: Achievement Rate: Average score from previous years with face-to-face exams *versus* score with online exams (Source: UNED Data Management Office)

* The difference is statistically significant (p<0.05 in one-way ANOVA)

5.5 Average Mark (AM) results

The impact of the online assessment on AM was also high (see Figure 7). The increase was statistically significant in 50% of the degrees (14 out of 28 degrees), with the highest increase in Criminology (1.51 points; p=0.00 significant), and the lowest in Electrical Engineering (0.14 points; p=0.92 non-significant). The average increase in all the Degrees was 0.8 points (*SD*=0.28). In all the cases, the Average Mark is over the pass score (5 points), which was not the case in previous years in two of the 28 Bachelor Degrees, in the Engineering area.

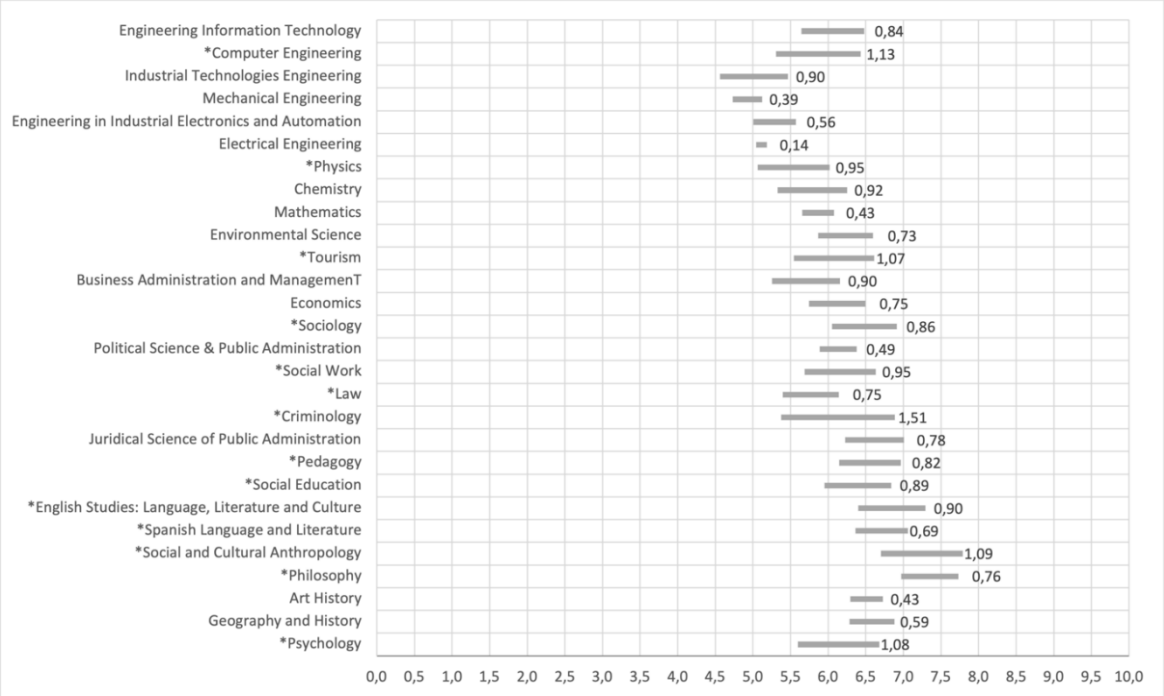

Figure 7: Average Mark: Average score from previous years with face-to-face exams *versus* score with online exams (Source: UNED Data Management Office).

* The difference is statistically significant (p<0.05 in one-way ANOVA)

The improvement in grades is paralleled by students' perception of the online assessment method as difficult. This would be adding value to the improvement in scores, in terms of the reliability of the examination system. The data from the Likert scale in Figure 8 show that a majority of students consider online assessment to be no easier than face-to-face assessment (39.5% strongly disagree; 24.3% disagree), with 25.7% thinking it is the same. In addition, the effect of a possible use of the survey by students to condition the difficulty of exams in the future could also be considered.

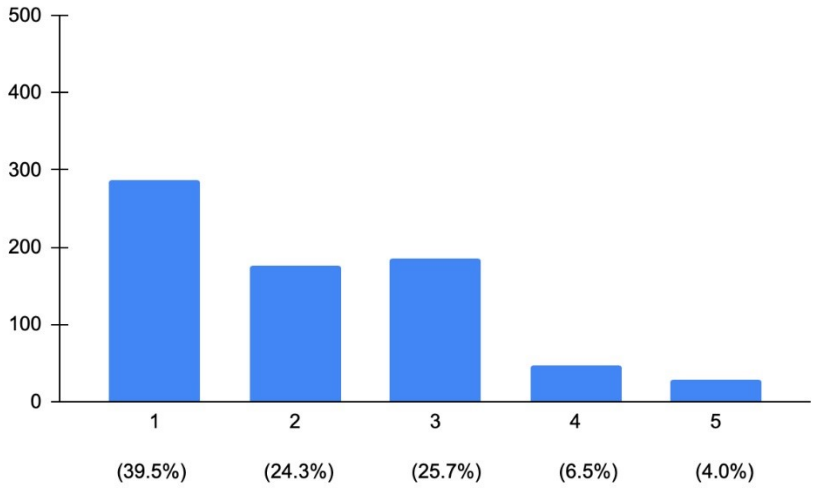

Figure 8: Data from the item: Are online exams easier than face-to-face ones?*

* (1) Strongly disagree; (2) Disagree; (3) Neither agree nor disagree; (4) Agree; (5) Strongly agree.

Also, the time variable is one of the most mentioned in the scientific literature on the integrity of proctored exams. It is also stressed that more time in exams does not improve student performance in terms of higher scores (Portolese, Krause and Bonner, 2016). On this occasion, Figure 9 shows a clear majority of students who

stated that the time available was short (60.2%), followed by those who had sufficient time (31.1%) and, residually, those who claimed to have more time than necessary. These results indicate that the high-performance scores were achieved under conditions of time constraints.

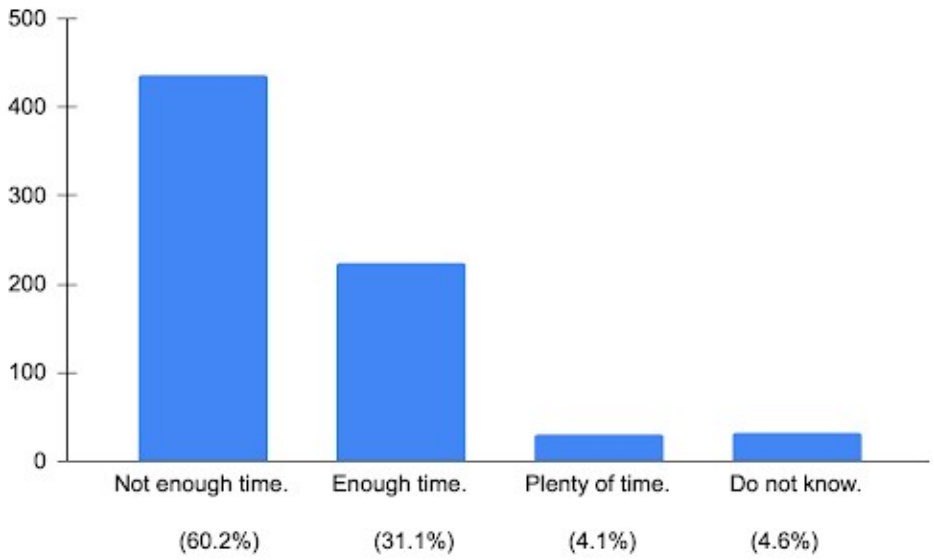

Figure 9: Data from the item: Have you had enough time to take the exam?

6. Discussion

Digital learning assessment methods have proved to be useful in improving teaching, mainly because of their flexibility and ability to adapt to individual student situations (Timmis, et al., 2015; Pauli and Ferrell, 2020). However, studies on its impact on academic performance have been inconclusive, and the only common element in the scientific literature is the strong link between performance and the academic conditions that frame online assessment —i.e., rapid organisational change, prior training of students in assessment, circumstances in which exams are held, etc.—. In the study presented here, the positive effect of online assessment on student performance is clear. And eventually, analysis of the findings must also consider the impact of academic conditions on outcomes.

The main evidence found is in response to RQ-1, since the results indicate a direct relationship between the use of an online assessment method and the performance improvement in all the indicators. So it is in the response to RQ-2 where the aspects related to the academic scheme of online assessment should be considered.

In the case of UNED, the academic issues that conditioned the online assessment revolved around the emergence of change as a consequence of the COVID-19. In addition, the speed of change also affected the type of technology and the assessment process in each case.

The results show that the improvement in performance indicators coincides with a high appreciation of online assessment by students; there are a residual number of students discouraged from taking exams when the system changed from face-to-face to online (Figure 3). The research suggests two factors that may explain the improvements, and these are provided below.

- The online assessment under analysis took place in June 2020 during the COVID-19 crisis that, in the case of Spain, led to a situation of population confinement. In this context, many distance students may have taken advantage of the slowdown in socio-economic activity to spend more time on academic activities. This situation may have altered the results, making it necessary to further study the impact of online assessment under “normal” circumstances.
- Another circumstance that can explain the positive results in performance is the protocol applied to design the exams. Due to the rapid change, teachers simply replicated the face-to-face exams in the online format, and tried to avoid extra difficulties for the students. It is possible that the online exams that were finally designed were less difficult than the original face-to-face version. Again, this possible

bias calls for alternative research on successive cohorts of students and also adding analysis of the process of test design by teachers.

The fact that research is contextualised in a distance university also has an impact on the acceptance of online assessment, as students eventually appreciate the ease of not having to travel to the examination centres. In this sense, the results are consistent with previous studies that highlight the preference of university students for online exams (Attia, 2014; Matthíasdóttir and Arnalds, 2016; Böhmer, Feldmann and Ibsen, 2018; Pagram, et al., 2018; Butler-Henderson and Crawford, 2020), and specifically in the context of distance learning universities (Gaytan and McEwen, 2007; Kim, Smith and Maeng, 2008; Yang, et al., 2017).

Another topic of discussion is the influence of online exam time on performance. According to the results of previous studies, this research also points out that students attach great importance to the time available. Here their perception is that examination time has been low (Figure 8), although, contrary to the results of other studies (Portolese, Krause and Bonner, 2016), the scores (average mark, see Figure 7) have been higher than in face-to-face exams with the same time available. Previous research relates time available to anxiety levels, and indicates that perceived negative factors about the dynamics of an online exam decrease after students have tried the system (Kumar, 2014; Kolski and Weible, 2018). While this study does not address the anxiety variable, it does reinforce students' concerns about the apparent lack of time to take exams and the difficulty that comes with it.

Another issue of interest concerns differences in performance in the various undergraduate degrees at the university. There is not enough evidence to establish sets of Bachelor Degrees with different performance values, since in all cases the scores on the indicators increased and in a majority of them (85.7%) the increase in assessment (AR) and achievement (Ar) rates were statistically significant. The lowest increase is the indicator Average Mark (0.14) in the Bachelor Degree in Electrical Engineering, and that is a degree where the average scores are usually very low (5.04). This reinforces the conclusion that the increase in the set of indicators in all cases is due to the general academic context —in the variables already analysed, and other potentials not covered in this research— and also to the accelerated change in the assessment method in a more specific way.

Finally, it is worth discussing the role of cheating in research results. The scientific literature highlights doubts in the integrity of online assessment due to the possibility of cheating, among other factors. In the study, this weakness attempted to be controlled by looking at the different control mechanisms (technological, time, question focus, process monitoring, etc.) that were applied in the UNED online exams. Table 1 shows the control technologies employed, and evidence was also collected on the difficulty of limiting the time available to take the exams (see Figure 9), which affects the intentionality to cheat in online performance situations (Capraro, 2017; Kubesch, Lankes and Maurer, 2019; Van der Cruyssen, et al., 2020).

7. Conclusions

The aim of the research is to take a broader view than the purely technical one of the consequences on academic performance of changing the assessment format —use of an online versus a face-to-face system—, incorporating academic factors —organizational context and students' perception of rapid change— which, according to the literature review, are also decisive in explaining student performance. To this end, data were collected from the first cohort of students using an online assessment system at the UNED.

The first research question focuses on the influence of the new online examination system on student performance. The study concludes that there is an increase in the academic performance of students who have taken the online exams in all the indicators analysed, and that the differences are statistically significant, specially in Assessment and Achievement rates (in 24 out from 28 Bachelor Degrees in each rate). Success rate and Average mark have also increased with the online assessment that was in place in 2020, but the differences were statistically significant in 50% (AM) and 35.7% (SR) of the Bachelor Degrees. The second research question focused on the possible change in students' perceptions of online examinations after experiencing the new method. And the research concludes that improvement in academic performance also coincides with a better perception by UNED students of online assessment as opposed to face-to-face assessment. In addition, the online format encouraged them to take the exams, although they did not perceive the online version to be easier and found the short time available a particular difficulty.

The contribution of the study to the issue of the integrity of the online assessment process is limited. However, the results of the survey on students' perceptions of online assessment point to a more difficult, time-sensitive and generally more complex system than face-to-face examinations. In this sense, the data indicate that students do not perceive online assessment as easy, with lower quality and less control. And in the specific case of distance learning universities, the most relevant academic aspect resulting from students' acceptance of the online method is the increase in Ar, considering that in distance learning higher education the number of students enrolled who pass the course is usually lower than in face-to-face universities.

There are also limitations when it comes to attributing a motivational capacity to online exams. In the research, students expressed a favourable tendency towards online exams, insofar as they had no influence or minimal incentive to take them (Figure 3) and are preferred over face-to-face exams (Figure 4). However, this effect seems to be more related to the context of a distance learning university —where students are more likely to opt for any non-face-to-face alternative— than for online exams *per se*. So, based on the data from this research, a conclusion on this aspect would require further inquiry in conventional face-to-face learning situations.

A possible implication of the implementation of the online assessment and the increase in academic performance is an expected reduction of dropout in the medium term. The significant increase in the achievement rate (figure 6), which means that a higher percentage of students pass a course, can positively lead to a higher enrolment in the next year. This impact on retention has a great significance in distance education, where dropout has been a permanent challenge (Garrison, 1987; Aretio, 2019).

The findings show that the students' academic performance in all the indicators and all the Bachelor Degrees has improved, and that the general opinion of the students who responded to the survey is good about the online system. The question then is how this experience will inform and drive long-term organizational change. In the case of UNED, the online final assessment system was also implemented in the September 2020 call and throughout the 2020-2021 academic year. But is this still an emergency solution, and will exams be held again face-to-face as long as the pandemic allows? Will online exams continue to be the main final assessment system after the COVID-19 crisis? Will online and face-to-face exams coexist in the future?

On the horizon, organisations are faced with questions about improving the reliability of online examinations, and administrative barriers related to agencies and quality standards. How to overcome these barriers and take advantage of the benefits of digital assessment will be factors to be analysed in the near future.

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Appendix

Table A: UNED students' academic performance indicators (AR, SR). Disaggregated data for all Bachelor Degrees, 2015-2019 and 2020 (Source: UNED Data Management Office).

	Assessment Rate (%)			Success Rate (%)		
Bachelor Degree	**2015-19 Average**	**2020**	**Difference**	**2015-19 Average**	**2020**	**Difference**
Psychology	61.95	73.96	**12.01**	65.16	79.09	**13.93**
Geography and History	51.27	63.81	**12.54**	78.62	87.49	**8.87**
Art History	49.83	65.03	**15.19**	77.98	86.94	**8.95**
Philosophy	44.16	56.29	**12.13**	85.33	93.42	**8.08**
Social and Cultural Anthropology	53.23	68.43	**15.21**	81.07	93.37	**12.30**
Spanish Language and Literature	45.36	62.53	**17.17**	78.18	86.96	**8.78**
English Studies: Language. Literature and Culture	50.26	68.48	**18.22**	77.02	88.67	**11.64**
Social Education	63.93	77.32	**13.40**	74.33	87.14	**12.81**
Pedagogy	59.21	73.89	**14.68**	76.34	86.63	**10.30**
Juridical Science of Public Administration	60.61	76.13	**15.51**	76.40	84.84	**8.43**

	Assessment Rate (%)			Success Rate (%)		
Bachelor Degree	**2015-19 Average**	**2020**	**Difference**	**2015-19 Average**	**2020**	**Difference**
Criminology	53.21	77.29	**24.09**	62.88	82.21	**19.33**
Law	52.71	69.80	**17.09**	65.45	74.95	**9.50**
Social Work	63.23	74.11	**10.88**	70.83	80.48	**9.65**
Political Science & Public Administration	52.33	66.25	**13.91**	73.37	80.28	**6.91**
Sociology	48.41	64.03	**15.62**	76.92	85.63	**8.71**
Economics	44.39	66.13	**21.74**	70.23	76.49	**6.26**
Business Administration and Managemen	46.74	63.43	**16.69**	62.12	69.72	**7.60**
Tourism	57.18	69.23	**12.05**	66.86	78.06	**11.20**
Environmental Science	52.59	67.21	**14.62**	71.32	80.37	**9.05**
Mathematics	34.30	49.13	**14.83**	66.75	72.61	**5.86**
Chemistry	43.91	52.89	**8.99**	63.78	75.61	**11.83**
Physics	39.96	48.54	**8.58**	55.59	69.09	**13.51**
Electrical Engineering	36.82	45.99	**9.17**	64.07	71.53	**7.46**
Engineering in Industrial Electronics and Automation	38.17	52.94	**14.76**	61.16	70.79	**9.63**
Mechanical Engineering	36.82	46.22	**9.40**	60.51	70.64	**10.13**
Industrial Technologies Engineering	35.48	58.09	**22.61**	59.76	70.40	**10.64**
Computer Engineering	42.32	56.26	**13.94**	66.07	78.16	**12.09**
Engineering Information Technology	45.11	53.71	**8.60**	71.33	81.37	**10.04**

Table B: UNED students' academic performance indicators (Ar, AM). Disaggregated data for all Bachelor Degrees, 2015-2019 and 2020 (Source: UNED Data Management Office).

	Achievement Rate (%)			Average Mark (1-10)		
Bachelor Degree	**2015-19 Average**	**2020**	**Difference**	**2015-19 Average**	**2020**	**Difference**
Psychology	41.80	59.23	**17.43**	5.60	6.68	**1.08**
Geography and History	40.76	56.14	**15.38**	6.29	6.88	**0.59**
Art History	38.40	56.60	**18.19**	6.29	6.73	**0.43**
Philosophy	38.02	52.67	**14.66**	6.97	7.73	**0.76**
Social and Cultural Anthropology	43.82	64.13	**20.30**	6.70	7.79	**1.09**
Spanish Language and Literature	35.61	54.90	**19.29**	6.37	7.06	**0.69**
English Studies: Language. Literature and Culture	39.02	61.03	**22.01**	6.40	7.29	**0.90**

	Achievement Rate (%)			Average Mark (1-10)		
Bachelor Degree	**2015-19 Average**	**2020**	**Difference**	**2015-19 Average**	**2020**	**Difference**
Social Education	47.38	67.54	**20.16**	5.95	6.84	**0.89**
Pedagogy	46.07	64.16	**18.09**	6.14	6.97	**0.82**
Juridical Science of Public Administration	47.60	65.09	**17.49**	6.23	7.01	**0.78**
Criminology	33.74	64.36	**30.62**	5.38	6.88	**1.51**
Law	34.46	51.95	**17.50**	5.40	6.14	**0.75**
Social Work	45.90	60.34	**14.44**	5.69	6.63	**0.95**
Political Science & Public Administration	38.62	53.25	**14.63**	5.89	6.38	**0.49**
Sociology	37.79	55.30	**17.51**	6.05	6.91	**0.86**
Economics	30.54	49.51	**18.97**	5.74	6.50	**0.75**
Business Administration and Managemen	29.21	43.84	**14.63**	5.25	6.15	**0.90**
Tourism	36.49	54.17	**17.68**	5.54	6.61	**1.07**
Environmental Science	39.10	54.38	**15.28**	5.87	6.60	**0.73**
Mathematics	23.98	36.78	**12.80**	5.65	6.08	**0.43**
Chemistry	29.52	39.35	**9.83%**	5.33	6.25	**0.92**
Physics	22.79	33.89	**11.10**	5.06	6.02	**0.95**
Electrical Engineering	20.26	28.00	**7.74**	5.04	5.18	**0.14**
Engineering in Industrial Electronics and Automation	19.80	31.63	**11.83**	5.01	5.57	**0.56**
Mechanical Engineering	20.50	31.28	**10.78**	4.73	5.12	**0.39**
Industrial Technologies Engineering	18.92	43.67	**24.75**	4.56	5.46	**0.90**
Computer Engineering	28.32	44.75	**16.43**	5.31	6.43	**1.13**
Engineering Information Technology	30.22	38.62	**8.40**	5.64	6.48	**0.84**

Distance Learning During the COVID-19 Pandemic: The Experience of Ukraine's Higher Education System

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Abstract: The COVID-19 pandemic has created a new paradigm of 'life in social distancing', which in its turn has had a massive impact on education. Continuing education delivery through alternative channels of instruction became a top priority for education institutions aiming to minimize impacts of the pandemic on education. Most universities shifted from conventional, face-to-face instruction to distance teaching and learning, which meant that teaching approaches, tools of assessments, and ways of teacher-student communication had to be modified. Since the pandemic wake, various global educational organizations have carried out studies to identify threats and potential opportunities for higher education within and beyond the pandemic. Some attempts to analyze the experience of the Ukrainian higher education system transition to mass distance instruction have also been made. However, this research was limited by a territorial or time span, sectoral analysis, or focus on specific issues. Lack of comprehensive cross-sectoral nationwide research regarding the perceptions of the main actors of Ukraine's higher education system (teachers and students) on outcomes of this abrupt transition, inspired the current research. In this regard, we saw the objective of the study in exploring the experience of mass distance learning application in Ukraine's higher education system due to COVID-19 and identifying considerations for e-learning in the national system of higher education within and beyond the pandemic. The research was carried out using a survey. The order of the researchers' actions was as follows: questionnaire compilation, data collection, data analysis, and knowledge generation. In this study, a closed-format questionnaire containing questions with pre-offered answers (multiple choices) was the main research instrument. The questionnaire was distributed to Ukrainian university teachers and students by snowball sampling. The data analysis phase involved analyzing the quantitative datasets. The interpretation of the analyzed information led to the generation of knowledge. 882 responses from 65 Ukrainian higher education institutions were received. The survey data showed that the mass transition to distance learning was a challenge for the majority of Ukrainian universities: only 45.5% of the respondents reported experiences with distance teaching/learning before the pandemic. On the basis of the obtained data, several groups of problems were identified: problems of a technological nature associated with the improper digital infrastructures of Ukraine's higher education institutions, unequal access of teachers and students to electronic devices and Internet connection; problems of a methodological nature associated with a lack of methodological support and special training programs for teachers to carry out distance instruction; problems of a psychological nature associated with the development of motivation, teachers' commitment, and establishing new communication patterns. The research supports the e-learning practice of providing data regarding the experiences of Ukraine's national higher education system on mass and the abrupt transition to distance learning and advances in e-learning knowledge area by envisaging potential for this mode of instruction beyond the pandemic and specifying directions for further research (development of the methodological, technological and informational support model for teachers; studies of the impact of digital learning tools on the mental health of university students; comparative analysis and adoption of the results of international studies into the practice of national education systems; creation of high-quality platforms with an accessible interface and algorithm of use).

Keywords: Ukraine's higher education system, survey, transition, experience, distance learning, the COVID-19 pandemic

1. Introduction

The COVID-19 pandemic as a major factor in the economic, social and mental transformation of the society has become a hot topic of discussion in the world. Social and physical distancing, restrictions on mobility, emergence of alternative forms of work and learning have had short and long term consequences in the global and national dimensions. The pandemic caused the largest malfunction of education systems throughout history, affecting nearly 1.6 billion students in more than 190 countries on all continents (United Nations, 2020). Following the

endorsement of national social distancing directives, education institutions had no option but to resort to distance learning environments and other e-learning resources (Gewin, 2020).

Although education systems were forced to undergo this radical and abrupt shift in teaching and learning and experienced disruptions and challenges, they quickly managed to respond to the force majeure situation, showing innovative approaches in support of education and training continuity. Moreover, the sector of higher education turned out to be among the most prepared to shift the majority of its processes to distance mode. The International Association of Universities (IAU) claimed that disruption caused by COVID-19 also gave an opportunity for higher education to reflect, change and innovate in order to adapt to meet arising societal needs (IAU, 2020).

Since the COVID-19 outbreak, many global and national educational and non-educational organizations have carried out research to analyze impacts, challenges and innovations caused by the pandemic on worldwide higher education (Education International, 2020; Marinoni, Land and Jensen, 2020; Pearson, 2020). Ukraine's higher education system being inextricably integrated into the global one has experienced similar difficulties and challenges. Many Ukrainian teachers had no experience of distance teaching before the pandemic. Therefore, they had to acquire an extensive set of skills over a short period, adapt content and structure of their offerings to new modes of instruction, and select the most efficient methods and techniques of instruction to encourage active distance learning. Several attempts have been made by Ukrainian researchers to analyze difficulties and achievements of the national higher education systems' transition to mass distance learning by which we understand "a method of study where teachers and students do not meet in a classroom but use the Internet, e-mail, mail, etc., to have classes." (Merriam Webster, 2021). However, this research has been limited either by a span of observation (one-time snapshots) (Nenko, Kybalna and Snisarenko, 2020), sectoral analysis (Skrypnyk, et al., 2020), or prevailing attention on a particular set of challenges (e.g., communication, psychological, etc.) (Kovtun, et al., 2021). The lack of comprehensive cross-sectoral nationwide research on manifold difficulties and challenges experienced by Ukrainian teachers and students as the main actors of emergency distant virtual educational environments motivated us to carry out this research. This study aims to explore technological, methodological and psychological difficulties and challenges experienced by Ukraine's higher education system and its actors (teachers and students) in the process of mass and abrupt transition to distance learning due to the COVID-19 pandemic outbreak. The data collected via Ukraine's nationwide survey, properly analyzed and interpreted aims to contribute to advancing the e-learning knowledge area in the global dimension.

2. Literature Review

Analysis of the research on the implementation of distance learning in the COVID-19 pandemic in the system of Ukrainian higher education showed that mass transition to distance education that involves the use of e-learning tools in the online environment was realized in extreme conditions to ensure continuity of the educational process. Most higher education institutions in Ukraine were not fully ready to implement mass distance learning, although regulations on distance learning in Ukraine were approved by the Ministry of Education and Science of Ukraine (MESU) in 2013 (MESU, 2013).

Sultanova and Zheludenko (2020) analyzed the potential of higher education in a crisis situation, explored drawbacks and prospects of digital education as a tool for sustainable development of society and social security of society. Nenko, Kybalna and Snisarenko (2020) identified the inconsistency of distance learning in Ukraine with the requirements of the society to modern information technologies due to "low funding of distant learning technology developments, necessity to upgrade computer equipment and facilities, limited access to the Internet for teachers, lack of adequate technical equipment and access to the Internet for students living in rural areas" (Nenko, Kybalna and Snisarenko, 2020, p.16). This is contrary to the view held by Skrypnyk, et al. (2020). The researchers concluded that with modern information opportunities it was possible to integrate distance learning into education. This could expand the creative possibilities of the educational process, ensure access to education without affecting its quality, increase the availability of knowledge, and the quality of fast-updating content, flexibility, mobility and modularity, which meets the requirements of modern higher education.

Prokopenko and Berezhna (2020) identified the difficulties and advantages of distance learning according to the results of an online survey of Ukrainian students and teachers of higher education institutions on socio-economic issues during the coronavirus. The researchers identified technical issues and psychological problems.

In order to find out problems, difficulties and advantages of the abrupt transition to distance learning in Ukrainian universities Nenko, Kybalna and Snisarenko (2020) conducted an online survey from 01 to 10 April 2020, with the participation of 540 respondents from three major higher educational institutions located in one of the Ukrainian towns (Cherkasy Institute of Fire Safety, Cherkasy Medical Academy and Bohdan Khmelnitsky National Pedagogical University). The authors outlined the current problems that had to be solved to ensure effective distance learning in Ukraine.

Another group of Ukrainian researchers (Grynyuk, et al., 2020, p.2920) held the survey among the university students learning English in four Ukrainian universities: Borys Grinchenko Kyiv University, Kyiv National Aviation University, Kyiv National Linguistic University and Kyiv National University of Trade and Economics. The total number of the respondents was 488. The survey diagnosed the level of psychological readiness of university students to study in conditions of mass and abrupt transition to distance learning and the impacts of new conditions of education on the performance of students. Among the problems that affect psychological readiness of students to study in the altered mode of instruction are the following: low level of motivation, the effect of technology overload, lack of self-discipline and social interaction, time planning, anxiety, perception of information and organizing the place to study.

Khomenko-Semenova, Alpatova and Prokhorenko (2020) studied the problems of the adaptation of humanities students to the conditions of distance learning. 182 respondents of the National Aviation University participated in the survey. The identified problems included the lack of live communication with teachers and group mates, and the absence of social activities at the university campus.

Ukrainian researchers, after examining the rapid transition to distance learning in the higher education institutions of Ukraine, have compiled recommendations. Nenko, Kybalna and Snisarenko (2020) thought that some measures should be taken. These measures include: development of the concept of distance education and the corporate network of universities; implementation of network tools (creation of electronic textbooks and teaching materials); training and retraining of teachers and staff in the methodology and information technologies of distance education; creating an electronic library and its integration into the corporate network of libraries in the region; membership into the International Association of Open Electronic Libraries and other relevant organizations; establishment of distance education centers in universities and unified inter-university system, aimed at “the development of uniform norms, standards, provide methodological support” to improve “the educational process, as well as conduct selective control of educational institutions” (Nenko, Kybalna and Snisarenko, 2020, p.17).

Grynyuk, et al. (2020, p. 2920) proposed to create “the most favorable conditions for students and teachers during the learning process and their full adaptation to training conditions”; provide “individually-differentiated approach to teaching”; create “a well-thought-out system of professional development and retrain teachers” (with organizational and methodological assistance; distant and networked forms of organization; mentoring, exchange of good practices and experience).

Analysis of the literature shows a wide coverage of the concept of "distance learning". At the same time, a gap in the psychological readiness of teachers and students for distance learning was revealed.

The research process aimed at identifying and eliminating the shortcomings of distance learning, the use of its typical tools determined the direction of the present study. The purpose of this study is to study the technical and methodological aspects of distance learning enforcement in the system of higher education in Ukraine. Technical aspects include the availability of software and sufficient equipment to organize the workplace of teachers and students. Methodological aspects are the availability of digital educational resources, methodological support for teachers in distance learning, teachers' experience in organizing distance learning (lectures and practical classes), teachers' competence in assessing the progress of students in the modified mode of learning. We consider these criteria as the key ones for distance learning.

The survey questions for the given study were developed by the team of scholars working over the problem. All in all, there were 4 sections and 30 questions. The current study represents only 4 questions out of 30.

3. Methodology

The study was carried out by a survey organizer - National Aviation University - within the framework of the research project "Potential of higher education in conditions of the pandemic: global, European, national dimensions" of the National Research Fund of Ukraine.

3.1 Research context

After the novel COVID-19 began its global assaults, Ukrainian Government introduced on March 12, 2020 a full lockdown in the educational sphere. Ukrainian education institutions of all levels (universities, colleges, schools) suspended their offline (face-to-face) instruction and abruptly shifted to distance teaching/learning, experiencing difficulties of the forced transitional period. What at first was viewed as a temporary, emergency precaution quickly gave way to a new normal, because the majority of higher education institutions in Ukraine did not manage to return to offline instruction when the 2020-2021 academic year started. As the pace of vaccination against COVID-19 in Ukraine is very low (according to official governmental data "About vaccination against COVID-19 in Ukraine" (Vaccination against COVID-19, 2021), on April 23, 2021, only 508 044 people had received their first dose, that represents only 1.25% of the 40 million Ukrainian population), it is very likely that the Ukrainian higher education system will keep distance instruction as the main mode of instruction in the following 2021-2022 academic year. In this regard, it is important to research impacts and challenges imposed by the COVID-19 pandemic on Ukraine's system of higher education after its forced and abrupt transition to distance teaching/learning in order to accumulate positive experiences and envisage ways for overcoming constraints and advancing e-learning.

3.2 Research design

The analysis of quantitative data begins with description. Appropriate methods are very simple, but at the same time extremely informative. Methods of descriptive statistics were used while conducting the research and solving the tasks. The method of statistical experiment allowed us to analyze the problem under study and process the empirical data with the necessary systematization. The sample – a part of the general population of elements covered by the experiment (observation and survey) – is representative. Thus, the article presents a concise and concentrated characteristic of the phenomenon under study, presented in the form of pie charts, a table and numerical expressions.

More precisely, to achieve the objectives of the research we chose a mixed multi-phased research design implying the use of quantitative and qualitative research methods. A quantitative method was used to process respondents' answers to the questionnaire. In a qualitative method, semi-structured interviews were carried out to gain insights on particular issues in focus group discussions. The study was characterized by four sequential phases: questionnaire compilation, data collection, data analysis, and knowledge generation.

3.3 Participants

The study participants comprised both representatives of teaching staff and students of higher education institutions of Ukraine. Teachers and students were eligible to participate in the study if they were involved in remote class during spring and autumn 2020. The total number of participants was 882. The study was conducted in compliance with the ethical research standards. Prior to the survey, all the participants were informed about the goals of the research and assured that their answers would remain confidential and would be used for the research purposes only.

3.4 Survey instruments

The questionnaire was chosen as the main tool of the online survey method. Practicability of the online questionnaire method was primarily stipulated by the conditions of the COVID-19 pandemic. Among other advantages of this method is the wide coverage of the audience (in our case, teachers and students of higher education institutions) and minimal time consumption.

The survey was conducted using a convenient tool - Google Forms (Vasantha and Harinarayana, 2016), which provided quick feedback from respondents in the form of answers to questions.

The chosen questionnaire method allowed us to solve the main tasks of the current study of distance learning in the higher education institutions of Ukraine during the pandemic and the impacts of the new educational environment on student learning outcomes, namely: identify the benefits of distance learning for teachers and

students; determine the level of the target audience loyalty to distance learning; identify the level of awareness of respondents about possible solutions to problems related to distance learning in the context of the COVID-19 pandemic.

For the purpose of the results credibility, the main limitation of this method was taken into account, which was seen as the lack of control over the high level of representativeness of the sample, as well as the inability to explain questions to the respondent, respectively - low reliability of the data collected. Since the study did not involve high-risk tasks, these limitations were considered not to significantly affect the outcome.

In this study, a closed-format questionnaire containing questions with pre-offered answers (multiple choices) was the main research instrument. Prior to compiling the questionnaire, we reviewed relevant literature on e-learning, studied practices of universities worldwide on evaluating their distance learning performance since the onset of COVID-19, searched official websites of Ukrainian higher education institutions for announcements on changes implemented due to the COVID-19 outbreak, and conducted a focus group discussion with students and teachers. Using this background data, we developed a questionnaire that was composed of three segments. The first segment collected demographics of the participants (belonging to a particular higher education institution, status (teacher/student), age, and gender). The second segment of the questionnaire was aimed at assessing the perception of survey respondents regarding the social and psychological readiness of different actors (authorities, teaching staff, and student population) of the Ukrainian higher education system to the abrupt transition to distance instruction. The third segment (that was viewed by the researchers as the core one) was aimed at assessing the perception of survey respondents regarding the quality of virtual educational environments, educational platforms, teaching tools, techniques and technologies implemented during the abrupt transition to distance instruction in Ukraine's higher education.

3.5 Procedures

The order of the researchers' actions was as follows: questionnaire compilation, data collection, data analysis, and knowledge generation. The compiled questionnaire was aimed at assessing the perception of teachers and students regarding the abrupt transition to distance learning due to the pandemic COVID-19, and its effect on the teaching/learning process in the system of Ukrainian higher education. At the data collection phase, the questionnaire was distributed to participants by employing a snowball sampling method (the researchers asked the initial participants to pass on the link to the questionnaire to their peers who fit the description of potential participants). Participation in this data collection initiative was voluntary, anonymity was guaranteed. The data analysis phase of this study involved the analysis of quantitative datasets. The interpretation of the analyzed information led to the generation of knowledge, which constituted the last phase of the research design. The field stage embraced November 20 - December 15, 2020.

4. The study results

4.1 Survey respondents

We received a total of 882 responses from 65 Ukrainian higher education institutions. 78.5% of the respondents were students and 21.5% of the respondents were teachers. 86.8% of them were female and 13.2% were male. 59% of the respondents were aged 20 and under, 21 to 30 were 19% of the respondents, 31 to 40 - 7.6% of the respondents, 41 to 50 were 7.6% of the respondents, 51 to 60 were 5.3% of the respondents, those over 60 represented 1.5% of the respondents.

The most active in the survey were teachers and students of the National Aviation University, Kyiv National University of Trade and Economics, Flight Academy of the National Aviation University, Lesya Ukrainka Volyn National University, National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute", Odesa State Agrarian University, Borys Grinchenko Kyiv University, Rivne State University of the Humanities, Ivan Ziaziun Institute of Pedagogical Education and Adult Education of the National Academy of Pedagogical Sciences of Ukraine, National University "Odesa Law Academy", Taras Shevchenko National University of Kyiv, which amounted to 39.1% of all respondents. Since it was impossible to draw conclusions for each region within the framework of this study, the analysis was carried out according to the average indicators of the whole sample (Table 1).

Table 1: The characteristics of the survey respondents

Characteristics / *Percentage*	Actors of the educational process		Sex		Age					
	Students	Teachers	Female	Male	≤20	21-30	31-40	41-50	51-60	60>
%	78.5	21.5	86.8	13.2	59	19	7.6	7.6	5.3	1.5
Totally:	100%		100%		100%					

4.2 Readiness of a higher education institution to implement mass distance learning

This study examined the readiness of the university to implement mass distance learning according to various criteria. The following criteria were taken as such:

- The experience of the actors of the educational process of distance learning before the introduction of quarantine measures in connection with the pandemic COVID-19.
- The availability of software and sufficient equipment to organize a teacher's workplace in education institutions.
- The availability of digital educational resources in education institutions.
- The availability of a system of methodological support for teachers in distance learning.

The tasks of collecting and analyzing the information on the implementation of the requirements and recommendations of distance learning by the educational organizations, the difficulties encountered and the results, are solved through various sociological studies and monitoring conducted by various governmental, public structures, educational and scientific organizations.

In a fairly short time before and after the announcement of the pandemic, the introduction of quarantine and transition to distance instruction in Ukraine, many different studies and surveys of teachers, students and parents have been conducted. A review of such studies gives a general idea about the main problems of the introduction of distance learning, its impact on the educational results of students and the prospects for development.

An analysis of the survey participants' responses has revealed that the mass transition to distance instruction in connection with quarantine measures has become a new reality for most universities. Accordingly, 48.2% of the respondents reported on the partial realization of distance learning, meanwhile the teachers had minimal experience in implementing this format of education. 45.5% of respondents emphasized the full realization of distance learning. 6.3% of respondents have not implemented this format of training (Figure 1).

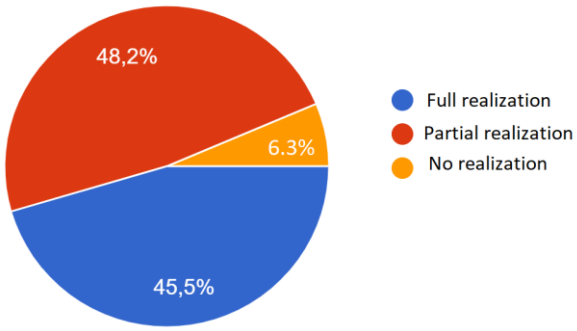

Figure 1: The experience of the actors involved in the educational process of distance learning before the introduction of quarantine measures in the context of the pandemic COVID-19

The analysis of the survey data identified four groups of teachers' problems as the main hardships: video lessons; practice of using online resources; technical problems; organizational problems. It's worth mentioning that even those teachers who did not have a high level of computer literacy before the mass transition to distance instruction quickly oriented themselves and mastered new forms of communication with their students. This conclusion correlates with the conclusion made by UNESCO regarding the progress of distance learning in the context of the pandemic.

Analysis of the opinions of survey participants on the availability of software and sufficient equipment for the organization of the teacher's workplace in universities showed that the awareness of the need and the actual situation in universities on this criterion are different. 59.4% of the respondents who took part in the survey actually indicated the imbalance between the necessary conditions, which, in their opinion, should be created in universities to implement distance education, and the actual state of affairs in universities. 50.1% of the respondents indicated partial realization, 9.3% indicated no realization.

The following were identified as the main obstacles:

- Lack of stable and sustainable connection to the Internet (and the paramount importance of this condition is quite natural);
- Lack of an equipped workplace for the teacher (laptop, computer, tablet, online whiteboard with the possibility of real-time collaboration. It can be assumed that some teachers in the conditions of self-isolation rely on their own home technical resources);
- Insufficient measures of methodological support for teachers in distance learning (Figure 2).

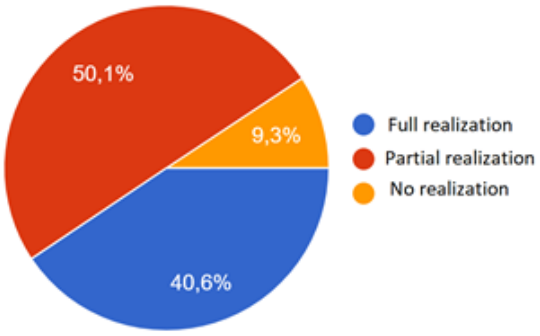

Figure 2: Availability of software and sufficient equipment to organize a teacher's workplace in educational institutions

One of the determining conditions of teachers' readiness is the availability of a system of methodological support. 47.5% of the respondents were aware of this need. Only 45.7% of teachers received such support in the form of master classes, webinars, consultations, etc. (Figure 3). According to the interviewed teachers, today the educational organization does not always have the opportunity to provide full-fledged work and support for the teacher in implementing quality distance learning in the conditions of self-isolation.

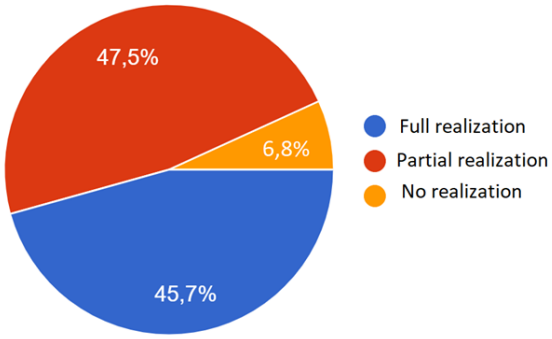

Figure 3: Availability of digital educational resources in education institutions

The effectiveness of distance learning in self-isolation is largely due to the organization of the university administration, psychological readiness and motivation of the teaching staff, students and parents. From the beginning of the pandemic, teachers have been challenged to implement distance learning methods - often without sufficient guidance, training, or resources. In fact, they were largely unprepared to ensure the continuity of instruction and the transition to new teaching methods.

Thus, in response to the difficulties of transition to the new mode of work and study, the support system grew rather quickly. Particular recommendations have been prepared to help administrators and teachers: - general recommendations for the organization of distance learning in the educational organization during restrictive measures in the current epidemiological situation; - methodological recommendations on the organization and conduct of educational work on additional educational programs using e-learning and distance technologies.

These recommendations are elaborated not only on a functional principle, but also take into account the procedural and substantive features of distance learning, and reflect the communicative aspects of the organization of "home" education in an epidemiological situation.

Accordingly, virtually all universities in Ukraine sent faculty members methodological recommendations. The universities created special websites or sections of official websites to inform and help teachers in the current situation. They also launched programs of methodological support for teachers. The most active teachers shared their experience, their knowledge of resources through social networks, and held special webinars.

The diagram in Figure 4 demonstrates that 54% of teachers had a high demand for access to online educational resources with ready-made content for the preparation and delivery of training sessions; 39.9% of the respondents actually had such access. 54% of the teachers believe that the availability of a database in digital format, including multimedia and interactive, test and measurement materials, is a prerequisite for the organization of distance learning classes. However, only 33.9% of the respondents confirmed that such a base is available in the educational organization.

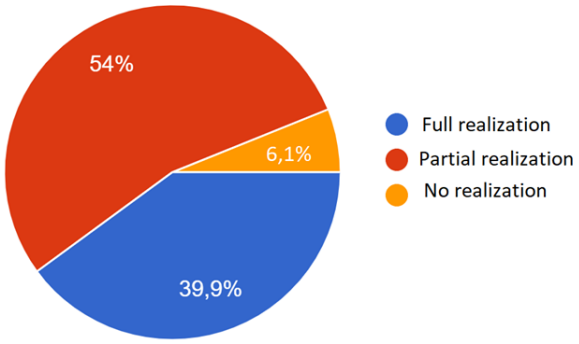

Figure 4: Availability of a methodological support system for teachers in distance learning

4.3 Support for the university administrationand teaching staff in the transition of education to a distance learning format during the COVID-19 pandemic

The critical situation required a high degree of mobilization of university management teams to respond quickly to the emerging need, find and implement solutions to non-standard tasks and problems, take the initiative, activate horizontal links of the university community, consolidate forces and resources to restart the entire higher education system online. Thus, the quality of management, both at the level of a particular university and at the level of departments, has become a critical factor in the successful response to the stress test of the pandemic. Most universities formed special management structures in the first days to make operational decisions and implement them. In many cases, however, university senior managers waited for instructions and unambiguous orders from regional authorities. Such caution can be explained by the fear of violating any regulatory restrictions that have been developed in the Ukrainian higher education system.

All in all, the study results (the actual diagram is not given in the text due to the obvious reasons of being limited by the paper size requirements) revealed that 58% of the respondents are satisfied with the support received from the university administration. 18.8% of the respondents are indifferent. 40.6% of the respondents are satisfied with the support of the Department of Planning and Finance, while 35.6% of the respondents are indifferent, 13.2% – unsatisfied, and 5.75% – very satisfied. 47.1% of the respondents are satisfied with the support of the Department of Technical and IT services whilst 29.4% of the respondents are indifferent. The students admitted that they were satisfied with the support of the Department of Student Affairs. 6.4% of the respondents were completely satisfied with the support of the Department of International Cooperation,

whereas 47.7% were absolutely indifferent. 36.4% of the respondents were fully satisfied with the support of the Department of Public Relations. 63.7% were entirely satisfied with the support of the teaching staff.

4.4 The satisfaction level towards various forms of distance lectures due to the cancellation of face-to-face classes

The transition to distance instruction was not a planned but a forced measure, so there was no special training for teachers in this area. Adaptation of teachers and students to the changed conditions of professional activity occurred at different speeds and with different results. Moreover, there is a need to conduct a comprehensive study to understand teachers' and learners' satisfaction towards online learning for effective implementation of the program. The present study aims to assess the satisfaction level of respondents towards use of distance learning and teaching during the COVID-19 pandemic. It is hoped to provide insights on steps necessary for further improvement. Also, this study intends to investigate the benefits of distance learning and teaching for students and teachers which may affect students' productivity levels.

According to the results, the satisfaction level of respondents towards various forms of distance lectures is the following: the majority of the respondents – 66.9% – are satisfied with live distance lectures (videoconferencing) while 18.1% of the respondents are very satisfied and 7.9% – unsatisfied. 45.2% of the respondents are satisfied with video recording (not live), though 31.3% of the respondents think that this form of lecturing cannot be applied. Distance lectures and sending presentations to the students are positively taken by 60.0 % of the respondents, 19.7% of the respondents are very satisfied whilst 9.5 % say that this form cannot be applied. The form of written communication (forums, chats, etc.) is seen positively by 57.5 % of the respondents, 19.4% of the respondents are very satisfied, 9.3% – unsatisfied.

So, we can conclude that among the respondents, the category of students, unlike teachers, was more loyal to the changes in the forms and methods of instruction due to the transition to distance learning. Students had a growing demand for flexible educational trajectories and a variety of learning forms.

4.5 The satisfaction level towards the organization of practical and seminar classes due to the cancellation of face-to-face classes

From the results of the survey it can be observed that the majority of the respondents (66.8%) are satisfied with live distance classes, 15.9 % of the respondents are fully satisfied. It follows that a distance learning environment encourages a positive influence on students' knowledge and the teachers' perception on online education during the COVID-19 pandemic. In addition, there is interaction between participants and real-time feedback.

The graph also shows that half of the respondents are satisfied with distance classes, conducted via pre-recorded video, whilst 30.6% of the students and teachers considered that this mode of distance learning could not be applied (these results can be explained by disadvantages of asynchronous learning: the instructor and the learners are not involved in the learning process at the same time and there is no real-time interaction).

The rate findings of the survey regarding the distance classes, conducted via pre-recorded audio look very similar to the above stated, for instance, half of the respondents are satisfied with distance classes, conducted via pre-recorded audio, some of them are fully satisfied, at the same time about 15% of the respondents are unsatisfied with this type of learning, 34% of the respondents consider distance learning to be insufficient to practice. We can conclude that audio texts are not interactive, so they do not provide the visual elements that many students need. As for teachers, they sometimes encounter obstacles related with the identification of expectations, providing feedback, time management, and technical support while preparing for distance classes, conducted via pre-recorded audio.

The study also reveals the respondents' attitude to presentation-based distance classes. Consequently, the majority of the respondents (78.1%) are satisfied with that mode of distance learning when the instructor sends presentations to the students and they get all the necessary information from presentations. 16.15% of the respondents are fully satisfied. The interpretation of the given data suggests that students have a high level of motivation to attend presentation-based distance classes due to its benefits: visual effects, precise and systemic knowledge structure. About 10% of the respondents are unsatisfied or very unsatisfied with presentation-based online classes. 11.6% of the respondents believe that this mode of distance learning could not be applied.

The survey results clearly demonstrate that the majority of respondents (79.3%) are satisfied with written communication, 16.4% of them are fully satisfied. It should be noted here that written communication allows students to learn at their own pace by giving them full responsibility for learning and the power to attend classes only when it is convenient for them. As for teachers, written communication also has various positive aspects such as: keeping linguistic and factual knowledge, stimulating speaking, listening and reading in a foreign language. Still, about 13% of the respondents are unsatisfied or very unsatisfied with written communication. 7.6% of the students and teachers consider that this mode of distance learning could not be applied.

4.6 Educational technologies of face-to-face instruction which are effective for distance learning in a pandemic environment

As Figure 5 shows, the vast majority of the respondents think that educational technologies such as collaborative learning (56.6%) and individualization of learning (55.9%) are effective. We can assume that the technology of collaborative learning is considered to be productive both by students and teachers due to its benefits. The use of educational technologies, mentioned above, help to develop leadership skills, interaction, self-management, etc. The individualization of learning technology allows students to learn at their own pace. 44.2% of the respondents think that the technologies such as the development of critical thinking, project-based learning (40.1%), experiential learning (30.4%) and problem-based learning (26%) are effective for distance education.

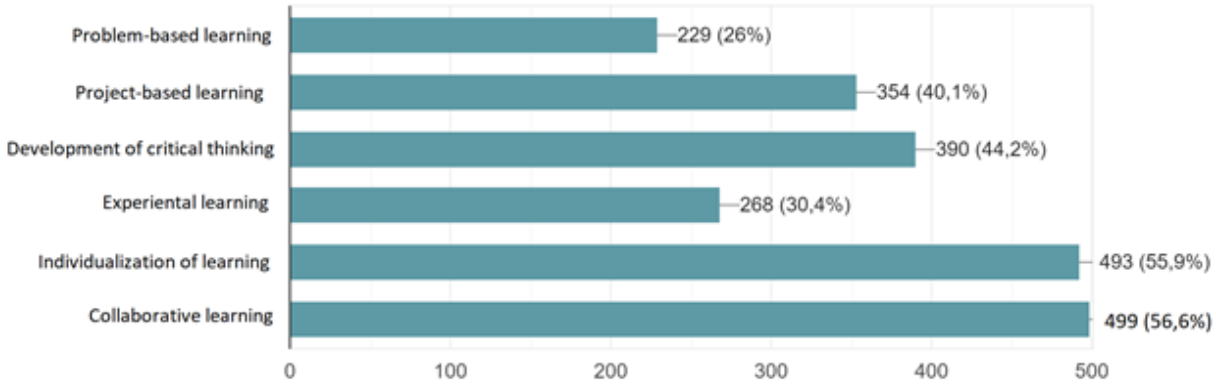

Figure 5: Educational full-time learning technologies that can be implemented for effective distance learning

4.7 The format in which instructional materials are provided

As Figure 6 shows, the majority of the respondents have indicated text (90.2%), E-resources links (69.2%), and video file (64.1%) as the most common formats for instructional materials. Analyzing the students' and teachers' responses, we can suggest that text documents, or files are easy to work with, they can be opened on different platforms being small in terms of memory size. E-resources links could be a rich source of information for those students who use extra learning materials in addition to their regular classroom activities. Video file format makes an educational process more interesting due to its visual effects. The other formats of online resources according to the survey are podcast format, presentations, E-resources and others.

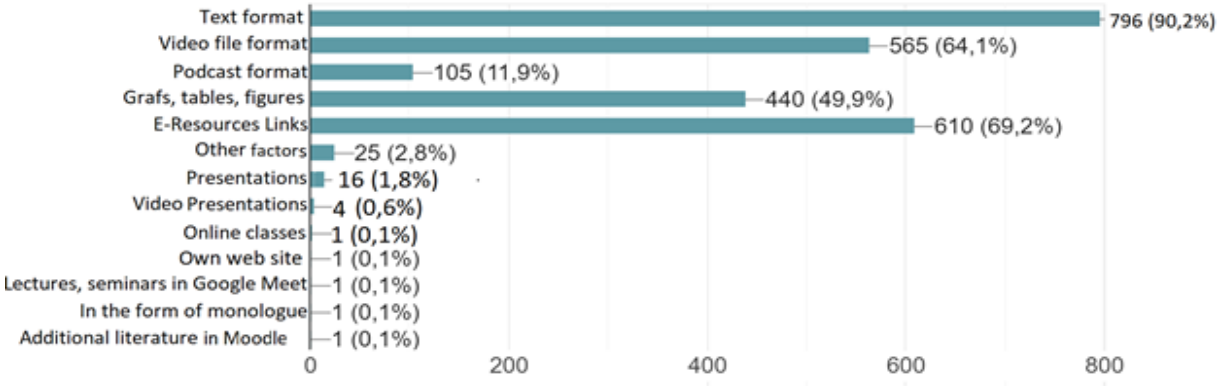

Figure 6: The format online resources are provided

4.8 Factors that hinder full-fledged distance learning

Figure 7 indicates that the majority of the respondents consider students' assessment, and a lack of online resources to be the factors that prevent them from effective distance learning. We can assume that all the factors that hinder fully fledged distance learning, can cause the following situation: students attribute a low value to learning and they do not believe that their effort can improve their performance. Teachers do not believe that their effort can improve the students' performance and increase their motivation.

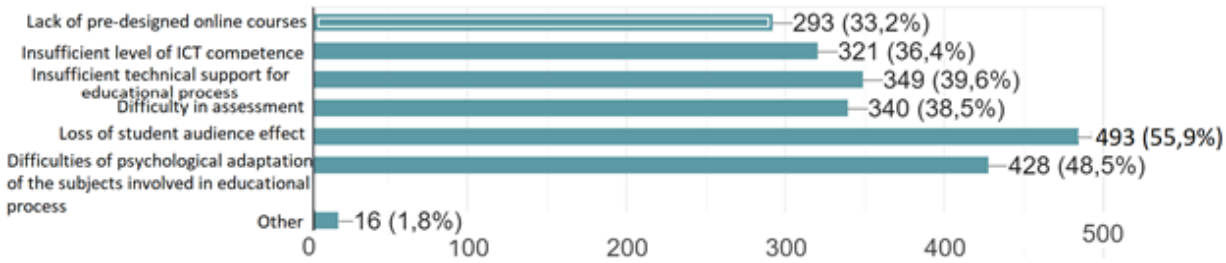

Figure 7: Factors that prevent distance learning

4.9 Distance resources used in the organization of distance learning, preparation for distance classes, formation and performance of homework, control and assessment materials

Figure 8 reveals that the majority of the students and teachers use the resources from such online educational platforms as Zoom (88.3%) and Classroom (85.3%). This fact proves that the innovative approach of Zoom and Classroom technology enhances positive learning outcomes for students. Other respondents use resources from such distance educational platforms and tools as: YouTube (49.5%), Moodle (47.3%), Teams (35.7%), Skype (32.9%), Microsoft (12%), Coursera (7.7%), Kahoot (7.6%), Education (7%), etc.

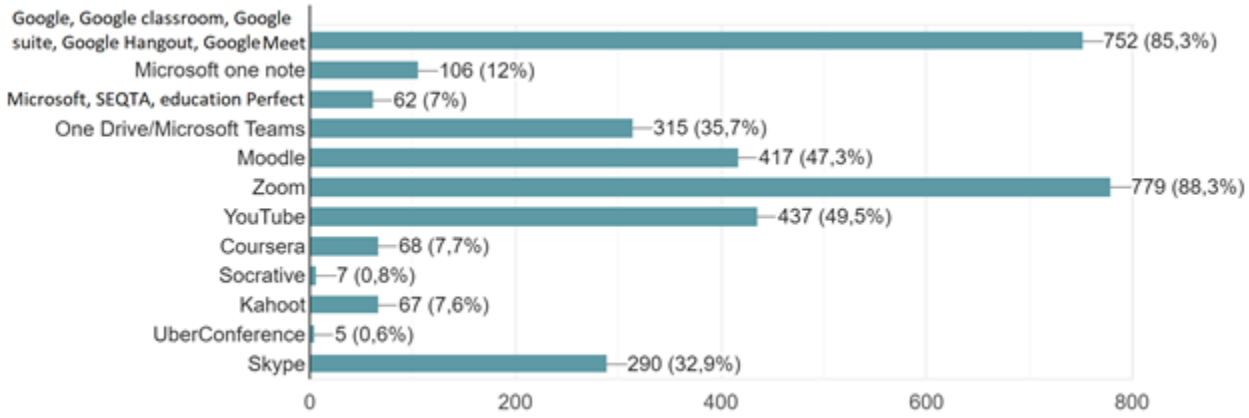

Figure 8: Distance resources, used by the students in the process of preparing for distance classes, tests, doing home assignment

5. Discussion

Survey data showed that:
Ukrainian institutions of higher education were only partially ready for the introduction of distance education. In particular, only half of the respondents managed to shift to distance learning mode during the first weeks of the quarantine period caused by the COVID-19 pandemic. The reasons vary. Firstly, insufficient technical support, lack or improper computer equipment, software problems, limited Internet access (e.g., in rural areas) make distance learning impossible or inefficient; additionally, the lack or insufficient level of methodological competence of teachers to carry out distance instruction, as the latter requires special knowledge and skills. Moreover, teaching methods that are the most appropriate for offline education are not suitable for the distance mode of instruction. It is important for a teacher to know how to encourage students and keep them interested in the online classes.

In order to eliminate the above-mentioned problems and establish effective distance learning, it is necessary:

- at the state level: to increase funding and promote the digitalization of education assuming that modern education is based on the capabilities of the Internet and digital resources. The use of new digital technologies in the distance mode of instruction has already led to a greater flexibility and creativity of both teachers and students. Distance education provides a unique opportunity to ensure continuity of the educational process regardless of destabilizing factors;
- at the scientific level: to substantiate and suggest an educational model for widespread implementation that allows a quick transition from a traditional (face-to-face) education to a distance one and vice versa; to study successful international experience of tackling the problem in order to adapt some elements into the system of higher education of Ukraine;
- at the university level: to focus efforts on teachers' training to carry out distance learning, and to develop new platforms for distance learning.

The survey showed that teachers need support from the university administration, the Department of Technical and IT services. The introduction of short-term forms of advanced teacher training will solve this problem. Teachers need to be told about the advantages of different forms and methods of distance instruction, about the peculiarities of distance education (technical, visual, psychological, methodical, etc.). An important issue is the adaptation of syllabi and curricula, control activities and assessment tools to distance education peculiarities.

Special attention should be paid to international cooperation as an important component of the European integration of Ukraine's education system. The border closure led to a sharp decline in academic mobility and the financing of the international projects. The cancellation of overseas travels and the postponement of scientific conferences were the most common consequences of the COVID-19 pandemic. At the same time, the forced transition to distance instruction opened up new, more flexible educational prospects (blended or hybrid learning, combination of synchronous and asynchronous e-learning). COVID-19 increased virtual mobility and/or collaborative online learning as an alternative to physical mobility of teachers and students.

In general, the survey results showed that the effectiveness of distance learning depends on the joint efforts of university administration, teaching staff and all, without exception, university departments.

As for the respondents' satisfaction with various forms of online lectures due to the cancellation of face-to-face classes, it should be noted that students turned to be more loyal to the changes in the modes and methods of instruction caused by the transition to distance learning. Most students were fully satisfied with this way of learning and the suggested forms and methods of e-learning. The same can be said about the organization of practical and seminar classes.

We assume that students' satisfaction with online lectures and seminars is connected with their understanding of e-learning tools and their ability to manage the gadgets necessary for distance learning. Students also appreciate the possibility to improve self-management skills, time-management, task formulation, etc. However, according to the survey results, a certain percentage of respondents indicated dissatisfaction with the organization of online classes. We believe that the following objective factors serve as justification: an increase in the number of tasks and a short time span for completing them, poor task assessment, lack of skills to work with online resources, same-type tasks, etc. In this regard, we can conclude that students showed their readiness to continue studies in distance mode beyond the pandemic. However, there is a need to reconsider the online mode both for students and teachers. In particular, we consider it effective to reduce the duration of online classes, to use special forms and methods of instruction, and improve the system of students' assessment in distance learning mode.

The survey results showed that some educational technologies of conventional education are effective for distance learning in the pandemic. Among them are: the technology of collaborative learning, the individualization of learning, and the development of critical thinking. Other technologies (project-based learning, experiential learning, and problem-based learning) were recognized by the students as less effective. This result confirms the idea that distance education requires special methodological elaborations on learning technologies.

The issue of using modern learning technologies was relevant in Ukrainian education before the COVID-19 pandemic. In particular, according to the government's "Medium-Term Action Plan until 2020" (Government

portal, 2017) and other documents, the Ukrainian society needs highly competent, mobile, responsible specialists endowed with a culture of professional communication and willingness to generate their own scientific innovations that will contribute to economic and social development. Today, in the conditions of distance learning, effective technologies enable not only the acquiring of new knowledge and skills, but they also ensure the development of soft skills, which are an integral constituent of a competitive specialist in the labour market. This is evidenced by numerous studies showing that high unemployment rate among university graduates occurs because teachers ignore soft skills, especially the so-called 4C (creativity, critical thinking, communication and cooperation).

According to the survey, text is the main format in which learning materials are provided. We agree with the researchers that the development of effective online programs that can fully replace offline learning, making it interactive, rather than simply transferring information into a digital format, needs special knowledge and skills, programming skills, in particular. In our opinion, the development of such programs requires the collaborative efforts of IT-specialists and the specialists in the field of higher education (specialists in various disciplines). Accordingly, it requires additional funding. In addition to the development of programs, methodological teacher training for online instruction and practical teacher training in mastering modern Internet technologies are also needed.

The survey revealed that the main factor preventing fully fledged distance learning, according to students, is the objectivity of results assessment in the distance learning mode. It is obvious that for greater objectivity it is necessary to change the forms of control. Accordingly, special attention should be paid to the objectivity of control measures (exams, tests, thesis defenses, etc.). Therefore, the successful experience of higher education institutions in European countries should be used by the national education system of Ukraine.

The importance of using the Internet resources in higher education lies in the following. Information technology is not only a tool for solving specific pedagogical tasks, but it also brings variety into the organization of the educational process, develops the skills of independent learning, and stimulates the designing of educational processes.

The survey revealed that the majority of teachers used only two online educational platforms for the distance learning process: Zoom and Google Classroom. Undoubtedly, the free web service for distance learning Google Classroom combines services Google Drive, Google Docs, Gmail, Calendar, etc. and is one of the most effective means of solving educational tasks. Sultanova and Zheludenko (2021) conducted the research. The study results correlate with the findings of the current research and confirm the effectiveness of using the cloud technology in distance learning. However, other platforms and resources are not used at full strength, despite their extensive opportunities. In the transition of education to distance learning, digital and information support is of paramount importance, because the success in society is associated with the Internet in the broadest sense and with gadgets in the narrow sense as working tools, sources of information and means of self-realization.

6. Conclusions

On the basis of the obtained data, several problem groups can be identified:

- problems of a technical nature: technical maintenance (the Internet quality, the availability of modern technical digital learning tools) and technical support. According to the research made by the Ministry of Digital Transformation of Ukraine, 65% of villages do not have broadband Internet access (Epravda, 2020);
- problems of a methodological nature: lack of methodological support and special training for teachers to carry out distance instruction. Teaching methods that are sufficient for offline education are not suitable for distance learning. Only 45.7% of teachers had the opportunity for methodological support in the form of workshops, webinars, consultations, etc.;
- problems of a psychological nature: the development of motivation, the teachers' commitment, the establishing of a new communication pattern, and maintaining the value of education as one of the priorities in the system of universal values. What is more, a digital society is creating emotional and psychological problems for students who have limited access to the Internet and they automatically find themselves in social isolation, thus, developing the basis for social inequality;
- problems of a content nature: task overload, the content of online platforms, the quality of learning materials, the correlation of the informative nature of the materials and their quantity;

- lack of digital infrastructure which provides access to the Internet and a mechanism for filling in the platforms, optimal tools for work with platforms, development of methods for determining performance criteria, etc.

The analysis of the survey results allows us to formulate the positive characteristics of distance learning in the pandemic:

- high demand for access to online educational resources, satisfaction with online classes in real time, self-paced learning, the development of critical thinking (this result indicates the great potential of the distance learning method, but at the same time points to the need for self-organization, which in the context of distance education has acquired the important status of a basic component of learning);
- the level of respondents' awareness of e-learning tools and the opportunities to use them. Popular digital tools (Zoom, YouTube, Google Classroom, Moodle) are the basis of education. The overall statistics on the number of users of the most popular digital tools is quite compelling: the number of Zoom users in March 2020 was over 200 million users per day, and the number of Google Classroom downloads as of March 30, 2020 was over 50 million.

7. Research prospects

- The transition to distance learning should be considered comprehensively, as a phenomenon of an information-technical, psychosocial nature, given the rate of updating and the volume of information content on the Internet. In practice, this can be achieved by creating a single digital market for services and knowledge, which will help to adapt to the changes associated with digital transformation.
- The development of a methodological, technical and informational support model for teachers; the study of the impact of digital learning tools on the mental health of university students; the comparative analysis and the adoption of the results of international studies into the practice of the national education system.
- The development and the integration of a new model of education, providing a combination of traditional and distance learning; the criteria development for successful distance learning implementation and the optimal time management model (online learning in real time and time to process and prepare the material); the creation of high-quality platforms with an accessible interface and algorithm of use.

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This is not (the New) Normal. Students' Attitudes Towards Studying During the COVID-19 Pandemic and the Determinants of Academic Overload

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Abstract: The measures taken to combat the pandemic COVID -19 suddenly changed the way of studying in many countries around the world. Because of the abrupt change, faculties did not have time to develop strategies for implementing online study, so faculty were busy finding new ways to teach their courses. As it turned out, many of them were not prepared for such a change. They lacked the technical understanding of how to use online tools and platforms, as well as the pedagogical knowledge of the dynamics of online teaching. In this paper we discuss how students from the Faculty of Arts at the University of Ljubljana, Slovenia, experienced the changes in the way they study. We conducted an anonymous online survey among 1,827 students from the largest faculty at the University of Ljubljana. The survey took place in February and March 2021. The results show that there were differences between students in their assessment of the appropriateness of different teaching approaches regarding various factors, which highlights the conditions students had at home to study. The conditions at home affected students' attitudes towards distance learning, their assessment of competence for distance learning, as well as their motivation to study and their sense of being overwhelmed. Thus, more study difficulties, negative attitudes and motivation problems were observed among students who were not provided with adequate study conditions. Nevertheless, the results of the study show that distance learning also has potential, but this potential can only be realised if all those involved in the process are provided with the right conditions. We conclude the study with four main recommendations, namely that the quality of distance learning requires (1) adequate conditions for students to participate in distance learning; (2) an appropriate choice of teaching methods is important; (3) teachers need to be didactically trained for distance learning; and (4) during distance learning, cooperation between the teacher and the students and between the students themselves should be encouraged.

Keywords: online learning, COVID-19, teaching methods, assessment, student attitudes

1. Introduction

In March 2020, as the world was faced with the outbreak of the COVID-19 pandemic, many countries put on hold their established way of educating and implemented distance schooling as part of their measures to contain the virus. According to the Director- General of UNESCO, Audrey Azoulay, the disruption to education caused by the COVID-19 pandemic was unprecedented, with more than 200 million students worldwide trapped in the "pandemic classroom" (UNESCO, 2020). The Faculty of Arts, University of Ljubljana, was one of the first faculties in Slovenia to substitute face-to-face lectures for online lectures by dean's decree before a strict lockdown was enforced across the country. A few days later, following the government's decree, the entire country came to a halt and educational processes on all levels were fully transferred online and continued as distance learning. At the time, probably no one expected this measure would go on significantly longer than initially forecasted and that it would bring so many changes with it. Due to the sudden transition, the faculties did not have time to prepare strategies for the implementation of the online study process, whilst professors were forced to look for new ways of teaching their courses themselves. As it happened, many of them were not properly trained for such transition due to their lack of technical knowledge on using online tools and platforms, as well as lack of pedagogical knowledge on the dynamics of online education. What is more, many faculties were suddenly faced with lack of suitable technological equipment and professional support (Bao, 2020). All in all, it was the students who most acutely felt those changes by having to cope with very diverse teaching methods and approaches and being forced to become quickly acquainted with a variety of web tools, applications and online environments used by their teachers to deliver their course (Katz et al., 2021). During the pandemic, this method of teaching came to be known as "emergency remote teaching" (Hodges et al., 2020).

1.1 Emergency remote teaching

The first studies on the impact of an epidemic on education systems appeared shortly after the outbreak of COVID-19. The UNICEF survey found that online learning was the most common form of distance learning and that adoption rates were higher at higher levels of education (UNICEF, 2020). Carrillo and Flores (2020) reviewed

the literature on online pedagogy for teacher education and pointed to the need for a comprehensive understanding of how online education can integrate technology to enhance teaching and learning. Authors dealing with online learning (Bates, 2015; Means et al., 2014; Oliver, 2006) list the following conditions as prerequisites for its successful implementation: good planning (which can take several months), adequate teacher training (knowing the dynamics of working in an online environment, using appropriate methods and ways of working, managing online learning environments), the size of groups involved in e-learning, suitable technological equipment for learning online, as well as strong support service available to both teachers and students when problems arise. Given that those prerequisites were not met during the period of lock-down, the process of transition, as well as the process of conducting studies after the lock-down, turned out to be a rather stressful period for professors and students alike.

If at first it seemed that fast transition to distance education in the pandemic would be easier, given that many saw important similarities and benefits of online learning – teaching strategy that was known to be effective. It quickly became apparent there were several important differences between these two concepts of education. On top of that, the situation we found ourselves in made it clear that we cannot classify this the sudden transition to distance education as online learning, but rather as "Emergency Remote Teaching" (Hodges et al., 2020).

Hodges and his colleagues (2020) defined emergency remote teaching (ERT) a temporary shift of instructional delivery to an alternate delivery mode due to crisis circumstances. It involves the use of fully remote teaching solutions for instruction or education that would otherwise be delivered face-to-face or as blended or hybrid courses and that will return to that format once the crisis or emergency has abated. The primary objective in these circumstances is not to re-create a robust educational ecosystem, but rather to provide temporary access to instruction and instructional supports in a manner that is quick to set up and is reliably available during an emergency or crisis (Hodges et al., 2020). Due to the COVID-19 pandemic, ERT was introduced for all students of all study programmes, without giving them enough time to properly prepare for it or a possibility to use blended approaches. Furthermore, the implementation of emergency remote teaching did not allow for voluntary inclusion into this form of education. All students were forced to accept it, as it was presented as the only available method for continuing their studies.

1.2 Universities and the use of digital technologies before the pandemic

Authors who studied the use of technology in a university setting before the pandemic write that, for example, "many university students [had already been] 'digital residents', that is, accustomed to experiencing digital technologies as seamless, 'always-on' and highly participatory social spaces" (Wright et al. 2014) and that "for these students, digital environments, such as the Internet, are a way of life rather than discrete functional tools that can be turned on and turned off" (Henderson et al., 2015, p. 1). However, this does not apply to the use of technologies for the purposes of teaching and studying. Selwyn (2014) underlines that the use of digital technologies for learning and teaching has long been inconsistent – varying considerably between subject disciplines, levels of study, modes of delivery and institutions.

Accordingly, authors such as Henderson et al. (2015) and Selwyn (2016) find that "*students' use of technology in higher education is mostly limited to performing routine tasks and they often need support when using technology*", whilst O'Connell and Dyment (2016) demonstrate that students are not as digitally savvy as educators believe and that they prefer to do tasks using basic technologies such as e-mail, Google search, or word processing. As regards students, their use of technology for study purposes is related to the requirements and expectations of their professors and faculties. Students do not use technology for study purposes to a great extent, unless instructed to do so by professors who often make decisions about using technology for study purposes based on their own beliefs and understanding of technology (Jääskelä et al., 2017). In addition, the teachers' beliefs about technology can be very different and rather resistant to change (e.g., Pajares, 1992). However, academics' fears about the use of technology are needless, since Henderson et al. (2015) demonstrate that digital technologies are not transforming the character of university teaching and learning, or even significantly disturbing the student experience, which could be the reason for or represent the fear of a more systematic use of technology in a university setting for study purposes as well. Additionally, the authors write that universities have an obligation to support these beneficial aspects of students' digital studies and advise universities to continue developing their digital resource repositories, enhancing the reliability and usability of learning management systems, and expanding the availability and accessibility of other core systems (ibid).

According to Ashour (2020), to capitalize on students' enthusiasm for technology, new digital choices for teaching, assessing, and presenting course materials might be employed both in and outside of the classroom to supplement traditional approaches. Students interact with technology tools, according to the author, when they are implemented by instructors (ibid.). They must be taught in a way that is tailored to them, using a range of adaptive teaching methods as well as a variety of tools, technologies, and places.

1.3 The use of technology for study purposes as seen by students

In addition to the aforementioned erroneous belief that today's students are a digital generation with full command of digital technologies, we often come across another belief, namely that the use of digital technologies for study purposes will contribute to greater study efficiency and outcomes. However, students are rather critical of the use of technology and clearly point out its weaknesses. In a study asking the students to assess the use of online environments which they assessed as particularly impractical or useless for their studies, Selwyn (2016) identified four categories:

1. *Digital technology as a disruptive factor,* in which the use of technology was recognised primarily as a distraction of the student from studying. In this category, students listed social networks (e.g., Facebook, YouTube) and the use of smartphones as a means for procrastination during lectures or while studying.
2. *Disruptions in technology operation,* where students identified disruptions of a more technical nature (e.g., poor Internet connection, power outages, frequent charging of batteries for mobile devices), as well as professors' ignorance on how to use a particular technology. Such disruptions were perceived by students as wasting valuable time during lectures, as an obstacle to productivity, plus they made them feel there was no point in participating in such lectures. Students considered such technical disruptions and the professors' struggling when using technology as an obstacle to their own academic pursuits.
3. *Digital technology as a problem,* where persistent barriers to the use of technology were identified. Students reported suffering from physical exhaustion, headaches, and eye problems due to staring at the screen for hours on end. Within this category, students perceived incongruence between the time spent for such studying and the effect or contribution of this manner of studying. Students often attributed these problems to inconsistent design and organisation of such forms and methods of education.
4. *Harmful digital technology*, which included both poor quality teaching materials (poor document resolution, poor video quality) and bad learning experience in courses supported by digital technology (i.e., ill-conceived online activities which do not facilitate gaining deeper insight and reflection in students). Within this category, students often mentioned poor quality of presentations used by professors during lectures. The professor's bland reading of the text from a PowerPoint presentation, as well as too much text in the presentation distracted the students and reduced their willingness to participate in such lectures. Students pointed out that the unsatisfactory use of technology by professors reduced the quality of the pedagogical process itself (Selwyn, 2016).

Selwyn (2016) emphasises that statistically significant differences were observed between students in groups which assessed the identified categories differently. The groups comprising men and younger students assessed to a larger extent that digital technology can be a disruptive factor in studying, whilst senior students and those with a higher-grade point average perceived digital technology as more harmful than other groups.

Similar and other also some additional problems with distance learning have been reported in surveys evaluating students' experiences during COVID-19. Research shows that students not only need to overcome technological difficulties, but also need support to prepare for the lecture and teacher's support to stay engaged (Giannoulas et al., 2021; Velde et al., 2021).

Ashour (2020) writes that the reckless use of technology for study purposes *"has shaped not only the practices of the students, but also their expectations around higher education. It shows that contemporary students are becoming passive consumers rather than just the producers of information. The study found that the students are not making use of the potential of technology in education.*" Both Selwyn (2016) and Ashour (2019) suggest that universities and colleges ought to put more effort into developing institutional policies and practices that promote improving the use of existing technologies rather than into continuous introduction of new ones. An important part here includes the development of didactic skills since mere technical ability of professors to use technologies does not affect the quality of technology-supported learning. The COVID-19 pandemic cut into such (un)prepared university setting.

1.4 Purpose of the study

In the introductory, we briefly describe the problems of higher education during the pandemic and point out the difficulties that faculties have faced in making the transition. In the second part of the paper, we present the results of the survey conducted at the Faculty of Arts, University of Ljubljana (Slovenia). We wanted to investigate students' experiences of studying during the pandemic, their evaluation of study activities and their attitudes towards distance learning. We also wanted to find out what factors influence the feeling of academic overload that many students have reported in other studies.

With this in mind, we asked three main research questions:

1. Are there differences in the experience of distance learning between study conditions, level of study, year of study and gender?
2. How students' attitudes about distance education are correlated with variables such as the living conditions, study conditions, level of study and gender?
3. Which factors influence the students' feeling of being overburdened during a period of distance learning?

2. Method

2.1 Participants

In the survey, 1827 students participated, which represents more than 40% of all students at the faculty (N = 4487 in the academic year 2020/2021). The surveyed students comprised of 83% female students and 16% of male students, whilst 1% of respondents did not specify their gender. This percentage is representative of gender shares of the students enrolled in the faculty. We divided students according to the (Bologna) level of study (undergraduate/postgraduate), year of study (1 through 5) and place of residence (rural/urban). The data show that most of the responses are from undergraduate students (72%). On the undergraduate level, almost half of the answers were from first-year students (45%), followed by second- and third-year students. The data is representative in all dimensions according to the actual characteristics of students' population currently enrolled in the faculty, with the sample size that covers almost half of all enrolled students.

Table 1: Demographic characteristics of the respondents (N=1827)

Demographic variables	***Percentage***
Gender	
Female	83.3
Male	16.7
Study level	
Undergraduate (UG)	72.2
Postgraduate (PG)	27.8
Year of study	
1 (UG)	32.7
2 (UG)	21.0
3 (UG)	18.8
4 (1st year PG)	12.6
5 (2nd year PG)	14.8
Place of residence	
Rural	53.4
Urban	46.6

Note: UG = Undergraduate level; PG = Post graduate level

2.2 Instrument

For the purposes of this study, we prepared a questionnaire, which consisted of various scales and questions. We were interested in the basic demographic characteristics of students (gender, place of residence) and data on their studies (e.g., study year and study level). In addition to their enrolment data, we were interested in their experience of studying during the pandemic. We designed three scales; the first one was "Attitudes Toward Teaching Approaches", where 5-point Likert scale was used: the score of 1 meant "Not appropriate at all" and the score of 5 meant "Very appropriate.", the second was the scale with the same items, but the students indicated the frequency of use of teaching methods. Students rated how often, on average, teachers used a particular approach. The scale ranged from 1 - "In (almost) no course" to 5 - "In (almost) all courses".

We were also interested in the attitudes of students about online learning in general, so we created "Attitudes Towards Distance Learning Scale", which consisted of six items. The students expressed their attitudes on the 5-point Likert scale, where the score of 1 meant "I do not agree at all" and the score of 5 meant "I fully agree."

In the analysis, we created a new variable called "**Learning Conditions Index**" (LCI), which was calculated from student responses on whether they had (1) an appropriate study setting, (2) a quiet space to study, (3) appropriate office furniture, (4) own hardware, (5) own software, and (6) reliable Internet connection. Students answered dichotomously (Yes/No). From the answers, we calculated the index of learning conditions, which was used in the analyses (min = 1, max = 6, M = 4.92, SD = 1.27).

We were interested whether students perceived distance learning at the faculty as more or less stressful than the face-to-face learning experience before the pandemic. The question was not answered by the first-year students because they had not yet had this experience. The students answered on a scale from 1 - "My study load during the epidemic was much lower" to 5 - "My study load during the epidemic was much higher". The answers to this question have been labelled as the degree of academic overload.

Overall, variables included in the statistical analysis are:

- **Attitudes Toward Teaching Approaches**: assessing the appropriateness of each teaching approach. A higher score means that students rated an approach as more appropriate.
- **Frequency of Teaching Approaches Use**: assessing the appropriateness of each teaching approach. A higher score means that students rated an approach as more appropriate.
- **Attitudes Towards Distance Learning**: attitudes to some aspects of studying at a distance learning. A higher score means that students have a more positive attitude towards a particular aspect of distance learning.
- **Study level**: the level of study in which the student is enrolled (1 - undergraduate; 2 – postgraduate)
- **Year of study**: the year of study the student is attending (1 thru 5)
- **Learning Conditions Index**: conditions of student's learning environment at home. High scores indicate better learning conditions.
- **Rural/urban**: place of residence (0 = rural, 1 = urban environment)
- **Academic overload**: feeling of being overwhelmed by distance learning requirements. High scores indicate higher perceived burden of studying online.

2.3 Procedure and data analysis

The survey, which took place in February 2021, included all enrolled students of the Faculty of Arts. We created an online survey, which was sent to students' email addresses by the faculty management. On average, they took 10 minutes to complete the survey and their answers were anonymous. Statistical analysis was carried out using the SPSS software package.

3. Results

3.1 Differences in the experience of distance learning per gender (study conditions, level of study and year of study)

Our first research question is related to experiences of distance learning during the pandemic. Students were assessing the appropriateness of the most used teaching methods during this time. We made some comparisons if these attitudes are in any way correlated to their learning conditions, study level, and study year.

Table 2: Pearson's correlation coefficients for attitudes toward teaching approaches, and learning conditions (LCI), study level and year of study

Teaching Approaches Scale	LCI	Study Level	Year of study
Live lectures via Zoom	0.30***	0.04	0.04
Recorded lectures (long)	0.11***	-0.09***	-0.10***
Recorded lectures (short)	0.12	-0.09	-0.10***
Study material without activities	0.07**	-0.02	-0.06*
Study material with activities	0.09***	-0.05	-0.09***
Communication via e-mail	0.06*	0.02	-0.04

***$p < 0.001$; **$p < 0.01$; *$p < 0.05$

Note: LCI = Learning Conditions Index

Although the correlation coefficients are low, some correlations indicate high statistical significance. In terms of conditions in which learning took place (LCI) the correlation analysis, not surprisingly, showed that students who had appropriate study conditions during the period of distance learning assessed live lectures via Zoom very highly as the suitable way of distance teaching ($r = 0.30$; $p < 0.001$), followed by longer pre-recorded lectures ($r = 0.11$; $p < 0.001$) and study material with activities organised in course's LMS ($r = 0.09$; $p < 0.001$). Students from the same group assessed study material without activities ($r = 0.07$; $p < 0.01$) and communication via e-mail ($r = 0.06$; $p < 0.05$) as more appropriate, but with a lower statistical probability and weaker correlation coefficients.

Undergraduate students assessed longer pre-recorded lectures as more appropriate than post-graduate students ($r = -0.09$; $p < 0.001$). Lower-year students assessed the pre-recorded longer lectures ($r = -0.10$; $p < 0.001$), shorter pre-recorded lectures ($r = -0.10$; $p < 0.001$) and study material with activities as appropriate ($r = -0.09$; $p < 0.001$).

We also wanted to know whether gender influences the assessment of the appropriateness of teaching approaches.

Table 3: Analyses of variance for effects of gender the assessment of adequacy of teaching approaches

	Gender				ANOVA
	Female		Male		
Attitudes Toward Teaching Approaches	M	SD	M	SD	*F(*1.1474)
Live lectures via Zoom	4.25	1.04	3.89	1.17	23.661***
Recorded lectures (long)	3.39	1.30	3.16	1.27	6.418*
Recorded lectures (short)	3.54	1.22	3.24	1.23	12.593***
Study material without activities	2.82	1.33	3.04	1.37	5.567*
Study material with activities	3.35	1.22	3.38	1.28	0.079
Communication via e-mail	4.09	1.19	3.98	1.31	1.638

***$p < 0.001$; **$p < 0.01$; *$p < 0.05$

When assessing the adequacy of individual learning approaches by gender, there were several statistically significant differences: female students rated live lectures via Zoom as more appropriate ($p < 0.001$, $F = 23.661$) than male students, followed by pre-recorded shorter lectures ($p < 0.001$, $F = 12,593$) and pre-recorded longer lectures ($p < 0.05$, $F = 6.148$). The only teaching method that the male students rated better than their female counterparts is the study materials without activities, which are published in the LMS or sent by e-mail ($p < 0.05$, $F = 5.567$).

3.2 Attitudes toward distance learning and their correlation with frequency of teaching, study conditions, level of study, and gender.

In the next research question, we wanted to investigate how the attitudes toward distance learning are related to frequency of teaching approaches, learning conditions, study level, and gender.

Table 4: Pearson's correlation coefficients for the frequency of teaching approaches and attitudes towards distance learning

	Attitudes Towards Distance Learning Scale						
Frequency of Teaching Approaches	1	2	3	4	5	6	7
Live lectures via Zoom	0.00	0.05	0.05	0.05	0.06	-0.04	0.02
Recorded lectures (long)	0.11**	-0.12**	0.04	0.09	-0.01	-0.01	0.03
Recorded lectures (short)	0.13**	-0.14***	0.06	0.11*	0.09*	-0.05	0.12
Study material without activities	0.04	-0.03	-0.01	-0.04	0.01	0.03	0.07
Study material with activities	0.07	0.01	0.02	0.02	-0.04	-0.03	0.13**
Communication via e-mail	0.05	-0.03	0.04	0.12*	0.09*	-0.04	0.05

***$p < 0.001$; **$p < 0.01$; *$p < 0.05$

Note: 1 - Distance learning is generally more suitable for me than face-to-face lectures; 2 - Distance learning makes it more difficult to maintain motivation to study; 3 - I have adapted well to distance learning; 4 - I have acquired the same amount of knowledge by studying at a distance as with face-to-face lectures; 5 - I have the appropriate ICT skills to follow and participate in the distance learning process; 6 - I am worried about passing online exams because I do not know how they take place; 7 – By studying at a distance, I have gained more knowledge than with attending face-to-face lectures.

As the correlation analysis in Table 4 shows, the Pearson correlation coefficients are low, although some characteristics are statistically important. The highest correlation between the frequency of teaching methods and students' attitudes towards distance learning was found in the difficulty of maintaining motivation to learn (item 2 in the table) while watching recorded lectures (long or short). The more often these teaching methods were used by the teacher, the less difficulty students had in maintaining motivation to learn (r = - 0.14; p < 0.001). We found slightly lower correlation between the use of certain teaching methods and the claim that students have acquired more knowledge during the period of distance learning (item 4). Those students who received more frequently study material with activities were more likely to assess that they had acquired more knowledge during the period of distance learning (r = 0.13; p < 0.01). The same correlation can be observed between the students' view that distance learning is generally more appropriate for them than face-to-face lectures and pre-recorded short lectures. Students who received more frequently pre-recorded shorter lectures during the period of distance learning were more likely to assess that distance learning was generally more suitable for them than face-to-face lectures (r = 0.13; p < 0.01).

The following table shows the results of the correlation between attitudes towards distance learning and the level and year of study.

Table 5: Pearson correlation coefficients between attitudes towards distance learning, study conditions, and study level

Attitudes towards distance learning	LCI	Study level
Adequacy of distance learning	0.26***	-0.41***
Difficulty in maintaining motivation	-0.29***	0.44***
Adaptation to distance learning	0.37***	-0.38***
Gained the same amount of knowledge by studying at a distance	0.35***	–0.44***
Having appropriate ICT skills for distance learning	0.38***	–0.25***
Concerned about online exams	–0.29***	0.29***
Gained more knowledge by studying at a distance	0.28***	-0.39***

***p < 0.001; **p < 0.01; *p < 0.05

Note: LCI = Learning Conditions Index

Correlation analysis shows that there are quite a few statistically significant correlations and that most of the correlations are moderately high. The highest correlations are related to study level. The results show that postgraduates had more difficulty in maintaining their motivation to study during distance learning than first-level students (r = 0.44; p < 0.001). On the other hand, undergraduate students expressed to a greater extent than their master's degree colleagues that they had acquired the same amount of knowledge during the period of distance learning as with face-to-face lectures (r = –0.44; p < 0.001). In addition, undergraduate students also more in agreed that distance learning is generally more suitable for them than face-to-face lectures (r = –0.41; p < 0.001), that they had acquired more knowledge during the period of distance learning (r = –0.39; p < 0.001), that they had adapted well to distance learning (r = –0.38; p < 0.001), as well as that they have adequate ICT skills for distance learning ICT (r = –0.25; p < 0.001). In contrast, master's degree students expressed greater concern about distance exams (r = 0.29; p < 0.001).

The comparison of attitudes with learning conditions also showed statistical significance among all items. Students who indicated they had appropriate learning conditions during the period of distance learning were more likely to express that they had appropriate ICT competencies for distance learning (r = 0.38; p < 0.001), that they had adjusted well to distance learning (r = 0.37; p < 0.001), that during the period of distance learning they acquired the same amount of knowledge as with face-to-face lectures (r = 0.35; p < 0.001), that they acquired more knowledge during the period of distance learning (r = 0.28; p < 0.001) or that distance learning was generally more suitable for them than face-to-face lectures (r = 0.26; p < 0.001). However, students who did not have adequate study conditions during the period of distance learning were more likely to indicate difficulties with maintaining motivation to study (r = - 0.29; p < 0.001) and expressed concerns about distance exams (r = –0.29; p < 0.001).

The analysis by gender did not reveal any major differences, and even those that are statistically significant are quite small.

Table 6: Analysis of variance for differences in attitudes towards distance learning by gender

	Gender				ANOVA
	Female		Male		*F*(1.1474)
Attitudes towards distance learning	M	SD	M	SD	
Adequacy of distance learning	2.78	1.40	2.53	1.42	6.399*
Difficulty in maintaining motivation	3.93	1.28	4.00	1.24	0.606
Adaptation to distance learning	3.77	1.06	3.64	1.11	3.277
Gained the same amount of knowledge during distance learning	3.12	1.30	2.92	1.33	3.075
Having appropriate ICT skills for distance learning	4.24	0.86	4.39	0.86	6.169*
Concerned about online exams	2.90	1.34	2.68	1.26	5.480*
Gained more knowledge during distance learning	2.26	1.09	2.18	1.16	0.621

* $p < 0.05$

The analysis of variance revealed differences in the assessment of the relevance of distance learning ($p < 0.05$, $F = 6.399$) and concerns about taking exams online ($p < 0.05$, $F = 5.480$). Both statements were rated higher by females, while the assessment of having adequate ICT skills for distance learning was rated higher by males ($p < 0.05$, $F = 6.169$).

3.3 Which factors influence the students' feeling of being overwhelmed during a period of distance learning?

In the last part of the data analysis, we conducted a standard multiple regression analysis to determine which variables influence the students' academic overload (feeling of being overwhelmed by distance learning) to the greatest extent. As a measure of academic overload, we used a scale where students expressed their feeling of being overwhelmed with studying of a distance.

Variables included in the analysis:

- Independent variables:
  - Attitudes toward teaching approaches
  - Attitudes towards distance learning
  - Study level
  - Year of study
  - Learning Conditions Index
  - Rural/urban
- Dependent variable:
  - Academic overload

Table 7 shows the significance of factors that may influence the feeling of academic overload during distance learning. The results of the analysis showed that all variables used together explain 29% of the reasons for higher or lower overburdening ($R^2 = 0.294$; $F = 8.592$; $p < 0.001$).

Table 7: Regression Analysis Summary for Factors Influencing Feeling of Being Overwhelmed

Independent Variables	***B***	***SEB***	***β***
Attitudes toward teaching approaches			
Live lectures via Zoom	0.131	0.085	0.070
Recorded lectures (long)	0.090	0.123	0.041
Recorded lectures (short)	0.049	0.150	0.018
Study material without activities	0.003	0.051	0.003
Study material with activities in LMS	-0.060	0.056	-0.054
Communication via e-mail	0.039	0.048	0.039
Attitudes Towards Distance learning			
Adequacy of distance learning	-0.046	0.056	-0.062
Difficulty in maintaining motivation	0.180	0.055	0.217***
Adaptation to distance learning	-0.003	0.069	-0.003
Gained the same amount of knowledge	-0.142	0.061	-0.175**
ICT skills for distance learning	-0.082	0.066	-0.067
Concerned about distance exams	0.086	0.040	0.108*

Independent Variables	*B*	*SEB*	*β*
Gained knowledge during distance learning	-0.024	0.067	-0.024
Study level	-0.251	0.205	-0.106
Year of study	0.152	0.066	0.205**
Learning conditions index	-0.066	0.043	-0.079
Rural/urban	-0.011	0.097	-0.005

Note: R^2 = =0.294. (N = 367, F = 8.592; $p < 0.001$); Dependent variable: Academic overload
***$p < 0.001$; **$p < 0.01$; *$p < 0.05$

The results show that four independent variables statistically significantly predict academic overload. The feeling of academic overload is most strongly influenced by difficulty in maintaining motivation, the year of study and the assessment of the quality of distance learning. The more difficult it was for students to maintain motivation while studying, the more they felt overwhelmed during distance learning ($p < 0.001$). Academic overload is also influenced by the year of study - the higher the year of study ($p < 0.01$), the higher the overload. Another important predictor of academic overload was the attitude that one can acquire the same amount of knowledge in distance learning as in face-to-face courses ($p < 0.01$). In this case, the correlation was negative, i.e., students who felt that distance learning did not provide the same amount of knowledge felt more academically overloaded than students who rated the quality of distance learning the same as face-to-face learning. Academic overload was also influenced by the level of concern about distance exams. The more they worried about how they would pass the exam in the course, the more they felt academically overloaded ($p < 0.05$). It is interesting to note that the use of different teaching approaches or methods (e.g., recorded lectures, live zoom sessions, etc.) had no influence on the feeling of academic overload, but the personal experience of distance learning had a greater influence.

4. Discussion

In the survey we investigated how students at the Faculty of Arts, University of Ljubljana, experienced distance learning under the conditions we defined as 'emergency remote teaching'. We were interested in how students' attitudes towards distance learning were related to factors such as gender, study conditions and level of study, and whether there were differences between groups. In the following chapter, we summarise and discuss the main findings, which we divided into three sections.

4.1 Experiences with distance learning during the pandemic

In the first part, we determined the correlation between the assessment of adequacy of individual teaching approaches according to factors such as study conditions, level of study and gender of students. We established that students who assessed that they had appropriate conditions for study during the period of distance learning also assessed as appropriate and suitable for achieving their learning objectives most of the activities which they had received during the period of distance learning (face-to-face lectures, pre-recorded longer lectures, study material with activities, study material without activities and communication via e-mail). Furthermore, statistically significant correlations were determined in categories covering study level. It is an interesting finding that first-year students assessed asynchronous forms of study as more appropriate way of studying (shorter and longer lectures were recorded in advance and they were provided study material with activities) then postgraduate students. The fact that live video meetings (e.g., via Zoom or a similar tool) were rated as more relevant by students who had good conditions for learning from home is not very surprising. Interestingly, students with poorer conditions did not rate other forms of study as more appropriate (e.g., recorded lectures). This could be due to the quality of the videos themselves and their fit with the course content, or to students' expectations of their studies: as a form of learning that takes place face-to-face, as a communication between the teacher and the students, etc. As Choe et al. (2019) point out, the students' satisfaction with pre-recorded lectures and their efficiency largely depends on the way the video is prepared, its length, etc. The same applies to the negative correlation between study level, and lecture videos. The correlations are very low, but we can still see a negative trend and suspect that such results are due to the nature of study at the master level. This is mainly carried out in small groups, is often project-based, active teaching methods are used, etc. In short, approaches that are simple and obvious in face-to-face environment, are more difficult to implement in an online environment, especially if the lecturer has no experience of using technology in such situations.

Gender differences were apparent in assessing the adequacy of individual teaching approaches (Table 3). We found that female students rated face-to-face lectures as more appropriate, followed by shorter and recorded lectures (long), whilst male students assessed independent study with material without activities as more

appropriate. These results are surprising, since they are not connected with gender differences in attitudes towards distance learning (Table 6), and their ICT skills. Male students rated higher the statement that they have the appropriate ICT skills for distance learning than female students, whilst female students rated slightly higher the adequacy of distance learning and expressed greater concern about distance exams. Our theoretical expectations would be that positive attitudes would be positively correlated with ICT skills. These results would be congruent with previous studies on the correlation between attitudes and use of technology and ICT skills (e.g., Romero Martínez et al., 2020). Our findings are more in line with those of Casillas et al. (2017), who studied the digital literacy of 580 education students at the University of Salamanca (Spain) and found that female students had more positive attitudes towards technology than male students, although male students had higher levels of technology literacy. Similar, Colomo-Magaña et al. (2020), found that female students assessed the usefulness of certain forms of study (such as the flipped classroom) during a period of distance learning as more useful for promoting independent learning than the male students.

In the second segment, we explored whether there were any correlations between the frequency of teaching methods used in their courses and their attitudes towards distance learning (Table 4). The results show that students who indicated that videos of course lectures were more frequent in their course suggested that it was easier for them to maintain their motivation during distance learning. There can be many reasons for this. The asynchronous format allows students to watch the lecture video when they are motivated to do so and have the most time available. Another feature of recorded video is that it can be watched repeatedly or in shorter clips. All of this can have a positive effect on maintaining motivation, compared to live lectures that are broadcast via Zoom and that students must follow according to the course schedule. In effect, they found this form of studying was generally more suitable for them than attending face-to-face lectures. This data is somewhat surprising, since surveys usually show that the use of recorded lectures, whilst allowing for greater flexibility of study, are often more problem-oriented and have a positive effect on motivation to study (Noetel et al., 2021; Vlachopoulos and Jan, 2020). However, this is not necessarily true for all generations of students. As established by Velde et al. (2021), although the lower-year students positively assess the flexibility provided by asynchronous lectures, they also emphasise as more important their need for guidance in learning new content, direct communication and motivation generated by their professor (Velde et al., 2021). Similarly, Harrison (2020) found in his exploratory qualitative study that while most distance learners liked and watched the videos, a significant proportion did not because of the poor quality of the production. These and similar findings show that the quality of the teacher (in this case as the creator of the video) has the greatest impact on student learning.

Another important finding is that students who had more learning material with subsequent activities in course's online classrooms estimate that they even acquired more knowledge this way than in face-to-face classes. This is quite an important result, showing that guided or self-directed activities in Moodle are quite useful for studying, provided they are properly planned. This insight is not only important for ensuring the quality of distance learning in general, but also for the introduction of blended or flipped learning in the future.

4.2 Attitudes toward distance learning and academic overload

The analysis of the correlations between attitudes towards distance learning, learning conditions and the level of study (Table 5) revealed some interesting results. When analysing learning conditions in connection with the attitudes of students, we found that study conditions affected their attitudes towards distance learning, their assessment of competence for distance learning, as well as their motivation to study and the feeling of being overburdened. Namely, we identified some negative attitudes and difficulties with motivation in students who did not have adequate study conditions available. These results reaffirm the fact that although distance education shows great potential, it can only be realised if everyone involved in the process has the right conditions available. As many studies have shown, school closures have affected all students, but especially the most vulnerable ones who are more likely to face additional barriers, such as poor Internet connection, inadequate hardware or software, inadequate study space and often underdeveloped ICT competencies (Aristovnik et al., 2020; Czerniewicz et al., 2020; Katz et al., 2021; OECD, 2020) The results also suggest that postgraduate students had more difficulty than undergraduate students in maintaining their commitment to distance learning. On the other hand, undergraduate students were more likely to estimate that the knowledge they acquired in distance learning was equivalent to the knowledge they acquired in face-to-face learning. In addition, undergraduate students felt that distance learning was more suitable for them than face-to-face courses and that they had acquired more knowledge during distance learning. In general, students adapted better to distance learning and rated their ICT skills as competent.

Finally, we examined which factors influence students' academic overload during distance learning (Table 7). As for the feeling of academic overload, it is interesting, even surprising, that the teaching methods themselves did not influence this thinking. We had expected that the large number of recorded lectures and the various activities organised by teachers in the online classrooms would have an impact on workload and stress during distance learning, but these expectations proved to be wrong. The perception of academic overload was mainly influenced by psychological factors and the learning conditions while studying at a distance. In this respect, the analysis highlights in particular the difficulties in maintaining motivation, but also concerns about the (new) methods of assessing knowledge. Another important factor influencing the feeling of academic overload was the level of study, or rather the year of study. The higher the year of study the students were in, the more they felt overloaded, which is certainly an indicator of the teaching approaches and teachers' expectations. It would be interesting to see if these results are specific only to social studies or also to science and engineering programmes. To some extent, our findings are consistent with the research of Chen et al. (2011), who analysed the factors that influence information overload in online learning. They included learning preferences and time constraints among the important factors. Similar factors were also identified in the present study. However, our findings are also similar to studies conducted during the Covid-19 pandemic (Alheneidi et al., 2021; Al-Kumaim et al., 2021; Lazarevic and Bentz, 2021). These include time pressure during the study period, access to learning materials (Lazarevic and Bentz, 2021), changing learning modes and distracting learning environments at home (Alheneidi et al., 2021), teacher workload due to online learning platforms, technical problems, and psychological difficulties due to social isolation (Al-Kumaim et al., 2021).

4.3 Strengths and limitations

This survey identifies potential barriers to effective distance learning, as well as its opportunities for improving the students' experience of it. Survey was conducted on a large sample of students (almost 50% of the total enrolment) and yielded some interesting findings about distance learning during the pandemic, but it also has some limitations. Among them, we list the sampling method and the research method itself. The sample was selected on an ad-hoc basis and the survey was conducted online. This automatically means that the questions were most likely answered by those students who had better study conditions at home and who did not have major problems with distance learning. Moreover, online surveys are often responded to by those who have a more positive attitude towards the topic the survey is dedicated to. For this reason, we conclude that this affected the magnitude of the differences we established in the study. In other words, they are in fact larger than revealed by the survey. In the future, it would certainly make sense to validate these results with other qualitative methods in addition to expanding the student survey sample with students from other programmes (i.e., not just from social sciences).

5. Conclusion

In this paper, we described some of the factors which influenced the quality and experiences of study for students during the pandemic at the selected faculty in Slovenia. survey was conducted on a large sample of students (almost 50% of the total enrolment) and yielded some interesting findings about distance learning during the pandemic. We found that we cannot make a clear judgement on whether learning at a distance even if label it as "emergency remote teaching" is harmful or beneficial to students. As the results showed the evaluation of this form of study was highly dependent on the teaching approaches used, course requirements and the prevailing teaching approaches experienced in the pre-pandemic period. It also showed that in some cases the teaching approaches were not as important a factor as the learning conditions under which the student participated in the distance learning activities. Unfavourable conditions at home can lead to despair, stress, and apathy on the part of students during their studies. Nevertheless, we believe that some solutions and didactic strategies should be maintained and further developed in the post-pandemic period, but under certain conditions: (1) In order to actively participate in distance learning, all students must have the same learning and technical conditions (hardware and software, good internet connection, quiet learning environment, etc.). (2) Teaching methods must be adapted to the environment in which learning takes place, therefore (3) teachers must be didactically trained for distance learning. (4) Collaboration between teacher and students and between the students themselves, must be facilitated as one of the ways of academic and psychological support during distance learning.

The pandemic has made it clear that the school systems and the universities are far from being prepared for this kind of teaching and learning. For this reason, and because of the lack of contact between the participants in education, such a form of education simply cannot become "the new normal".

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Relocating Online a Technology-Enhanced Microteaching Practice in Teacher Education: Challenges and Implications

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Abstract: The rich repertoire of online practices adopted by educators during the Covid-19 pandemic opened up new perspectives for educational research to consider e-learning post-pandemic. Focusing on teacher education, it is worth considering the practices adopted to inform the development of future curricula that cultivate teaching competencies for e-learning. This paper examines microteaching, a well-established practice realised in teacher education as a learning-to-teach experience. As was the case with other teacher education practices, the forced online transition heavily compromised the vividness of microteaching -a technique inherently connected to face-to-face interaction-. On the other hand, this online relocation can be an opportunity to capitalise on online microteaching as a fulfilling e-learning experience in teacher education. The paper has two parts. In the first part, we conceptualise the potential of microteaching while applying Technology-Enhanced Learning (TEL). The second part reports our experience relocating online a mature technology-enhanced microteaching practice (successfully implemented in face-to-face settings for seven years) due to the Covid-19 pandemic. Our research design utilises two implementations of microteaching practice. One was conducted in a typical face-to-face context pre-pandemic, and another was conducted in an online context during a lockdown imposed by the pandemic. On a first level, collecting qualitative data from both contexts allowed us to observe common TEL-related challenges. On a second level, we focused on identifying challenges distinct at the online context to infer and highlight the implications of the online relocation. These implications relate to (i) the organisational changes, as experienced from the instructor's perspective, (ii) the technologies adopted for applying TEL, and (iii) the challenges that pre-service teachers (PSTs) face in the online environment. Our findings extend the previous research scope on face-to-face microteaching practice. New challenges of relocating technology-enhanced microteaching online include technical difficulties in handling technologies and reduced participation in whole-class discussions. However, challenges that remain relatively unaffected concerning the typical face-to-face practice are (i) the PSTs immersion in the roleplaying character of microteaching, (ii) the misconceptions on the principles and methods of teaching techniques roleplayed, (iii) the adoption of digital tools for applying TEL, (iv) the selection of suitable digital tools, and (v) the burden of time limitation. In conclusion, we argue that these insights reveal an unexplored potential for technology-enhanced microteaching in an online context. We discuss how the implications of shifting microteaching practise online may model future microteaching implementations in teacher education post-pandemic. We support that online microteaching, apart from providing an alternative method when circumstances impose it, should be integrated within the typical teacher education curriculum to cultivate teaching competencies for e-learning.

Keywords: teacher education, technology-enhanced microteaching, online practices, covid-19

1. Introduction

In spring 2020, due to the Covid-19 pandemic, most countries in the world experienced an unprecedented total or partial lockdown, which subsequently caused universities and schools to suspend their face-to-face operation and relocate it online. With approximately 1.5 billion students away from classrooms and restricted at home (UNESCO, 2020), established practices changed quickly, with educators having to show "pedagogic agility" (Kidd and Murray, 2020).

Researchers acknowledge that handling online educational contexts requires a "new and extended skills set" (Gachago et al., 2017; Peachey, 2017). The challenge of any kind of online teaching is "transferring the skills of content delivery, student engagement, motivation, and assessment into the new delivery venue" (Clement, 2010: 97). Specifically for pre-service teachers (from this point on referred to as "PSTs"), skills are indeed a key factor for integrating e-learning in their practice rather than having the intention to do so (Olugbara and Letseka, 2020). Another critical factor is the obstacle of time: One of the greatest misconceptions about online teaching is that it is somehow a quick and dirty version of the much more complex classroom teaching reality. Nothing could be further from the truth. "Teachers who have taught online will usually say that their face-to-face classrooms are far less time-consuming" (Brookfield 2006, 91, in Clement 2010, 97). Another issue relates to the design constraints on pedagogical innovation posed by virtual conferencing tools (such as Zoom, Blackboard, Google classroom, or Microsoft Teams). In this respect, Mishra (2020) cautions on schools' uniform responses to the Covid-19 crisis regarding the adoption of these tools and on decisions taken under immense time pressure, which have the power to shift the balance and direction of the emerging educational ecosystem. An

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interesting example is that of virtual conferencing sessions: they have become more "bumpy" and teacher-centred than face-to-face sessions, with long silences, shorter student responses, and lack of paralinguistic communication as many students prefer to have their camera off (Peachey, 2017). However, researchers claim that during the Covid-19 pandemic, many teaching practices and values remained unchallenged despite the relocation to newly formed online spaces as "there was a sense of both sameness and difference in some of the innovative pedagogies developed on the (g)local level" (Kidd and Murray, 2020).

Due to the Covid-19 pandemic, the need to rapidly adapt to new teaching and learning online contexts affected teacher education profoundly (la Velle et al., 2020; Flores and Swennen, 2020). Institutions and teacher educators were confronted with an "unexpected and forced transition", creating the need for decisions, choices, and adaptations, meeting the expectations of student teachers, and the requirements of teacher education institutions (Carrillo and Flores, 2020). In this context, among other issues, it is interesting to notice the practices adopted in teacher education regarding PSTs learning-to-teach experiences.

PSTs missing practicum in schools and the challenges entailed for doing it "virtually" have been recently addressed in educational research (see, e.g., Assunção Flores and Gago, 2020; Coolican, Borras and Strong, 2020; Kidd and Murray, 2020; la Velle et al., 2020). However, no previous study addressed microteaching practice during the Covid-19 pandemic to the best of our knowledge. This paper explores microteaching, which has already been reported to effectively bridge the school placement gap (Griffiths, 2016), as an alternative method providing a compelling learning-to-teach experience in an online context. Indeed, as the opportunities for developing new pedagogies for online teacher education opened up dramatically during the Covid-19 pandemic (la Velle et al., 2020), we capitalise on practising online microteaching during this period. Acknowledging the significance of understanding the implications of e-learning among PSTs (Sadeck, Chigona and Cronjé, 2020) we intend to provide original insights into the challenges of relocating online a learning-to-teach experience that may guide the integration of e-learning in teacher education.

Narrowing down on the contextual background of this research, at a macro-level, microteaching as a practice in teacher education has a long tradition in Greece. However, it is not generalised, i.e. globally adopted by all official teacher education providers. Microteaching was first introduced in 1973 at the School of Pedagogical and Technological Education (ASPETE), where it is still practised as an integral part of technological education's PST practicum. It is also a tradition of the Aristotle University of Thessaloniki (Schools of Primary and Secondary Education), since 1987, also followed by other Schools and Departments in Northern Greece, such as that of Primary Education of the Democritus University of Thrace (Chatzidimou, 2011). Overall, from the total of 21 Pedagogical Departments in Greece, about half (11) include microteaching in their study guides, either as an autonomous module, a laboratory exercise, or as part of students' teaching practicum (Fykaris and Papaspyrou, 2014). However, neither incorporating digital technologies in microteaching to apply Technology-Enhanced Learning (TEL) nor online implementation has been previously studied in a Greek educational context.

At a micro-level, microteaching applying TEL (from this point on referred as technology-enhanced microteaching) has been an integral part of the post graduate module undertaken by the researchers for the past seven years, first at the University of Athens, in face-to-face settings and then completely online, at the University of West Attica, where the online relocation took place (see section 3. Methodology).

In what follows, we provide a theoretical background of microteaching in terms of its TEL perspective and then attempt to illustrate this perspective in practice. In the methodology section, we describe our qualitative research design (Willig, 2013) and our approach to the challenges of relocating online a technology-enhanced microteaching practice. We report findings regarding (i) the challenges of teacher educators for organising microteaching practise, (ii) the challenges regarding the application of TEL and (iii) the extra challenges that PSTs face when practising online microteaching. At the end of the paper, we argue about the potential of technology-enhanced microteaching in an online context. Also, we discuss how the implications of this shift of microteaching practice may model future practices in teacher education post-pandemic.

2. Microteaching meets TEL: towards integration

2.1 Microteaching and online microteaching

Microteaching is a condensed lesson unit delivered within a roleplaying context (Ledger and Fischetti, 2020), where peers act as "students". Karlström and Hamza (2019) note that the typical structure of microteaching

involves three phases: (i) the planning phase in which PSTs plan a short lesson unit, (ii) the teaching phase in which they teach the unit to peers, and (iii) the reflection phase for reflecting on what happened during the microteaching session. Researchers report that, despite its inherent nature of artificiality, the microteaching experience allows PSTs to apply theoretical knowledge and develop practical teaching competence (Yan and He, 2017). PSTs can transform their subject matter knowledge and pedagogical content knowledge (Baştürk, 2016) by scaling down the classroom's complexity into a controlled and monitored training environment (de Lange and Nerland, 2018). Practising microteaching empowers PSTs to (i) evolve their pedagogical knowledge and competence (Fernández, 2010), (ii) connect theory with teaching practice (Mergler and Tangen, 2010), and (iii) develop basic teaching skills (Yan and He, 2017). Furthermore, microteaching supports PST's reflective practice in the planning phase (Karlström and Hamza, 2019; Zalavra et al., 2020), in the teaching phase (Diana, 2013) and, of course, in the reflection phase (Griffiths, 2016; Straková and Cimermanová, 2018).

Research in online microteaching is relatively limited, accounting for two different approaches. Kusmawan's (2017) online approach refers only to the reflection phase by incorporating video recordings into the traditional microteaching technique and making them available online. As Kusmawan (2017) reports, the open online distribution of microteachings' video recordings allowed PSTs to view and reflect on their practice. Participants had positive perceptions of this experience with regards to (i) improving their professional teaching, (ii) boosting their confidence in their teaching and (iii) developing critical and reflective thinking. In line with our approach to online microteaching that focuses on practising the teaching phase in an online context is the research by Mergler and Tangen (2010). These researchers report a comparative study with one group of PSTs practising microteaching in a face-to-face context and the other in an online context. The findings of Mergler and Tangen (2010) reveal that the PSTs who practised online microteaching had higher efficacy levels than those who practised the traditional face-to-face microteaching.

2.2 Microteaching and TEL

Recent years have witnessed the internationally recognised importance of teachers designing learning tasks (Goodyear and Dimitriadis, 2013) and appropriately integrating technology into teaching (Zalavra and Papanikolaou, 2019). Technology integration should be interweaved with learning design as it offers many opportunities to engage learners and strengthen the learning process (Papanikolaou et al., 2016). In this line, researchers endorse that the pedagogical use of digital technology should be embedded in teacher education programs to improve current teaching and develop new approaches (Kirschner, Wubbels and Brekelmans, 2008). They also envision the modern-day teacher being able to apply effective, efficient, and enjoyable pedagogic/educational techniques while using the different tools and technologies afforded at this moment (Kirschner, 2015). Practising technology-enhanced microteaching may expedite the time it takes PSTs to progress to more innovative and meaningful uses of technology in subsequent field experiences and efforts as in-service teachers (Dawson, Pringle and Lott Adams 2003). Therefore, we argue for the necessity of promoting TEL as an integral teaching component of contemporary teacher education and subsequently stimulating PSTs to operationalise TEL while practising microteaching. To operationalise this argument, we present a representative instance (PST cohort) of our 7-year experience on TEL-enhanced microteaching in a face-to-face academic context. We then focus on the online relocation of this practice due to the covid-19 pandemic and its effects, both concerning previous TEL practice and its potential for future technology-enhanced online microteaching.

3. Methodology

3.1 Setting and Participants

During the spring semester of the academic year 2019–2020, the research team undertook the postgraduate course "Digital Technologies and Collaborative Learning" offered by the University of West Attica in Athens, Greece. The participants were 30 PSTs from several disciplines, such as Computer Science, Mathematics, Greek language, Primary Education, etc. The course was organised into two parts. In the first part, collaborative learning, its challenges and implications as illustrated in the relevant literature were approached. In the second part, PSTs were introduced to four collaborative learning techniques: Brainstorming, Debate, Jigsaw, and Roleplay. By the end of the course's first part, the Covid-19 pandemic discontinued face-to-face lectures. Thus, the second part of the course was relocated online, using the institutional platform MS Teams (https://teams.microsoft.com/) as the primary virtual conferencing tool. The 30 participants formed nine groups (we call them cohort B groups from now on). The teams were assigned to collaboratively develop a learning design in the learning design tool WebCollage (Villasclaras-Fernández et al., 2013) integrated into the

collaborative learning design environment of ILDE (Hernández-Leo et al., 2018). The main requirement that the learning design had to meet was to include a collaborative learning technique and integrate digital technologies in its implementation. The PSTs' teams could choose from a range of online Web 2.0 applications suggested by the instructors or make their own choices. The learning designs were initially authored, developed, and then implemented as technology-enhanced microteaching sessions. Specifically, each group had to "teach" the learning design in a simulated online context as a microteaching session, with their peers playing the students' role. To reflect on their practice, after each session, they participated in a peer-review activity to provide feedback to their peers and leverage from cultivating a community of inquiry (Makri et al., 2014).

The above course syllabus was similar to the one undertaken by the research team in the context of another postgraduate program at the National and Kapodistrian University of Athens, from 2011 until 2017. For the purposes of this study, we chose a representative cohort of 10 PSTs (from several disciplines) attending the course at the spring semester of the academic year 2017–2018. The 10 participants formed four groups (we call them cohort A groups from now on). This methodological choice was not made to support a comparative study. Instead, it aimed at (i) shedding light on the challenges PSTs face with the TEL aspect of microteaching and (ii) highlighting those aspects that remain the same or change across the two contexts, face-to-face and online.

3.2 Research Design - Data Collection and Analysis

Following a qualitative research design (Willig, 2013) our study addresses the following research questions:

- **RQ1:** What challenges do teacher educators address in relocating online an established face-to-face technology-enhanced microteaching practice?
- **RQ2:** How does relocation from face-to-face to online affect PSTs' technology adoption for applying technology-enhanced microteaching?
- **RQ3:** Do PSTs face extra challenges when practising online than face-to-face technology-enhanced microteaching?

For RQ1, we used data from our research diary and observations from both implementations (see Figure 1), as we identified similar or slightly different challenges in the online implementation in relation to the typical face-to-face implementation.

For RQ2, our data sources were both cohorts' deliverables (learning designs developed) and all participants' individual reflective text accounts, delivered at the end of both courses. In the case of cohort B, we also used the video recordings of microteaching sessions from the MS Teams platform. As in the previous RQ, we used data from both courses to highlight the effect of online relocation on TEL adoption.

For RQ3, we used participants' peer review comments regarding their experience as "students" and their individual reflective text accounts regarding their experience as "teachers" practising online microteaching.

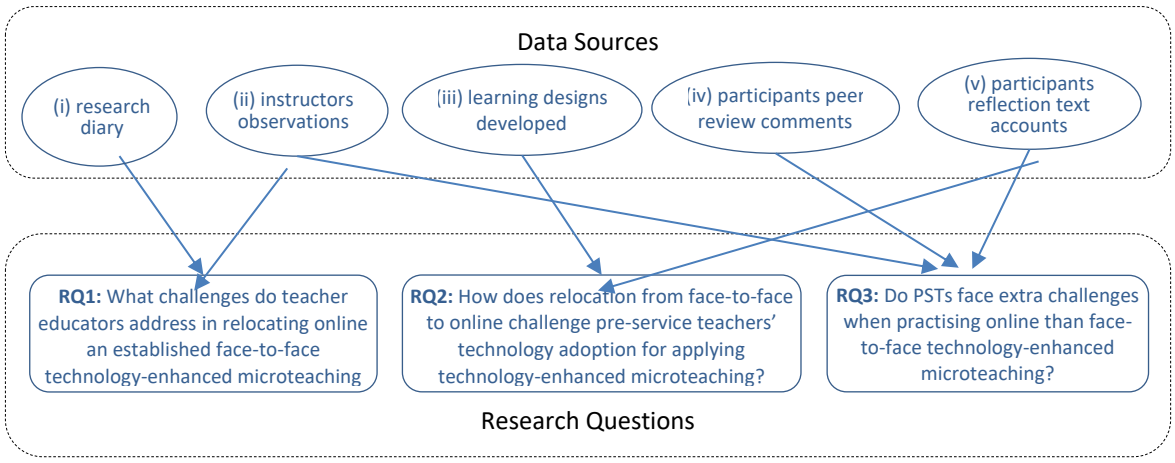

Figure 1*:* Correspondence of data sources to research questions

Participants from both cohorts gave us consent to use their texts and course deliverables for research purposes. We applied thematic analysis (Braun and Clarke, 2006), analysing data sources per research question as seen in

Figure 1. Both researchers were involved in the process, exhaustively negotiating themes to conduct a rigorous and relevant thematic analysis.

4. Findings and Discussion

4.1 The challenges that teacher educators address in relocating online an established face-to-face technology-enhanced microteaching practice

As the researchers were also the course instructors in both contexts (face-to-face and online), our research diary is a valuable source of thoughts, feelings and activities throughout the research process, from design through data collection and analysis to writing and presenting this study. During the spring semester of the academic year 2019–2020, we intended to follow the typical implementation for the course syllabus regarding PSTs practising face-to-face microteaching as we had practised it in the previous seven years. When the Covid-19 pandemic disrupted face-to-face classes, we were concerned if shifting online to a microteaching practice was feasible. The possibility of changing the syllabus by removing the microteaching session -and replacing it with presentations of each collaborative learning technique- was initially considered. Besides, we worried that lacking face-to-face communication with all its paralinguistic elements would make the practice of microteaching -in its essence, a roleplay- awkward at best and impossible at worst. Despite these concerns, we reached the final joint decision to assign PSTs to implement their microteaching sessions online. Oddly, supporting this decision did not drastically change the initial course design. After the instructors presented the four collaborative learning techniques: Brainstorming, Debate, Jigsaw, and Roleplay, the PSTs were split into groups, each group assigned to practice one technique. The groups used ILDE and WebCollage for authoring and peer-reviewing their microteaching sessions. They were free to choose which tools to integrate into their technology-enhanced microteaching sessions. Overall, the course design, goals, and objectives remained to a great degree unchanged. What was different in practical terms was the class size and the obligatory use of the institutional platform, MS Teams, for synchronous video conferencing, and in effect, for implementing the microteaching sessions.

From our perspective, that of the instructors, in our observations of the online implementation of the microteaching practice, we identified three interesting issues:

4.1.1 Immersion in the roleplaying character of microteaching

The first issue relates to our initial concern about the actual online transferability of the roleplaying character of microteaching. To our surprise, in all cohort B group sessions, both the PSTs playing the role of “students” and those playing the role of “teachers” indicated a behaviour of total immersion in their role. This was evident in “teachers” discourse styles when addressing younger age groups (primary school), as was the case with many sessions. On the other hand, “students” behaved as one would expect: asking many questions -sometimes even disruptive for the microlesson flow- and addressing their teachers as “sir” and “madam”. Though they participated in all assigned activities with diligence and zeal, probably motivated by collegial feelings towards their peers, they attempted to mimic children’s in-class behaviours and discourse at any instance possible. This impression was further validated by PSTs peer review comments, in which the “liveliness” and “positive climate” of the lesson are recurring themes. Although immersion in microteaching roleplay was a common phenomenon in face-to-face courses, it was unexpected in this first effort of online relocation.

4.1.2 Reduced participation in whole-class discussions

In contrast to their absolute engagement in their roleplay during practising microteaching, PSTs did not show the same enthusiasm in the case of whole-class discussions. This type of activity was a core element of the course rationale in its face-to-face version. The typical lecture, presenting each collaborative technique, was, in fact, an instructor-led discussion on the principles and application methods of the techniques. The participants actively participated by asking questions, requesting explanations and sharing their views. In addition, after each microteaching session, there was always time for discussing the first impressions of both “teachers” and “students” before proceeding with the more in-depth process of written peer review.

In the online relocation of the course, this rationale was challenged. Although practices towards building a sense of community (Makri et al., 2014) were adopted, this was not the case. From the first online lesson, it was evident that most participants were unwilling to appear on camera unless necessary. They were reluctant to interrupt the instructors and address questions verbally or use the “raise hand” symbol in MS Teams. Also, they hesitated to answer when asked, leading to awkward silence periods. When prompted to comment on their

colleagues' microteaching sessions, they preserved a politeness norm, keeping critical comments and suggestions for their written reviews.

To address these challenges, the instructors activated the "chat" feature of the platform. This feature is not enabled by default in MS Teams, unless the class is registered into a "team" with its own general chat area. Social presence was further pursued through the use of an application, Sli.do (https://www.sli.do) -also supported in mobile devices-, allowing participants to participate in brief polls activated during the course and post their questions on a "Question and Answer" area (for example, see Figure 2).

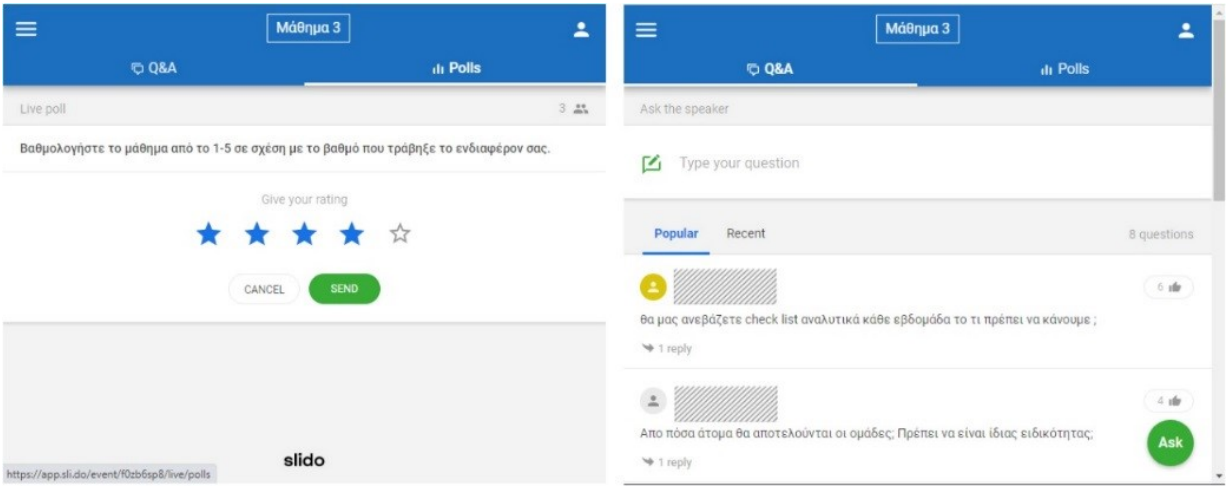

Figure 2: The "Question and Answer" and the "Poll" features utilised in Sli.do

4.1.3 Misconceptions on the principles and methods of collaborative learning techniques

A striking similarity between the two contexts (face-to-face and online) is that PSTs had the same typical misconceptions regarding the principles of collaborative learning techniques and application methods in their microteaching sessions. During our seven-year experience teaching the face-to-face course, the misconceptions we identified were also repeated in the course's online version.

While practising the Brainstorming technique in their microteaching sessions, the PSTs encountered difficulties in (i) keeping the session brief and not extending it into a discussion, as this is a method that usually comes after the "storming" phase, and (ii) categorising quickly and efficiently the words and ideas expressed by students. In both contexts, the "teachers" struggled to categorise the ideas using a digital tool in a straightforward and visible-to-all way.

Another common misconception is practising a Roleplay as a Debate. There were microteaching sessions of both cohort A and cohort B teams that assigned roles to "take sides" on a topic, which is actually the Debate technique's essence.

Lastly, we observed the same difficulty in implementing the Jigsaw technique in both contexts. The PSTs as "teachers" failed to organise the groups involved in the technique efficiently. Thus, the interplay of "home groups" and "expert groups" was often mixed up, with "students" ending up not acknowledging each group's function. This was especially evident in the online version of microteaching, as, in practical terms, there was the need for separate breakout rooms for "home" and "expert" groups. Online synchronous work in these different spaces had to be orchestrated and coordinated as seamlessly as possible so that "students" did not have to switch among other platforms and tools, thus shifting the pedagogical concerns of collaboration into technical frustrations.

4.2 The effects of face-to-face to online relocation on PSTs' technology adoption for applying technology-enhanced microteaching

We consider two dimensions of technology adoption while practising technology-enhanced microteaching. The first one involves preparing microteaching, whereas PSTs adopt technologies to design their lesson, and

communication means to collaborate on their design. The second one involves designing for TEL, and specifically designing for the collaborative learning technique to be practised.

4.2.1 The effects on a microteaching's preparation phase

The content analysis of the participants' reflection text accounts provides us insights into preparing their technology-advanced microteaching. As expected from their assignment, both cohorts in this study used the learning design tool WebCollage and collaborated in the ILDE platform for developing their learning design. Since communication means were up to team members, it is interesting to consider their methods. Although they all met face-to-face during lectures, one out of four cohort A groups reported working exclusively online synchronously and asynchronously. The rest of cohort A groups reported using several online tools apart from making use of their face-to-face encounters. Among the nine cohort B groups, two groups reported meeting face-to-face, which is an immensely exciting finding since this study took place in the period that either a coronavirus lockdown or restrictions on people's movement were imposed. The digital tools utilised by both cohorts for communicating online were similar: Skype (https://www.skype.com), MS Teams, Google Hangouts (https://hangouts.google.com), Messenger (https://messenger.com), and Viber (https://www.viber.com).

4.2.2 The effects on a microteaching's main phase

The content analysis of the developed learning designs provides insights into the means adopted. Despite cohort B using MS Teams as the synchronous tool for relocating the typical classroom's space to an online space, Table 1 summarises the means -digital tools and materials- used to apply TEL for each microteaching's collaborative learning technique. As seen in Table 1, both cohort A and cohort B groups used various digital tools. It seems that PSTs use equivalent methods for introducing their microteaching's topic and realising the collaborative learning technique and the subsequent assessment.

1. Introduction

We can see similarities in all the groups' introductory phases irrespective of the collaborative learning technique to be practised or the microteaching context. PSTs mainly used oral, video, and PowerPoint presentations to introduce their microteaching topic.

2. Roleplay technique

Animation, carried out with GoAnimate (www.goanimate.com) or Animaker (https://www.animaker.com), was used to practise TEL in either face-to-face or online Roleplay (for example, see Figure 3).

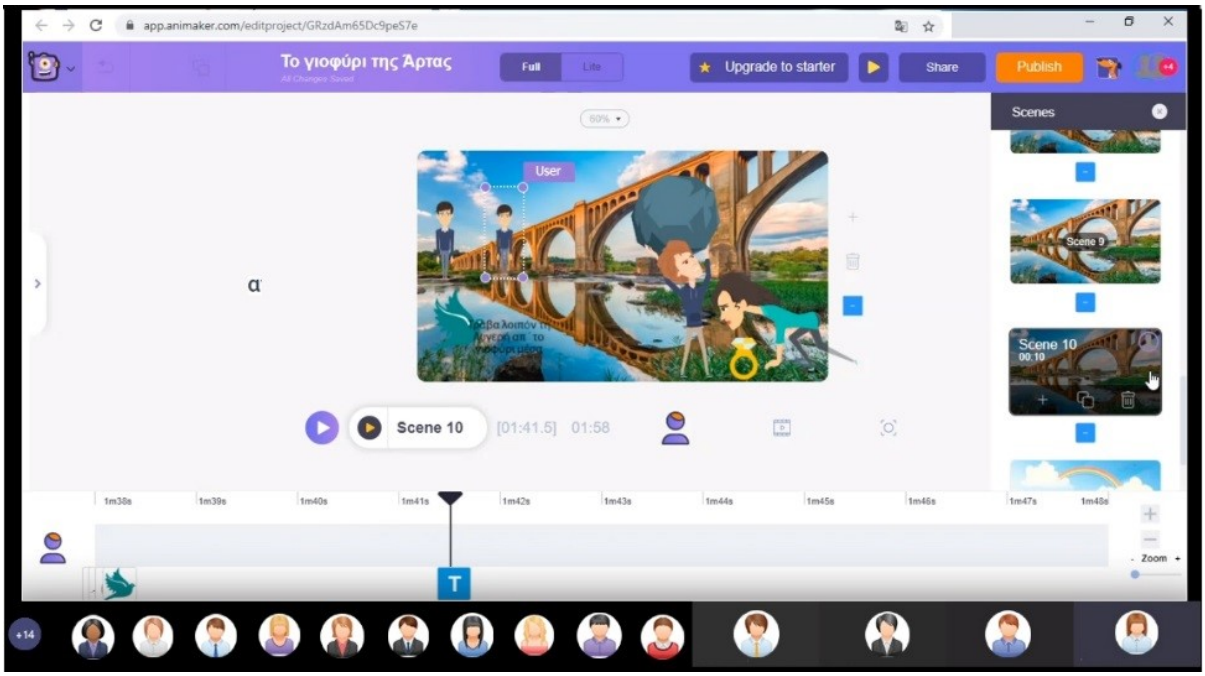

Figure 3: Collaborative animation creation in Animaker

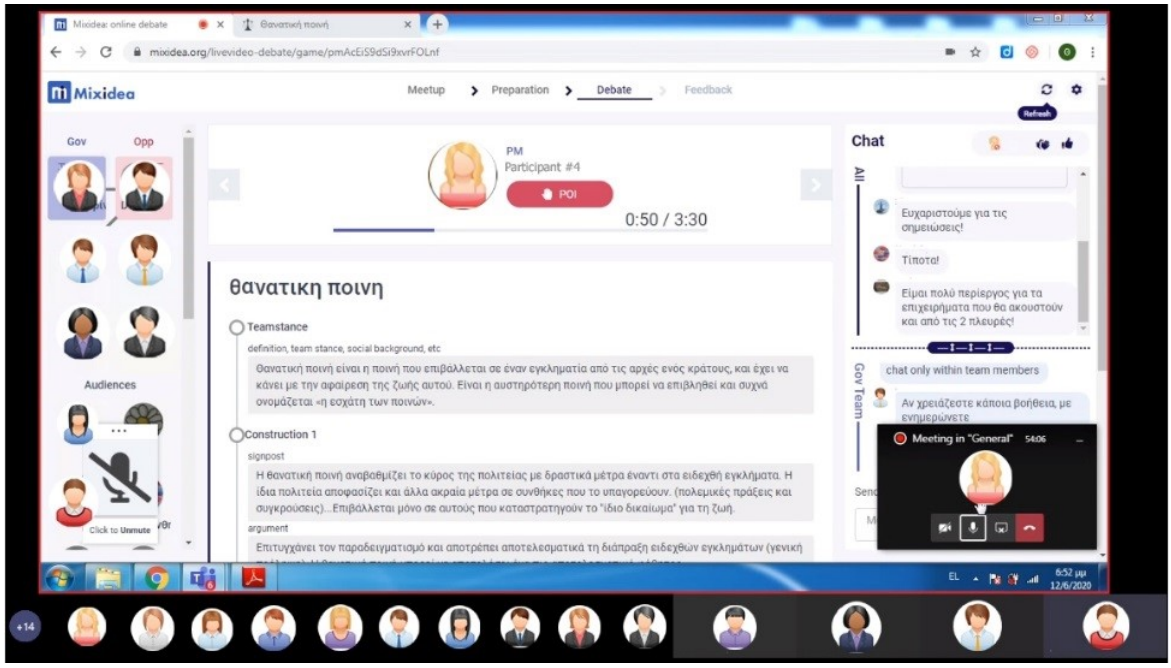

Figure 4: Online debating with Mixidea

One cohort B group enriched the Roleplay by ending the story with a presentation pre-created by teachers-PSTs in Second Life (https://secondlife.com). While cohort A groups used simple paper cards for assigning the roles of the Roleplay, cohort B groups used Google Docs (https://docs.google.com/document), Linoit (https://linoit.com) and AvatarMaker (https://avatarmaker.com).

3. Brainstorming technique

All the groups used collaborative online notice boards such as Padlet (https://padlet.com) and Stomboard (https://stormboard.com) for Brainstorming.

4. Debate technique

The Debate was organised in digital tools like CreateDebate (https://www.createDebate.com), Kialo-Edu (https://www.kialo-edu.com), and Mixidea (https://mixidea.org) by all the groups, regardless of their microteaching context (for example, see Figure 4).

5. Jigsaw technique

Likewise, all the groups opted to provide online resources to their students for elaborating the topic in the Jigsaw groups. One cohort B team also used Phet simulations (https://phet.colorado.edu) to approach a physics subject. Jigsaw intragroup communication was realised by texting in Ted-Ed (https://ed.ted.com), Google Hangouts, and MS Teams by the cohort B groups, while face-to-face was evident for the cohort A groups.

6. Assessment

Lastly, most groups chose digital options for the assessment phase of the topic explored in their microteaching session. They mostly used online polling in Google Forms (https://docs.google.com/forms) and opinion notes in Padlet for assessing Roleplay and Debate. At the same time, they preferred online quizzes realised in Kahoot (https://kahoot.com) and ClassMaker (https://www.classmarker.com) or presentations in Google Slides (https://docs.google.com/presentation/) and H5P (https://h5p.org) for the Jigsaw technique. The discussion was the only technique practised after Brainstorming. As expected, the cohort A team practised oral face-to-face discussion. In contrast, cohort B teams synchronously practised online discussion with MS Teams in oral form and with MeetingWorlds (https://meetingworlds.com) and Google Hangouts in written form.

Table 1: Means used in microteaching for applying TEL while implementing collaborative learning techniques

Cohort	Group	Technique	Introductory Phase	Technique's Phase	Assessment
A	1	RolePlay	Video presentation	Paper Cards for roles' assignment. Animation in GoAnimate	Discussion in a Forum in the class' Edmondo.
B	1		Oral Presentation and GoogleDoc.	GoogleDoc for roles' assignment. Animation in Animaker. Presentation in Second Life.	Opinion Notes in Padlet.
B	2		Powerpoint presentation.	Linoit for roles' assignment. PowerPoint presentation and synchronous voice animation.	Opinion Poll in Google Forms.
B	3		Video presentation and ThingLink interactive text.	Linoit Sticky Notes and Avatar Maker for roles' assignment. Synchronous voice animation.	Opinion Notes in Padlet.
A	1	Brainstorming	Oral presentation.	Padlet	Oral Discussion.
B	1		Video Presentation.	Padlet	Written discussion in MeetingWorlds.
B	2		Online resources in the class' Edmodo.	StormBoard and Wordle.	Oral discussion.
A	1	Debate	Powerpoint presentation.	CreateDebate, Rubric shared online, paper notes.	Oral discussion.
B	1		Online resources.	Kialo-Edu	Opinion Poll in Google Forms.
B	2		Video presentation	MixIdea, Rubric shared online.	Opinion notes in Padlet.
A	1	Jigsaw	Oral and on paper instructions.	Videos and Phet simulation given as resources. Student teams communicate face-to-face.	Presentation in Google Slide.
B	1		Oral instructions and introductory video.	Resources organised in Padlet. Student teams communicate by texting in GoogleSlides.	Presentation in Google Slide.
B	2		Oral instructions.	Resources organised in Ted Ed. Student teams communicate by texting in Ted Ed.	Presentation in H5P. Online Quiz in Kahoot.
B	3		Oral instructions.	Resources given in Google Docs. Student teams communicate by texting in Google Hangouts.	Online Quiz in ClassMaker

4.3 The extra challenges that PSTs face when practising online than face-to-face technology-enhanced microteaching

The content analysis of the instructors' observations, the participants' peer review comments and reflection text accounts allowed us to identify challenges they encountered when practising in terms of preparing and implementing their microteaching sessions.

4.3.1 The challenges in preparing microteaching

Regarding the challenges participants encountered while preparing their microteaching, three themes were extracted from data sources. There is a sense of sameness in the face-to-face and the online context as these themes occur in both cohorts. We report them along with quotes that support them.

1. Selecting suitable digital tools

The PSTs report a persistent design preoccupation over choosing and integrating pedagogically suitable technology while preparing their microteaching. Participants in both contexts - face-to-face and online- report that they spent a great deal of time, both individually and collaboratively, experimenting with various tools before finally choosing which ones to include in their designs. These final choices were later the object of peer-review scrutiny regarding their pedagogical added value. Exemplar quotes are the following:

> *We struggled to decide which digital tool best fits practising the Roleplay technique. We considered and tested several Web 2.0 tools used for creating comics or animations and even some suitable for video editing. The majority of them did not cover all our needs. We spent a lot of time and effort to conclude using GoAnimate.* (Member of Group 1 practising the RolePlay technique as teacher / Cohort A)

> *We considered several tools suitable for online argumentation. We concluded using Kialo-Edu. We liked that students can choose their side "pro" or "con" and add their own opinions via "claims".* (Member of Group 1 practising the Debate technique as teacher / Cohort B)

> *Kialo-Edu was easy to use, and its features facilitated an appropriate Debate structure. However, in my opinion, supporting only a text chat argumentation is a burden. I suggest practising Debate orally.* (Reviewer of Group 1 practising the Debate technique as student/ Cohort B)

2. The burden of time limitations

The burden of time limitations during a microteaching's preparation relates to the amount of time needed or finding the same time to collaborate. As the following quotations show, time burden is a recurring theme in all PSTs reflective accounts in both contexts.

> *We spent much time discussing and negotiating. Although this was beneficial because we got stimuli from each others reasoning, it was also sometimes tedious. I recall us having a rather long negotiation when I argued about incorporating a specific learning activity. My peers spent a lot of time to "convince" me over some structuring issues of our microteaching. However, I feel that all this time was worthwhile as most of the negotiations led to adequately preparing our microteaching.* (Member of Group 1 practising the RolePlay technique as teacher / Cohort A)

> *We all had different agendas, and we were preoccupied with several tasks. Therefore, it wasn't easy finding the same time available to collaborate. It was hard to sync our schedule, so we decided to work in a shared Google doc. Although this smoothed our collaboration, we still struggled to find the necessary time to organise our assignment.* (Member of Group 3 practising the Jigsaw technique as teacher / Cohort B)

3. Technical difficulties

Technical difficulties belong to a broad recurring category within our dataset.

Both cohorts of PSTs report a long learning curve in getting familiar with specific tools (especially animation tools, 3D virtual worlds, or technique-specific applications, for example, Mixidea for Debate). Disagreements among team members are also common, caused mostly by their different disciplinary areas and digital literacy skills. An impeding factor for specific tools' use is the limited time or features licences many Web 2.0 applications impose. Sample quotes are the following:

> *I diligently worked on getting acquainted with GoAnimate. Luckily, we supported each other as a team, and we managed to overcome technical difficulties. Although we split the task of creating scenes, we devoted a great deal of time and effort preparing the "half-baked" animation given to students.* (Member of Group 1 practising the RolePlay technique as teacher / Cohort A)

> *At first, we excluded Mixidea due to its requirement to log in only via a Facebook or Twitter account. After testing other tools, we decided to overlook this limitation and opt for it as we appreciated its*

straightforward approach to setting up a Debate event. (Member of Group 2 practising the Debate technique as teacher / Cohort B)

4.3.2 The challenges in implementing microteaching

In implementing microteaching, the time burden is observed in both cohorts. Furthermore, two more difficulties were detected only in cohort B teams and can be directly attributed to the online environment.

1. The burden of time limitations

Time management was critical in implementing microteaching in both cohorts. Regardless of the collaborative learning technique practised, many groups did not punctually implement their microteaching. In the case of online implementation, though, time became more critical, in the sense that technical difficulties due to the online nature of the task made time management even more complicated. For example:

We didn't manage to achieve our time allocation. One of the activities exceeded the time we had planned, so we had to hurry the rest of the activities and omit the last one. My impression is that when practising a Roleplay technique, many issues may occur, the students' engagement is critical, so no one can accurately allocate time and be sure that everything will run smoothly. (Member of Group 1 practising the RolePlay technique as teacher / Cohort A)

I felt pressure as a student in your microteaching session. I think that you used a long introductory video and spend a long time categorising the ideas. You didn't leave us enough time for the last task of creating the poster. You should have managed your time better. (Reviewer of Group 1 practising the Brainstorming technique as student / Cohort B)

I couldn't login in Mixidea. I kept getting an error code when connecting with my Twitter account. I had to create a new Facebook account. Consequently, I spent on this issue the time scheduled to study the Debate's topic and prepare my claims. Having missed this task, I couldn't adequately proceed with the rest of the tasks. (Reviewer of Group 2 practising the Debate technique as student / Cohort B)

2. The last-minute technical turmoil

As expected in online environments, cohort B participants experienced several technical issues during the implementation of online sessions. Slow/lousy connections and microphones echoing were typical issues experienced and confronted individually. Apart from individual problems, we observed two last-minute unexpected technical turmoils related to the microteachings' overall digital requirements. They both concerned sound-related issues. Specifically, the 3rd group practising the Jigsaw technique attempted to use two platforms simultaneously: MS Teams for virtual conferencing - whole class, and Google Hangouts for small group collaboration. This combination created noise (sound coming from two sources) that made the implementation of microteaching impossible. The group had to abandon their initial plan and, on the fly, create breakout rooms in MS Teams. Likewise, the 2nd group practising the Debate technique planned to combine using MS Teams for the introductory phase and then move to Mixidea to realise the Debate's phases. Unexpectedly, participants encountered sound problems when switching from one environment to another. The turmoil created could not be handled impromptu and omitted some participants from properly following the activities' sequence.

3. The inadequate resources provision

The second emerging difficulty exclusive to cohort B was the inadequate provision of resources and information to "students" and the unclear task communication by "teachers". Though the digital resources offered were rich enough and the "teachers" guidelines detailed enough, the "student" audience expressed the need for a more robust scaffolding mechanism on how to process them. Sample quotes are the following:

I was confused as a student during the individual phase of the Jigsaw technique over what my assignment was. The guidelines provided in your presentation slides were not clear. The clarification provided orally about searching the web for information on renewable energy sources was not enough as I was not sure what my inquiry exactly was. I would have appreciated more guidelines in your presentation slides. The Jigsaw technique is quite complex and practising it online makes it even harder. We, as students, cannot constantly ask for guidelines as we might have done in a face-to-face environment. (Reviewer of Group 1 practising the Jigsaw technique as student / Cohort B)

I found somewhat limited the instructions provided in the Edmodo virtual classroom. Maybe the fact that I participated using my tablet worsened my ability to follow the sequence of learning activities. I

> *had to switch screens between the instructions in Edmodo and the tasks related to Brainstorming that were carried out in Stormboard. The several questions addressed orally and in the chat reveal that I was not the only one who found the instructions limited.* (Reviewer of Group 2 practising the Brainstorming technique as student / Cohort B)

5. Conclusions

This paper reflects on our experience of relocating online a mature microteaching practice (as we successfully implemented in face-to-face settings for seven years) to respond to the Covid-19 pandemic.

We report the challenges of organising a technology-enhanced microteaching from the instructor's perspective. We can argue that relocating the course context –from face-to-face to online- did not influence the "essence" of the course and its main goal, which was to immerse in microteaching, under the strong effect of roleplay. This finding highlights the potential of online microteaching towards the new pedagogy emerging at the height of the Covid-19 pandemic. A pedagogy triggered by the sudden immersion of many into online learning and the subsequent exploration of e-learning beyond the pandemic.

Nevertheless, in the online context, we struggled to maintain the ambience of whole-class discussions. We had the "camera-off" effect, and we experienced reduced or reluctant participation with awkward silences, echoing the cautions of Mishra (2020) and Peachey (2017). Another interesting finding concerns applying collaborative learning techniques using a digital tool as a prerequisite for technology-enhanced microteaching. We observed PSTs in both contexts having the same typical misconceptions regarding collaborative learning techniques' principles and application methods.

Our findings indicate similar TEL application regardless of the context. As far as designing the microteaching session is concerned, PSTs seem to exploit contemporary communication means in both contexts. Still, at the same time, they value face-to-face collaboration. Regarding practising, we noticed minor effects of online relocation on PSTs repertoire of digital tools. PSTs adopt similar technologies for the introductory phase, the main phase applying collaborative learning techniques, and their microteaching session's final assessment phase. The inevitable change observed was using a discussion technique set in either a face-to-face or asynchronous online setting.

Finally, two challenges addressed by PSTs appear common regardless of the context. While designing their microteaching, PSTs were bewildered by the plethora of digital tools to choose the most suitable. In addition, during the preparation and the implementation of the microteaching sessions, they struggled to overcome time limitations. The online microteaching implementation has strikingly escalated the technical difficulties that PSTs encountered. However, though expected and manageable, the emerging technical difficulties should not be considered as isolated from the learning process as a whole since sometimes, these difficulties point towards pedagogical considerations. This was the case with the need to provide more systematic and careful support with instructions, guidelines, and digital resources in the online context.

Overall, relocating a technology-enhanced microteaching practice online was a rich experience for us and our students. It challenged our pedagogic agility as researchers and instructors, having to consider all aspects that needed to be transferred online: content delivery, student engagement, motivation and assessment (Clement, 2010). On the other hand, the PSTs did not miss the opportunity to have a compelling learning-to-teach experience in an online context. We consider that PSTs practising technology-enhanced microteaching online was a very effective "rehearsal" and dive into online teaching challenges within a safe and controlled environment.

Although the limitations of this study refer to the small sample of participants, our focus is grounding findings on a qualitative approach built from a robust dataset towards a more profound consideration rather than generalising based on quantitative results.

We deem that the implications of this shift of practice stimulate momentum for further attention to teacher education post-pandemic. Microteaching is by nature inherently connected to face-to-face human interaction related to teachers' body language, tone of voice, posture and reflects on their overall learning-to-teach experience. Moreover, collaborative learning techniques such as Brainstorming, Debate, Jigsaw, and Roleplay

are also activities that heavily rely on face-to-face interaction dynamics. Our study provides evidence that practising online microteaching achieved, if not a similar, at least a fulfilling learning experience despite its challenges. This fact opens up an unexplored potential to e-learning solutions beyond the scope of more common practices (e.g. lectures, quizzes, polls and the use of breakout rooms of platforms). These practices include coordination, cooperation and collaboration (in different levels) and demand augmented interaction to be successful, even for experienced teachers working in face-to-face settings. Transferring them online demands an extended repertoire in online teaching and tutoring, contributing to surpassing reported constraints in pedagogical innovation observed in online practices during the pandemic. Therefore, teacher education should consider online microteaching apart from an alternative method when circumstances impose it and integrate it within the typical teacher education curriculum to cultivate teaching competencies for e-learning. In our case, we intend to adjust our course's syllabus in the forthcoming academic years so that PSTs attending the particular postgraduate program practise both face-to-face and online technology-enhanced microteaching.

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A Predicting Analysis of Academic Staff's Motivation to Teach Online in a Nigerian University

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Abstract: This study examined the predictors of academic staff motivation for online teaching in a Nigerian University. Theory of Planned Behaviour served as the conceptual foundation for the study. A survey design was adopted and a total of one hundred and nine-five (195) academic staff participated in the study from a university that was purposefully chosen for the study. A questionnaire tagged 'Academic Staff's Motivation for Online Teaching Survey (SMOTS)' adapted from Chi (2015) was used for data collection. The questionnaire consisted of six domains - demographics, online teaching consideration, perception of online teaching, motivation for online teaching concerning resources, motivation for online teaching with respect to external factors and general motivation to teach online. Data were analyzed using percentages and frequency distribution, mean, standard deviation, multiple regression analysis, Pearson Correlation, T-test, One-Way Analysis of Variance (ANOVA) and Multivariate Analysis of Variance (MANOVA). Results of the study revealed that the perception of online teaching and academic staff's motivation for online teaching regarding external factors had a positive significant contribution to the general motivation of academic staff to teach online. Also, age was found to have a significant influence on academic staff's motivation to teach online indicators (perception of teaching online, motivation to teach online regarding resources, and motivation to teach online regarding external factors). Hence, it was concluded that adequate consideration must be given to these identified contributing factors to motivation for online teaching among academic staff by those who design and implement online teaching initiatives in the university to sustain academic staff's interest in online teaching over time. Equally, policy decisions on online teaching in the university should be based on clear objectives for the generality of the academic staff irrespective of age, gender, marital status, and faculty rank.

Keywords: Motivation; Online Teaching; Academic Staff; Nigerian Universities; Predicting Analysis

1. Introduction

The advent of the internet in the second half of the 20th century has facilitated the world becoming a global village and has significantly affected how people communicate as well as how information is accessed and shared. The Internet has revolutionized the concept of traditional education as being physically present in the four walls of the classroom is no longer the only learning option anymore. Access to quality education has now been made possible anywhere and whenever one has access to the internet and this has led to the concept of online education. Online education refers to a form of education that is delivered and administered synchronously or asynchronously using the internet (Schinkten, 2016). Online teaching and learning provide a viable and exciting method for instructional delivery to learners as a result of the flexibility of time and location inherent in the approach. This flexibility provides an alternative and innovative learning environment that gives learning a new relevance to contemporary society compared with traditional education.

Due to documented evidence in support of online teaching to increase access to education especially higher education and the fact that it brings greater flexibility into the instructional space, Nigerian universities like their counterpart in other countries of the world have embarked on a rigorous initiative to utilize the internet for effective online education and for cognate skills development required to make socio-economic contributions in the world of knowledge (Eze, Chinedu-Eze and Bello, 2018). However, these efforts are hampered by the poor state of infrastructure in the universities, lack of basic ICT skills among academic staff and students, limited expertise in instructional design, inadequate technical support staff, irregular power supply in the country, internet connectivity cost, abysmal university management commitment to interactive knowledge environment and resistance to online teaching due to the required role change necessitated by the move from the traditional

teaching approach to technology-based teaching as well as lack of commensurate reward system that can motivate academic staff to adopt online teaching (Oye, Salleh and Iahad, 2011; Afolabi, Adeyeye and Ayo, 2014; Fakinlede et al., 2014).

Considering the emergence of coronavirus (COVID-19) in China and its spread to the entire world leaving no continent untouched, there are rising concerns among nations of the world about measures to curb the rapid spread of the virus. Several countries of the world ordered the closure of academic activities concerning traditional face-to-face classes as a part of policy actions to curb the spread of the virus. While developed countries of the world quickly shifted instruction to online learning space during the lockdown period of the coronavirus as transition to online teaching is somewhat smoother and less demanding to them, developing nations educational system collapsed based on no existing structure that can facilitate online teaching (Saeed, 2020). This, therefore, exposed the emerging vulnerabilities in education systems in developing nations (Ali, 2020). With the need to continue educational activities in Nigerian universities as a result of the ease in COVID-19 lockdown, different policy initiatives are being launched in universities across the country to engage in online teaching for the safe return of students to learning activities and to limit the risk of the virus transmission. However, there is ambiguity on the readiness and preparedness of academic staff to adopt the online teaching approach as well as factors that can predict and influence their motivation for teaching online (Nwagwu, 2019). Therefore, understanding factors that predict academic staff motivation for online teaching will help facilitate the implementation of the new and expansion of current online teaching initiatives in Nigerian universities.

The university chosen for this study is the Nigeria's oldest and one of the prestigious universities in the country. The university is located about five miles from the centre of the major city of Ibadan, Southwest, Nigeria. Undergraduate and postgraduate academic programmes are offered across various faculties and institutes in the university. Due to the need to take a precautionary measure to control the ravaging COVID-19 infection, the university ordered a halt in academic activities till further notice and directed students to vacate the campus with effect from Friday, 20 March 2020 (UI Bulletin, 2020). Though the university still engages in skeletal activities, major activities were moved to online space to avoid mass gathering. Also, to intellectually engage students during the period of the pandemic lockdown, learning resources and information on general physical wellness was uploaded for students to interact with, thus, preparing them for the online mode of instruction (UI, 2020a). Before the emergence of the pandemic, the university had been planning and increasingly moving towards online learning. This was demonstrated by the training of over 400 academic staff under the Pedagogical Leadership for Africa (PEDAL) project. This project was led by the Partnership for African Social Governance Research (PASGR), Kenya, with financial support from the Department for International Development (DFID), UK. The core objective of the PEDAL project was to revolutionise teaching and at the heart of it is technology-enhanced teaching and learning. Equally, the university had implemented the complete Result Management System (RMS) and hoping to have Learning Management System. As a result of the industrial action embarked upon by the Academic Staff Union of Universities (ASUU) in March 2020, the preparations for migration to online instructional delivery was affected and became complicated with the COVID-19 pandemic (UI, 2020b). In the pandemic and post-pandemic era, online teaching is imminent for continuity of learning and fortification of the university against future emergencies. However, all indication points to the fact that the university's effort has mainly been directed at preparing students for online instruction and increasing academic staff's capacity to effectively utilize online platforms for instruction delivery. Little attention is given to academic staff's motivation to teach online without recognising that they hitherto have always taught on the face-to-face mode and shifting instruction to online mode will require understanding what could sustain their interest in it to be effective over time.

Worldwide, many studies have shown slightly different results on predictors of motivation to teach online among academic staff and this is mostly influenced by study population and environment (Hiltz, Kim and Shea, 2007; Fish and Gill, 2009; Osika, Johnson and Buteau, 2009; Gautreau, 2011; Casdorph, 2014; Mohamad, Salleh and Salam, 2015; Chi, 2015; Mohmedsali, Kadyamatim and Madzvamuse, 2017; Alsuwailem, 2018; Schifter, 2019; Ibrahin and Nat, 2019; Shea, 2019; Martin, Budhrani and Wang, 2019). Hiltz, Kim and Shea (2007) identified flexibility based on the ability to teach anytime and anywhere, personal interaction, and community building supported by online teaching and the technical and creative challenges inherent in the approach as leading motivating factors among faculty members to teach online. Also, Casdorph (2014) found performance expectancy, effort expectancy, social influence, motivation orientation to teach online, motivation to teach face-to-face, sex, and level of innovation to significantly predict academic staff behavioural intent to teach online. Equally, Chi (2015) found a statistically significant relationship between faculty perceptions of technology and

online teaching and faculty motivation to teach online. Other studies recorded somewhat different results on the influence of demographic characteristics of academic staff on their motivation to teach online (Knabe, 2012; Alsuwailem, 2018; Shea, 2019; Martin, Budhrani and Wang, 2019). For instance, while Shea (2019) and Martin, Budhrani and Wang (2019) found differences based on demographic factors among faculty members to teach online, Knabe, (2012) and Alsuwailem, (2018) found no relationship between demographic variables and intention to teach online.

Most of the previous studies identified above have looked at only a fraction of possible predicting factors for online teaching among academic staff mostly from the perspective of motivators and demotivators for online teaching within a particular institution. Also, none of these studies has reflected the peculiarities of academic staff in Nigerian universities. Response to predicting factors of motivation to teach online from academic staff may likely vary based on institutional culture and reality, and past innovation experience (Schifter, 2019). Studies are therefore required to understand the predictors of academic staff's motivation for online teaching in Nigerian universities and how socio-demographic variables affect certain motivation for online teaching indicators among academic staff in Nigerian universities. This study, therefore, takes a bold step at understanding factors that may potentially predict academic staff's motivation to teach online using a university's academic staff in the country. This is done to gain insight and provide evidence on the level of association between some factors and academic staff's motivation to teach online. This might help influence positively, university's policy response and strategies to make online learning adoption and use among academic staff more exciting and sustainable. The study is expected to add to the discourse on academic staff motivation and other associated factors as well as serve as a reference point for future studies.

Generally, the study aims to examine the individual and collective effect of online teaching consideration, perception of teaching online, motivation to teach online regarding resources and motivation to teach online regarding external factors (Independent Variables) on academic staff's general motivation to teach online (Dependent Variable). Specifically, the study attempts to identify if differences exist in the motivation for online teaching indicators (perception of teaching online, motivation to teach online regarding resources and motivation to teach online regarding external factors) relying on four socio-demographic characteristics (age, gender, marital status, and academic rank). Equally, the study answers the question: do age, gender, marital status, and academic rank interactively influence academic staff's motivation for online teaching indicators?

2. Theoretical framework – Theory of Planned Behaviour

The Theory of Planned Behaviour (TPB) is an offshoot of the Theory of Reasoned Action (TRA) propounded by Fishbein and Ajzen (1975) and Ajzen and Fishbein (2002) to predict and understand people's overt behaviours that are under their volitional control. The general assumption of TRA is based on the notion that people make systematic use of available information based on their rational sense. In other words, people's behaviour is not thoughtless, it's a product of critical understanding of the implications of their actions before engaging or refraining from such behaviour. Human actions are better understood within the framework of the causal chain (Kan and Fabrigar, 2017). Based on likely unrealistic assumption that behaviours are under one's volitional control in some contexts as a result of behavioural variations across different situations, Ajzen (2011) proposed the addition of the construct of 'perceived behavioural control' to the TRA which seeks to understand people's degree of control over a behaviour. This led to the formation of TPB and thus becomes a better construct to predict specific behaviours and/or to plan interventions to influence behaviour in various domains.

In the TPB, behaviours can be immediately determined through behavioural intentions and this consist of three basic elements

1. Attitude: This refers to the extent to which the target behaviour is considered desirable or otherwise and this can be measured either directly or indirectly. The direct measurement could take the form of cognitive (is it good or bad?) or affective (is it pleasant or not?) while the indirect measurement upshots from the juxtaposition of the beliefs about consequences and estimation of the value of those consequences of the behaviour.
2. Subjective norms: This relates to the social judgement associated with the target behaviour. It is the perceived social pressure to either engage or not in behaviour. Measuring subjective behaviour directly will require considering descriptive norm (assumed behaviour of people's close associate's likelihood of adopting the behaviour. Close associate includes friends, relatives colleagues etc.), and injunctive norm (estimating the expectation of the close associate regarding the adoption of the behaviour or not).

Indirect measurement of the subjective norm can be obtained through the connection between the belief in relevant persons' opinions and the inherent motivation for considering such opinions.

3. Perceived behavioural control: this refers to personal perception of one's control over the target behaviour concerning adopting such behaviour. Perceived self-efficacy and self-attributed behavioural control are the main information needed to measure perceived behavioural control directly while the indirect measurement takes the form of juxtaposing factors likely to either enhance or inhibit the behaviour adoption and the estimation of the intensity of the effect of those factors (Verpooten, et al., 2020).

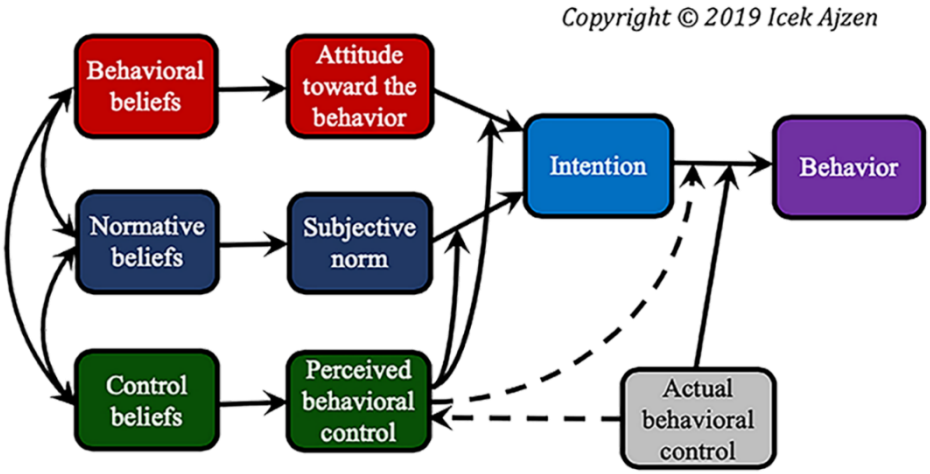

Figure 1: Synoptic representation of the Theory of Planned Behaviour with background factors (Reproduced with permission from Ajzen, 2019)

These three elements are critical predictors of intention and can be strongly influenced by context and experience. The context in this sense refers to circumstances that form the settings for the behaviour to be adopted while experience relates to prior knowledge or understanding of the behaviour. It was thus suggested that careful consideration of these factors especially understanding beliefs for behaviour from a target population and context and the possibility of adoption of behaviour in the past could affect future adoption of same, may help understand the target behaviour (Verpooten, et al., 2020). This study considers these factors as it is particularly relevant based on the belief that there are continuums in technology adoption and there is a cumulative impact of experience on the motivation to teach online. Also, demographic factors have been included in this study as a possible influential predictor of academic staff's motivation to teach online.

Several studies have used TPB as a theoretical framework in explaining behaviour related to technology adoption and motivation for e-learning as well as the interactive effect of demographic factors on technology adoption decisions (Morris and Venkatesh, 2000; Lee, Cerreto and Lee, 2010; Knabe, 2012; Keong, Albadry and Raad, 2014; Chi, 2015; Hadadgar, et al., 2016; Chu and Chen, 2016; Tao, et al., 2019; Verpoorten, et al., 2020; Ngafeeson and Gautam, 2021). For instance, Lee, Cerreto and Lee (2010) investigated teachers' intention to utilize a specific technology in a specific way using TPB. The primary objective of their study was to determine the direct and indirect factors that influence teachers' intentions to utilize technology. The result of the study showed that attitude, subjective norm, and perceived behavioural intention all served as significant antecedents to teachers' intentions to use technology but attitude had more than twice the influence of subjective norm and more than three times the influence of perceived behavioural intentions on the teachers' intentions to use technology. Similarly, a study conducted by Verpoorten, et al. (2020) to understand faculty perspective on blended learning in higher education through the lens of TPB. The result of the study indicates that attitude towards blended learning, subjective norm and perceived control explained 73% of faculty members' intention to use blended designs for teaching purposes.

Drawing lessons from the previous studies, this study found the relevance of TPB as an important predictor of motivation to teach online among academic staff based on the interplay of online teaching consideration, perception of teaching online, motivation to teach online regarding resources and motivation to teach online regarding external factors as well as academic staff's demographic characteristics. Specifically, this study adopts

TPB to determine likely predicting factors of motivation to teach online among academic staff of a university and which influencing factors are likely to work as an incentive for academic staff to adopt online teaching.

3. Methods and materials

3.1 Participants

A survey design was adopted where a total of one hundred and nine-five (195) academic staff randomly selected from various academic faculties and units in a university in Nigeria completed the survey. The university was purposively selected and the choice was based on being Nigeria's premier university and it has similar characteristics known with other universities in the country. A review of the socio-demographic distribution of the respondents across academic faculties and units indicate that majority of the respondent (74.4%) are within the 41-60 years age group while males accounted for more than half of the respondent. Almost all (94.4%) were married. The rank revealed that we have a more senior cadre of academic staff than junior cadre. Table 1 presents the socio-demographic distribution of respondents recruited for the study

Table 1: Socio-demographic distribution of respondents

Variable	Freq.	Percentage
Age		
20-40	35	17.9
41-60	145	74.4
61 & above	15	7.7
Gender		
Male	128	65.6
Female	67	34.4
Marital Status		
Single	6	3.1
Married	184	94.4
Divorced/Widowed	5	2.6
Faculty Rank		
Assistant Lecturer	16	8.2
Lecturer II	24	12.3
Lecturer I	53	27.2
Senior Lecturer	45	23.1
Reader/ Ass. Professor	23	11.8
Professor	34	17.4

3.2 Instrument

A structured questionnaire tagged 'Academic Staff's Motivation for Online Teaching Survey (SMOTS)' was the main instrument used for this study. The questionnaire consisted of six domains - demographics, online teaching consideration, perception of online teaching, motivation for online teaching concerning resources, motivation for online teaching with respect to external factors and general motivation to teach online. The demographic section includes age, gender, marital status, and faculty rank in the university. The online teaching consideration consists of one item in the Likert scale (Never, rarely, sometimes, most of the time and always) seeking to understand academic staff' frequency of considering teaching online. The perception of online teaching domain is a ten (10) items scale seeking academic staff's level of agreement (strongly disagree, disagree, neutral, agree and strongly disagree) with questions relating to their perceptions of teaching online (take less time than face-to-face classes, reach new audiences, flexibility for me, diversify programme offerings, improve my teaching, development of new ideas, professional development, motivation to learn new technology and intellectual challenge). Motivation for online teaching concerning resources is a five Likert scale (strongly disagree, disagree, neutral, agree and strongly disagree) that consists of 16 item questions on resources (onsite design help, group training, individual training, coaching, support group, own decision, own format, administrative support, technical support, time off, course release, stipends, grants, recognition, endorsement and promotion) that could motivative academic staff for online teaching. On the other hand, motivation for online teaching with respect to external factors consist of six (6) items (colleague adaptation, enrolment, programme priority, enhance student skills, institutional expectation and open to new technology for teaching) in a five (5) Likert scale (strongly disagree, disagree, neutral, agree and strongly disagree). While the general motivation to teach online consist of an item in a five Likert scale (strongly disagree, disagree, neutral, agree and strongly disagree) designed to measure the general feeling of motivation to teach online among the academic staff. Majorly,

SMOTS items were adapted from the "Readiness to Teach Online Scale" developed by Chi (2015). The justification for its adaptation was based on its close relevance to the objective of this study as its captured the academic staff's motivation the researchers were looking through. Unlike other survey items such as "Online Teaching readiness survey" developed by Indiana University (n.d.), and "Faculty Readiness to teach online" developed by Martin, Budhani and Wang (2019). These surveys primarily focused on online technical and organisational competencies to teach in virtual environments among faculty staff. SMOTS was validated through 3 expert reviews and the researchers got Cronbach's alpha of .94 from a pilot test of the questionnaire.

3.3 Procedure and ethics

The study got the required approval and participants' informed consent was obtained before participation in the study. Participants were assured of the confidentiality of the information given. The survey was administered via two main strategies- paper-based and Google Forms. The Google Forms was designed and its link-invitation was sent to academic staffs through E-mails and faculty social media groups. Also, the paper-based questionnaire was taken around academic faculties and units to get academic staff who still come to the office despite the shutdown of academic activities due to COVID-19 and the Nigerian Academic Staff Union of Universities (ASUU) strike. The study researchers ensured that those who have not participated in the survey online were the target of the paper-based. Data collection was done within three months starting from November 2020 to January 2021. A total of 120 academic staffs participated via online Google forms and 75 participated through the paper-based questionnaire administration.

3.4 Statistical analysis

Data were analysed using SPSS 25 version software. Counting data were analysed using descriptive statistics of percentages and frequency distribution, mean, standard deviation. To achieve the research questions of the study, multiple regression analysis, Pearson Correlation, T-test for independent samples, One-Way Analysis of Variance (ANOVA) and Multivariate Analysis of Variance (MANOVA) was performed. Before MANOVA computation, there is no evidence of multicollinearity in the data as none of the correlation coefficient is greater or equal to 0.90. A *P*-value of <0.05 (5%) was considered statistically significant.

4. Results

The result obtained in the study are presented below:
Table 2 shows the individual and collective interaction effect of online teaching consideration, perception of teaching online, motivation to teach online regarding resources and motivation to teach online regarding external factors (Independent Variables) on general motivation to teach online (Dependent Variable) among academic staff. The β values indicate the strength or contribution of each explanatory variable to the dependent variable. The results showed that all the independent variables contribute to general motivation to teach online positively, but the perception of teaching online contribute to the model significantly with coefficient parameter $(\beta_2 = 0.475), p < 0.000$. Also, the academic staff's motivation for online teaching with respect to external factors positively contributes to the model significant with $p < 0.046$. The overall model is a good predictive one because the $R^2 = 0.448$, with the independent values being a good fit for the model with $F(4, 189) = 11.835$ and $p < 0.000$.

Table 2: Regression analysis showing individual and collective effect of online teaching consideration, perception of teaching online, motivation to teach online regarding resources and motivation to teach online regarding external factors on general motivation to teach online among academic staff.

Variables	**Coefficient (β)**	**Standard Error**	**P-value**
Constant	0.665	0.503	0.188
Considering Teaching online	0.050	0.079	0.531
Perception of Teaching Online	0.475	0.128	**0.000**
Motivation for Online Teaching with Respect to Resources	0.092	0.117	0.431
Motivation for Online Teaching with Respect to External Factors	0.257	0.128	**0.046**
$\boldsymbol{R^2 = 0.448}$, $\boldsymbol{F(4, 189) = 11.835}$, $\boldsymbol{P - value = 0.000}$			

Bivariate correlation results in table 3, show that academic staff consideration for online teaching positively correlates with perception of online teaching and academic staff's general motivation to teach online with $r = 0.304; p < 0.05$ and $r = 0.162; p < 0.05$ respectively. Likewise, there is a positive correlation relationship between the perception of teaching online and general academic staff's motivation to teach online with $r = 0.395; p < 0.01$. The results further show that perception of teaching online positively correlates with academic

staff's motivation for online teaching with respect to external factors and motivation for teaching online regarding resources with $r = 0.444; p < 0.01$ and $r = 0.308; p < 0.308$ respectively. The motivation for online teaching regarding resources positively correlate with motivation for online teaching with respect to external factors $r = 0.643; p < 0.01$.

Table 3: Bivariate correlation between independent variables (perception of teaching online, motivation for online teaching with respect to external factors, motivation to teach online regarding resources, academic staff consideration for online teaching and dependent variable (general motivation to teach online)

	Variable	**1**	**2**	**3**	**4**
1	Perception of teaching online		-		
2	The motivation for online teaching with respect to external factors.	**0.444****			
3	motivation to teach online regarding resources	**0.308****	**0.643****		
4	Academic staff consideration for online teaching	**0.304****	**0.180***	0.126	
5	General motivation to teach online	**0.395***	**0.354****	**0.276****	**0.162***

** P-value <0.01, * P-value <0.05

Table 4 presents the separate influence of the socio-demographic variables on academic staff's motivation to teach online indicators (perception of online teaching, motivation to teach online concerning resources and motivation to teach online with respect to external factors). Using t-test for independent groups, on the three dependent variables considered (Perception of Teaching Online, Motivation for Online Teaching with Respect to External Factors and Motivation for Online Teaching concerning Resources), there were no significant differences between male and female individuals and there were not significantly different between single and married individuals with their respective p-value greater than p-value of 0.05. This implies that the gender of academic staff and their marital status does not influence online teaching indicators. Using One-Way ANOVA, the age group of academic staff does not significantly influence their perception of teaching online $F(2, 194) = 1.374, p = 0.225 > 0.05$, motivation for online teaching with respect to external factors $F(2, 194) = 0.640, p = 0.529 > 0.05$ and motivation for online teaching concerning resources $F(2, 194) = 1.121, p = 0.328 > 0.05$. Also, the rank of academic staff does not significantly influence their perception of teaching online $F(5, 194) = 0.4770, p = 0.799 > 0.05$, motivation for online teaching with respect to external factors $F(5, 194) = 1.039, p = 0.396 > 0.05$ and motivation for online teaching concerning resources $F(2, 194) = 0.987, p = 0.427 > 0.05$.

The MANOVA Pillai's Trace test results are shown in Table 5. There are significant differences in the combined dependent variables by individuals' age group, as shown in the Pillai's Trace value $= 0.074, F(6, 340) = 2.184, p < 0.044$, multivariate$\eta^2 = 0.037$. This suggests that 3.7% of the multivariate variance of the overall motivation to teach online indicators of individuals are influenced by the age group of academic staff. However, there is no significant gender difference in the combined dependent variables; thus, Pillai's Trace $= 0.017, F(3, 169) = 0.993, p > 0.398$, also, there is no significant rank difference of individuals in the combined dependent variables; thus, Pillai's Trace $= 0.127, F(15, 513) = 1.508, p > 0.098$. Age and Gender of academic staff does not influence the combined dependent variables with Pillai's Trace $= 0.044, F(6, 340) = 1.278, p > 0.267$, also, Age and Rank of academic staff does not influence the combined dependent variables with Pillai's Trace $= 0.083, F(15, 513) = 0.969, p > 0.437$. We further computed a follow up univariate ANOVA and the results are presented in Table 6.

Table 6 showed that the perception of teaching online was significant to the age group of individuals $F(2,194) = 3.928, p < 0.021, \eta^2 = 0.044$, while the motivation for online teaching with respect to external factors and motivation for online teaching concerning resources were not significantly different based on the age group of individuals $F(2,194) = 0.629, p > 0.534, \eta^2 = 0.007$ and$F(2,194) = 1.424, p > 0.244, \eta^2 = 0.016$ respectively. Specifically, the mean differences showed that age group 20-40 years were higher in all the three dependent variables considered than other age groups. Also, it can be deduced that motivation to teach online indicators were not significantly different based on Sex, Rank of individuals and their combination (Age and Sex, Sex and Rank, Rank and Age) as their respective p-value is > 0.05.

Table 4: Academic staff's motivation to teach online indicators based on their socio-demographic factors

	Perception of Teaching Online			The motivation for Online Teaching with Respect to External Factors			The motivation for Online Teaching concerning Resources		
Variable	**Mean (SD)**	**t**	**P-value**	**Mean (SD)**	**t**	**P-value**	**Mean (SD)**	**t**	**P-value**
Gender									
Male	3.92 (0.62)	-0.904	0.367	3.83 (0.72)	-0.901	0.369	3.61 (0.71)	-1.200	0.232
Female	4.00 (0.51)			3.93 (0.67)			3.73 (0.75)		
Marital Status									
Single	3.68 (0.37)	-1.13	0.262	3.92 (0.58)	0.191	0.849	3.59 (0.75)	-0.199	0.842
Married	3.96 (0.59)			3.86 (0.71)			3.65 (0.73)		
		F	**P-value**		**F**	**P-value**		**F**	**P-value**
Age (Years)									
20-40	4.00 (0.42)	1.374	0.255	3.78(0.56)	0.640	0.529	4.02 (0.50)	1.121	0.328
40-60	3.96 (0.62)			3.62 (0.77)			3.83 (0.76)		
61+	3.71 (0.58)			3.68 (0.74)			3.81 (0.59)		
Rank									
AL	3.99 (0.31)	0.470	0.799	3.87 (0.54)	1.039	0.396	3.95 (0.55)	0.987	0.427
LII	4.02 (0.58)			3.84 (0.59)			4.06 (0.62)		
LI	3.90 (0.69)			3.55 (0.75)			3.74 (0.85)		
SL	3.90 (0.55)			3.54 (0.72)			3.81 (0.75)		
Reader	3.90 (0.71)			3.69 (0.83)			4.01 (0.66)		
Prof	4.05 (0.47)			3.69 (0.80)			3.84 (0.53)		

Table 5: Multivariate Effect Of Age, Sex And Rank On Overall Motivation to Teach Online Indicators

Effect	**Pillars Trace Value**	**F**	**Hypothesis df**	**Error df**		**Sig**	η^2
Age	0.074	2.184	6.00	340.00		0.044	0.037
Sex	0.017	0.993	3.00	169.00		0.398	0.017
Rank	0.127	1.508	15.00	513.00		0.098	0.042
Age *Sex	0.044	1.278	6.00	340.00		0.267	0.022
Age*Rank	0.083	0.969	15.00	513.00		0.437	0.028
Sex*Rank	0.086	1.014	15.00	513.00		0.438	0.029
Age*Sex*Rank	0.037	0.721	9.00	513.00		0.690	0.012

Table 6: Univariate effect of gender, Age and Rank status on academic staff's Motivation to Teach Online Indicators

Source	**Dependent Variable**	**Sum of Square**	**df**	**Mean Square**	**F**	**Sig.**	η^2
Age	Perception of Teaching Online	2.624	2	1.312	3.928	**0.021***	0.044
	Motivation for Online Teaching with Respect to Resources	0.684	2	0.342	0.629	0.534	0.007
	Motivation for Online Teaching with Respect to External Factors	1.455	2	0.727	1.424	0.244	0.016
Sex	Perception of Teaching Online	0.030	1	0.030	0.091	0.763	0.001
	Motivation for Online Teaching with Respect to Resources	0.083	1	0.083	0.153	0.696	0.001
	Motivation for Online Teaching with Respect to External Factors	0.408	1	0.408	0.799	0.373	0.005

Source	Dependent Variable	Sum of Square	df	Mean Square	F	Sig.	η^2
Rank	Perception of Teaching Online	3.778	5	0.756	2.262	0.050	0.062
	Motivation for Online Teaching with Respect to Resources	2.679	5	0.536	0.986	0.428	0.028
	Motivation for Online Teaching with Respect to External Factors	3.057	5	0.611	1.197	0.313	0.034
Age *Sex	Perception of Teaching Online	0.678	2	0.339	1.015	0.365	0.012
	Motivation for Online Teaching with Respect to Resources	1.869	2	0.935	1.719	0.182	0.020
	Motivation for Online Teaching with Respect to External Factors	0.293	2	0.147	0.287	0.751	0.003
Age*Rank	Perception of Teaching Online	2.811	5	0.562	1.683	0.141	0.017
	Motivation for Online Teaching with Respect to Resources	1.509	5	0.302	0.555	0.734	0.016
	Motivation for Online Teaching with Respect to External Factors	1.345	5	0.269	0.527	0.756	0.015
Sex*Rank	Perception of Teaching Online	1.501	5	0.300	0.899	0.483	0.026
	Motivation for Online Teaching with Respect to Resources	3.927	5	0.785	1.445	0.211	0.041
	Motivation for Online Teaching with Respect to External Factors	1.124	5	0.225	0.440	0.820	0.013
Age*Sex*Rank	Perception of Teaching Online	0.898	3	0.299	0.896	0.444	0.015
	Motivation for Online Teaching with Respect to Resources	0.783	3	0.261	0.480	0.696	0.008
	Motivation for Online Teaching with Respect to External Factors	0.483	3	0.161	0.315	0.814	0.006
Error	Perception of Teaching Online	57.109	171	0.334			
	The motivation for Online Teaching concerning Resources	92.952	171	0.544			
	The motivation for Online Teaching with Respect to External Factors	87.355	171	0.511			
Total	Perception of Teaching Online	3107.708	195				
	The motivation for Online Teaching concerning Resources	2704.324	195				
	The motivation for Online Teaching with Respect to External Factors	3005.694	195				

5. Discussion

The study revealed that the perception of online teaching and academic staff's motivation for online teaching regarding external factors had a positive significant contribution to the general motivation of academic staff to teach online. Though online teaching consideration and motivation for online teaching concerning resources contribute to the general motivation of academic staff to teach online, their contribution is not significant. These findings correspond with existing studies which identify perception and extrinsic motivation as predictors of intent and motivation to teach online (Fish and Gill, 2009; Casdorph, 2014; Chi, 2015; Ibrahin and Nat, 2019; Shea, 2019). However, this study's findings can be ascribed to the perceived importance of online teaching in bridging the learning gap caused by the outbreak of coronavirus (COVID-19). COVID-19 disrupted the conventional instructional system in the university and the only notable option available is to shift into online teaching platforms as a result of foreseen uncertainties in pursuing the conventional teaching model. This factor provided the motivation and readiness among academic staff of the university to teach online. Also, online teaching presents an opportunity for academic staff to upgrade their ICT skills and other essential competencies needed to organise and manage online learning platforms. Furthermore, the institutional expectations about online teaching and students' enrolment have all provided the impetus for academic staff to feel motivated to teach online. This result further lends credence to TPB which asserts that people's evaluation of behaviour (perception of online teaching), perception of ability to perform the behaviour (online teaching consideration), and expectations from close associate (motivation for online teaching concerning resources and motivation for online teaching regarding external factors) are the direct determinant of intention to perform the behaviour (motivation to teach online).

We found that no difference in academic staff's motivation to teach online indicators (perception of online teaching, motivation to teach online concerning resources and motivation to teach online with respect to external factors) based on socio-demographic characteristics (age, sex, marital status, and faculty rank). In other words, academics staff, whether male or female, single or married, junior or senior in rank and fall in any of the age categories are not different in their perception of online teaching, motivation to teach online concerning resources and motivation to teach online with respect to external factors. These findings are consistent with the findings of Alsuwailem (2018), but inconsistent with Shea (2019) and Martin, Budhrani and Wang (2019) who in their various studies found differences in demographics as regards motivations to online teaching among faculty members.

It was further revealed that there exist significant differences in the combined motivation to teach online indicators (perception of online teaching, motivation to teach online concerning resources and motivation to teach online with respect to external factors) by individuals' age group. In other words, the age group has a significant influence on academic staff's perception of teaching online, motivation to teach online regarding resources and motivation to teach online regarding external factors. Specifically, results showed that the perception of teaching online was significant to the age group of individuals. Academic staff in age 20-40 years had a higher mean score in all the three dependent variables (perception of online teaching, motivation to teach online concerning resources and motivation to teach online with respect to external factors) than academic staff in other age groups. These findings could be attributed to the fact that academic staff in the age bracket of 20-40 are still relatively younger in the profession and are somewhat motivated by the opportunities to display competencies critical for tenure or promotion and other material incentives (Shea, 2019). Also, younger academic staff might believe that online teaching will help them fit into the 21st-century digital landscape that may enhance their prospect for higher opportunities.

6. Conclusion

The findings from this study indicate that motivation for online teaching among academic staff is significantly influenced by their perception of online teaching and motivation from external factors. This could imply that academic staff that have a positive perception about online teaching in terms of flexibility it offers in instruction delivery, reaching a new audience and the opportunity to learn new technology; and external factors such as colleague adaptation, enrolment, programme priority, and institutional expectation align with his desire, such academic staff would be more motivated to teach online compared to others who have negative perception and external factors are not favourable. This, therefore, points to the need for adequate consideration to be given to these factors by those who design and implement online teaching initiative in the university to sustain academic staff's interest in online teaching over time. Also, it was established that no socio-demographic difference in online teaching indicators among academic staff. Hence, policy decisions on online teaching in the university should be based on clear objectives for the generality of the academic staff irrespective of age, gender, marital status, or faculty rank.

7. Limitation of the study and suggestions for future studies

The study is not exhaustive of all factors that may predict academic staff's motivation for online teaching in the university. This study only examines these factors: demographic, online teaching consideration, perception of online teaching, motivation for online teaching regarding resources and motivation for online teaching with respect to external factors. This study, therefore, suggests that future studies should extend the scope beyond these factors Also, the study is limited to only one university, future studies should endeavour to explore multiple-case design that could make generalisation much easier. Equally, random sampling was used to select academic staff and this resulted into not having adequate sample size in some groups. Hence, future studies should adopt cluster and proportionate sampling techniques to have a sufficient sample size.

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WhatsApp as a tool for Building a Learning Community

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Abstract: WhatsApp groups are considered useful for creating and supporting virtual communities. This mixed method case study explores the patterns that emerged when we used WhatsApp to create a community of learning during the multimodal presentation of a postgraduate course in research proposal writing. Three questions drive the study: (1) What kinds of messages were sent? (2) Who participated and how? (3) How did the learners experience the use of WhatsApp in support of the community of learning? Data were collected during the presentation of a five-evening proposal writing workshop that was conducted using Zoom, WhatsApp, and YouTube as communication platforms. To answer the first question, all WhatsApp messages were analysed through both manual (individual) and automated (meta) content analysis. The third question was answered by analysing students' responses to the end-of session online questionnaire that was administered via Google Forms. Results indicate that many messages were administrative in nature, while the most notable academic messages concerned a discussion of empirical research, research paradigms, and research design. The presenter and co-presenter together accounted for almost half of the messages sent, and the other messages were evenly distributed between members of the class, with five notably vocal students. Student responses indicated that they liked the high level of interactivity and the content, but that they disliked the time it took to form groups. The paper contributes to the literature by showing how this use of multiple WhatsApp groups was effective in creating a sense of community by facilitating access, relationships, vision, and function (West and Williams, 2017). More research is needed in determining the extent to which students might support one another with conversations outside of the main WhatsApp group.

Keywords: COVID-19 pandemic, Emergency remote teaching, blended learning, WhatAspp, Zoom, student engagement

1. Introduction

At a contact university, it is easy to create a sense of community in a classroom using group-work and emphasising common tasks. In a distance-situation, students seldom get to mingle. This paper reports on a course where WhatsApp was used to create a feeling of community among a group of former contact students during the pivot to emergency remote learning brought on by the COVID-19 pandemic. We present an analysis of the WhatsApp messages sent during a five-day workshop, to show what patterns of use emerged.

In May 2020, at the height of the COVID-19 lockdown in South Africa, the authors were asked to present a one-week introductory workshop on proposal writing to a group of new Masters' and Doctoral students enrolled at a university of technology. It was early in the academic year and many students were not yet registered on, or familiar with the university virtual campus. In keeping with the institutional policy of *No student left behind*, we taught using the least available resources. Given widespread access to WhatsApp, and its low bandwidth advantage, we decided to host the workshop via the app's group chat feature. One hundred and fifteen students joined the group, and the workshop ran for one work week, from 17h00 to 20h00 every evening. The contribution of this paper lies in its presentation of a case in support of building a community of learning (Leonardi, 2017; Garrison, Anderson and Archer, 1999) using WhatsApp (Madge et al., 2019).

2. Research aims, objectives, and questions

The aim of this research was to uncover the elements that contributed to building a community of learning. The sudden move to emergency remote teaching in our context potentially undermined the learning experience. Our university has historically been a contact institution offering face-to-face learning. We had to establish whether and how learning occurred at a distance through a text-based instant messaging system. Although our findings cannot be generalised, we present them hoping they might resonate with the experiences of others and contribute to the unfolding stories of disruptive innovations resulting from the pandemic. We contribute to the emerging literature on facilitating communal distance learning through inexpensive, synchronous tools, in the

context of extreme disruption. Similar work was done in neighbouring countries (see Maphosa, Dube and Jita, 2020; Martins et al., 2021; Tarisayi and Munyaradzi, 2021.) There is little literature in the South African context (see Hedding et al., 2020). Collectively these cases can improve our understanding of those factors and patterns that affect student learning and community building at a distance.

Three questions drove this study:

1. What kinds of messages were sent?
2. Who participated and how?
3. How did the students experience the workshop?

The objectives with these questions were: Firstly, to see how the course unfolded, and which events in the course accounted for what types of messages. How many messages were technical or administrative in nature? How many were of an academic nature and what kind of topics did they cover? Secondly, to determine patterns of participation, to see how many students participated, whether some students overpowered others, and how some students were in the group without sending messages. We were also interested in the ratio of messages sent by the presenters versus those sent by the students. Finally, we wanted to know how the students experienced the learning event: what they liked, how we could improve, and what outcomes did they achieve?

3. Literature survey

This literature survey provides background regarding online learning communities, next-generation pedagogy, and WhatsApp at university.

3.1 Online learning communities

The socio-constructivist use of educational technology has seen the emergence of online or virtual communities, since learning is a shared, participatory activity, where "interpersonal transactions mediate the exchange of knowledge" (Ke and Hoadley, 2009, p.488). Learning communities are "a learning atmosphere, a context providing a supportive system from which sustainable learning processes are gained through a dialogue and collaborative construction of knowledge by acquiring, generating, analyzing, and structuring information" (Carlen and Jobring, 2005, p.273). Online communities need "commitment; connection to others; reciprocity; interaction; agency and consequences" (Hammond, 2017, p.118). Problem-based learning is a vehicle for building learning communities (Childs et al., 2015). Building a community requires a "therapeutic" facilitator (Bluteau, 2020). Therapeutic presence is a combination of social, cognitive, and teaching presence (Garrison, Anderson and Archer, 1999). Our analysis considers the activities of the two facilitators and the social dynamics such as the composition of groups that influenced how users share knowledge (Kwayu, Abubakre and Lal, 2021).

We use West and Williams's (2017) four "defining characteristics" of (online) learning communities: access, relationships, vision, and function. *Access* goes beyond physical or geographic space and refers to the *presence* of community members. Types of 'presences' include cognitive, social, and teaching presence, as per the Community of Inquiry model (Garrison, Anderson and Archer, 1999). *Relationships* extend beyond virtual-physical access and presence. Relational boundaries are critical and may include a sense of belonging, interdependence, and trust (West and Williams, 2017), while "[t]he effective use of an online social media network to support a virtual community of practice is dependent on the participants' awareness of the context within which the community exists and the willingness of the participants to accept differing views and opinions" (Moodley, 2019, p.1). *Vision* or 'sense of purpose' refers to a collective identity and shared image of the group's function (West and Williams, 2017). Developing a core vision involves negotiating a common language and agenda to achieve the overarching learning goal(s). The boundaries between real and virtual environments are blurred when "WhatsApp is used … as a key component (in) their way of dwelling with others" (O'Hara et al., 2014, p.1142). *Function,* or functional cohesion, is about what community members *do* to realise the common vision, while satisfying individual ambitions. Function lets community members work collaboratively, (a)synchronously, and relationally, but without necessarily having the same individual motivations or interpersonal agreements.

3.2 Blended learning and online pedagogy

Most definitions of blended learning refer to blends of contact and distance education (Friesen, 2012; Graham, 2006) but we support a definition in a previous issue of this journal, which points out that: "The concept of blended learning is derived from two words, blend and learning. The word blend means combining things and

learning denotes an assimilation of new knowledge" (Tshabalala, Ndeya-Ndereya and Van der Merwe, 2014, pp.102–103). Thus, blended learning may occur completely at a distance.

We will consider five characteristics of the IDEAS next-generation pedagogy for blended learning: Intelligent, Distributed, Engaging, Agile and Situated (Witthaus et al., 2016). *Intelligent* means the use of technology, including electronic communication, virtual and augmented reality and analytics. *Distributed* refers to a distributed ownership of the elements of learning between various stakeholders. *Engaging* means students should participate actively to co-create the learning process. *Agile* means the course is flexible and customisable to individual learners, and sensitive to changes in the internal and external environment. *Situated* refers to contextualisation and real-world relevance.

3.3 WhatsApp in higher education

Social media provides unique affordances that let individuals contribute to knowledge sharing (Leonardi, 2017). WhatsApp is one of the most widely used communication tools on the planet (whatsapp.com, 2021). In higher education, WhatsApp is an effective communication tool for academics and students (Klein et al., 2018). In pre-pandemic South Africa WhatsApp was 'the' key social media tool for African international distance students to transfer knowledge, sustain relationships, and to support self-directed, autonomous learning (Madge et al., 2019). WhatsApp affords and improves interactivity, knowledge sharing, collaboration, ubiquity, and achievement (Klein et al., 2018; Nitza and Roman, 2016). During the pandemic, it has been surprisingly agile in the education and mentoring of students (see Tarisayi and Munyaradzi, 2021). On the down-side, WhatsApp can disrupt learning communities in various ways, for example by creating an urgency to reply immediately, or by spreading disinformation (Ahad & Lim, 2014). Overlapping of message threads can be confusing (Smith and Tang, 2015).

4. Method

This case study involved the ex post facto analysis of data generated during the presentation of a multimodal distance course in research methodology for Masters' and Doctoral students at the beginning of their research journey.

4.1 The case: Course description

The first author had first taught a Web-based class in 1996, and has always been interested in universal design, and low-cost, low-bandwidth online teaching and learning. We incorporated much of the experience of those early bandwidth-hungry days into this course design. The main communication channel was WhatsApp, augmented by Zoom meetings, YouTube videos, Google forms (for attendance and feedback) and other websites. The course design was socio-constructivist. Students formed separate WhatsApp teams of six to promote interaction and mutual support. They received short learning tasks (individually or in groups) so that a few could be completed within one class period. Finishing the task meant achieving the learning outcome. Individual tasks were presented to the group of six, then posted to the larger group. Flexible design allowed that, should a task take longer, we could omit another or speed it up. There was overnight homework but no long-term assignments. Assignments were personalised – students were given frameworks but had to apply those to their own research proposals. There were no live video-based lectures.

4.2 Data collection and analysis

Data were collected and analysed in three activities: To answer question one, we read the whole communication stream like a script, to extract the narrative of the course. Then we pasted all interactions into Excel and coded manually using open coding. "Interactions" mean messages as well as indications of people joining or leaving the group. For qualitative intercoder reliability (see O'Connor and Joffe, 2020), the two authors cross-checked each other's coding to ensure they understood the same with each code.

To determine who participated and how (Question two), the WhatsApp messages were emailed to WhatsAnalyzer, a web-based tool from the University of Würzburg, Germany. WhatsAnalyzer collects and analyses chat histories of WhatsApp conversations (or chats): the data is completely anonymised, leaving core information like timestamps, message types and message lengths in place (Schwind & Seufert, 2018). The tool does not analyse *content* thematically, but provides metadata about complex group interactions. WhatsAnalyzer returned a thorough analysis of twelve dimensions, including who sent the most messages, who sent most

replies, how many messages were sent per day, who wanted to have the last say, and the like. We present some of the salient findings in the next section.

At the end of each session, students were encouraged to complete a Google asking: What did you like about the workshop? How should we improve the workshop? What did you achieve during the workshop? This data was pasted into a word-cloud generator and inspected through close reading to answer the third question.

5. Discussion of findings

The discussion follows three primary strands, aligned with the research questions: 1) message types, 2) nature of participation, and 3) qualitative evaluation. We interpret these results in terms of our conceptual-theoretical lens, grounding the phenomenon of blended distance learning in relation to community building through WhatsApp.

5.1 What kinds of messages were sent?

This section describes the first two days of the course, derived from reading all the messages. (The other three days followed a similar pattern and, for the sake of brevity, are not described here). After the story follows an analysis of the message types that were sent in developing the community of learners.

The course started on a Monday at 17h00. Students completed the attendance register on Google Forms. As they registered, they were placed into teams of six who had to form their own collaborative WhatsApp groups. After 30 minutes, all teams were formed, and the work could start. For the first activity, each student presented their research to their teams of six, in the form of a fairy tale: *Once upon a time, researchers believed that… But I think that maybe… So, I will <interview some people, or do a survey etc…>; And I hope to find … Which will change the way in which we…* Then, the teams put forward the best two or three for a plenary discussion via Zoom. Students presented their fairy tale proposals and instructors gave feedback. Alongside the Zoom meeting, students still commented and asked questions on the WhatsApp group. However, less than half of the students in the WhatsApp group joined the Zoom meeting. The rest relied on WhatsApp, and accessed the cloud recording afterwards. After the Zoom meeting, homework was announced on WhatsApp*: (1) Watch a 90-minute YouTube video about how to find an academic research problem; (2) Write a précis of a given passage reducing the word count from 94 to 30*.

Since not all participants of Day One attended Day Two, and a few new ones joined, we formed new WhatsApp teams. Because we knew it took so long, we started fifteen minutes earlier. For the first exercise teams circulated their individual précis and arranged them from best to worst. The criteria were: *How close to 30 words? How close to the original?* Questions posed to the large group showed some people had not done the homework. We posted the 94-word original again and pointed out that 'If someone did not do the homework, then obviously they move down to position 6 on your team's ranking with 1 being best and 6 being worst'.

While a few latecomers were still joining teams, and the teams were doing their rankings, we gave feedback about students' reactions to the previous night's class and answered questions about the video. After about half an hour, we started with feedback on the best précis from each team. At 17h57, we posted a link to a YouTube video with a model answer. A brief discussion followed. At 18h08, we posted the next task. The teams had to arrange 20 random sentences about smoking into a branching-tree diagram and then post a picture of their diagram to the main group. The first team response came in nine minutes later and we discussed it. The next one was so close to the model answer that we posted it in return and followed up with a voice note discussing why it looked the way it did. We then discussed and compared all other responses as they were received. At 18h30, we posted a voice note of the next task. Students had to design their own individual branching tree maps of their own research proposals. After 30 minutes, the first student posted a solution. We discussed the diagrams as they were posted. We wanted students to look at the diagrams during the discussion, so we presented our comments as voice notes. The students stuck to text. Never in the entire course did a student send a voice note. Class ended at 19h30 with homework, and a call for students to complete the post-session evaluation.

To see how individual messages contributed to creating the learning experience, all the interactions (messages and indications of joining, leaving, etc.) were imported into a spreadsheet and coded manually. Seven meta-codes were identified: Instructor, Admin&Log, Theme, Pedagogy, Mode, Channel, and Timeframe. These formed the headings of columns, with one interaction per row. Interactions were then scrutinised to identify themes in

one or more of the columns. The Instructor column was used to identify all messages sent by the presenter or co-presenter. Admin&Log identified interactions where people joined or left the WhatsApp group, formed sub-groups, joined Zoom, performed technical operations such as logging in, turning WhatsApp comments on or off, etc. Themes referred to the course content that was taught. Pedagogy included codes for acts of teaching and learning such as presentation, discussion, etc. Mode and Channel were used to identify images, documents, audio clips and Zoom sessions. Timeframe referred to opening time, closing time, as well as communication that was conducted outside scheduled class time. This paper will only consider Administration and Logistics, Themes and Pedagogy, as the other codes were used to give the authors an indication of the circumstances under which certain messages were sent.

5.1.1 Admin and Logistics

WhatsApp indicates if someone joins or leaves a group, as well as whenever the administrator turns group participation on and off. This indicates class size, late arrivals and early departures from class. Some students left the group after class and joined again the next day. Most stayed throughout the course. There were 156 joins and 26 leaves. Most messages (351) in this category involved the formation of teams, where the instructor posted the names of students in groups of six, and the students then had to form their own groups. This process was time consuming and in later versions of the course, the instructor formed the groups before class commenced. Technical messages (56) involved asking for Zoom passwords, learning how to use the desktop version of WhatsApp, or where to find certain features on Zoom. Administrative messages (43) dealt with moving the timeslot of a class meeting, or notifications of who would present on a particular evening.

5.1.2 Themes and pedagogy

The course curriculum comprised 12 themes, described chronologically in Table 1 and discussed below.

Table 1: Themes (n = number of interactions per theme)

Code	n	Description
Story	25	Describe your research as a fairy tale using the format "Once upon a time, researchers believed that… but I thought that maybe… So, I… and I found that… which will change the way we…
Paragraphs	91	In your groups consider three paragraphs and identify the topic sentence as well as the organising principle (Chronological, general to specific, etc.)
Video1	75	Watch a one-hour video on how to extract a research aim out of a literature survey
Précis	46	Students were asked to reduce the length of a paragraph from 94 words to 30 without losing meaning
Smoking	39	Use a branching tree diagram to organise 20 sentences about smoking
Ownmap	40	Organise your own research in the form of a branching tree diagram
Wordcloud	61	Paste the abstracts of all the articles you have read into a word cloud generator
Empirical	133	Discussion of empirical research
Topquest	44	Discussion on empirical research topics and associated questions
Resdesign	117	Research design for topics and questions
Analysis	22	Quantitative and qualitative analyses of the previous day's messages
Paradigms	126	Discussion of a video on research paradigms and questions

1. Story (25 messages)

For the first exercise, presented as an icebreaker, students had to describe their research as a fairy tale. They were still quite shy and uncertain so they first shared their stories in WhatsApp teams of six. Forming teams and discussing stories took about an hour, after which the plenary Zoom discussion lasted another hour. WhatsApp messasges were entirely administrative and technical by nature, with students asking to be put in a team, or for the Zoom link and password. Using smaller teams in the initial phase contributed to student confidence and their willingness to participate in the large group.

2. Paragraphs (91 messages)

In their teams, students considered three paragraphs to identify the topic sentence as well as the organising principle (chronological, general to specific, etc.). This was the first exercise via WhatsApp only. The worksheet document was shared on WhatsApp and students answered the questions in their small team first before a plenary session in the main WhatsApp group. Teams had 10 minutes for discussion. During the plenary session, the presenter asked volunteers to suggest topic sentences and structuring principles of the paragraphs. In this

question and answer session, students would answer and the presenter would respond telling them why they were correct or incorrect. The exercise took 22 minutes. Once again the smaller teams built confidence in the students.

3. Video1 (75 messages)

The Presenter had recorded and uploaded onto YouTube a video lecture on extracting research aims from the literature. It was always homework after the first (contact) lecture and tformed homework for this class also. This 11-minute discussion session covered what the students learnt from the video and how it would influence their study. The discussion flowed over into the first 8 minutes of the next session and was revisited two days later. Here we see how WhatsApp sessions can become confusing, as some students would still discuss one theme, while the group may have moved on to the next discussion.

4. Precis (46 messages)

For homework, students reduced a paragraph from 94 words to 30 by précis. In class, they first ranked their versions in the smaller WhatsApp teams.Then they sent the best examples to the plenary group for the presenter to comment. Finally, they were directed to a brief model answer on YouTube to watch later. This exercise again shows how external resources such as YouTube videos can be incorporated into a WhatsApp class.

5. Smoking (39 messages)

In their teams, students drew a branching tree diagram to organise 20 sentences about smoking. Then they posted pictures of their branching tree to the main group for discussion, after which they were given a link to the model answer on YouTube. Here we see how WhatsApp allows sharing of images, leading to richer multimodal information.

6. Ownmap (40 messages)

Having participated in a team exercise on making branching tree diagrams, students had to organise their own research in the form of a branching tree diagram. Again they presented it to the main group as a photograph or screenshot. The instructor presented a critique of each contribution in such a way that it was relevant to the whole group. He used a voice note so that students could look at the diagram and listen to the voice note.

7. Wordcloud (61 messages)

Students pasted the abstracts of all the articles they had read into a word cloud generator. They presented their word clouds via the group and the presenter commented by voice note. The activity took 45 minutes, and shows how a thrid-party application such as a word-cloud generator can be incorporated into a WhatsApp class.

8. Empirical (133 messages)

The co-presenter facilitated a discussion of empirical research. He followed a Socratic process by posing problem questions via voice notes, with the students responding via text. Two things were learnt here. As a result of all the previous excercises, students had developed confidence and a sense of community and were no longer shy to participate. The “I-thou” power relationship between the faciltator and the students became evident in that the facilitator used voice notes, but the students still used text only.

9. Topquest (44 messages)

The discussion on empirical research flowed naturally into a discussion of empirical research topics and questions, which the students first discussed in groups and then in the main group. The discussion then evolved into adding research questions to the specific topics.

10. Resdesign (117 messages)

The same groups that had proposed topics and questions now had to propose a research design to answer them. These were discussed in the next session. By now, the discussion format had been well-established and students participated freely, indicating a high level of trust in the facilitators and one another.

11. Analysis (22 messages)

This exercise involved a quantitative and qualitative analyses of the previous day’s messages. In their teams students used all the messages of the previous day as a data set, hen developed two research questions: one qualitative/narrative and one quantitative/numeric. They then used the data to answer those questions and presented it to the big group during the Zoom session. Most WhatsApp messages were administrative, although some students shared their results on WhatsApp as well as Zoom. Here we learn that when WhatsApp is used

in support of a Zoom meeting, the messages tend to be administrative rather than related to teaching and learning.

12. Paradigms (126 messages)

This exercise was a discussion of a video on research paradigms and questions. For homework, students had to watch a second one-hour YouTube video in which the presenter explained how to develop research questions based on Burrell and Morgan's four paradigms of social science research, and then to develop their own questions for their own research. These were discussed on Zoom, with the discussion duplicated to WhatsApp via voice notes. The presenter made these voice notes while he was speaking over Zoom, as some students could not access Zoom. This final exercise was a veritable cacophony of interaction, and showed the interaction of two parrallel platforms, WhatsApp and Zoom, working simultaneously in facilitating teaching and learning. Student comments at the end indicated that they were happy with the process and quite able to cope with this style of blended or multimodal delivery.

A quantitative analysis of the messages (Figure 1) shows that activities with individual or group tasks generated fewer WhatsApp messages to the group, while discussions generated more.

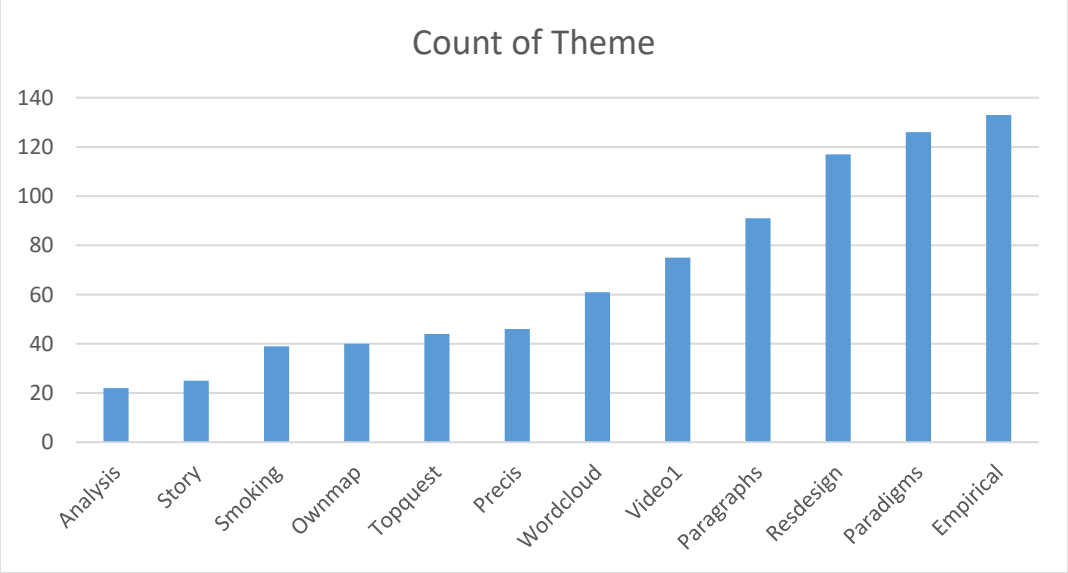

Figure 1: WhatsApp messages per theme

5.1.3 Pedagogy

Codes related to pedagogical acts were identified as praise, thanks, humour, Q&A, present, clarification, instruction, feedback, and discussion. These codes are clarified in Table 2 (n = number of interactions in the category).

Table 2: Pedagogical acts (n = number of interactions in the category)

Pedagogy	n	Description
Praise	23	Presenters praising students with quality of work, students praising presenters with the course quality, congratulations to the co-presenter
Thanks	34	General expressions of thanks, including emojis
Humour	36	Light-hearted comments and "lol" and smiling emojis
Q&A	69	Presenter asks a short-answer question and waits comments on student responses
Present	73	Longer one-way communications, or the presentation of a document, picture, or audio clip
Clarification	80	Follow-up messages to clarify instructions or questions
Instruction	91	Administrative or learning tasks set for students, both in-class and homework
Feedback	145	Feedback from students and lecturers about the quality of work or the course, as well as requests for students to complete the feedback form
Discussion	516	Longer sections of Socratic questioning rather than quick question-and-answer sessions

In the coding, Q&A was distinguished from discussion as short answer questions that were easily answered:

> *Message 344: Any suggestion of the topic sentence?*
> *Message 346: First sentence*
> *Message 347: Yup. Indeed. First.*

Discussions were longer exchanges [sic]:

> *Message 1330: Just difficult to find litriture for the Lit Review on the subject beca use it is so new 🤔 Or at least a variety only a few are avadible and that can cause a ethical issue?*
> *Message 1331: And like you can't just use websites...*
> *Message 1332: Yes please can the Profs expand on [Name withheld]'s comment of little Literature , I am finding that in my topic, Spent weeks looking and found almost nothing on specifically consent period to adoptions studies. People just accept the law as is...*

The quantitative analysis (Table 2) showed that most messages were in discussion format. Feedback had the second highest volume. The presenters encouraged students to complete a feedback form after every class since, as there was no visual feedback, it was impossible to see body language or, in fact, if a student was attending at all. Clarification messages were almost equal to instruction messages, as nearly every instruction had to be clarified. In distance mode, it is difficult to see if a student understands. Given the presenters' socio-constructivist approach and the high level of groupwork, there was little outright presentation. This is also because some of the direct presentation was done by way of homework assignments to watch YouTube videos.

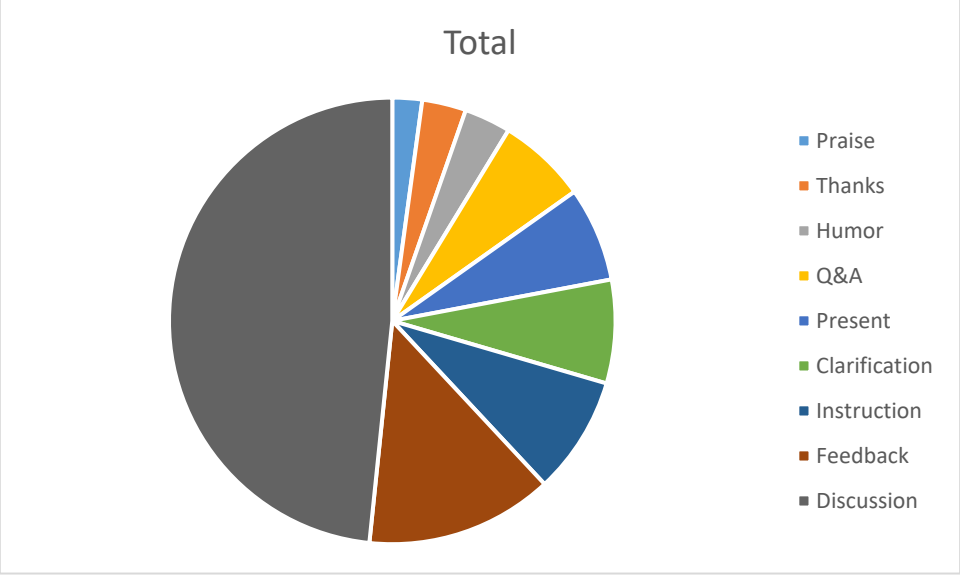

Figure 2: Messages related to pedagogy

5.1.4 Presentation style

Over the five days, the presenter posted 402 messages and the co-presenter 127. From these messages, the therapeutic nature of the facilitation becomes evident in terms of social, cognitive, and teaching presence (Bluteau, 2020; Garrison, Anderson and Archer, 1999). *Teaching presence* is seen in presenting, giving instructions, clarification, and feedback. *Cognitive presence* comes from Q&A and discussion while humour and praise relate to *Social presence*. Separating out the percentages in the categories of pedagogy for the two, showed interesting differences in style. As shown in Figure 3, the presenter followed a project-based approach in which he gave the students learning tasks and discussed what they had learnt in the process, so the presenter had more instances of instruction (17%) than the co-presenter (15%). The co-presenter never ran a question-and-answer session, preferring Socratic discussion (60%) over the 44% of the presenter, which accounts for the biggest difference in presentation style between the two.

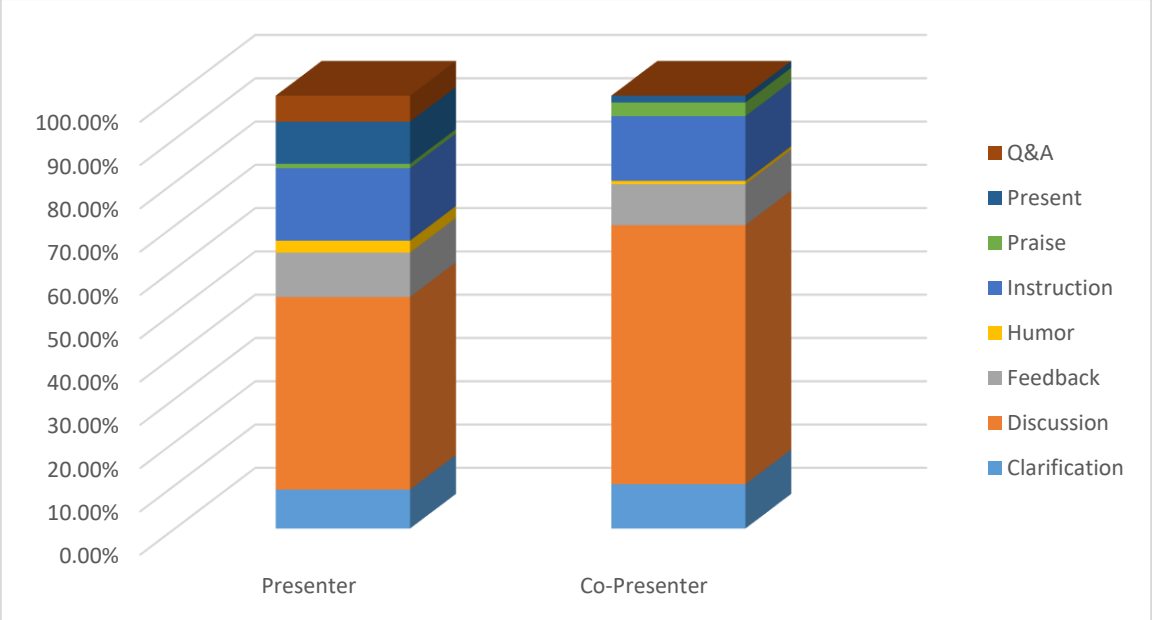

Figure 3: Differences in instructor style

5.2 Who participated and how?

This metadata extracted through WhatsAnalyzer reveals information about the nature of participation according to twelve dimensions as described in Table 3. Importantly, each dimension gives only a fractional insight into overall engagement; and while there may be overlap, not all dimensions are of equal conversational (or pedagogical) value.

Table 3: WhatsAnalyzer depiction of twelve dimensions of group engagement

Dimension	Description
1	Who sends the most messages
2	Who replies to whom most often
3	Who sends how many messages of a particular type (media and text)
4	Who sends how many text messages
5	Who starts a new session (chat) after a period of inactivity
6	How many messages were sent on each day
7	Which day of the week is most popular for texting
8	What time of day is most popular for texting
9	Who uses the most emojis
10	Who uses the most emojis in single messages
11	Who sends the longest messages
12	Who wants to have the 'final say'

By structuring the data in this way, we are able to present a meta-classification of the group chat over the week. This classification is summarised in **Figure 4**:

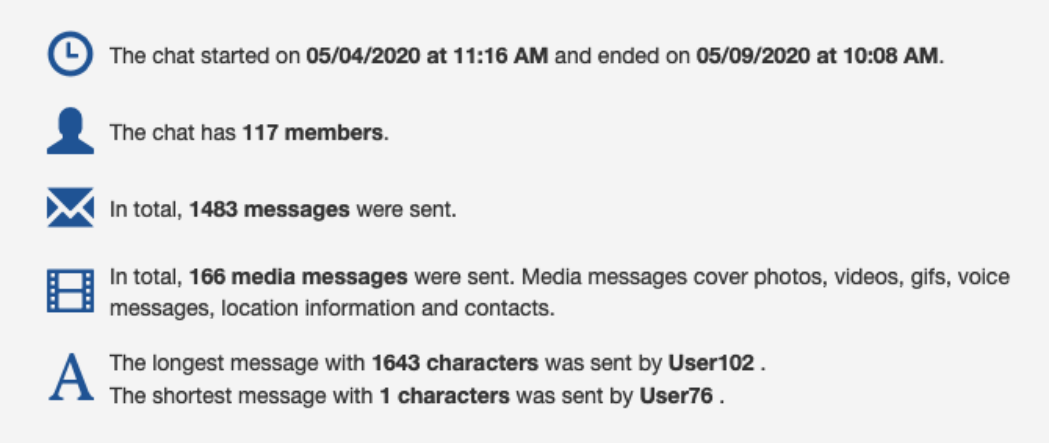

Figure 4: Meta-classification of the group chat (week 1) as extracted from WhatsAnalyzer

The group chat effectively ran for five days and had 117 members, including two instructors (Users 1 and 52). Expectedly, according the first five dimensions of WhatsAnalyzer, the instructors drove the engagement. As shown in Figure 5, they sent the most messages – 504 (34%) and 147 (10%) respectively. Instructors also replied to themselves and one another the most. Nonetheless, the majority (56%) of total interactions were from non-instructors, indicating group participation.

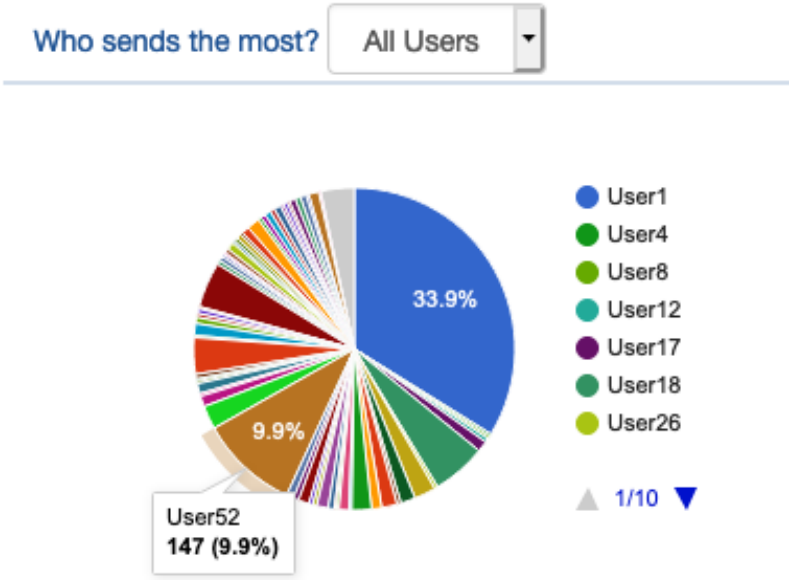

Figure 5: Proportion of messages sent per user

The overall data shows that engagement was distributed, in that many students (of course, some more than others) took part in the overall discussion. Out of 1483 exchanged *text* messages, the instructors accounted for 526 (35%) of them. While there is no universal 'ratio' of acceptable participation, the data suggests that instructors drove the engagement on an equitable basis. Additionally, we could find no straightforward evidence that some students overpowered others by dominating the discussion. The three most active contributors (non-instructors) only accounted for 13% of the total exchanged text messages. Interestingly, as per dimension 11, neither instructor was in the top five of the longest messages sent, which suggests longer queries or discussion points on part of students.

Other dimensions not mentioned above might be of less immediate value, apart from the engagement trajectory throughout the week:

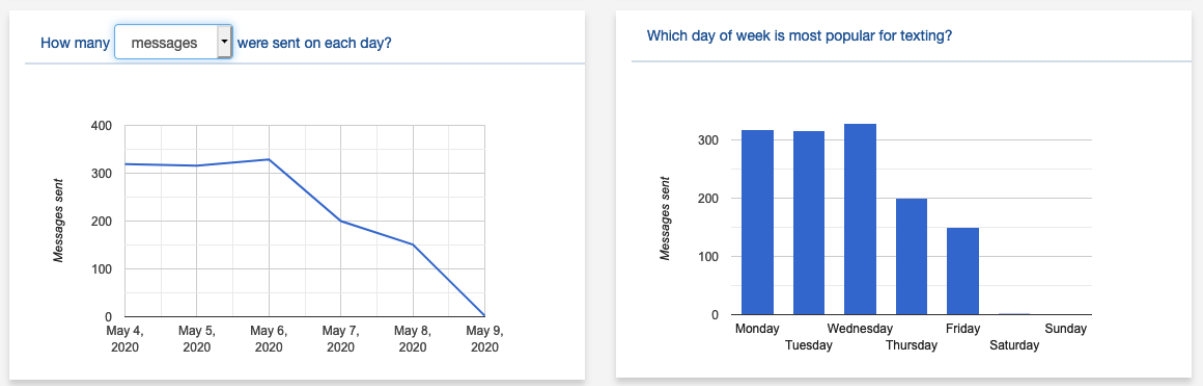

Figure 6: Messages sent throughout the week

Figure 6 shows participation was high upfront, but tapered off nearer to the end of the week. This is not an unexpected finding, given the phenomenon of increasing digital fatigue, and is in line with that of a large cross-sectional study conducted by Malik and colleagues (2020). The researchers found that the intensity of social media use is a strong predictor of social media fatigue, which in turn contributes to a decrease in academic performance. However, another reason for the tapering off on Thursday was that much of the discussion took place on Zoom.

In summary, from this dimensional analysis of group-based engagement and participation, we determine the following: a) instructors have a key role of facilitating the discussion through self-replies; b) participation was distributed and equitable, with minimal overshadowing; and c) participation dwindled nearer to the end of the week.

5.3 How did the students experience the workshop with WhatsApp in support of the community of learning?

At the end of every session, students were asked to fill in a simple Google form with three questions: *What did you like? What can we do better?* And *What did you achieve?* The resultant Google sheet was analysed by generating a word clouds and a word count through Voyant Tools, (see Figure 7) and then performing a close reading of the student feedback to identify themes from their experience.

What did you like?	What can we do better?	What did you achieve?
		
informative (11); prof (10); research (10); feedback (8); understand (8)	time (23); group (11); groups (9); workshop (7);	research (31); topic (14); writing (9); questions (8); information (7)

Figure 7: Word clouds and word count

5.3.1 What they liked

The most frequently used words in the feedback on what students liked, were: informative (11); prof (10); research (10); feedback (8); understand (8). The fact that *prof* – the title of both facilitators, appears so frequently supports the concept of teaching presence in therapeutic facilitation (Bluteau, 2020). Cognitive presence is indicated by *informative*, *research* and *understand,* while *feedback* may indicate cognitive, teaching and social presence (Garrison, Anderson and Archer, 1999).

Student comments focused on the information they received, feedback on their work, the exercises as well as the interactivity and sense of community it created. There were also a few comments relating directly to the platforms (WhatsApp, Zoom, and YouTube).

They liked the format that each student would present and then the presenter would give feedback to the whole group. Two participants commented:

> *Feedback given to everyone so that each student can see if that applies to their work.*
>
> *It made me engage deeply with my plans for my research - especially when reflecting about what I have learnt after the session. It was fun and interactive. Nice to hear everyone's proposals.*

The student population was highly diverse, coming from all six faculties of the racially diverse university. They were also Masters' and Doctoral candidates. Students perceived the diversity as a benefit. Working in groups increased interactivity and promoted a sense of community:

> *very informative and the groups helped to understand concept better from different people without the distraction of man people posting in the main groups*
>
> *I love the collaboration of different disciplines, its super interesting to hear what people have brought to the table and how we encourage each other in the group*

The integrated nature of the platform and the permanency of WhatsApp was also noted [sic]:

> *i joined the class very late but very informative feedback given to others. i loved the zoom call and watsapp interaction simultaneously*
>
> *My network was poor so I will go through that voice note notes afterwards*

There was even some praise for the technological fluency of the presenter:

> *Prof got it all right! whats-app, zoom, muting mics. Well done!*

5.3.2 Recommended improvements

The most frequently used words in the students' recommendations for improvement were time (23); group (11); groups (9); workshop (7). Although they really liked the groups, they found the logistics cumbersome.

Despite most comments in this section being favourable, there were several valuable recommendations that pertained to time, discipline, and pedagogy, as well as administrative and technical issues.

Two aspects of time were mentioned: The actual duration of the class, and the time it took to form the smaller WhatsApp teams. Concerning the duration of the class, the responses were conflicting, some wanting it to be longer, others shorter:

> *The time. Due to being a full time employee working at home and my Masters being coursework based, I still have assignment submissions for this week and I feel that the workshop time can be reduced.*
>
> *I feel it's too long but the then again...there's plenty of students perhaps 2 hours is required*
>
> *We are a large number of individuals who can't get enough time to speak to Prof one by one, I feel like we can increase Time so that we can also get to ask questions*

Joining time was identified as both a logistical and a disciplinary issue:

> *For future reference, if we will be put into groups I think we should get the list before time to avoid time wastage*
>
> *Workshop logistics should improve if students focus on being on time, however, starting 15 minutes early helped a great deal.*

Other disciplinary issues regarded Zoom etiquette:

> *Please ask delegates more clearly to mute their mikes. Unfortunately I had no sound on my computer so had to switch to phone.*

Pedagogically, some groups were unresponsive, or students requested more direct presentation, such as slideshows and YouTube presentations. Students also asked for a clearer agenda, and a slower pace. One student asked that the Masters' and Doctoral students should be dealt with separately:

> *My group members were very unresponsive / inactive. We did not work together as a group at all.*
>
> *Coordination of the groups and a more of slide show presentation of the topics to be covered by the presenter hence a better understanding of the subject matter being discussed hence the exercises would be easier to do*
>
> *Go a bit slower because some people get their whatsapps delayed because of connection.*

Zoom was seen as a valuable additional technology:

> *The WhatsApp messages (in the main group) was overwhelming and easy to get lost in and was very convoluted. Having Zoom meeting and having students respond on there would be better and easier to follow.*

5.2.3 What they achieved

The most frequently occurring words were research (31); topic (14); writing (9); questions (8); information (7) indicating that the students certainly achieved the outcomes of the course, which was to provide them with information about finding a research topic, developing research questions, and writing a proposal.

While most students simply wrote a sentence or two about the thematic content of the evening, two of them mentioned affective and higher cognitive aspects such as motivation, companionship, and critical thinking skills:

> *The motivation to continue with research and support from other colleagues. At least I know now I'm not alone in this journey.*
>
> *More focused thinking, seeing thought processes and analysing feedback helped me to look at my ideas and processes critically and amend where needed. The grind work starts after class.*

6. Conclusions

We present our conclusions in reverse order, looking first at the students' experience of the course, then the pedagogy, and finally the use of WhatsApp in creating a sense of community. The contribution of this paper lies in its support of other theoretical and practical contributions regarding the use of WhatsApp in building a community of learning, and in our conclusions, we tie back to these.

6.1 Affective aspects

Student feedback showed that they appreciated the content, and the sense of community that was evoked by the WhatsApp groups (Kwayu, Abubakre and Lal, 2021). They had reservations about the time to form groups. Some felt the evening was too long, while some had problems attending because of family or work commitments. Thus, although WhatsApp does put learning in their pockets, they might just not have the time to attend to it. Finally, they regarded the course as motivational, as well as a growth opportunity.

6.2 Pedagogy

Considering the IDEAS framework (Witthaus et al., 2016), we cannot claim a high level of *Intelligent* systems. The course ran on WhatsApp, Zoom and YouTube, so although the level of technology use was high, it was relatively low technology, and the analytics were done after the course. We can, however, argue that the course

was highly *Distributed*. Sources of information came from the two presenters, Internet-based resources as well as students' own contributions, which contributed to making the course *Engaging*. Students pointed this out in their feedback, as reported above, in that they liked the group work and felt part of the community. Evidence that the course was *Agile* comes from the fact that it was run on an easily accessible platform as a response to both the external pandemic conditions, as well as the internal conditions of students not having much access to cheap bandwidth. All Zoom lectures were recorded and students were given links to YouTube videos to watch later in places that offered free Wi-Fi. The WhatsApp platform was selected because of its ubiquity and low bandwidth usage. The course was *Situated* in that students were given the opportunity to relate every aspect of the curriculum to their own studies and, given the currency of the COVID-19 epidemic at that stage, many students chose to study aspects related to the pandemic in their own proposals.

6.3 Community

This section will re-visit the elements of community discussed in the literature and consider how they resonate with our findings in terms of access, relationships, vision, and function.

6.3.1 Access

Our WhatsApp groups were developed to provide access at a time of social distancing, for discussing and sharing study information (Ahad & Lim, 2014), but moved beyond that towards presence, where we identified instances of cognitive, social and teaching presence.

In the count of who sent the messages, the two presenters emerged as the main senders. For the rest, apart from three talkative students, the rest of the senders were evenly distributed, indicating that nobody dominated the conversation, and that the reciprocal nature was respected. The high number of messages labelled as presentation or discussion also indicated that the main reason for the group was to give and receive information (Kurniasih and Riyadhsyah, 2017). The strong sense of teaching presence led to feedback that *"[t]he WhatsApp messages (in the main group) was overwhelming and easy to get lost in".* The blurring of the boundaries between real and virtual environments was evident in students' mentioning that they were working from home and that class time should be reduced.

6.3.2 Relationships

The dialogical nature of our language became evident from the high number of feedback messages that were counted, as well as messages of praise and thanks. The I – thou power relationships between the presenter, co-presenter, and students were scrupulously adhered to and, although the presenters often communicated via voice notes, the students never did.

Students reported their own increased confidence during the running of the course, indicating an increase in their agency (Aizenkot and Kashy-Rosenbaum, 2019). We found no instances of cyberbullying.

Several elements helped to develop trust in the community. The instructors and students remained respectful throughout. A clear set of behaviours developed throughout the workshop, although, as was pointed out by some students, the lack of discipline decreased trust because of all users not adopting specific behaviours (Ruas, Cardoso and Nobre, 2017). Critique of student work was done in such a way that everybody could learn from it, thus contributing to altruism.

6.3.3 Vision

The students' appreciation for learning from the experiences of their peers shows an awareness of the context of the community (Moodley, 2019, p.1). Students also mentioned the value of diversity and different opinions and of knowing that they were not alone. In the student feedback, interactivity was one of the most mentioned aspects. Students also mentioned how much they learnt from others.

6.3.4 Function

One of the downsides of our workshop was that in some of the smaller teams, the interaction was too low, as was pointed out by a respondent. We were fortunate in not having examples of conflict and coercion, although there certainly was competition between some members – particularly those who posted most frequently. The WhatsApp groups formed valuable "collaboration-oriented functionalities" (Cabitza et al., 2016, p.216).

7. Summary and recommendations

The aim of this research was to explore the emergent patterns of use of WhatsApp in support of a community of learners to contribute to the unfolding stories of the disruptive influence of the COVID-19 pandemic. Our research underscores the cognitive, teaching and social role of the therapeutic facilitator (Bluteau, 2020; Garrison, Anderson and Archer, 1999), and shows they can use WhatsApp effectively in all three modes. At a post-graduate level, the cognitive aspect elicited most messages. We also found WhatsApp useful in supporting problem-based learning in a big-group, small-group co-operative pedagogy, which was supported the IDEAS framework. Although it was not very 'Intelligent', the data shows that it was distributed, engaging, agile and situated. Finally, WhatsApp was able to provide access, strengthen relationships, focus a common vision, and assist in the functioning of the group.

We present the following recommendations in the hope that they provide some guidance to others using WhatsApp in teaching and learning.

7.1 Recommendations for improved efficiency and effectiveness

From the analysis in section five, we see that using smaller groups initially creates student confidence and willingness to participate in the large group. WhatsApp sessions can become confusing, as threads overlap. External resources such as YouTube videos and third-party websites can be incorporated into a WhatsApp class. WhatsApp allows sharing of images, leading to richer multimodal information so that students could look at a diagram and hear a voice description. The "I-thou" power relationships related to teaching and learning are upheld by WhatsApp. When WhatsApp is used in support of a Zoom meeting, the messages are administrative rather than pedagogical. Students are comfortable with multimodal delivery.

Other recommendations include: Smaller groups should be formed before the start of the programme. Groups should be larger than four, since some students leave, and others are shy to participate. As indicated by Koomson (2019), some students had to be intentionally taught certain aspects of WhatsApp, such as how to form groups and how to work from WhatsApp for desktop computers. Students intuitively recognised certain design decisions in the course, such as the use of YouTube videos in the place of Zoom lectures, the decision to discuss every student's contribution in such a way that it would be useful to all, and the decision to make smaller groups.

A clearer agenda with learning outcomes, as well as examples of what is wanted from students during the exercises , would reduce the number of instructions and clarifications required.

7.2 Recommendations for further research

Further research could determine optimal small group size. One could also consider the extent to which smaller groups survived and thrived after the closing of the large group, indicating sustainable peer support. It would be useful to determine the extent to which students supported one another via WhatsApp outside the groups altogether, forming an actual community of learners. Finally, one could determine the relationship between participation in the WhatsApp group and successful course completion.

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College Students' Preferences on Principles for the Effective Instructional Video Design for Online General English Classes in Korea

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Abstract: The present study investigates the preferences of students regarding the principles for the effective design of instructional videos to identify factors that influence engagement. A questionnaire was distributed to 232 students enrolled in online liberal arts classes at a private university in South Korea. Frequency analysis was conducted to determine preferences, whereas an independent sample *t*-test and one-way analysis of variance were administered to verify any differences in preferences according to gender and grade. The findings are as follows. First, out of the 12 principles that should be considered in the design of instructional videos, the students most preferred the review quiz principle. Moreover, this factor was found to exert the greatest influence on engagement. Second, incorporating real-life situation principles into instructional videos also had a significant impact on engagement. Third, female students expressed higher levels of preference than did male students in terms of the preview, course content on screen, and review quiz principles. Fourth, sophomores preferred the review quiz principle more than the freshmen did. The results of the present study are in line with those of previous research in that the effective instructional design of multimedia lessons requires reducing extraneous processing, managing essential processing, and fostering generative processing. Particularly, the study found that Korean students value video lectures with generative activities for meaningful learning. Based on the findings of the study, pedagogical considerations of the design of recorded lectures and its structure for active engagement, and suggestions for future studies are provided.

Keywords: instructional video design, fostering engagement, movie English, cognitive theory of instruction, multimedia principle

1. Introduction

Coronavirus disease 2019 (COVID-19) has led to considerable changes to the educational environment worldwide (Moser, Wel and Brenner, 2021). The majority of university classes in South Korea have been forced to switch to online education called emergency remote learning (Korean Ministry of Education, 2020) at short notice. Particularly, liberal arts classes have been conducted almost entirely online since the spring semester of 2020 because of the large number of students. In Korea, non-face-to-face classes have been conducted in one of three types, namely, synchronous courses using live video conferencing software, such as Zoom; asynchronous courses with prerecorded instructional videos; and hybrid courses using a combination of both types.

Among them, instructional videos are popular among students (Henderson, Selwyn and Aston, 2015). This medium gives them control over the pace of learning (Murray, Koziniec and McGill, 2015) and easy access anytime and anywhere. Moreover, teachers can track students' learning. Videos can hold learners' attention with a lecturer's narration, onscreen printed text, and diverse media. Scholars found that effectively designed videos can facilitate better learning (Castro-Alonso, Wong, Adesope, Ayres and Paas, 2019; Höffler and Leutner, 2007) and increased motivation (Abeysekera and Dawson, 2014).

However, the rushed transition to online teaching came with various drawbacks. It failed not only to check the learners' attitude, interest, and understanding but also to sustain attention to lectures (Szpunar, Jing and Schacter, 2014) as verified by the dropout rate, which was reported to be higher than that of offline classes (Lim, et al., 2021). Several studies argued that online education is not as effective as face-to-face traditional instruction (Krause and Coates, 2008; Pickering and Swinnerton, 2019) and that poor course designs and pedagogies for online instruction have led to poor learning outcomes (Woodworth, et al., 2015). Furthermore, problems with the low-quality lectures because of unprepared learning design are constantly being raised (Kong and Lee, 2021).

Teaching online is fundamentally different from face-to-face teaching (Johnston, Killion and Oomen, 2005; Mayer, 2014b). In terms of technology use, the content design, learning assessment, student motivation,

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student diversity, and online settings are different (Boettcher, 2011; Clark, 2014; Davis, 2000; Fayer, 2017; Quitadamo and Brown, 2001). Thus, online classes require different approaches (Choe, et al., 2019) and necessitate the development of new lesson planning skills among instructors. Moore (2003) stressed that the quality of instruction has far more of an impact on the students' decisions to attend lectures than giving penalties.

Unfortunately, the majority of professors in South Korea have hardly conducted online classes or video production. They are unprepared to teach with little resources and time (Che and Lee, 2020). Even so, creating high-quality instructional videos after a short training course continues to be difficult. One of the challenges for professors is creating appealing instructional videos while maintaining high levels of educational outcomes, motivation, and engagement. Hence, identifying the factors that influence online classes is crucial for improving student engagement. Engagement is a useful variable that directly or indirectly predicts the learning process and learning outcomes. Moreover, several studies reported that the level of engagement exerted a significant effect on class satisfaction (Lim, et al., 2021).

Previous research listed principles for effective instructional designs (Fyfield, Henderson and Philips, 2019; Mayer, 2020; 2021). However, empirical studies on whether such principles can be applied to actual online classes for general English within the context of Asian countries are few (Costley, Hughes and Lange, 2017). To address this research gap, the present study aims to provide basic data for the quality management of instructional videos and improvement of satisfaction with online classes. By applying the existing evidence-based principles for the effective design of instructional videos in online classes, this study intends to investigate the preferences of students and to identify factors that influence engagement. The research questions for the study are as follows:

1. What are the preferences of college students in terms of the design of instructional videos for liberal arts classes?
2. Are there differences in preferences by gender and year?
3. What is the relationship between preferences on instructional design principles and student engagement?

2. Literature Review

2.1 Cognitive Theory of Multimedia Learning and Instruction

Mayer (2021) suggested evidence-based principles for designing instructional videos and for grounding in cognitive theories of learning and instruction. According to Mayer (2021), three principles from the science of learning are dual channels, limited capacity, and active learning principles. In other words, learners apply separate visual and verbal channels and should engage in active cognitive processing. However, they can only process a limited amount of information in each channel at one time (Swelle, Ayres and Kalyuga, 2011). With these principles regarding human cognition, Mayer (2021) also listed three demands on the learner's cognitive resources during instruction, namely, extraneous processing, essential processing, and generative processing.

Extraneous processing occurs when interesting but distracting and irrelevant materials are included. When an extremely extraneous overload occupies cognitive capacity, there is not enough room for the others (essential processing and generative processing) to process. Essential processing is related to content complexity. When learners engage in essential processing, they pay attention to the content and that leads to better retention of information. Lastly, generative processing helps learners to get motivated and to transfer information from working memory to long-term memory. Notably, the effective instructional design of multimedia lessons requires the reduction of extraneous processing, management of essential processing, and fostering of generative processing (Buchner, 2021; Mayer, 2021).

2.2 Principles Implemented in Video Lecture Design

Specifically, Mayer (2021) suggested 13 principles for the design of instructional videos (p.5). First, to reduce extraneous processing, videos should contain relevant materials (coherence principle), highlight key parts (signaling principle), avoid the addition of captions for the same narration (redundancy principle), place text next to the graphic (spatial contiguity principle), and present visual materials with corresponding narration (temporal contiguity principle). Second, to manage essential processing, a video should be broken down into several parts (segmenting principle), should introduce key concepts at the beginning (pre-training principle), and present words as spoken text instead of written text alone (modality principle, see also Mayer, 2019). Lastly, to foster

generative processing, instructors should use conversational language (personalization principle), speak in a friendly manner (voice principle), avoid static photos of the instructor (image principle), include gesture (embodiment principle), instruct learning strategies like summarizing, self-testing and self-explaining (Fiorella and Mayer, 2016), and add activities for meaningful learning (generative activity principle).

Furthermore, Fyfield, et al. (2019) identified 25 principles for the design of instructional videos that consider cognitive efficiency and presented a fourth category named interface design principles besides the three categories presented by Mayer (2014a; 2014b; 2021). Under this category, the subcategories are (1) learner control effect, which denotes a video interface controlled by learners for pausing, playing, speeding up, and slowing down (Kühl, et al., 2014); (2) segmentation, which suggests that a pause should follow important information (Mayer and Pilegard, 2014); and (3) integrated practice activities, such as those about activity integration during the presentation or after watching a video (Szpunar, et al., 2014).

To sustain attention to online lectures, Szpunar, et al. (2014) implemented interpolated testing. In two experiments, 80 students were instructed to conduct a test four times while watching a 21 min video lecture. The findings demonstrated that interpolating an online lecture with testing helped students to quickly and efficiently learn lecture content and to retain more information. Moreover, they reported increased note taking, less mind wandering, and even reduced anxiety for the final test. Roediger and Karpicke (2006) also supported the idea that tests could be used to significantly enhance learning. Lee and Song (2021) reported the positive effect of video lectures with embedded quiz questions.

2.3 Previous Studies on Effects of Lecture Video Design

Choe, et al. (2019) conducted a survey to identify the preferred styles of students for online lecture videos. A total of 183 undergraduates at the University of California, Los Angeles, CA, USA, participated and expressed strong preferences for video styles using Learning Glass and Demonstration. Additionally, they strongly preferred engagement and connection even in asynchronous courses, which supported the concept of Mayer's (2021) personalization principle. Brame (2016) considered three elements for video design, namely, cognitive load, student engagement, and active learning. Cognitive load follows Mayer's (2021) three demands on the cognitive resources of learners during instruction. To maximize student attention to educational videos, Brame (2016) recommended creating videos with duration of 6-9 min and using a conversational style to develop a sense of social partnership. Strategies to promote active learning are (1) packaging videos with interactive questions, (2) using guiding questions, and (3) making videos as part of a larger homework assignment. Rickley and Kemp (2021) conducted a quasi-experiment to observe the effect of video lecture design on perceived learning and student satisfaction. They found that principle-based designed video lectures had a meaningful effect on learners' perceived learning and satisfaction. Jamie et al. (2017) pointed out that only a small number of students are watching video lecture. To figure out the relationship between the perception of the instructional design and engagement, they conducted a survey to 1801 cyber university students. Based on the results, they concluded five key elements of instructional design for online classes, namely, designing methods, setting the curriculum, establishing time parameters, establishing netiquette, and utilizing the medium effectively (p.200)

3. Method

3.1 Participants

Participants comprised students enrolled in the course Movie English for Speaking at a private university in Seoul, South Korea. The researcher took charge of two classes with 130 students per class and taught them for the whole semester. The course was elective and held once a week for 100 min across 15 weeks. All liberal arts classes were conducted online only because of the COVID-19 pandemic. Recorded video lectures were provided to students for 13 weeks except for the course introduction and orientation at the first week and the final exam at the 15th week. A total of 260 students completed the questionnaire. However, 28 were excluded from analysis because they were given the freedom to skip any question if they were hesitant to answer. Out of 232 students, 81 (34.9%) and 151 (65.1%) were male and female, respectively. There were 47 (20.3%) freshmen, 60 (25.9%) sophomores, 70 (30.2%) juniors and 55 (23.7%) seniors.

Their scores for the Test of English for International Communication ranged from 135 to 985 points with an average score of 604. Scores below 550, between 551 and 700, and above 701 were considered beginner, intermediate, and advanced levels, respectively.

The majors of the students varied and were classified into three groups on the basis of the academic division of the university, namely, Humanities and Social Sciences (n=103; 44.4%), Engineering and Sciences (n=99; 42.7%), and Arts and Sports (n=30; 12.9%). Table 1 provides a summary of the demographics of the participants.

Table 1: Demographics of participants

Category	Item	N	%
Gender	Male	81	34.9
	Female	151	65.1
Year	1	47	20.3
	2	60	25.9
	3	70	30.1
	4	55	23.7
TOEIC score	Beginner (below 550)	94	40.5
	Intermediate (551–700)	73	31.5
	Advanced (above 701)	65	28
College	Humanities and Social Sciences	103	44.4
	Engineering and Sciences	99	42.7
	Arts and Sports	30	12.9

3.2 Data Collection Instrument and Method of Analysis

To obtain data for the study, a questionnaire was distributed to investigate the students' preference for the design instructional videos. Through a preliminary survey on 135 students at the beginning of the semester, the students were asked what elements should be included in online instructional videos. Twelve items were selected for the final questionnaire (Table 2).

Table 2: Twelve video design principles and survey items

Principle		Items
Extraneous load	Spatial/temporal contiguity	Course content on the screen
	Signaling	Highlight key parts
	Redundancy (caption)	Subtitles
	Redundancy (music)	Background music and sound effect
Essential load	Segmenting	Wrap-up (summary of the lesson)
	Modality	Diverse media
	Pre-training	Preview (for the previous content)
Generative load	Personalization	Incorporating real-life situations
	Generative activity (organize)	Teaching digital skills
	Generative activity (compare)	Feedback on assignments
	Image/embodiment	Instructor's face and gesture
	Generative activity (test)	Review quiz (immediately after videos)

For student engagement, three items were used from the questionnaire of Kim and Lee (2019), namely, (1) When I start watching videos, I pay attention to them and watch all at once without pause; (2) I take notes while watching videos; and (3) I work as hard as I can to carry out assignments and quizzes related to the videos. Cronbach's alpha value for the items was .656, which indicates that they are valid and acceptable.

The researcher translated and applied the questionnaire to facilitate ease in the understanding of statements. Items were rated using a five-point Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree). The collected data were analyzed using SPSS for frequency. After ranking the preferences for the 12 items for instructional design on the basis of mean and standard deviation, repeated-measures analysis of variance (ANOVA) was performed to verify if a difference exists between the means for the one to five rankings.

Additionally, an independent sample *t*-test and one-way ANOVA were administered to determine any differences in the 12 preferences according to gender and grade. Scheffé's method was applied as a post hoc test. To further investigate the effect of preference on engagement, linear regression was used.

3.3 Procedures of the Study

3.3.1 Week 1: Preliminary Survey

At the beginning of the study, the students were requested to respond to a preliminary questionnaire regarding instruction design preference, which included multiple questions and open-ended questions. Data from short-answer questions were translated, counted, and categorized into groups on the basis of the frequency of topics and are presented descriptively.

3.3.2 Weeks 2–13: Online classes with recorded videos

The researcher of the study was the instructor for Movie English for Speaking class. Students were taught about the culture and language on the basis of movie scripts. The talking head style video (Choe, et al., 2019) was provided. Video production was made using the university's content management system and sent to students via a learning management system (LMS). Additionally, this LMS space was used for attendance, video lectures, forums, quizzes, assignments, and surveys. The students watched three videos (20 min each) per week, and 12 instruction design items (Table 2) were incorporated into the videos at least four times. Watching the video lectures once a week was compulsory within the designated period, and students must click the video for attendance.

3.3.3 Week 7, 14: Questionnaire

Learner preference on the selected 12 principles for instructional design of online lectures was investigated using Likert-type scales with and one short open-ended question. The questionnaire was administered twice by dividing the 12 principles into two. Six principles were included in the first questionnaire and the other six principles were asked later (see Appendix). A total of 260 students completed the questionnaire, whereas 28 questionnaires for students with missing items, those who missed watching videos, or those who refused to respond were excluded from the analysis.

4. Results

4.1 What are College Students' Preferences on Instructional Video Design in Liberal Arts Classes?

Table 3 provides the results of the ranking of the preferences for the 12 principles of instructional design. The top five items are review quiz (4.17; highest average), course content on the screen (*M*=4.04, *SD*=0.84), wrap-up (summary of the lesson: *M*=4.02, *SD*=0.74), incorporating real-life situations (*M*=3.75, *SD*=0.79), and highlight key parts (*M*=3.75, SD=0.74).

Table 3: Descriptive statistics for instructional design principles (n=232)

Rank	Items	Min.	Max.	M	SD
1	Review quiz	2	5	4.17	0.60
2	Course content on screen	1	5	4.04	0.84
3	Wrap-up (summary of the lesson)	2	5	4.02	0.74
4	Incorporating real-life situations	1	5	3.75	0.79
5	Highlight key parts	2	5	3.75	0.74
6	Teaching digital skills	2	5	3.65	0.73
7	Diverse media	1	5	3.54	0.69
8	Subtitles	1	5	3.53	0.92
9	Preview (for the previous content)	1	5	3.51	0.85
10	Feedback on assignments	1	5	3.03	0.85
11	Background music and sound effect	1	5	2.94	0.91
12	Instructor's face and gesture	1	5	2.64	0.82

The results of repeated-measures ANOVA for the top five rankings to verify a difference between means are as follows: The Greenhouse-Geisser correction was applied because the sphericity test result was significant (Mauchly's W=.920, p<.05). A significant difference was observed between the means the top five rankings (F=17.309, p<.001). Consequently, the average score of the first (M=4.17, SD=0.60), second (M=4.04, SD = 0.84), and third (M=4.02, SD=0.74) ranks were higher than those of the fourth (M=3.75, SD=0.79) and fifth (M=3.75, SD=0.74) ranks, as shown in Figure 1. The results are in line with those of previous research (Buchner, 2021; Mayer, 2021) in that the effective instructional design of multimedia lessons requires reducing extraneous

processing(course content on screen), managing essential processing(wrap-up), and fostering generative processing(review quiz) (Buchner, 2021; Mayer, 2021).

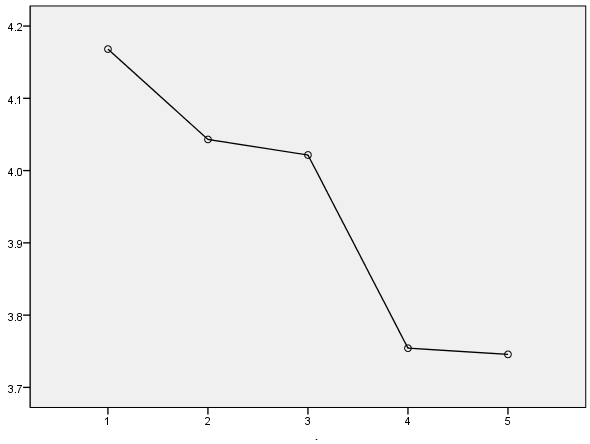

Figure 1: Average score difference among the top five items

4.2 Are There Differences in Preferences by Gender and Year?

We conducted a *t*-test and a one-way ANOVA to verify any difference between gender and year (freshmen to seniors). Table 4 indicates a significant difference between males and females. Specifically, the female students mainly preferred preview for the previous content (t=−2.373, p<.05), course content on the screen (t=−2.566, p<.05), and review quiz (t=−2.957, p<.05). As confident independent learners, female students tend to actively use quiz questions to monitor their learning.

Table 4: Instruction design preference by gender

	Gender	N	*M*	*SD*	*t*	*p*
Preview (for the previous content)	M	81	3.33	0.82	−2.373	.018*
	F	151	3.61	0.86		
Course content on the screen	M	81	3.85	0.79	−2.566	.011*
	F	151	4.15	0.85		
Review quiz	M	81	4.01	0.64	−2.957	.003**
	F	151	4.25	0.56		

After examining differences by year, significant differences were found only for the review quiz (F = 3.758, p< .05). Moreover, the sophomores prefer review quiz than the freshmen do. This could indicate that freshmen students viewed review quizzes right after videos as an extra assignment, while others took such quizzes as a way of checking whether they remembered the key content of the class, without viewing them as a burden because they are aware they can be related to final exams and grades.

Table 5: Instruction Design Preference by Year

	Year	N	*M*	*SD*	*F*	*p*	Scheffé's correction
Review quiz	1	47	3.94	0.57	3.758	.012*	2 > 1
	2	60	4.32	0.62			
	3	70	4.19	0.52			
	4	55	4.18	0.64			

4.3 What is the Relationship Between Preferences on Instructional Design Principles and Student Engagement?

Table 6 presents the results of correlation analysis to determine the correlation between preferences and engagement. For student engagement student engagement (N = 232, Min = 2, Max = 5, M = 4.01, SD = .599)., three items were used from the questionnaire of Kim and Lee (2019), namely, (1) When I start watching videos, I pay attention to them and watch all at once without pause; (2) I take notes while watching videos; and (3) I work as hard as I can to carry out assignments and quizzes related to the videos. Items were rated using a five-point Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree). The relationship between

engagement and incorporating real-life situations (r=.156, p<.05) and review quiz (r =.466, p<.001) displayed a significant correlation.

Table 6: Correlations between top five instructional design principles and student engagement

	Engagement	Review quiz	Course content on the screen	Wrap-up	Incorporating real-life situations	Highlight key parts
Engagement	1					
Review quiz	.466***	1				
Course content on the screen	.021	.097	1			
Wrap-up	.007	.080	.075	1		
Incorporating real-life situations	.156*	.097	.178**	.202**	1	
Highlight key parts	.062	.127	.157*	.297***	.159*	1

*p<.05, **p<.01, ***p<.001

To evaluate the effect of preference on engagement, the results of investigating the effect of the top 5 rankings are shown in the following Table. The low R-squared value indicates an inherent amount of unexplainable variability. Considering the scarce empirical studies that investigated whether the principles of instructional video design can be applied to actual online classes for general English are few, this result implies that the factors influencing the engagement or satisfaction of recorded video lectures remain unidentified and warrant further study.

Review quiz (β=.462, p<.001) and incorporating real-life situations (β=.129, p<.05) exhibited significant results, course content on the screen, wrap-up (summary of the lesson), and highlight key parts were insignificant. Thus, the instructional design principles that influence engagement are review quiz and incorporating real-life situations, and the effect can be seen that review quiz is larger than incorporating real-life situations.

Table 7: Model summary for regression values

	Unstandardized coefficients		Standardized coefficient	*t*	Sig.
	B	SE	β		
Review quiz	.463	.059	.462	7.826	.000***
Course content on the screen	−.031	.043	−.044	−.732	.465
Wrap-up (summary of the lesson)	−.044	.050	−.055	-.882	.379
Incorporating real-life situations	.097	.046	.129	2.127	.035*
Highlight key parts	.005	.050	.006	.095	.924
R^2=.235, adj. R^2 =.218, F=13.851, p<.001					

5. Discussion

Out of the 12 principles that should be included in the instructional videos, the students mainly preferred review quiz. Moreover, the study found that this factor exerted the greatest influence on engagement. For offline classes, taking quizzes or tests are the typical factors that give students feelings of stress (Staats, Cosmar and Kaffenberger, 2007). In online classes, however, students can check the extent of their understanding of the content of lessons without pressure. As such, review quiz was considered to be beneficial for engagement (Dykman and Davis, 2008; O, 2020). This finding is consistent with those of previous research, i.e., review quizzes are effective for learners (Brown, et al, 2015).

Moreover, the students preferred the reduction of extraneous load, as indicated by the ranking for course content on the screen (second). Looking at course content on the screen, including texts, PowerPoint slides, and other visual aids, while listening to the instructor's narration not only helps to reduce extraneous load but helps students focus on essential materials. Moreover, searching for lesson contents in textbooks, while listening to the instructor's explanation without displaying the text on the screen, can be distracting for learners.

Additionally, to reduce the load on the learner's information processing, instructors should emphasize the important points through verbal and visual signals (highlight key parts, top five). Alternatively, the findings suggest that providing a subtitle (top eight), which is identical with instructor's narration and background music, or sound effect (top 11) and instructor's face and gesture (top 12) are redundant, such that extraneous materials

should be excluded rather than included. This result is in contrast to those of previous studies, i.e., students performed better when the instructor maintained eye contact (Fiorella, et al., 2020) and showed gestures (Mayer and DaPra, 2012). Thus, the study infers that subtitles, background music, and the instructor's face and gestures are seemingly irrelevant with the visual input through text and movie scenes on the screen and the auditory input of the teacher's narration.

To manage essential processing, the segmenting principle should be considered, as Mayer (2021) stated that segmenting enables learners to build a mental representation of the part before moving on to the next (p.7). The participants preferred a summary of the lesson (top three) at the end of videos and initiating videos with a preview of the previous lesson (top nine) instead of lengthy storytelling-style videos. Moreover, the participants reported that understanding and remembering the course content by utilizing diverse media (top seven) are easy. Notably, students learn better with text on the screen instead of spoken words from a video lesson in learning a second language in particular (Lee and Mayer, 2018).

The findings confirm that the effective design of instructional videos requires fostering generative processing. Seemingly, the participants prefer not only an explanation of the contents of textbooks but also how these contents can be applied to real-life situations (incorporating real-life situations, top four). For instance, they were interested in the instructor's personal story regarding misunderstandings due to cultural differences.

Additionally, they wanted to hear from the instructor on how to study English and organize materials and useful websites with recommendations and guidance on use (teaching digital skills, top six). This result supports the findings of Magnussen (2008), Brown and Ford (2002), DeRouin, Fritzsche and Salas (2004) that is, e-learning platform proficiency influenced engagement. As Darrington (2008) pointed out, many students are not tech-savvy, which is necessary for learning. Hence, instructors should consider providing guidance on essential digital skills. Several students preferred feedback on assignments (top 10) to be included in video lectures to help them better prepare next time. Notably, effective instructional videos help learners to get motivated and to transfer information from working memory to long-term memory.

Female students were more likely to prefer review quiz and course content on the screen. The results demonstrate that they are confident independent learners who are academically engaged in online courses and may outperform their male counterparts online (Price, 2006). Additionally, Hsiao (2021) stated that face-to-face courses are more suitable for male students, who tend to be passive in learning and display less independent learning abilities. Seemingly, constant attention and monitoring for male students are required in the e-learning environment.

Significant differences in preferences according to year were found only for review quiz (F=3.758, p<.05). Specifically, the preference levels of the sophomores were higher than those of the freshmen, who exhibited the lowest preference levels. This result could be an indication that freshmen students recognized review quiz immediately after videos as an extra assignment, whereas the others took the quiz to verify whether they remembered the key contents of the class because they are aware that review quizzes can be related to final exams and grades. This discrepancy should be considered for freshmen students without university experience and interaction due to COVID-19. As such, further studies that provide detailed instructions and explanations why students should take review quizzes and their benefits for learning are required.

6. Conclusion

This study investigated preferences for the design of instructional videos and their relationship with engagement in videos among college students enrolled in general English online lectures at a private university in South Korea. The study found that out of the 12 design principles, review quiz immediately after videos was highly preferred and exerted the greatest influence on engagement. Incorporating real-life situations (top four) also exerted a significant impact on engagement. Based on the results of this study, the following instructional video structure can be made as shown in Figure 2. To manage essential processing, a video should be broken down into three parts: pre-, while-, and post-video lecture (Segmenting principle). At the beginning of the lecture, instructors should preview of the previous lesson and its connection with today's lesson. In the middle of the video lecture, course content (texts, PowerPoint slides, and diverse media) should be incorporated and instructors should emphasize the key points and explain how these contents can be applied to real-life situations (incorporating real-life situations). In contrast, extraneous materials such as subtitles, background music, or

sound effect and instructor's face and gesture should be excluded. At the end of the video lecture, instructors should give summary of the lesson. Finally, a review quiz right after the video lecture promotes student engagement, therefore, should be provided to check their understanding.

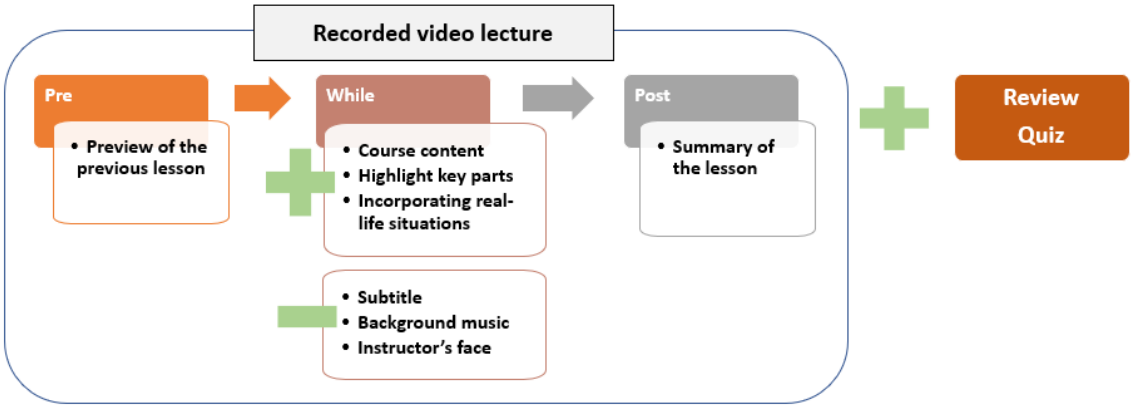

Figure 2: Suggested recorded video structure of this study

The findings of the present study draw pedagogical implications for the design of recorded lectures and their structure for active engagement. The results of the present study are in line with those of previous research in that the effective design of multimedia instructional videos requires reducing extraneous processing, managing essential processing, and fostering generative processing. Particularly, it was found that Korean students value video lectures with generative activities for meaningful learning. Based on these findings, the study suggests that instructors should make generative activities integrated with recorded video lectures less of a burden.

Particularly, participation should be prioritized over scores. Hence, teachers should be creative in designing instructional videos and activities for learners to enhance their motivation and transfer of knowledge from working memory to long-term memory.

The present study acknowledges its limitations, which should be addressed in future studies. For instance, the results were obtained from a particular set of students in the South Korean context. Thus, further research using different contexts and long-term and qualitative data is necessary to verify this study.

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Appendix

Questionnaire #1

1. Which method of learning do you favor/prefer the most?
□ Prerecorded video lectures □ Zoom lectures □ Both prerecorded video and Zoom lectures
2. Suitable duration for online classes (per class)
□ less than 10 min. □ 10-15 min. □ 15-20 min. □ 20-30 min. □ more than 30 min.
3. With a scale from 1 to 5, please give me your opinion on the items for instructional design of online lectures. How important is each of the following statements?

Items	Not important				Very important
	1	2	3	4	5
Preview					
Diverse media					
Feedback on assignment					
Instructor's face and gesture					
Course content on the screen					
Highlight key parts					

4. Please write any additional comments in the space below.

Questionnaire #2

1. With a scale from 1 to 5, please give me your opinion on the items for instructional design of online lectures. How important is each of the following statements?

Items	Not important				Very important
	1	2	3	4	5
Incorporating real-life situation					
Summary of the lesson					
Background music					
Teaching digital skills					
Subtitle					
Review Quiz					

2. Please rate how strongly you agree or disagree with each of the statements.
(1) When I start watching videos, I pay attention to them and watch all at once without pause
Strongly disagree Strongly Agree
① ② ③ ④ ⑤
(2) I take notes while watching videos.
Strongly disagree Strongly Agree
① ② ③ ④ ⑤
(3) I work as hard as I can to carry out assignments and quizzes related to the videos.
Strongly disagree Strongly Agree
① ② ③ ④ ⑤
3. Please write any additional comments in the space below.

Impact of an Instructor's Personalized Email Intervention on Completion Rates in a Massive Open Online Course (MOOC)

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Abstract: Although Massive Open Online Courses (MOOCs) are increasing in popularity, they have been subject to criticism due to the high dropout rate. This study examined the impact of an instructor's personalized email intervention on the rate of completion of a nine week course, which included seven weekly quizzes, and the rate of completion of the final exam. The participants, who took an Israeli noncredit academic MOOC on negotiation management, were randomly assigned to two groups. Treatment group participants (N = 576) who did not complete the weekly quiz received a tailored reminder by email from their instructor encouraging them to complete the quiz and offering them assistance in order to deal with the past week's contents. The control group (N = 608) that did not complete the weekly quiz did not get any emails from the instructor. The impact of the intervention was measured in three different ways: the immediate-impact, the delayed-impact and a cumulative impact. The increase in quiz completion within a week after the instructor's email was defined as an immediate-impact. The increase in the completion of the next quiz was defined as a delayed impact. The increase in the final exam completion rates was defined as a cumulative impact. The results show that the weekly intervention had an immediate impact as well as a cumulative impact on the final exam completion rate. The results suggest that an instructor's acknowledgement and interest might increase learners' commitment to learning in a MOOC. This study aimed to gain insight into learners' propensity to stay active in a MOOC and to increase completion rates. Findings of this study can be useful to MOOC designers and instructors to design and facilitate more effective MOOCs for learners by using email interventions to prevent students from dropping out of courses.

Keywords: MOOC, massive open online course, email intervention, dropout rate, completion rate, online learning

1. Introduction and literature review

Since 2011 to the end of 2020, more than 180 million students were enrolled in more than 16,000 Massive Open Online Courses (MOOCs) carried out by about 950 universities all over the globe (Dhawal, 2020), allowing participants to earn microcredentials, academic degrees and/or professional development and skills (Barak, Watted and Haick, 2016; Breslow et al., 2013; Evans et al., 2016). These courses are delivered by well-established MOOC platforms, such as Coursera and Udacity (USA), edX (USA), XuetangX (China), Future Learn (UK), and Swayam (India). In Israel, a digital platform named Campus IL (https://campus.gov.il/en/about/) was established by the Ministry of Social Equality, enabling free MOOCs based on the edX platform.

It seems that MOOCs are gradually becoming an integral part of the learning process, especially in higher education settings (Schuwer et al., 2015; Soffer and Cohen, 2015). These courses provide high-quality content and allow students to experience diverse learning practices online that enhance their learning experience (Cho and Byun, 2017; Mohamed et al., 2015). However, there are drawbacks, such as a large number of dropouts, inability to validate the learner's identity, barriers to learners' satisfaction, and difficulties in studying complicated subject matters, e.g., engineering and sophisticated quantitative materials (Dalipi et al., 2018; Rabin et al., 2020; Schuwer et al., 2015).

The dropout rates of MOOCs are high. For example, for certificate courses, the completion rate is in the range of 2%–10% (Reich, 2014). In another study, the completion rates of 221 MOOCs varied from 0.7% to 52.1%, with a median value of 12.6% (Jordan, 2015). Indeed it has been found that more than half (52%) of the students who registered never entered the courses at all (Reich and Ruipérez-Valiente, 2019). Typically, there is a steep decline in participation throughout the course (Edinburgh Group, 2013).

There are several reasons for dropping out of MOOCs, some of which are related to the learners and some to different aspects of design and marketing. Learner-related reasons are most often a lack of motivation, lack of

time, and lack of ability or background (Alario-Hoyos et al., 2017; Chaw and Tang, 2019; Cisel, 2018; Lee and Choi, 2011; Rabin et al., 2020). The reasons related to the MOOC drop outs often involve the way the MOOC was designed, lack of interaction, and other hidden costs (Dalipi, Imran and Kastrati, 2018; Hone and El Said, 2016; Lee and Martin, 2017; Padilla Rodriguez and Armellini, 2015).

In a survey study exploring factors that influence retention in a MOOC, Hone and Said (2016), found that the course content was a significant predictor of MOOC retention. Interaction with the instructor of the MOOC was also found to be a significant predictor of course retention. Interactions, particularly between the instructors and students, were found to be a significant factor determining student engagement and thereby the completion rate (Hew, 2015). One of the primary means of interaction in MOOCs relies on discussion forums (Baxter and Haycock, 2014; Chen et al., 2019), and there have been different attempts to increase participation and involvement in forums (Kizilcec et al., 2014). In some cases, the availability of the instructor's or course staff member's email address for assisting in specific problems (e.g., code debugging) (Kizilcec et al., 2014) increased students' motivation. In an article describing a case study of a MOOC on user experience (UX) design involving group projects, effective communication was found to be essential for building trust among students and having a substantial impact on reducing dropout. However, several participants reported that they experienced a high degree of stress caused by constant communication with the teams (Cheng et al., 2019).

In another study focusing on learners who wanted to complete the course but experienced challenges in solving the exercises, the course developers created adaptive automatic just-in-time interventions encouraging students to ask for help if they needed it. The approach was evaluated in over 5,000 active students in a MOOC course via a survey, and the metrics were gathered alongside it. The results showed that the intervention increased the callouts for help by up to 66% and lowered the dwelling time until initiating action (Teusner et al., 2018). However, intervention studies have not always yielded positive results. For example, Borrella, Caballero-Cabllero and Ponce-Cueto, (2019) reported an intervention at MIT that consisted of sending tailored encouragement emails to learners at risk of dropping out. In this work, the researchers tried to address psychological attributes (lack of motivation) through an intervention that encourages learners to complete an important course activity at one specific moment (halfway through the course before the mid-term exam). The statistical analysis of the results demonstrated that the email intervention had no effect on reducing the dropout rate associated with the mid-term exam. The findings of this study can be explained by the fact that the intervention setup should be more frequent and not at a single point in time during the course.

In the present paper, we used a quantitative study with an experimental design method to examine the impact of the instructor's tailored encouragement emails on the rate of completion of seven weekly quizzes and the rate of completion of the final exam during the nine weeks of the course. There is empirical evidence that an effective intervention research methodology, like the one we chose for the current research, can reduce the dropout rate in MOOCs (Borrella et al., 2019). Although the use of a reminder email is not a new method for instructors, in the present study, the context in which the emails were sent is unique, e.g., after the due date for the quiz had passed. The concept of sending individual emails each week to students who did not complete the weekly quiz with an offer of assistance is rooted in the teaching presence (TP) element in the community of inquiry (CoI) framework of learning processes in online educational environments (Garrison et al., 2000). Part of TP includes facilitation of learning and direct instruction in the online space (Garrison and Anderson, 2003). These tailored encouragement emails, delivered outside of the course's environment, can be viewed as part of the facilitation of learning and direct instruction. Moreover, they can be viewed as part of a method for the humanization of MOOCs, where faculty actively engage learners to communicate throughout an entire course (Evans, Kensington-Miller and Novak., 2021; Kilgore and Lowenthal, 2015), sending an individual email not generated as an automated reminder. From a behavioral economics and psychology point of view, we can view this intervention as a "nudge". Thaler and Sunstein (2008) have suggested that a nudge is an effective way to influence social or individuals' decisions or behavior by slightly altering the choice architecture in which decisions are made. In our context, the notion of "choice architecture" is the equivalent of using or not using the instructor's intervention. We can consider this influence as a nudge, as it does not limit the choice set or make other alternatives appreciably more costly (Hausman and Welch, 2010).

2. Purpose of the research and research questions

The goal of this study was to examine the impact of the instructor's tailored emails on the completion rate in weekly quizzes and the final exam. The immediate-impact corresponds to the increase in the quiz completion in

the week after the instructor's email was sent (Figure 1A). Students from the treatment group who did not complete a specific quiz a week after it was opened received an email regarding their lack of participation and an offer of assistance. The students from the control group did not receive such an email. A week later, we tested whether the students completed the quiz. The immediate-impact effect was measured by comparing the sum of differences between the students' completion rate after one week and after two weeks for all seven quizzes between the control and experiment groups.

The delayed impact was defined as the effect on the following quiz completion (Figure 1B). For example, after receiving an email regarding their lack of performance on quiz number one, the student completed quiz number two. Thus, the effect of the delayed impact was tested by comparing the sum of students who completed quiz number two after one week for all seven quizzes between control and experiment groups. To explore the cumulative impact on the final exam completion rate, we compared the rate of completion of the final exam between control and experiments groups. Figure 1 illustrates the immediate-impact, delayed impact, and cumulative impact on final exam completion rate. The specific measures will be further explained in the findings section.

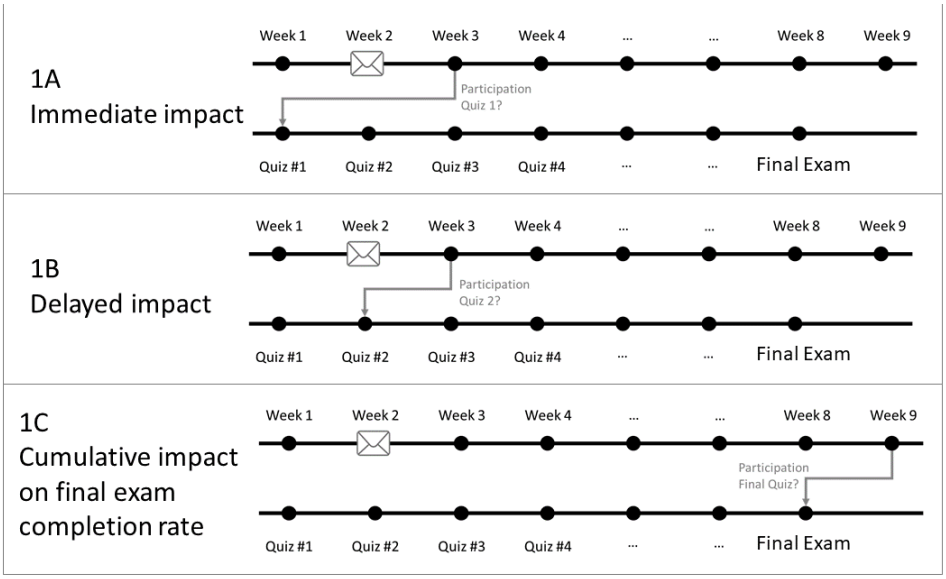

Figure 1A–C: An example of a certain intervention and the three types of impact: (1A) immediate impact, (2A) delayed impact, and (1C) cumulative impact on final exam completion rate.

Three research questions guided the process of this research:

1. What is the immediate impact of the instructor's email intervention on the quiz completion rate?
2. What is the delayed impact of the instructor's email intervention on the quiz completion rate?
3. What is the cumulative impact of the instructor's email intervention on the final exam completion rate?

3. Methodology

3.1 The research environment: MOOC *negotiation management*

The production of the MOOC *Negotiation Management* was part of the Israeli National Project for Digital Learning named CAMPUS. The goal of CAMPUS is to promote general, academic, and professional education in Israel in order to reduce social gaps and accelerate economic growth (https://campus.gov.il/en/about/). The course aimed to impart knowledge and skills in negotiation, understand complex negotiation processes, and allow learners to build a "personal toolbox" that will allow them to negotiate optimally (https://campus.gov.il/course/course-v1-hitacd_hit_361negotiation). In general, negotiating is an important skill that is relevant to each person's personal and professional life. The ability to understand the process, isolate its components, manage it, and lead to a successful integrative solution can provide a real advantage to managers and employees in changing human and digital environments (Kopolovich, 2020). Course topics include the following: conflicts, interests, and negotiations; conflict management styles; addressing objections in negotiations; negotiation strategies and tactics; culture and negotiations; body language and negotiation.

The course offers weekly video clips, readings, quizzes, and discussions. The videos included a series of narrative scenes that are kind of "mini-cases" that the instructors analyze. The mini-cases consist of a series of episodes played with four actors, presenting daily situations in their natural environment (e.g., home and/or work). The integration of video content stems from the insight that it is difficult to focus attention over time on a lecture type "talking head" format (Fyfield et al., 2019; Guo, Kim and Rubin, 2014). The use of mini-cases is based on cognitive flexibility theory, which advocates the creation of a learning process involving repetitive transitions, "crisscrossing a landscape", mini-cases, and relevant conceptual knowledge (Spiro and Jehng, 1990).

The MOOC includes eight modular learning units, mostly in Hebrew. Each unit stands on its own and is linked to other units, thereby producing a synergy of knowledge and process. At the end of each unit, participants are required to complete a quiz testing the level of knowledge and understanding of the content being studied.

The MOOC is offered in two modes. The first mode is as a free instructor-led MOOC. The second mode is a blended academic course at Holon Institute of Technology (HIT) in Israel that combines three to five face-to-face meetings. The course was first presented in winter 2018. To date, there have been three rounds of the free MOOC and fifteen rounds of the academic session. Approximately 13,500 participants, mainly from Israel but also from 25 other countries, have registered in both modes of the course.

3.2 Participants, data collection and data coding

One thousand one hundred eighty-four participants registered for the free instructor-led *Negotiation Management* MOOC in the winter semester of 2018. Upon enrollment, the participants filled out a personal demographic information survey. Of the respondents, 51% were female, while 49% were male.. The average age was 41 (SD = 16). The majority (71%) said that they held a higher education degree (BA, MA, PhD), while 29% held a high school education or lower.

The participants were randomly assigned to a treatment group and a control group (therefore, according to the binomial distribution, the group size is not equal). Examining the differences in the demographic characteristics of the two groups yielded no significant differences; that is, both groups were identical in their personal background characteristics (see Table 1 below).

Table 1: Personal background characteristics of participants by groups

	All	Treatment group	Control group
N	1,184	576	608
Mean age in years (SD)	41 (16)	41(16)	42 (15)
Male	49%	50%	47%
Female	51%	50%	53%
Higher education degree	71%	69%	74%
High school education or lower	29%	31%	26%

As outlined above, each week a different learning unit was opened, which included a quiz to evaluate students' level of understanding. Students of the treatment group who did not take the weekly quiz after one week received an email from the instructor: *"We have noticed that you have not begun to answer the quiz following lesson No. 1 (*for example*). If you need any assistance, we are here to help you. Yours sincerely, Orna and the course team*."

The control group students, who did not complete the weekly quiz, did not receive such an email. The impact of this intervention was measured in three different ways: the immediate-impact, the delayed-impact and the cumulative impact on the final exam completion rate. The increase in quiz completion within a week after the instructor's email was defined as an immediate-impact. The increase in the completion of the following week's quiz was defined as a delayed impact. The completion data for each quiz and completion of the final exam were derived from the online log file. The data collection was held between November 2018 and December 2018.

The data were coded for each quiz as follows: "0" for no participation and "1" for completion. Participation was documented over two cycles: a week after the quiz had been opened for students, Cycle 1 ("C_1"), and two weeks after the quiz has been opened for students, Cycle 2 ("C_2").

The study received full ethical approval from our host institution, the Holon Institute of Technology, Israel.

4. Findings

4.1 Immediate impact results

In order to explore the immediate impact of the instructor's intervention, we examined the completion rate in Cycle 1 and Cycle 2 for each quiz. This rate was compared between control and treatment groups. As shown in Figure 2 and Figure 3, the completion rate in C_2 was higher than in C_1. In addition, the results indicate that the difference in the students' completion between cycles, meaning $C_2 - C_1$, in the treatment group was higher and that completion in C_2 decreased over time for the control and treatment group.

In order to quantify the immediate impact of the instructor's intervention, we calculated the sum of differences between the students' completion rate in Cycle 1 and Cycle 2 for all seven quizzes.

$$TDC = \sum_{i=1}^{7} C_2 t_i - C_1 t_i$$

Where $C_1 t_1$ indicates the completion rate in Cycle 1 for quiz 1; $C_2 t_1$ indicates the completion rate in Cycle 2 for quiz 1, and the total difference between cycles (TDC) is the sum of differences between the rate of completion in the two quiz cycles (Cycle 1 and Cycle 2). When the delta value for a specific quiz (e.g., quiz 1) is 0, there is no difference in participation between Cycle 1 and 2. It may indicate that the student did not complete the quiz in any of the cycles or completed the quiz in Cycle 1 and therefore had the same result in Cycle 2. When the delta value for a specific quiz value is above 0, participation in Cycle 2 was coded as one and was coded as 0 in Cycle 1. As TDC is a quantitative variable, we can examine the differences in the average of TDC, meaning the total differences between cycles divided by number of participants between the control and treatment group. In order to examine the immediate impact, an independent sample t-test was conducted, using TDC as the dependent variable and the group (treatment vs. control) as an independent variable.

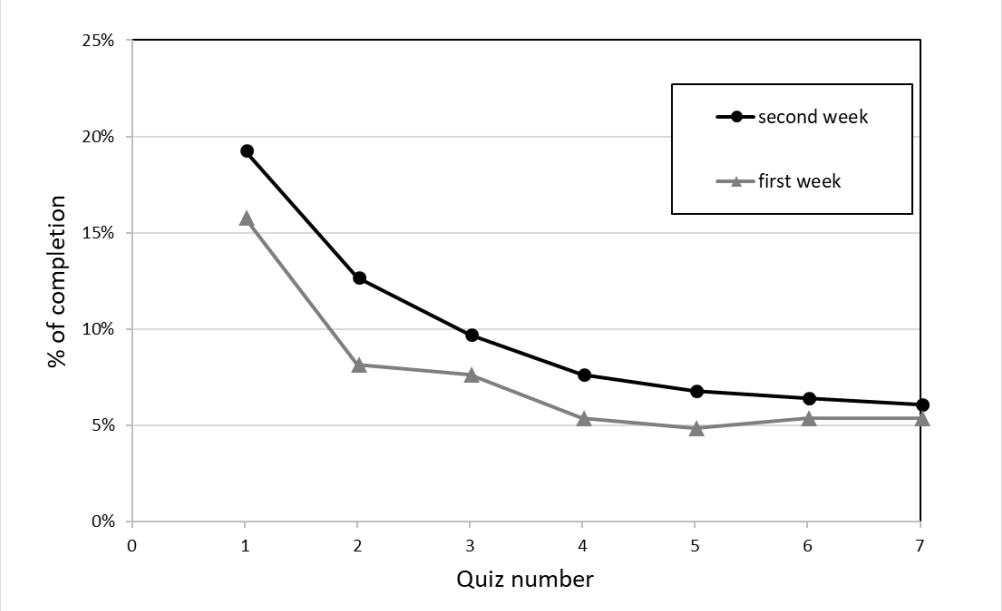

Figure 2: Percentages of completion in $C_2$and C_1 for each quiz—control group

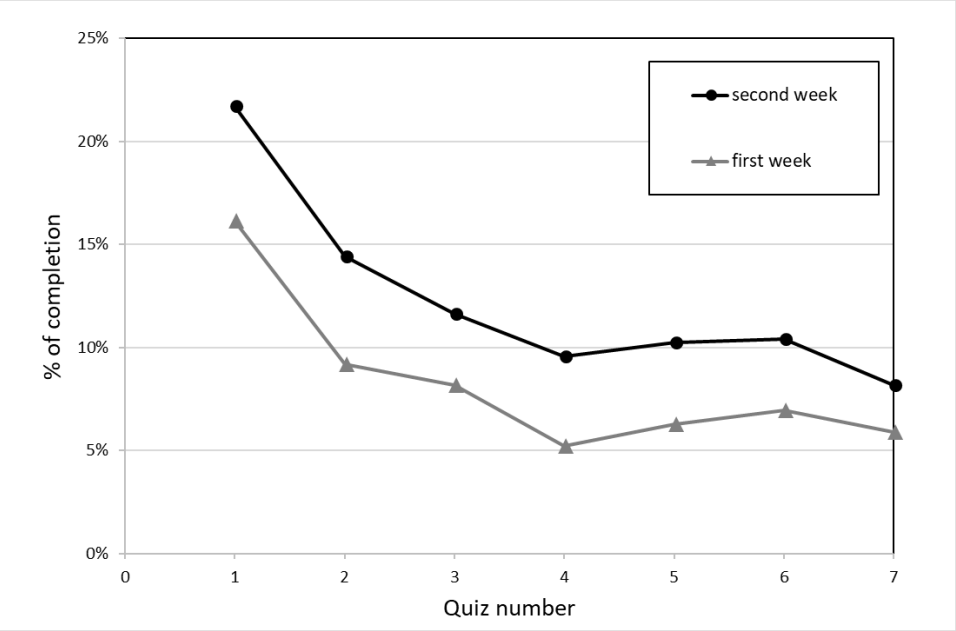

Figure 3: Percentages of completion $C_2$and C_1 for each quiz—treatment group

The results of the independent sample t-test showed a significant difference in the average of TDC between the control group (M = 0.151, SD = 0.513) and treatment group (M = 0.283, SD = 0.772), t(993) = -3.435*, p-value < 0.01.* The average TDC for the treatment group (0.283) was higher than the average TDC for the control group (0.151), which means that the instruction's intervention had a statistically significant effect, as seen in Table 2.

Table 2: Number of completions in each quiz cycle

		Control	Treatment
Total		608	576
Quiz 1	*Cycle 1*	91	93
	Cycle 2	111	125
Diff		20	32
Quiz 2	*Cycle 1*	47	53
	Cycle 2	73	83
Diff		26	30
Quiz 3	*Cycle 1*	44	47
	Cycle 2	56	67
Diff		12	20
Quiz 4	*Cycle 1*	31	30
	Cycle 2	44	55
Diff		13	25
Quiz 5	*Cycle 1*	28	36
	Cycle 2	39	59
Diff		11	23
Quiz 6	*Cycle 1*	31	40
	Cycle 2	37	60
Diff		6	20
Quiz 7	*Cycle 1*	31	34
	Cycle 2	35	47
Diff		4	13
Sum TDC		92	163
Average TDC		0.151	0.283

4.2 Delayed Impact

In order to examine the delayed impact, we tested the percentages of completion in C_1 for each particular quiz and compared it between the control and treatment groups. We argue that higher completion in C_1 in the treatment group in comparison to the control group may indicate a delayed impact of the intervention, meaning that students have developed an independent behavior without relying on the instructor's nudge. Based on a

chi-square analysis, there was no significant difference between the control and treatment groups for any of the quizzes (*p-value > 0.1* for all the quizzes).

Figure 4 shows the completion in C_1 for each quiz for the control and treatment groups.

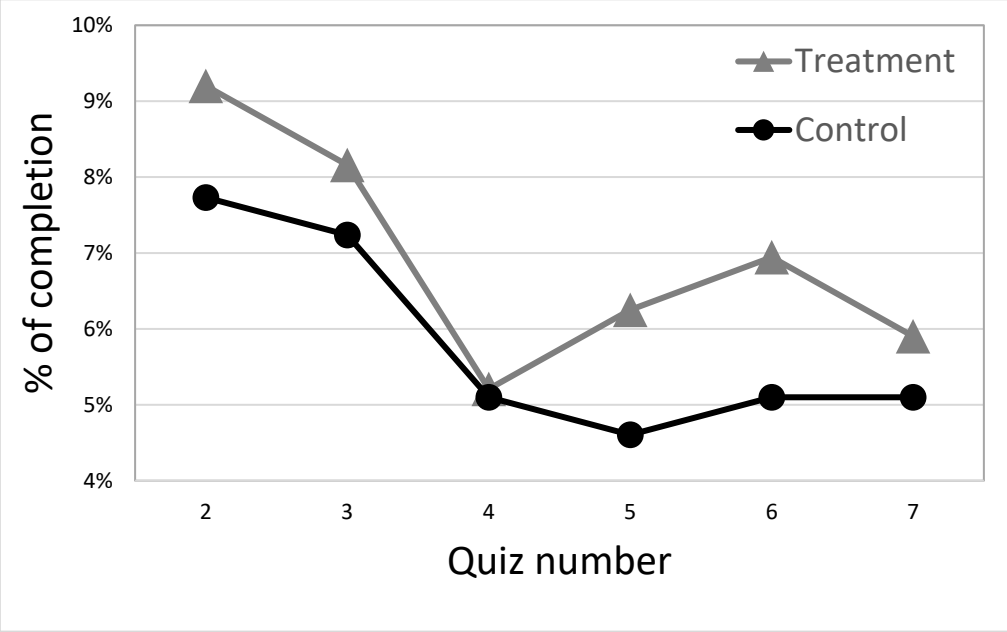

Figure 4: Percentage of completion in C_1 for all quizzes—control and treatment groups

In order to quantify the cumulative completion in C_1 during all of the quizzes, we calculated the sum of students' participation in C_1 for quizzes no. 2-7. Quiz No. 1 was not included as independent behavior could have developed following the first experience only.

$$SC_1 = \sum_{i=2}^{7} C_1 t_i$$

Where SC_1 indicates the total completion in Cycle 1 for all six quizzes. In order to examine the difference between the average SC_1 for the control and treatment groups, an independent sample t-test was conducted (using SC_1 as the dependent variable and the group, treatment vs. control, as an independent variable).

The results of the independent sample t-test showed that the SC_1 for the treatment group (M = 0.417, SD = 1.226) was higher than the SC_1 for the control group (M = 0.349, SD = 1.161). However, no significant difference was found t(1182) = -0.980*, p-value = 0.327.* Figure 5 shows the average SC_1 for both groups.

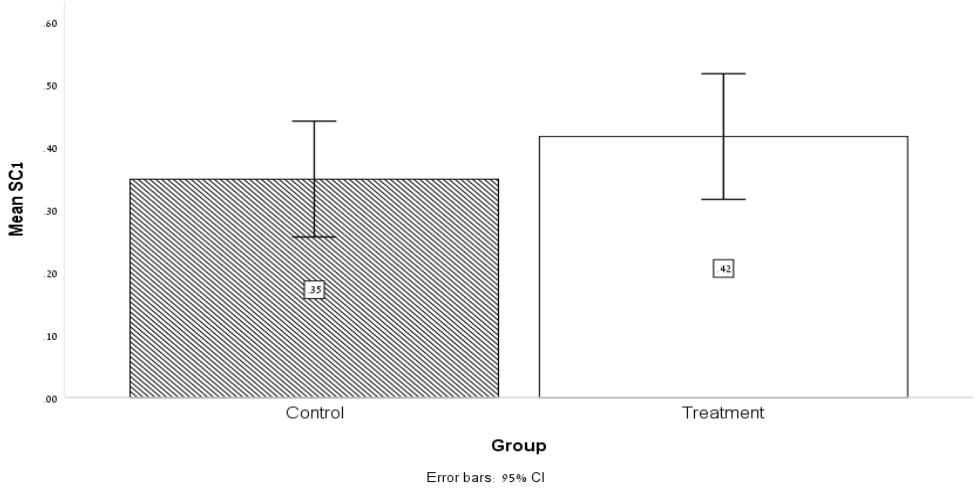

Figure 5: Average SC_1 for control and treatment groups

4.3 Cumulative impact of final exam completion rate

The cumulative impact on the completion rate of the final exam was determined through the completion of the final exam.. The final exam participation percentage for students in the control group, as shown in Figure 6, was 4.1%, and the percentage of completion for those in the treatment group was 7.5%.

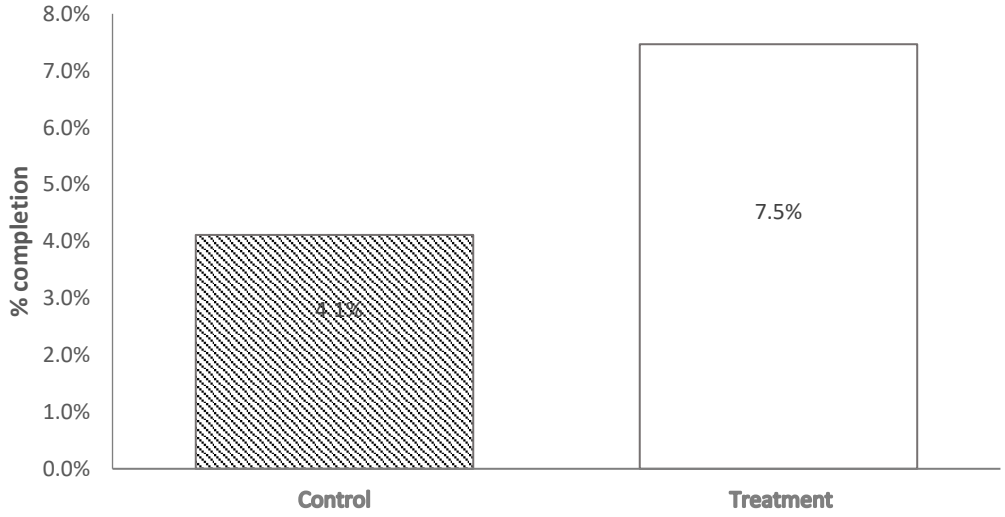

Figure 6: Percentage of completion in the final exam: control vs. treatment

5. Discussion

The increase in demand for MOOCs over time requires not only creating more high-quality courses but also supporting the learners' mental and pedagogical needs. In most MOOCs, there is little or no tutoring to help learners (Min and Jingyan, 2017).

In the current study, we examined the impact of a tailored instructor's email intervention on the rate of completion in seven weekly quizzes and the rate of completion of the final exam during the nine weeks of a MOOC. We compared the results to a control group that did not receive an email from the instructor. This nudge effect was examined for the immediate impact, delayed impact, and the cumulative impact on the final exam completion rate. In the study, we used nonparticipation in a weekly quiz as an indicator of future dropout or the need for support. Therefore, an email from the instructor was sent to these learners every time they did not participate.

The results show that weekly intervention had an immediate impact as well as a cumulative impact on final exam completion rates. One might argue that a 3.4% effect size (see Figure 6, Impact of final exam completion rate result) is not that impressive. We would suggest that with popular courses, in which thousands of students enroll, such an effect is, indeed, quite meaningful. For instance, it means that our modest “nudge” intervention might affect the progress of 680 students in a course with an accumulative enrollment of 20,000 students. These results suggest that an instructor's acknowledgement and interest might increase learners' commitment to learning in a MOOC. The findings of the present study are in line with Teusner, Hille and Staubitzs (2018) study, which highlighted the role of the instructor as a source of assistance as part of the TP element (Garrison and Anderson, 2003) where the faculty actively engage learners throughout an entire course (Kilgore and Lowenthal, 2015). We did not find a significant difference for the delayed impact measurement between the control and treatment groups, indicating that the effect of the instructor's email intervention was limited in its impact and did not impact the next quiz. A limited time effect of the intervention can provide a partial explanation. When students in the treatment group received the email, it motivated them to take an action only for the specific quiz. By the time the following quiz was due, the effect of the email had already dissipated. Moreover, perhaps the students in the treatment group got used to receiving a reminder about the quiz and therefore did not bother to take the quiz in the first week upon receipt, knowing they would receive the reminder and then be able to take it (i.e., have enough time for it). Completion rate in the treatment group is probably higher due to the cumulative effect of the instructor's intervention. An alternative explanation might be that eventually the students in the treatment group invested more in the course and therefore participated in more quizzes.

Therefore, it was a "pity" for them not to take the exam, or their motivation to take the final exam was higher in order to complete the course and prove to themselves that they had completed the course successfully.

We would like to suggest that the instructor's seemingly minor intervention, namely noticing that a student did not participate in a course activity, and gently offering support, might have created what the psychoanalyst Winnicott (1982) referred to as a "holding environment". This is supported by the small number (2 participants) that requested additional assistance, which was technical assistance.

Winnicott's concept of a "holding" is related to the nurturing quality of infant-mother relationships. This concept was extended to organizational and educational settings (Ghosh et al., 2013; Kahn, 2001). It suggests that when a learner/worker experiences suitable holding by a leader/instructor/parent, they will dare to take risks and inquire about new territories: "The quality of such holding (i.e., the sense in which it engenders basic trust in one's surrounding) determines the extent to which the person can become a genuine, creative individual" (Van Buskirk and McGrath, 1999, p. 808). In context of our MOOC, it might suggest that the instructor's gentle gesture toward the learner might have provoked a sense of belonging, defused a sense of anonymity, and increased a sense of security and trust.

Despite the encouraging findings, more research with further rounds of the same course and additional courses will present an increasingly robust picture of the effects of an instructor's interventions on the completion rates of MOOCs. Also, while there are many factors that have contributed to the completion rate, we only looked at completion in quizzes and the final exam. In future research, we recommend that other course components, like video clips, readings, and participation in the discussions, be examined to broaden our understanding.

We believe that this study provides insight into learners' propensity to stay active in a MOOC. We hope that future MOOC designers and facilitators will experiment with similar interventions in an attempt to increase completion rates.

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A Paperless Classroom: Importance of Training and Support in the Implementation of Electronic Textbooks in Gauteng Public Schools

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Abstract: The Gauteng Department of Education (GDE) is responsible for managing and administering public and registered private educational institutions within this South African province. The GDE has introduced a Paperless Classroom project where prioritised schools are provided with smartboards, laptops and tablets to teachers and learners in targeted grades. This study aims to add to the corpus of knowledge on Information and Communication Technologies (ICT) in education by establishing whether schools in Gauteng are ready to adopt and implement electronic textbooks in their classrooms in terms of support and training. The focus of this study is on the training and support, as the GDE received an influx of requests from these teachers on receiving additional training and better support shortly after receiving the ICTs. The study followed a pragmatic approach using a parallel concurrent mixed-method design where quantitative and qualitative data were collected using an online questionnaire and an interview protocol. Purposively sampling was used to collect quantitative data and 55 responses were received, whereas both purposive and convenience sampling were used to collect qualitative data and 20 participants were interviewed. The study used the Technology Acceptance Model as a theoretical framework through which the study was conducted. The Perceived Usefulness construct focused on the usefulness of electronic textbooks, while the Perceived Ease of Use and the External Factors are constructs facilitating and enabling the use of electronic textbooks. Quantitative data analysis was done using SPSS. Interviews were transcribed and thematically analysed. Most respondents were not satisfied with the training they received. It was entry-level basic training and did not help schools use ICTs and address the technical glitches they experienced pedagogically. The quality of the devices was not up to standard. The e-textbooks had licensing issues, and only a limited number were available. Although technical support was provided, it was not adequate. Many systemic issues such as maintenance and replacement plans of the devices, safety, update, and the licensing of the electronic textbooks should still be addressed for successful implementation. The results of the study may offer some insights before the roll-out of electronic textbooks is done to the whole province. Furthermore, the study may also provide clues to the South African provinces that may envisage introducing ICT in education. Within the nine provinces in South Africa and in the education community worldwide, the information provided by this study can be of great significance for the envisaged training and the support needs of the schools on the use of ICTs in education.

Keywords: electronic textbooks, Technology Acceptance Model, tablets, smartboards, ICT integration

1. Introduction

The popularity and availability of the internet and connectivity have encouraged the use of Information and Communication Technologies (ICTs) in schools (Tay et al., 2014). Many countries have introduced policies or initiatives to improve learner achievement through the use of technology. The use of ICTs in education is promoted by the United Nations (UN) in its 2030 Agenda for Sustainable Development (UN General Assembly, 2015). In a very broad sense, this type of sustainable development aims at improving the state of nations and the world itself. The Sustainable Development Goals (SDGs) are viewed as a roadmap to achieving a better and more sustainable future for all, by addressing the global challenges humanity faces. The fourth goal, SDG4, deals with education and aims to "develop education systems that foster quality inclusive education and promotes lifelong learning opportunities for all" (UNESCO, 2017, p. 7). More specifically, SDG4 encourages the use of ICTs to support the principles of improving access to inclusive and equitable education and providing a good quality of education for all. As we are now in the Fourth Industrial Revolution, the type of education referred to in SG4, must seek to match the needs of learners required for the 21st century. Where the Third Industrial Revolution used electronics and ICTs to automate production, the Fourth Industrial Revolution is building on the Third and is characterised by a fusion of technologies that is "combining the digital, physical and biological worlds" (Schwab, 2016, p. 60). Schwab (2016, p. 7) further stated that "… governments and institutions are being reshaped, as are systems of education, healthcare and transportation, among many others."

The readiness to use ICT in South African classrooms depends on various external and internal factors that may limit or enhance their use. The external factors that may enhance the use of technology in the classroom include, among others, access to infrastructure, internet connectivity, timeous training and readily available support, and the existence of an ICT policy, while the internal factors relate to the teachers' attitudes, beliefs, confidence and ICT skills (Fleming, Becker and Newton, 2017; Mathipa and Mukhari, 2014). This article focuses on two of these external factors, namely training and support. In the Gauteng Province of South Africa, the Gauteng Department of Education (GDE) has invested a massive amount of money into providing schools with ICTs and training and support in the use of these resources is also provided. The focus of this study is on training and support, as the first author, who works at the GDE, noticed an influx of requests from Gauteng teachers on receiving additional training and better support. Attention was paid specifically to the perceptions of teachers concerning the training and support provided to schools by the GDE in their drive to integrate educational technologies into the classrooms, and specifically, the introduction of electronic textbooks. The latter is important, as the COVID-19 pandemic has forced most countries from face-to-face to online teaching for some period of time in 2020 to 2022 and possibly in the future and many researchers have shown to value of the use of electronic textbooks in online teaching (Arham et al., 2021; Escudero et al., 2021; Oktafiani, Widiatningrum and Retnoningsih, 2021). Escudero et al. (2021), concerned that young children need face-to-face interaction, conducted a study on American four-year'olds where face-to-face versus online learning via electronic textbooks were explored, and found that not only do electronic books have many advantages over traditional methods, but their children's performance was comparable across face-to-face and online testing modes; thus, eBook online learning was successful. Arham et al. (2021), in their study on 171 Malaysian students on the use of eBooks for online learning, found that it is very successful and provided recommendations for even more improved success, such as the creation of tutorial videos on how to navigate eBook platforms. Oktafiani, Widiatningrum and Retnoningsih (2021) who conducted a study on 36 Indonesian learners found that the use of eBooks in online learning encourage learner-centered learning as the learner is more involved and not depend as much on a teacher.

2. Context

South Africa, as a developing African country, has nine provinces. Although Gauteng is the smallest of the nine provinces in South Africa, it is highly industrialised and urbanised. It is, therefore, not surprising that the GDE launched the Paperless Classrooms programme that focused on establishing digital classrooms in schools and included the roll-out of smartboards, tablets, laptops, connectivity, and training regarding the use of the new infrastructure (GDE, 2014). The programme unfolded in phases, and the schools sampled in this study were all part of the second phase of the programme that benefitted schools in 2017.

The GDE is investing a massive amount of money into driving the Paperless Classroom initiative and announced a R17 billion investment in it (Monama, 2016). With pilot phases well underway, the GDE invested in excess of R800 million in the 2015/16 financial year (GDE, 2015). In the 2016/17 financial year, the GDE allocated a further R1 billion to the transformative *ICT in Education* initiative (GDE, 2016). In the 2017/18 and 2018/19 financial year, the GDE allocated a further R274 million (GDE, 2017) and R238 million (GDE, 2018) for the continued roll-out of e-Learning strategy. In the 2019/20 financial year, the GDE allocated R815 million for e-learning devices and e-LTSM with the aim of transforming township schools into functional ICT-enabled learning spaces (GDE, 2019). However, Atabek (2019) states that technology integration in education still encounters obstacles despite the significant investment. This is why training and support are of great importance.

The discussion that follows focuses on the literature relating to electronic textbooks and ICT in education, and the theoretical framework for this study. The methodology follows, and finally, the results and findings, as they relate to the training and support that have been provided to the schools that benefitted from the Paperless Classroom project.

3. Literature review

Due to the global technological revolution of the 21st century, the education sector and especially secondary schools were bound to be affected. Progress in the field of education technology will result in teachers having to adapt to new ways of teaching and learning that include the use of ICT (Mathipa and Mukhari, 2014). It is argued that the adoption of technology in the classroom, and specifically the introduction of electronic textbooks, could be beneficial to the schools (Chigona, Chigona and Davids, 2014; Masango, Van Ryneveld, and Graham, 2019).

3.1 Readiness to integrate ICT in Education: A South African perspective

Readiness to integrate ICT in education can be categorised into two elements: the state's readiness to integrate technology and the readiness of schools to do so. The state would involve the government bodies, both national and provincial, while the schools would include, among others, the school's governing body, the principal, the teachers and the learners.

In South Africa, the White Paper on e-Education of 2004 acknowledged the magnitude of providing ICT with the necessary infrastructure required by schools (Nkula and Krauss, 2014). This dilemma was widely supported in the existing literature that states that considerable investment was required for the implementation of ICT in Education project (Department of Education (DoE), 2004).

Despite the factors hindering the implementation of the ICT in Education project in South Africa, local researchers have urged the Department of Basic Education (DBE) to acknowledge the huge potential reform that can be brought about by e-textbooks (Nkula and Krauss, 2014). It was argued that the DBE, together with the provincial departments of education, should use the opportunity that ICT in education reforms can bring by introducing educational technology into all the schools (Lee, Messom and Yan, 2013). Sadly, the provincial departments of education often embark on silo bound initiatives to implement ICT in Education projects due to the lack of a national comprehensive ICT policy from the DBE (Mathevula and Ulwizeyimana, 2014). However, the adoption of electronic textbooks into South African classrooms was anticipated to be a preferred mode of teaching and learning in future, as some provinces have already moved towards implementing the prescripts of the White Paper on e-Education (Lee, Messom and Yan, 2013).

3.2 Electronic textbooks

Electronic textbooks are books on a particular academic subject that are available in digital format and can be used in the classroom for curriculum delivery (Gakibayo, Ikoja-Odongo and Okello-Obura, 2013) and other academic purposes (Al-Mashaqbeth and Shurman, 2015; Lee, Messom and Yan, 2013). In most cases, the introduction of electronic textbooks in a school is a welcome change from the usual use of printed paper-based textbooks (Masango, Van Ryneveld and Graham, 2019). However, the adoption and use of electronic textbooks occur at a slow rate and, as a consequence, the potential benefits are not being fully realised as yet (Masango, Van Ryneveld and Graham, 2019; Pérez-Sanagustín et al., 2017).

In Gauteng, the electronic textbooks that are available for use in public schools are those that are listed on the National Curriculum Assessment Policy Statements (CAPS) catalogue, which was developed by the national DBE (GDE, 2017). Public schools in South Africa are only allowed to use textbooks that appear on the CAPS catalogue as core textbooks and those that are not in the catalogue, as supplementary textbooks. Schools are advised to select their electronic textbooks from the titles that are available at the time. These titles are then automatically preloaded onto the tablets, laptops and smartboards given to prioritised schools. It is, therefore, clear that Gauteng schools that benefitted from the Paperless Classroom project should, in theory, have been able to integrate electronic textbooks into their classrooms, as they do have access to the necessary hardware and at least some electronic textbook titles.

3.3 Parental involvement

Parents are important stakeholders in education. The involvement of parents in the education of their children motivates learners and increases their academic achievement (Fang, 2018; Heath, Maghrabi and Carr, 2015; Ramorola, 2013). However, not all parents can be involved in the schooling of their children due to various factors, including long working hours (Fleischmann and De Haas, 2016).

Parental support provided to children on matters relating to ICT usage is termed parental e-nvolvement (Gu, 2017). Parental e-nvolvement helps learners to access electronic information resources that, in turn, is helpful in schooling (Heath, Maghrabi and Carr, 2015). However, most parents are unable to provide support on the technological aspect of the ICT used in the classroom because of the technological challenges they experience themselves (Gu, 2017; Heath, Maghrabi and Carr, 2015; Ramorola, 2013). Many of the ICT devices and the recent applications used in schools are also new and foreign to parents who may find themselves willing, but unable, to assist (Heath, Maghrabi and Carr, 2015). It is important to realise that the burden of training and support is on the teachers themselves, and if they do not feel empowered and confident in their skills relating to electronic textbooks and ICTs, the seamless integration thereof may be hampered.

4. Theoretical framework

The theoretical framework underpinning this study is the Technology Acceptance Model (TAM), as developed by Davis, Bagozzi and Warshaw in 1989. Figure 1 shows the TAM model, which we adapted to include and highlight training and support with regards to the implementation of electronic textbooks in public schools. Another adaption is the fact that we use the abbreviations Perceived Usefulness (PU), Perceived Ease of Use (PEoU), Attitude towards use (AU) and Behavioural Intention of Use (BI) which differs from the abbreviations on the TAM figure that is licenced under CC BY 3.0 (TAM, 2020). The adapted TAM focuses on the influence of training on the PU and PEoU variables, and the influence of ICT support on the actual use variable. The external factors are those factors that facilitate and influence the internal factors. The internal factors are the PU, PEoU, AU, BI and the actual use.

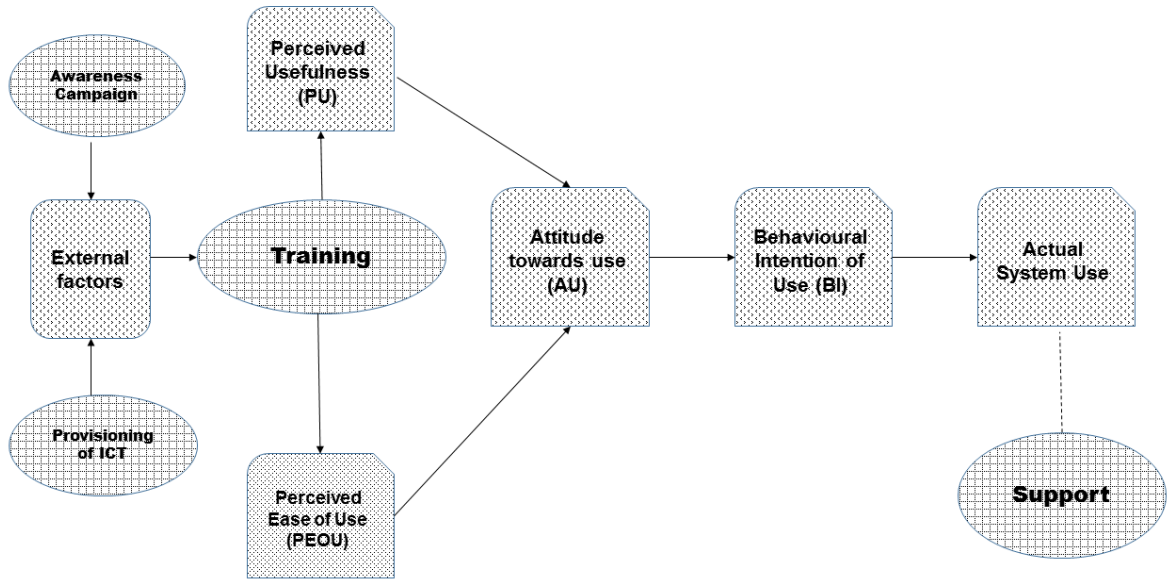

Figure 1: Adapted Technology Acceptance Model by Davis et al. (1989) licenced under CC BY 3.0 (TAM, 2020)

The beliefs and viewpoints of stakeholders such as the principals and the teachers in the sampled schools were regarded as important internal factors when looking at the integration of electronic textbooks in the classroom. To have a positive attitude towards the integration, adequate support, both externally and internally, is required. External support is typically provided by stakeholders outside the school milieu, such as the DoE, parents and other private organisations; whereas school governing bodies, principals, and often experienced teaching staff provide internal support.

The AU of electronic textbooks can only be reinforced by the PU, the PEoU by the teachers and learners alike, and their positive AU and BI to use the electronic textbooks in the school environment as depicted in Figure 1. With a positive attitude about perceived usefulness, users will know the importance of using ICT and electronic textbook integration. Users with a positive attitude on perceived ease of use will view ICT and specifically electronic textbooks as easy to use and integrate into teaching and learning. Moreover, Li and Choi (2014) found that the social capital of a school had a direct influence on teachers' receptivity towards technology use.

5. Method

A concurrent mixed-method design was used for the study because both qualitative and quantitative research were done simultaneously (Fetters, Curry and Creswell, 2013; Hadi et al., 2013; Johnson and Christensen, 2012). The researchers collected and analysed the data, interpreted and inferred findings that were both qualitative and quantitative (Hadi et al., 2013). Quantitative information is measurable as it involves numbers and quantities; however, it ignores an individual's feelings and emotions. On the other hand, a qualitative method is used to gather in-depth information about a certain issue, but is subjective in nature. A mixed-method design

holds the advantages of both approaches and provides a better understanding of research problems than either approach alone (Molina-Azorin, 2016).

In 2017, the GDE prioritised 356 out of the 2 080 schools in 15 district offices in Gauteng to receive ICTs and training and support on the use of them, and these 365 schools form the population of this study. These 356 schools were listed on an ICT beneficiary database provided by the e-learning section of the GDE. For the quantitative component of the study, all 365 prioritised schools were purposively sampled and 55 responses were obtained. The sampling method was purposive as these schools had the unique qualities of receiving ICTs and training and support on the use of them. For the qualitative component of the study, 35 schools in the Tshwane West district were conveniently and purposively sampled from the population of 356 schools due to their close physical proximity to the researcher and 20 participants agreed to be interviewed; convenience sampling due to close physical proximity and purposive sampling due to the unique qualities of receiving ICTs and training and support on the use of them.

An online questionnaire was developed using Google Forms and sent via email to collect the quantitative data. For qualitative data, an interview protocol was developed. Both instruments focused on the aspects of the readiness of schools to integrate electronic textbooks into their classrooms by exploring schools' perceptions about the training initiatives and support structures provided to the schools.

The target audience of this study was principals, deputy principals and ICT coordinators.

Data collected from the questionnaire was processed quantitatively, while the interviewees' data were processed qualitatively. The GDE permitted the collection of data from February to September 2017. The designation of respondents who completed the questionnaire and the participants who participated in the interviews, as depicted in Figure 2, show a greater number of school ICT coordinators for both the questionnaire and the interview. The ideal group of people to answer the questionnaires, and to participate in the interviews, were the principals and ICT coordinators of the schools, however, deputy principals were also considered and accepted if they were either acting on behalf of the principal or were acting as the school's ICT coordinators.

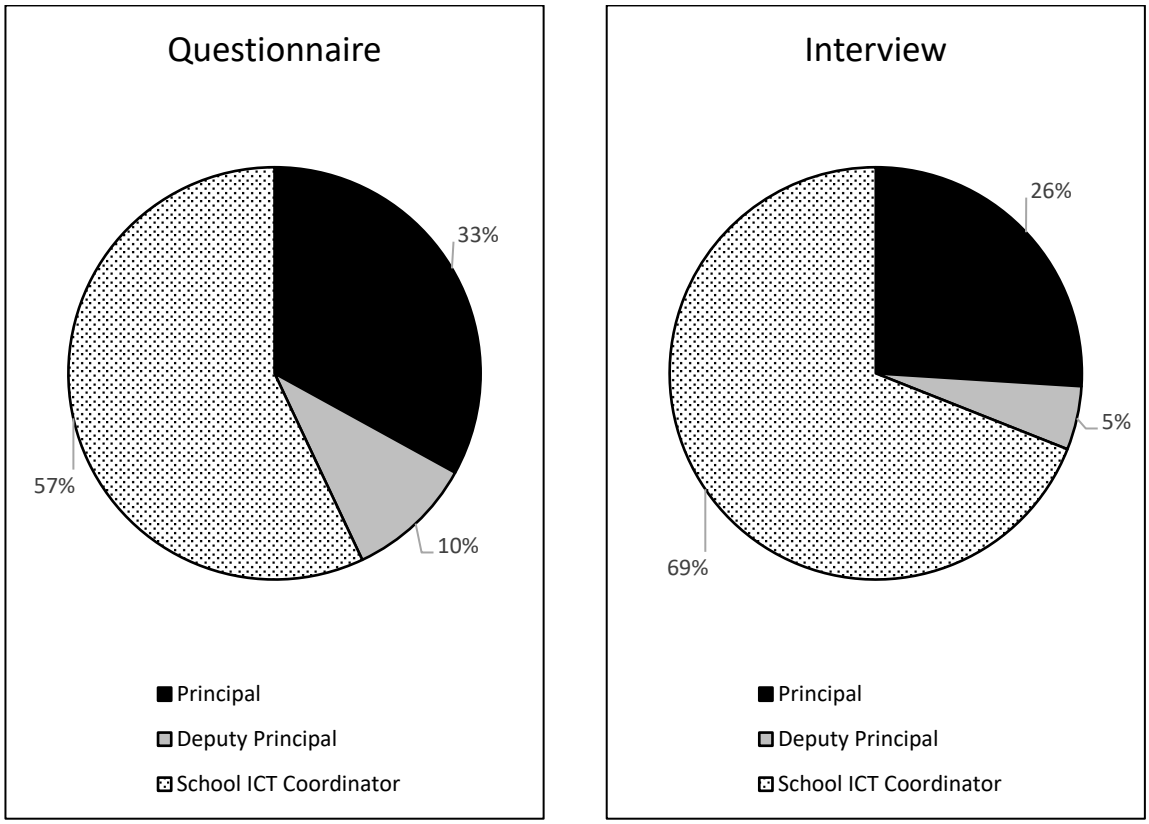

Figure 2: Designation of respondents to the questionnaire and participants in the interviews

A Cronbach alpha measure of internal consistency was calculated to measure the reliability of the questionnaire. The overall Cronbach alpha value was above 0.6, showing that the questionnaire was valid and reliable (Goforth, 2015).

The recordings of the interviews were transcribed and coded using thematic analysis. The interviewees were given code names for principals and/or deputy principals with suffix PRINC1 to PRINC6, and school ICT coordinators with suffix COORD1 to COORD13 to the prefix INT.

6. Results and Findings

The results and findings for both quantitative and qualitative data are presented with a focus on the training initiatives and support structures provided to schools.

6.1 Provisioning of ICT for integration

The questionnaire found that the respondents in this study thought that it was the responsibility of the DoE to provide schools with ICT devices. The participants confirmed that the DoE did indeed provide desktop computers, laptops, and tablets for some schools through interviews. The maintenance and support to keep the devices up and running were, however, not provided. For example, when updating the smartboards at one school, all the electronic textbooks were accidentally erased, and there was no one available to upload them again. One ICT coordinator noted thus:

> *"…we were able to share information with the learners from these smartboards, but then all the textbooks were wiped out and then we struggled to get the technicians to fix or to recover the textbooks."* [INTCOORD7]

The results also showed, on the one hand, that mobile phones were not available for use in teaching and learning, since those that were available were mostly personally sourced by teachers and learners themselves, and were thus not used for educational purposes in the classroom. On the other hand, participants confirmed that smartboards were provided in the classrooms for educational use.

6.2 Training on ICT in education

Teachers of the schools that benefitted from the Paperless Classroom project received introductory training on the use of the provisioned ICT devices and the electronic textbooks that was uploaded on them. All schools that received ICTs also received training on how to integrate and use them in the classroom. For example, training would be based on how the electronic textbooks loaded in the devices could be used in the classroom. The training provided by Matthew Goniwe School of Leadership and Governance (MGSLG) was a once-off training intervention. Table 1 shows that many teachers were only trained on how to operate the smartboard and the laptop and integrate electronic textbooks using the smartboards (74.55%); and approximately a fifth of the respondents indicated that they were trained on both smartboards and laptops (29.09%). It seems as if the focus of the training initiatives was mainly on integrating electronic textbooks using smartboards and laptops.

Table 1: ICT devices that teachers received training

ICT devices	Percentage
Smartboard	56.35
Smartboard and laptop	20.00
Laptop	9.09
iPad	3.64
Computer	1.82
Smartboard, tablet and laptop	1.82
Not applicable	1.82
Not certain	1.82
None	1.82
Missing	1.82
Total	**100**

The interviewees confirmed that most of the training was focused on the use of the smartboard, for example:

> *"Yes, I attended many training sessions about a lot of things, [for example, on] how to use smartboard."* [INTCOORD2]

The other school ICT coordinator also confirm this about the training that was provided:

> *We do go to Matthew Goniwe's[1] workshops, been trained about using ICT, and they teach you how to operate a smartboard. There was a workshop also in school, which was organised by Matthew Goniwe. All [the neighbouring] schools had to come to our school as we are one of the first schools that received smartboards for Grade 12*. [INTCOORD4]

With training provided on how to operate the smartboards, teachers could access the electronic textbooks and draw the attention of all learners in the classroom by using them in front of the classroom. They could do this even if their learners also had access to the electronic textbooks on their tablets. The priority given to smartboard training was to ensure that teaching and learning could proceed smoothly. The use of the smartboards in the classroom did not give learners the flexibility to use electronic textbooks outside the classroom environment if they did not have their own electronic device. The type of training provided was more on operating the devices and accessing the electronic textbooks rather than on how to integrate technology pedagogically. In addition, technical training was not provided to enable users to troubleshoot in case of malfunctions.

Results have shown that teachers mainly were given entry-level training on the use of smartboards at MGSLG. When asked who they expected to be responsible for the training of teachers on ICT integration in the classroom, many respondents from the questionnaire confirmed that the district officials were the most capable, available and relevant officials to provide them with training (69.09%); shown in Table 2. "It is important to note that teachers taught themselves how to integrate technology in the classroom, as 'self-study' ranked at 7.27%". These teachers were leading as champions at their schools and provided training to their colleagues, as confirmed by one of the principal interviewees (INTPRIN6).

Table 2: Expected training responsibility relating to ICT integration-related matters

Officials	**Percentage**
District officials	69.09
Head office officials	10.91
School ICT coordinators	9.09
Self-study	7.27
Principals	3.64
Total	**100**

The interviewees also confirmed that their district officials provided training. One school principal indicated that:

> *We received training, yes, training was [provided] by district and then also they sent "ke reng" [how should I put it] those people of ICT. GDE provides interns to provide training and support.* [INTPRIN1]

Some school principals confirmed that training and support were provided through the availability of the interns who served as technicians for the challenges that schools experience daily [INTPRIN1; INTPRIN2; INTPRIN4]. Other challenges were referred to as the support structure at MGSLG. Challenges, both on the devices and the pedagogical use of ICT, that schools and districts cannot resolve, are referred to IT specialists at MGSLG [INTPRIN2; INTCOORD7]. The initiative may have the challenge of waiting time for the intervention as the ICT may delay and compromise the teaching and learning at the school. Rather, the service provider should mediate the challenges at the school within a reasonable period.

The DBE is aware that training is a requirement for the proper implementation of technology in the classroom (Bladergroen and Buckley, 2016). As shown in Figure 3, almost three-quarters of the respondents (72.5%) mentioned that district officials provided training on the integration of electronic textbooks.

Through their e-Learning units, the district offices seem to provide training and support for schools despite their minimal staff complement. In terms of the organogram of the GDE District, the staff complement of the e-learning section is composed of two officials (GDE, 2014). The interns (ICT technicians) provided were stationed at some of the schools and were invaluable in addressing challenges experienced by teachers and learners when

[1] The Matthew Goniwe School of Leadership and Governance is an institution that is responsible for providing training of GDE officials on management and governance issues. Mostly the principals and the newly elected School Governing bodies were trained at this institution.

they ran into trouble using the devices in the classrooms. The interns were useful in addressing technical malfunctions that teachers and learners experience. The e-Learning coordinators addressed subject-specific challenges based at both head office and the districts.

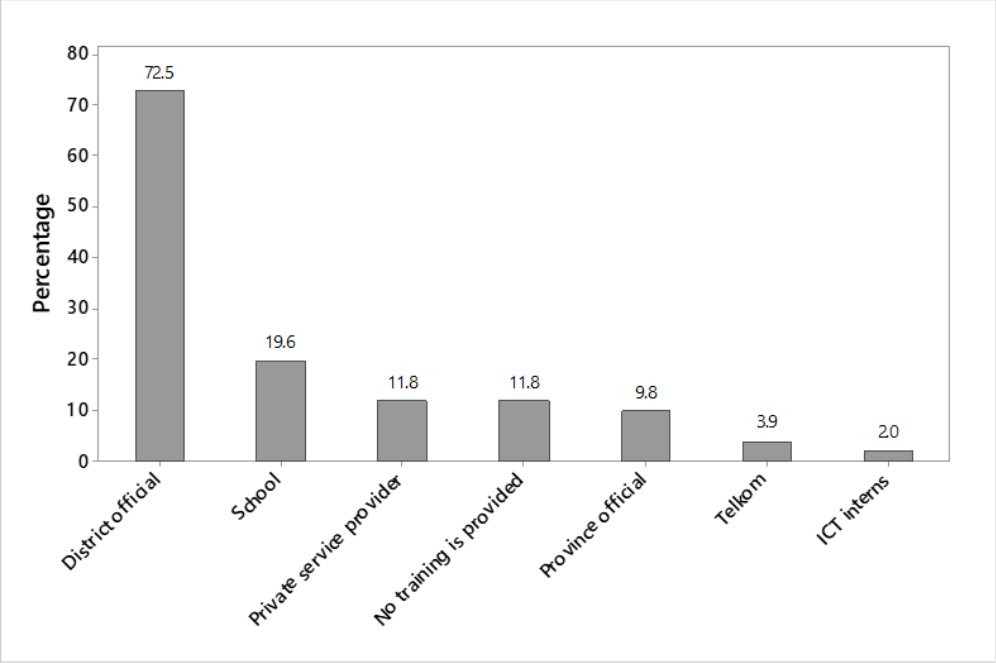

Figure 3: Trainers on the integration of electronic textbooks

6.3 Organising workshops

Participants reported that workshops were essential for school teachers to grasp the teaching and learning possibilities that become a reality because of the availability of ICT, and to become competent in the use of ICT in the classroom [INTCOORD3]. Many respondents agreed that training initiatives were taken by schools, the district offices, and the head office, respectively, in organising workshops on the integration of technology in classrooms. Despite the confirmation that district officials are the most relevant trainers on ICT integration, respondents agreed that schools (81.82%), district offices (92.73%) and head offices (87.28%) were collectively responsible for organising workshops, as shown in Table 3. The frequencies translate to more than 80% of respondents who agreed that workshops were organised for teachers.

Table 3: Organise workshops for teachers

Level of agreement	School (%)	District offices (%)	Head office (%)
Totally disagree	1.82	0.00	0.00
Disagree	5.45	1.82	3.64
Neutral	10.91	5.45	9.08
Agree	69.09	76.36	74.55
Totally agree	12.73	16.37	12.73
Total	**100**	**100**	**100**

Although the results indicate that workshops were organised for schools, the rate at which electronic textbooks were integrated into the classrooms was still low, mainly because of the challenges relating to the infrastructure and the technical glitches experienced (Heath, Maghrabi and Carr, 2015; Hernandez, 2017; Pérez-Sanagustín et al., 2017). Regular training seems to be required for schools to overcome some of the challenges posed by the inability to operate the devices. It also appears as if there may be room for improvement as far as the scope and depth of the training interventions are concerned.

6.4 Support on ICT integration

Schools were supported on ICT integration through visitations, workshops, teacher encouragements, collaborations and parental involvement.

6.4.1 School visitation (on ICT integration)

The respondents indicated that district officials (specifically the e-Learning coordinators) visited their schools to provide support on integrating technology in the classroom. Almost a third of respondents mentioned that district officials do visit either monthly or quarterly (27.27%); as depicted in Table 4.

Table 4: School visitation on ICT integration in the classroom

Visitations	Percentage
Quarterly	27.27
Monthly	27.27
Once off visit	23.64
Half-yearly	9.08
No visits	3.64
Irregular	3.64
When the need arises	1.82
Whenever invited or there was a need too	1.82
Weekly	1.82
Total	**100**

The rate of school visitations was important for the schools so that intervention measures can be taken to mediate barriers to ICT integration and the implementation of electronic textbooks. Therefore, the success of implementing electronic textbooks will depend largely on the frequency rate of school visitations. A high rate of school visitations increases the opportunity for feedback so that the response time for support can be quicker as well. The school visitations could be increased as part of the support for ICT integration.

6.4.2 Support initiatives for ICT integration in the classroom

Responses on initiatives taken to support the integration of ICT were analysed and categorised as encouragement, collaboration, and parental involvement. Stakeholders who encourage teachers to integrate ICT will be discussed first.

Teachers need regular encouragement to use the technology provided to schools for teaching and learning (Bladergroen and Buckley, 2016). Respondents were asked to highlight their level of agreement on how schools, districts and head offices encouraged them to integrate ICT in education. More than 70% of respondents were in agreement that schools, district offices and head office do encourage teachers to integrate ICT in the classroom, as shown in Table 5.

Table 5: Stakeholders who encourage teachers to integrate ICT

Level of agreement	School (%)	District offices (%)	Head office (%)
Totally disagree	0.00	1.82	0.00
Disagree	1.82	1.82	1.82
Neutral	9.09	9.09	20.00
Agree	70.91	70.91	63.64
Totally agree	18.18	16.36	14.54
Total	**100**	**100**	**100**

Although there seems to be partial support in place for teachers to integrate and use electronic textbooks, there were still challenges that teachers' experience. There are no adequate resources that teachers can be motivated to integrate. There is still a lack of proper and comprehensive maintenance of the ICT devices. Next, stakeholders who encourage teachers to collaborate is considered.

The competency level of all the teachers at particular schools and district offices is not the same; therefore, collaboration is invaluable so that teachers can benefit from each other (Hamid et al., 2015). On determining their level of agreement, respondents indicated how they were encouraged to collaborate on ICT issues. Table 6 shows the frequencies on the level of agreement on the encouragement of teachers to collaborate with their peers within and outside the school. Between 69% and 73% of the respondents were in agreement that teachers were encouraged by schools to collaborate on subject-specific projects.

Also, the district offices use a social media communication medium, namely a WhatsApp group of the Tshwane West district. The medium helped address some challenges experienced by teachers and serve as a communication medium for planned meetings and workshops [INTCOORD5]. Next, parental involvement in ICT activities is considered.

Table 6: Stakeholders who encourage teachers to collaborate

Level of agreement	School (%)	District offices (%)	Head office (%)
Totally disagree	1.82	0.00	1.82
Disagree	10.91	7.27	5.44
Neutral	18.18	20.00	23.64
Agree	58.18	56.37	54.55
Totally agree	10.91	16.36	14.55
Total	**100**	**100**	**100**

Parents are typically expected to help learners with their homework and other projects (Gu, 2017). Schools often expect parents to be aware of the ICT in Education project and thus be able to help their children use ICT for learning (Heath, Maghrabi and Carr, 2015). The respondents indicated in Table 7 their level of agreement regarding parental involvement in ICT activities. Although many respondents agreed that parents were involved in the ICT activities, a significant number of the respondents, as depicted in Table 7, were neutral on this subject (school = 25.45%; district offices = 27.27%; head office = 29.09%).

Table 7: Parental involvement in ICT activities

Level of agreement	School (%)	District offices (%)	Head office (%)
Totally disagree	3.64	3.64	3.64
Disagree	21.82	21.82	25.45
Neutral	25.45	27.27	29.09
Agree	38.18	41.82	38.18
Totally agree	10.91	5.45	3.64
Total	**100**	**100**	**100**

As it does not seem as if parents are playing a huge role in supporting their children regarding ICT, schools have to ensure that they have mechanisms in place to fulfil that role. Once again, though: If teachers themselves don't feel confident in their ability to use ICT, it is unlikely that they will be able or willing to support the learners in their classes in a meaningful manner. Next, external service providers on ICT integration is considered.

The support provided by the external service providers was minimal. Most respondents indicated that there was no external support provided for the integration of electronic textbooks in the classroom. Seventy-three percent of the respondents mentioned that there was no support from external providers. However, two school ICT coordinators reckoned that the external service providers provided mobile tablet trolleys for use by learners in the grades that GDE did not allocate. One school ICT coordinator confirmed:

> *I feel we are receiving special care. Why am I saying so? After we got the sponsorship from Telkom, the district partnered with Telkom, and they have given full support, full ICT support to the school.* [INTCOORD6]

It may, therefore, be worthwhile to investigate the used external service providers as an additional support structure when new technologies are introduced in schools. Next, maintenance of ICT is considered.

Although schools had access to infrastructure and were trained at MGSLG on smartboards, laptops, tablets, and electronic textbooks, there were still challenges regarding their maintenance. All electronic textbooks used in schools require the renewal of the annual license as well as the unavailability of the relevant textbooks in the devices.

The maintenance of the ICT devices was a challenge for schools because regular use of the devices depended on their smooth and ongoing operation. Due to a lack of updates, the devices were often infected with viruses and were either non-operational or lagged in response time. The interviewees mentioned the following regarding viruses:

> *"…and if educators also can acquire viruses their laptops, the whole lesson is disturbed."* [INTPRIN6]

> *"… it keeps on loading because there is a virus inside the laptops. Those are the barriers that even though we have anti-virus protection, anti-virus programs end up being the virus because it is not updated regularly."* [INTCOORD9]

With regular maintenance, an updated anti-virus program will run on all the devices to operate optimally. The schools also indicated that the devices provided were of poor quality as they froze within a week of their starting to use them [INTCOORD12]. One interviewee suggested that the DoE should:

> *"…make sure that there is enough finance for maintenance of this hardware."* [INTCOORD4]

The maintenance issue also relates to the challenge of the annual licensing fees for electronic textbooks. If the licences for the electronic textbooks are not renewed, then they cannot be opened on the devices provided to schools.

7. Discussion

Initial training was provided on the use of ICT devices and electronic textbooks in the classroom. The training was mostly at an introductory level and focused on using smartboards and electronic textbooks by teachers. Recent literature has emphasised the need for continuous training and for teachers in ICTs (Iqbal, 2017; Perry; 2018; Saal, Graham, and Van Ryneveld, 2020). While this study did not explore the curricula covered as part of the training initiatives, it was clear that teachers did not get sufficient exposure to why they needed to adopt electronic textbooks in their classrooms. It seems that the same teachers do not necessarily perceive the electronic equipment in class as useful and that even though they are superficially aware of the benefits, they are not yet convinced that it is worth the effort.

There was no confirmation of any training provided to the learners on tablets or for teachers to support learners in case they experienced technical glitches. On support, the GDE, as an external variable, provisioned the ICT necessary for use in the classroom. The role played by the Provincial Department of Education, the school, the school governing body and vendors of electronic textbooks seemed to have enhanced the perceived ease of use on the teachers and learners. Yet, the adoption of electronic textbooks was not realised.

Technological devices are liable to technical glitches and challenges (Heath, Maghrabi and Carr, 2015). Any technical glitches may delay the start of the lesson, even though technicians are on-site at the schools. There should always be constant support to schools experiencing technical malfunctions so that they can adopt and integrate technology in the classroom. Recent literature has shown the importance of support to teachers who work with technology (Kruger, 2018; Liao, 2018). The support provided through the project, though minimal, went a long way in encouraging both teachers and learners to use technology to access electronic textbooks. One principal has the following suggestion for technical problems experienced in the classroom:

> *"We need, let me say, classroom-based interns. This one serves the whole school, and the teachers would have to [face] challenges in the classroom."* [INTPRIN4]

Some schools were lucky enough to be provided with an intern who served the role of technical support. However, there was only one technical staff member who needed to support the entire school. Logistically, one person alone cannot provide sufficient support to all the paperless classrooms, especially not when teachers are not yet comfortable in doing their own troubleshooting. Teachers may be able to turn on the smartboards and open an electronic textbook. Still, if something out of the ordinary happened, they were handicapped and reliant on the support of a technical person. Not all schools got technical interns, and in cases where one was deployed, they did not always have the necessary know-how to troubleshoot themselves; teachers often needed to wait for days or even weeks for the next visit from the district officials before a technical problem was addressed. This meant that teachers no longer trusted the technology and became demotivated to invest time and effort in preparing their lessons around the availability of electronic textbooks.

The quality of the devices provided to the schools was also a cause of concern. The low-quality devices often needed maintenance and/or endless repairs, which had a negative effect on teachers' willingness to embrace the use of electronic textbooks in their classrooms as teachers sometimes have to wait a long period of time for maintenance/repairs to be done. As confirmed by participants (INTCOORD2; INTPRIN1; INTCOORD6), the department responds very slow in addressing the maintenance problems experienced by schools. The maintenance issues are reported, and in one instance, the smartboard had been not working for more than

three months (INTCOORD6). The other challenge faced by schools was the security risks that came along with ICT. These risks included, for example, viruses infecting computers, smartboards, laptops and tablets, which in turn affected the smooth functioning of hardware and resulted in distracting from the teaching and learning processes. One ICT coordinator summarised:

1. "they [Department of Education] must provide us with the e-textbooks that we need,
2. networks [Internet]
3. anti-viruses for both laptops and the smartboards
4. learner tablets of good quality". [INTCOORD12]

8. Conclusion and Recommendations

The GDE has succeeded in certain components of the ICT in Education project, such as the provisioning of the hardware for the learners, teachers and the classrooms. While teachers are critical of the quality, and in some cases, the quantity of the ICTs provided, the first constructive steps towards implementing electronic textbooks have been taken. Most teachers were also aware of the GDE's Paperless Classroom project and appreciated the Department's commitment to supply the latest educational technologies to them.

However, how the project has been rolled out has been questioned. The implementation of the Paperless Classroom project requires a systemic approach where the phasing-in of the ICT and electronic textbooks start at the entry grades in the secondary schools or at least at the lowest grade of a particular phase, for example, Grade 10, where the roll-out can then progress logically through the phase to the final year (Grade 12). It seems as if the introduction of technologies and electronic textbooks in the later years, e.g. Grades 11 and 12, a lot of anxiety and disturbance were created among learners and teachers (INTCOORD5).

The initial training given to teachers at MGSLG appeared to be insufficient in enabling the teachers to embrace technology integration and do troubleshooting fully. Another shortcoming in training is the fact that it was a once-off intervention. As it is hardly possible for teachers to learn all they need to know in a single training session, it is recommended that training interventions be designed to be ongoing and that the pace be slow enough for teachers to grasp without feeling overwhelmed. It may furthermore be beneficial to revisit the topics that have been addressed. Without exploring the nature of the themes discussed, it is obvious that many teachers have not yet grasped the pedagogical value that electronic textbooks can add to a classroom.

There seem to be certain components of the support structures that are still lacking, such as the maintenance of hardware, the software updates, the technical support in the classroom, safety and security issues, and the availability of electronic textbooks for all the subjects in the targeted grades. The district office team should be trained as a core group that will be readily available to provide necessary support within a reasonable time frame. Support to schools cannot be left to the IT technicians based at the schools only because they may not be able to provide support on pedagogical practice. The IT technicians can only assist in solving technical glitches experienced by teachers and learners. Technical glitches may be resolved by the IT technician, such as login and updates, while the huge ones, such as non-operation of the devices, maintenance and power outages, may require an external service provider that normally takes a longer time to access.

During this lull period, the electronic textbooks may not be accessed, thus hampering teaching and learning at the schools. Where possible, the Department of Education should consider loaning ICT hardware such as smartboards, laptops and tablets in case schools experience non-operation of their devices. The Department of Education interventions can help mitigate the delay experienced when the broken or damaged devices are still repaired. The intervention can ensure that the use of ICTs does not compromise the process of teaching and learning.

Training and support on ICTs in schools are two of the main factors that contribute to the successful implementation of electronic textbooks for teaching and learning. Without training and support, teachers will lack guidance and a positive attitude towards electronic textbooks and thus result in the prolonged and unsuccessful implementation of electronic textbooks in the classroom.

A final recommendation is that similar studies to this one can be done using teachers and learners, as this study only made use of principals, deputy principals and ICT coordinators.

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Acceptance of Serious Games to Develop Digital Competencies in Higher Education

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Abstract: Serious games are the focus of the current research agenda. They show promise for allowing students to learn and practice skills. In fewer studies, they are used for the development of academic competencies. Therefore, it is of interest to deepen the research on the benefits of serious games in academic education and training. This article presents a study using serious games aimed at higher education academics' training for the development of digital competencies. The study was carried out with 56 academics, using the serious game called AstroCódigo. The study analyzed the level of acceptance of serious games using the TAM model and what factors the academics believe affect this acceptance. It is important to know possible barriers that affect the development of actions oriented to the formation of academic competencies through serious games, which can also affect the adoption of games as a resource for teaching situations. None of prior studies have focused on analyzing the technological acceptance of serious games used for the development of academic competencies. The results of this research indicate that participants believe that using serious games can be beneficial to drive digital competencies. However, there are aspects such as the highest academic qualification, work experience, professional development, perceived usefulness, ease of use, and fear of change associated with age rank which can play a negative role in the use and acceptance of digital technologies by academics, particularly serious games. These results may be a clue to the barriers linked to the fact that most of the participants in this study do not use serious games in their classes or for their digital skills training. Additionally, the possibility to try and fail and the increased level of challenges proposed in the serious games, related to enjoyment, were valued by academics, during the sessions with AstroCódigo. These findings open the door to organize strategies for academic training in digital competencies within higher education institutions. They can also impact the design decisions of new serious games.

Keywords: serious games, digital competencies, academics training, technology acceptance model, higher education

1. Introduction

The fast progress of Information and Communication Technologies (ICTs) has caused the proliferation of new tools and applications that help and support people in their everyday activities, regardless of their occupations (Gisbert and Lázaro, 2014). Serious games and games in general have gained popularity in the industrial sector, health, business, government, and education, where they have been used with different purposes, going from entertainment to simulation and training (Vlachopoulos and Makri, 2017; Leonard et al., 2018; Mittal et al., 2021; van der Lubbe et al., 2021).

In the educational context, and specifically, higher education, serious games have been used for training and/or acquiring skills and competencies in various knowledge areas, combining fun, entertainment and learning, mainly with students (Boyle, Connolly, and Hainey, 2011; Chua and Balkunje, 2012; Girard, Ecalle and Magnan, 2013; Sung and Hwang, 2013; Vlachopoulos and Makri, 2017). Serious games are a way to teach digital competencies in a motivating manner as they help to reduce the frustration and stress level of academics by combining them with entertainment. They allow for immediate and frequent feedback, as well as visualizing progress in a step-by-step manner (e.g., through badges or scores), aspects that characterize them and make them different from other technologies (Sánchez-Mena, Martí-Parreño, and Aldás-Manzano, 2017; Krath, Schürmann, and von Korflesch, 2021; Min, Min, and Kim, 2021; Kroustalli and Xinogalos, 2021). However, only limited research (Annetta et al., 2014: Nousiainen et al., 2018; Sánchez, 2013; Tondeur et al., 2018) has been dedicated to using serious games for the development of digital competencies for academics in Higher Education Institutions (HEI) (Sánchez, 2013).

This article focuses on the analysis of the development of digital competencies for academics of HEI using serious games. The research also proposes an analysis of the acceptance of this type of technology, as no previous studies revised focus on this type of analysis. Developing a technology acceptance analysis makes it possible to

know the perceived usefulness of academics in relation to serious games. At the same time, it allows to know their beliefs of the ease of use and other variables that will affect their adoption and use (Teo, 2009; Sampiero and Barragán, 2018). There is a need to investigate possible barriers which may affect the development of actions, by educational institutions, aimed at the formation of academic competencies through serious games, which can also affect the adoption of games by academics as a resource for teaching situations. Considering this, a study was conducted with 56 participating academics, using the serious game AstroCódigo for the development of digital competencies. The study sought to investigate the technological acceptance of the game for the development of these competencies, using the Technology Acceptance Model (TAM) (Davis, 1989; Teo, 2009). During the study, a methodology was used to guide the decisions related to the integration of serious games for an educational situation. Thus, the research carried out allowed the authors to understand the barriers and potential that can influence the training of academics in digital competencies through serious games. Also, to analyze what other factors impact the adoption of serious games as a teaching resource for academics themselves, since, these types of games enhance motivation (Bozkurt and Durak, 2018; Tang et al., 2019; Kiron et al., 2020), improve student involvement in educational activities (Ekici, 2021; Mullen, Milechin, and Milechin, 2021), and contribute to their learning experience (Guillén-Nieto and Aleson-Carbonell, 2012; Krath et al., 2021), among other benefits.

Going forward, this work is organized as follows: Section 2 discusses the concept of technology-related competencies (digital competencies), technology acceptance models, and it defines what a serious game is. Section 3 describes the research methodology used; Section 4 presents in detail the methodology proposed for integrating and evaluating the use of serious games. Then, Section 5 describes the results of a study carried out using the methodology proposed with a group of 56 academics at the Atlantic Branch of the University of Costa Rica. Section 6 includes the conclusions and highlights future lines of work.

2. Literature Review and Theoretical Background

This section presents, on the one hand, the importance of serious games for the educational field and, in particular, for the training of digital competencies. On the other hand, it describes the contributions of the TAM model, linked to discovering how a technology can be adopted or not, identifying the factors that could influence such acceptance, in this particular case the focus is on the acceptance of serious games.

In this work, the following definition is used: digital competencies are understood as a construct of pedagogical knowledge mediated by ICTs, and they include cognitive and instruction tools that boost knowledge acquisition and learning (Nousiainen et al., 2018). According to Choi, Cristol and Gimbert (2018), academics need ongoing training to acquire new knowledge and skills in digital technologies that will allow them to facilitate teaching and learning processes in accordance with the educational demands of the current society.

On the other hand, the correct use and integration of ICTs in educational processes require faculty to be technology- and pedagogy-wise competent with technological, pedagogical, and disciplinary skills (Calvo-Morata et al., 2019; Dalal, Archambault and Shelton, 2017; Scherer, Siddiq and Tondeur, 2019). Having digital competencies is a necessity of these times regarding the increase of careers in hybrid modalities that make it possible to meet the needs of lifelong learning; the contribution of technologies to enrich the educational scenario, and situations such as the Covid-19 pandemic that show the need for training in digital competencies of academics and students (Pedró, 2020).

2.1 Serious Games

The concept of serious games has been defined by a wide variety of researchers (Sandí and Sanz, 2020; Calabor, Mora and Moya, 2017; López et al., 2019; Michael and Chen, 2006; Pellas, 2014). The term serious games was first introduced in 1970 by Abt (1970), who focused on researching the possibilities these games offered in an educational, entertaining, and social context. His aim was to identify the possibilities to use serious games for instruction, training, education, fulfillment and/or as a source of enjoyment and motivation and to develop new skills and knowledge (Abt, 1970).

Michael and Chen (2006) state that the purpose of serious games is not only entertainment, enjoyment, or straight fun, but that they essentially have an explicit and carefully thought-out educational purpose. In this regard, Archuby, Sanz, and Pesado (2019) reviewed the concept and presented a game called Desafiate for students' self-evaluation. Serious games have been used in and applied to different knowledge areas for

educational purposes and to drive significant changes in attitudes and behavior in people, to help them acquire and develop skills and competencies that will produce meaningful knowledge for adequate performance in their everyday chores (Muñoz et al., 2011).

According to different systematic literature reviews (Bozkurt and Durak, 2018; Dimitriadou et al., 2021; Hassan, Pinkwart, and Shafi, 2021; Krath et al., 2021; Min et al., 2021), it is evident that the use and integration of serious games in training processes, present the following benefits: they allow changes in attitude, behavior, emotions recognition and production, as well as enhancing thinking, reasoning, motivation, communication and the promotion of digital competencies among students and academics. For the purposes of this study, a serious game is therefore defined as one characterized by having an approach that goes beyond entertainment or fun, that is, it can be used to enhance different areas of knowledge, to promote attitude or behavior changes, to generate emotions, to address the acquisition of skills and competencies, collaboration and interactivity, among others.

In order to investigate backgrounds of serious games that have been used for the development of competencies, a specific study of different articles was conducted. Among the main cases studied some are mentioned in the following paragraphs.

A research project, related to what kind of competencies academics need in using game-based pedagogy (Nousiainen et al., 2018), proposes the following conceptual framework: “using educational games, using entertainment games, learning by making games, and using game elements in non-game contexts (i.e., gamification)” (Nousiainen et al., 2018, p.86). Considering this framework, the study proposed here focuses on using educational games for academics’ digital competencies training.

There are some researches who analyzed the use of serious games, considering different variables. For example, the one that proposes the use of “Science Training Immersive Modules for University Learning Around Teacher Education (STIMULATE), which is a Serious Educational Game designed to advance science teacher preparation and development” (Annetta et al., 2014, p.61). This work analyzed the “usability and effectiveness of STIMULATE’s initial build on 31 preservice teachers” (Annetta et al., 2014, p.61). The results suggest positive learning gains from the preservice science teachers in science preparation and development. Also, the proposal of Cisco Packet Tracer, that created a simulator type game aimed at training and empowering a network of configuration skills for all audiences (academics, students, technicians, among others) (Janitor, Jakab, and Kniewald, 2010). Later, the simulator was used to develop a plugin for Moodle called “PTActivity”. Petcu et al. (2013) indicate that the integration of the PTActivity module offers the possibility of improving the technological skills training process, the collaborative work and the learning experience for academics and students. The serious game, called NoviCraft, was developed with the objective of promoting, through training, the acquisition/formation of pedagogical and technological competencies in academics and students (Häkkinen et al., 2012). NoviCraft has been used in different universities in Finland and the United Kingdom. As a result, it was found out that the game allows the improvement of work skills such as communication, collaboration, technology, management, and leadership (Romero, Usart and Ott, 2015). NoviCraft also boosts motivation, interest, and commitment on the part of the players (Juzeleniene et al., 2014). In France, the French Institute of Education developed the serious game Tamagocours with the purpose of training academics in technological-pedagogical skills in higher education (Sanchez, 2017). Specifically, Tamagocours allows to enhance the skills and competencies required to articulate the integration of digital technologies and the Internet in the training processes (Sanchez, 2013). In total 81 participants used the game to prepare for the certification called Informatics and Internet Certificate for Teachers. The result was that academics developed different game strategies: try and failure, controlled choice, and collaborative game (Sanchez and Emin-Martínez, 2014; Sanchez, Emin-Martínez and Mandran, 2015).

Up to this point, the antecedents in which serious games are used have been described and/or analyzed to enhance digital competencies in academics and/or with students. None of these studies have focused on analyzing the technological acceptance of serious games used for this purpose. In this sense, the contribution of this research is to provide an analysis from the academics' belief in relation to the acceptance of serious games for digital competencies training, and to analyze their beliefs about the factors that can impact the use of this type of games, and the value relevance of these games. Particularly, this project focuses on HEI academics to determine what barriers are found to deepen the formation of digital skills for academics, and that they in turn adopt the serious games in their teaching contexts.

2.2 Technology Acceptance Model (TAM)

In this subsection, the TAM is discussed in more detail. Some of the existing models that allow measuring the acceptance level of digital technologies by users were studied (Ruiz, Pardo, and San Martín, 2010; Hernández-Arellano, 2016; Dell'Olio et al., 2018; Burić and Kim, 2020; Fakhari and Rima, 2021; Yin and Huang, 2021). One of these models was TAM by (Davis, 1989) and its variants: TAM2 (Venkatesh and Davis, 2000) and TAM3 (Venkatesh and Bala, 2008). The TAM model highlights two relevant aspects in the intention of use for any given technology – perceived usefulness and perceived ease of use (Scherer et al., 2019). The TAM2 model, on the other hand, focuses on expanding and inquiring about the constructs that can have some sort of influence in relation to perceived usefulness (Venkatesh and Davis, 2000). Finally, the TAM3 model focuses on the aspects that can affect perceived ease of use (Sampiero and Barragán, 2018).

Various studies have measured technological acceptance, both among students and faculty (Bachtiar, Rachmadi and Pradana, 2014; Liqin and Mengmeng, 2016). For our case in particular, experiences directly related to technological acceptance are of interest. Table 1 details some relevant previous experiences using the TAM model to analyze technological acceptance, particularly in academic scenarios.

Table 1: Examples of previous projects using TAM to measure technological acceptance

Country, Researcher/s	Objective
Taiwan (Wang and Wang, 2009)	Measuring academics' acceptance level when using web-based learning systems.
Singapore (Teo, 2009)	Studying academics-to-be attitudes towards the use of technology in education.
United States of America (Chen, 2010)	Developing a model that appropriately represents the factors affecting the use of technological resources by academics in training.
Malta (Camilleri and Montebello, 2011)	Measuring academics' technological acceptance in relation to the use of *Virtual Worlds* in their pedagogical practices.
Turkey (Acarli and Sağlam, 2015)	Measuring the intentions of a group of academics in relation to the use of social media as part of their academic activities.
Spain (Sánchez-Prieto, Olmos-Migueláñez and García-Peñalvo, 2015a; 2015b)	Assessing the behavior and the behavioral intention to use mobile learning, specifically, the use of mobile technologies in classes by academics taking their initial courses towards a Bachelor of Arts degree in Primary Education at the University of Salamanca.
England (Rienties et al., 2016)	Examining the interaction of academics when faced with using a new *Virtual Learning Environment*, aimed at identifying and perceiving how support and technological acceptance affect complying with tasks (perceived and real).
China (Quadir and Zhou, 2021, p1)	Investigating how students "perceived the effect of the Tencent Meeting system features on the two main determinants of the TAM model, namely perceived ease of use (PEOU) and perceived usefulness (PU). The study further analyzed the effects of these two determinants on learning performance".

The examples of previous projects shown in Table 1 correspond to instances where the TAM model was used to measure, evaluate and/or examine the acceptance level of digital technologies by academic institutions in various countries. They highlight the value of this model. However, there are few studies that show the use of TAM to evaluate the acceptance of serious games. In this sense, researchers López et al. (2021) carried out a study in Spain to analyze the intention to use the serious game Lego© Serious Play© which was aimed at training management skills in higher education students. To achieve the objective of the study, López et al. (2021) adapted the TAM model and the CAN model (Cognitive-Affective-Normative). The result was that the most influential factor in the intention to use serious game was linked to the expected learning performance.

In another study in Spain, Sánchez-Mena et al., (2017), using the TAM model, studied the factors that could influence the intention to use educational video games in the classroom by a group of 312 academics at higher

education level. The result was that the perceived utility directly and positively influences the intention of academics to use educational video games. Likewise, the study allowed to conclude that perceived ease of use indirectly influences the intention of use.

In Greece, Kroustalli and Xinogalos (2021) conducted a study at secondary level and they used the TAM model to determine the acceptance, ease of use and perceived usefulness by students in relation to using the serious game CodeCombat to acquire competencies in programming, and problem solving through Python. As a result, CodeCombat had a positive evaluation in relation to the ease of use, perceived usefulness and attitude towards its use. The results were positive in terms of the use of serious games for general programming.

None of the previous studies used TAM to determine the acceptance of serious games. Therefore, in the current study, the game Astrocódigo was used for the development of digital skills in academics. Other factors that academics perceive may influence the use of these types of games are also investigated. In this way, this study contributes to understanding the barriers and possibilities of serious games perceived by academics for their training in digital skills, as well as their intentions to use them for the integration into their own educational practices.

3. Research Methodology

Research questions were defined to guide the study, focus on the acceptance of serious games by academics and the variables that affect it. This study can later help to work with academics on the barriers that influence the use of this type of games, and in organizing teacher training strategies related to digital competencies in HEI. In addition, it can help to define design guidelines for new serious games oriented to the educational scenario.

The research questions (RQs) used for this study encompassed aspects such as: RQ1. What is the academics' attitude towards digital technologies? RQ2. What is the level of acceptance of the serious game used in the study, and how do the factors like age, gender, highest academic qualification, professional training, and seniority impact on this acceptance according to the beliefs of academics? RQ3. According to TAM's dependent variables, what factors could affect the academics' decision to integrate digital technologies? RQ4. What is the academics' level of interest for exploring, using, and integrating serious games into their educational activities? RQ5. What is the academics' acceptance level for using serious games to enhance their technological skills?

In order to answer the research questions, a study with a set of sessions was carried out with 56 academics (among them 5 directors of the participating institution) from the Atlantic Branch of the University of Costa Rica, Costa Rica, in which quantitative-qualitative data were combined. At the beginning of each session, the objectives were explained to the academics together with the competencies to be worked on and the methodology used to plan the study and some basic aspects of the use of Astrocódigo. Most of the academics worked individually and some worked in pairs. For the analysis of the results, a series of evaluations were carried out considering variables of TAM to measure the technological acceptance and in turn, describe the attitudes of the academics towards the use and acceptance of digital technologies (All, Núñez Castellar and Van Looy, 2016; Sung et al., 2017; Wronowski et al., 2020): (a) Pre-Test: a diagnostic questionnaire, b) Intermediate Evaluation: through a questionnaire about the experience with the serious game and observation of the sessions, and c) Post-Test: an opinion questionnaire and interviews). Also, in order to understand the entry level of the participants, their beliefs about their level of competencies related to the use of internet, social media, cloud computing tools of possible use in education, and the pedagogical use of digital technologies were analyzed (through the Pre-test questionnaire) (Cabero, Sampedro, and Gallego, 2016; Wronowski et al., 2020; Mullins and Cronan, 2021).

Among the 56 participants, 5 directors were interviewed. The interview was applied to the directors to get a more institutional vision related with the topic of study. The purpose was to investigate what related factors administrators consider influence in the use or not, the integration and acceptance of digital technologies by the academics, and particularly of serious games. The interviews were applied at the offices of the administrators, they were recorded in audio and transcribed. The responses were organized and processed by category of analysis and tables were used to synthetize the information.

For the current study, six customized scenarios of the AstroCódigo game (http://www.astrocodigo.com/) were used. AstroCódigo is a serious game where problems are solved algorithmically. The game was designed to help

structure and organize thought and solve problems by creating algorithms. Among its capabilities, it helps develop technological competencies by taking the users (in the current study, the academics) through a journey exploring concepts such as hardware and software and providing the users with problems that have to be solved in a structured manner, promoting algorithmic thought, abstraction capabilities, and using digital technology to plan actions (Bione et al., 2017).

The following section describes the methodology proposed and used for integrating serious games into academics training programs.

4. Methodological Steps for the Development of Sessions with the Academics

In this section, an account of our work methodology is provided, aimed at developing and/or strengthening academics' training in technological competencies through the use of serious games. To guide the selection of which technological skills to focus on, the classification of technological competencies created by the Ministerio de Educación de Chile (2006) and the proposal prepared in Spain by Prendes (2010) and Prendes and Gutiérrez (2013) were considered. This was based on the fact that the classifications presented by these studies were appropriate to the country where the current study was carried out. Figure 1 provides a summary of the sequence of methodological steps followed during the study (Sandí, Sanz, and Lovos 2018).

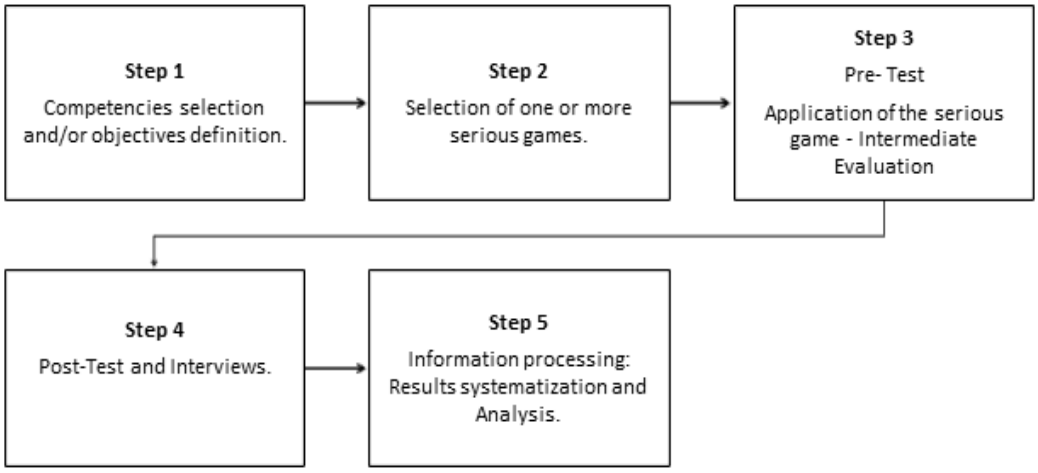

Figure 1: Methodological sequence for serious game integration and evaluation in academics education and training. **Source**: Authors' own compilation.

The following section explains in more detail the results obtained after implementing the steps highlighted in Figure 1 to conduct the study.

4.1 Applying the Methodology

A study using serious games was carried out in an academic training process at the Atlantic Branch of the University of Costa Rica with the following objectives: a) to consider if the methodological strategies proposed are effective, and b) to assist academics to develop technological competencies from serious games integration, analyzing their level of acceptance and determining the factors they believe affect this acceptance. It should be noted that both the study and the results obtained are presented considering the beliefs of the academics in relation to the variables that might affect their own acceptance of digital technologies, these views being important to consider during the process of technological acceptance by academics (Jääskelä, Häkkinen and Rasku-Puttonen, 2017). The findings will assist to determine if the participating academics show a good level of acceptance of the serious games in order to be able to subsequently address any possible barriers that may arise. In addition, the findings can contribute to the design of future serious games oriented to the educational scenario, seeking to break down the barriers encountered, and to their integration in educational processes.

When planning the study with the academics, the methodological steps, proposed in Figure 1, were followed. Table 2 summarizes the main decisions made in each step.

Table 2: Methodological application.

Steps	Activity	Decision
Step 1	Competencies selection and/or objectives definition.	Selecting the competencies to be enhanced - Five competencies matching to the dimension of "teaching" in the profile defined in Spain by Prendes and Gutiérrez (2013) were selected. These are: a) knows new concepts and basic components linked to ICTs, b) designs activities that use ICT resources, c) uses various methodological strategies with ICTs, d) implements educational activities that use ICT resources, and e) participates in ICT-related training activities (Prendes and Gutiérrez, 2013; Hernández, Arévalo, and Gamboa, 2016; Silva et al., 2016).
Step 2	Selection of one or more serious games.	Selecting the game - The serious game AstroCódigo which solves scenarios in an algorithmic and fun way was selected. This game helps developing technological competencies because: a) it asks academics to find out about concepts such as hardware and software (competencies a, b and d, from Step 1); b) it proposes solving the problems in a structured manner, which helps develop the kind of structured thinking required for planning and using digital technology (competencies b, c and e, from Step 1) (Boyle et al., 2011; Giannakos, 2013; Hainey et al., 2016).
Step 3	Pre-test application of the serious game - intermediate evaluation	Pre-test using the game - On-site sessions to use AstroCódigo were carried out with 56 academics from the Atlantic Branch of the University of Costa Rica. These sessions had an approximate duration of 150 minutes each, and there were between 4 to 12 participants in each group. Participation was free and voluntary; participants were from different subject fields. The invitation was sent to all the academics of this branch, but only 56 decided to participate (Chang et al., 2012; Almerich et al., 2016; Qian and Clark, 2016).
Step 4	Post-Test and interviews	Three evaluation stages were used - The participants were asked to answer 3 questionnaires. First, a Pre-Test (diagnostic questionnaire) was used to identify academics' current status concerning their digital competencies and their opinion related to ICT and their opinion and knowledge about serious games. Second, an Intermediate Evaluation was used to analyze how academics accept the serious game, their beliefs of the game, whether acceptance or rejection was observed, and the variables proposed in the TAM model were examined. Third, a Post-Test was used to contrast the evolution of the academics' competencies and beliefs after applying the game (Campos and Lule, 2012; Sung and Hwang, 2013; All et al., 2016; Sung et al., 2017; Winke, 2017). The interviews applied to the 5 directors of the participating institution were done individually.
Step 5	Information processing: Results systematization and Analysis	Processing the information - The information obtained was organized into tables, systematized and analyzed using charts, tables and graphs. Data were analyzed using the SPSS statistical package Then, findings and conclusion reports were prepared (Díaz-Bravo et al., 2013; Hernández, Fernández, and Batista, 2014).

As indicated in Step 3 of Table 2, AstroCódigo was used with six customized scenarios of increased difficulty where academics had to program a virtual robot to recover some pieces of a ship, using instructions to achieve this goal. This was part of the story of the game. AstroCódigo is designed to help structure and organize thought and solve problems by creating algorithms.

In regards to the evaluation, as part of the initial evaluation process, the authors decided to develop an instrument to carry out a previous assessment of participants, with the purpose of defining the entry point and to identify academics' attitude towards technology, prior to the use of the game to visualize the previous approach and the motivation of the participants in relation to digital technologies. For this purpose, a questionnaire with multiple choice and Likert-type questions was used, with previously delimited categories or response options. This instrument was developed from questionnaires available in the literature (Chiou, Lee, and Tsai, 2013; Hwang, Yang, and Wang, 2013; All et al., 2016; Sung et al., 2017).

The initial questionnaire (pre-test) consisted of 55 items: 7 multiple choice, close-ended questions and 48 statements to be rated using a 5-point Likert-type scale. Questions and statements referred to participation in previous training sessions in the HEI (2 statements), Internet competencies, social media and cloud computing (6 statements), pedagogical use of digital technologies (16 statements), attitude towards digital technologies (3

statements), ethical and technological competencies (4 statements), attitudinal competencies and technological acceptance (before the experience with AstroCódigo) (12 statements), beliefs and attitudes in relation to serious games and acquisition of technological competencies (5 statements).

Similarly, the post-test was custom-created for the study and consisted of 35 items: 3 multiple choice, close-ended questions and 32 statements to be rated using a 5-point, Likert-type scale. These statements revolved around attitudinal competencies and technological acceptance, serious games and the acquisition of technological competencies. The statements were aimed at identifying attitudes and technological acceptance (after using AstroCódigo) (12 statements), Perceived Ease of Use (PEU) (5 statements), Perceived Usefulness (PU) (4 statements), behavioral Intention to Use (BIU) (5 statements), Self-Efficacy (SE) (3 statements), and Anxiety (A) (3 statements) when using serious games in general and AstroCódigo in particular. Also, the effect of the process on the acquisition of the desired competencies based on the goals proposed was assessed, two yes-no questions with space for justification were added related to the opinion of using AstroCódigo for digital competencies development and about the interest in developing new training instances of these competencies using serious games. This was based on current literature (Khenissi, Essalmi, and Jemni, 2015; Sánchez-Prieto et al., 2015b).

Questionnaire reliability was measured using Cronbach's alpha (Cronbach, 1951), which has been widely used in educational technology research (Hernández et al., 2014). In the current study, Cronbach's alpha analysis was applied to both questionnaires (pre-test and post-test). Data were analyzed using the SPSS statistical package, and both questionnaires yielded a high reliability index, as shown in Table 3.

Table 3. Reliability of pre-test and post-test.

Test	Cronbach's α	# elements
Pre-test	0.924	55
Post-test	0.886	35

The intermediate evaluation consisted of 21 items (19 single-selection and 2 multiple choice questions). The questionnaire was applied while participants were using AstroCódigo, and photographic, audio and video support, as well as an observation guide. Also, some questions were formulated by the researchers during the sessions in order to deepen the opinion of the participants. This evaluation allowed registering mainly whether academics had achieved any progress in solving scenarios with or without help (Giannakos, 2013; Campos and Lule, 2012; Winke, 2017).

Interviews with the participating directors were semi structured with questions related to the research questions.

It is important to mention that there were no ethical problems or problems at the level of the processes before, during or after the development of the study, because before the application of the different instruments (questionnaires and interviews), the academics and HEI administrative staff knew and previously signed the informed consent form (to be a research subject). The academics authorize the researchers to record the sessions on audio and video, as well as to use and make public the information obtained and the results of the study through reports, sessions to present results and / or publications in journals. The instrument was created by the authors, taking as reference the informed consent form based on Law N ° 9234 "Biomedical Research Regulatory Law" and the "Scientific Ethical Regulation of the Vice-rector for Research of the University of Costa Rica for research involving human beings.

Finally, it should be noted that the instruments (pre-test questionnaire, intermediate evaluation, and post-test questionnaire) were validated with five national and international experts (from Argentina and Costa Rica), who participated as external judges and critically assessed the statements included in all questionnaires to be used and suggested adjustments, they deemed necessary based on the research objectives proposed.

The following section discusses the main results obtained in all three evaluation phases applied to the study.

5. Results and Discussion

This section discusses and presents the results obtained. Results are organized in response to the RQs.

RQ1. What is the academics' attitude towards digital technologies?
The preliminary evaluation (Pre-test) was used to establish the profile of the participants. Also, their opinions in terms of technology integration, and their beliefs related to the variables they think affect digital technology acceptance by academics in general, and about serious games and the acquisition of technological competencies. Additionally, their starting status was analyzed in relation to the competencies that are to be developed.

The pre-test included a specific question to participants: **Have you received previous training in the development of technological competencies?** In general, it was observed that participants had a low level of previous training (M= 4.50 and SD= 1.859). They pointed out that they are rarely trained to acquire technological competencies (see Table 4). For this reason, they mentioned that it would be a good idea to plan actions aimed at creating projects that could offer them more opportunities in relation to access to ongoing training programs in various knowledge areas in general and digital competencies in particular. This coincides with the necessities mentioned in (Choi et al., 2018; Pedró, 2020).

Participants had a very high level in Internet, social media and cloud computing competencies (M= 25.07 and SD= 3.144; see Table 4). They indicated they were proficient users of e-mail, social media, Office packages and use of cloud-based services (like Google Docs, Dropbox, Google Drive). This means that participants have knowledge about these technologies, which could be useful on a pedagogical level. However, they only mentioned using Virtual Teaching and Learning Environments (VTLEs), spreadsheets, word processors, software to create, edit and design electronic presentations, and electronic mail. They stated that they needed training for the pedagogical use of certain digital technology tools (authoring tools, wikis, educational digital games, mobile apps) so as to be aware of their possibilities applied to teaching and developing skills to use them to create innovative pedagogical activities. This coincides with what is indicated in Section 2, where the correct use and integration of ICTs in educational processes require a faculty that is technology- and pedagogy-wise competent; with technological, pedagogical and disciplinary skills (Calvo-Morata et al., 2019; Dalal et al., 2017; Scherer et al., 2019). Participants showed interest in using digital technologies – they believe these benefit classrooms learning and help improve some aspects of teaching quality. Academics' attitude towards digital technologies was good (M= 12.30 and SD= 2.304; in Table 4).

Regarding serious games and the acquisition of technological competencies, participants were very interested (M= 22.33 and SD= 3.533) in incorporating serious games to their practices. They also considered these games as beneficial for their work and for their technological competencies training process. This could indicate that participants have a predisposition to exploring, using and integrating these games into their educational activities, but they are not applying them in their educational practices. It is likely that the lack of a training program in this regard is the reason why they are not yet included. It is therefore also important to know what barriers may affect the development of these programs and the adoption of serious games in their educational practices.

As regards attitudinal competencies and technological acceptance, in the pre-test it was observed that there was a very high belief (M= 51.23 and SD= 7.644) that there are variables that affect technology acceptance, such as, the Perceived Ease of Use (PEU), the Perceived Usefulness (PU) and Behavioral Intention to Use (BIU) associated with enjoying. Seventy-five percent of the participating academics totally agreed that when they perceive a digital tool as easy to use and useful, they feel a greater incentive to use it; while a 16.07% agreed with this statement; the rest of the participants (8.93%) were undecided.

These results match those obtained in theoretical research studies, where TAM proposes precisely these variables as relevant factors that affect the decision to use any given technology. In addition, there are factors that participants believe may affect the acceptance of these types of technologies such as: as academic training, professional training, seniority in the job, age range, and so forth. This is further discussed in RQ2.

RQ2. What is the level of acceptance of the serious game used in the study, and how do the factors like age, gender, highest academic qualification, professional training, and seniority impact on this acceptance according to the beliefs of academics? and RQ3. According to the TAM model dependent variables, what factors could affect the academics' decision to integrate digital technologies?
To answer RQ2 and RQ3, from the initial questionnaire, beliefs of participants in relation to technology and serious games, in particular, were analyzed. This can be seen in Table 4. After carrying out the study, in the post-

test, they were asked about these beliefs again, in order to identify the potential impact on participants after using the serious game.

As regards attitudinal competencies and technological acceptance, there was a slight increase in the mean of the post-test, from 51.23 to 51.75 (post-test: M= 51.75 and SD= 7.166), versus the pre-test in the belief that certain factors affect technological acceptance (like: Highest academic qualification, professional training, seniority in the job). Table 5 summarizes some of the results obtained on a general level when comparing the dimension "attitudinal competencies and technological acceptance" in both questionnaires. It can be seen that there was a slightly change in the belief regarding which factors affect technology acceptance. After using the game, some participants no longer believe that age is a barrier to technology integration (M=3.82 and SD= 1.193), which can be due to an increased confidence in using games regardless of their age. Even though there is a slight variation in the mean, the belief that other variables such as academic training (M=3.96 and SD= 1. 206), professional training (M=3.96 and SD= 1. 279), seniority in the job (M= 3.82 and SD= 1. 177), and attitude towards digital technologies (M=4.75 and SD= 0.640) can affect technology acceptance remains unchanged.

The Perceived Ease of Use (PEU) of Astrocódigo (M= 21.71 and SD= 3.473) is very high. On one hand, participants indicated that serious games could provide flexibility and interaction capabilities, in particular AstroCódigo, which they found easy to use. They showed interest in serious games, both as regards learning how to use them as well as in integrating them to their classes. On the other hand, participants rated the Perceived Usefulness (PU) of using serious games as very high (M= 17.32 and SD= 2.601), after using AstroCódigo; they considered that these games could help them improve their performance. These results coincide with the ones obtained by Sanchez-Mena, Martí-Parreño, and Aldás-Manzano (2017) and Kroustalli and Xinogalos (2021).

As regards participants rated the Behavioral Intention to Use (BIU) towards serious games as high (M= 20.76 and SD= 3.247); they highlighted that using these games could be a good idea and integrating them to the teaching and learning process could be enjoyable. Similar results were presented by López et al. (2021). Likewise, participants indicate the necessity to find the adequate game and of having more training. In relation specifically to AstroCódigo and the consideration of the variable Self-Efficacy (SE), participants rated it as high (M= 11.76 and SD= 2.783), after sessions performed. They stated that they feel confident enough to use AstroCódigo and to integrate it into their educational activities. In relation to Anxiety (A), participants rated it low (M= 6.34 and SD= 3.147); only a few participants expressed some kind of concern, fear or stress about using AstroCódigo. Some expressions were found during the interviews that help to understand this last result, such as: "In my case, I would need to get closer to these technologies, for someone who is from a completely different area, and for an age issue too, my training has been outside of digital technologies, and I'm approaching it timidly, and this experience is something that allows me not to be so frightened and to feel more secure".

Finally, participants indicated that they found AstroCódigo interesting to approach the use of these technologies. It should be noted that the dimension "attitudinal competencies and technological acceptance" in Table 4 is similar in both instruments to favor subsequent comparisons and the identification of any changes in attitude as regards ICT and serious game acceptance (before and after interacting with AstroCódigo).

Table 4: Results by analysis dimension (Pre-test and post-test)

Pre-test	**Mean**	**SD**	**N**	**C***
Level of previous training in technological competencies	4.50	1.859	56	L
Internet, social media and cloud computing competencies	25.07	3.144	56	VH
Pedagogical use of digital technologies	51.89	12.579	56	H
Attitude towards digital technologies	12.30	2.304	56	H
Ethical-technological competencies	11.92	4.655	56	I
Attitudinal competencies and technological acceptance	51.23	7.644	56	VH
Serious games and technological competencies training	22.33	3.533	56	VH
Post-test				
Attitudinal competencies and technological acceptance	51.75	7.166	56	VH
Perceived Ease of Use (PEU)	21.71	3.473	56	VH
Perceived Usefulness (PU)	17.32	2.601	56	VH
Behavioral Intention to Use (BIU)	20.76	3.247	56	H
Self-Efficacy (SE)	11.76	2.783	56	H
Anxiety (A)	6.34	3.147	56	L

Note: *Classification: VL= Very Low, L= Low, I= Intermediate, H= High, VH= Very High.

Table 5: Comparison of the dimension "Attitudinal competencies and technological acceptance" in Pre-Test and Post-Test

	Pre-Test		Post-Test		N
	Mean	**SD**	**Mean**	**SD**	
I consider that a good *attitude towards digital technologies* favors their use and integration in teaching and learning processes.	4.63	0.822	4.75	0.640	56
When I perceive a digital tool as being easy to use, I feel more incentive to use it.	4.66	0.640	4.64	0.724	56
When I find a digital tool hard to use, I abandon it.	3.36	1.257	3.36	1.327	56
My academic training (*highest academic qualification*: BA, specialization, master, doctorate) has an effect on how I use and accept ICTs.	3.61	1.410	3.96	1.206	56
My basic *professional training* has an effect on how much I accept digital technologies.	3.93	1.277	3.96	1.279	56
Age affects ICT use and acceptance by academics.	3.89	1.317	3.82	1.193	56
I consider that training processes should be followed up in my work context for the acquired knowledge to be used for the development and use of technologies in the classroom.	4.70	0.737	4.64	0.699	56

RQ4. What is the academics' interest level for exploring, using, and integrating serious games into their educational activities? and RQ5. What is the academics' acceptance level about using serious games to enhance their technological skills?

The intermediate evaluation allowed the authors to carry out a comprehensive analysis of the sessions, digging deep into some factors that, according to TAM, could affect the decision to integrate this technology. In particular, serious games were considered as part of the teaching practice, and the level of difficulty, perceived benefits of the game (AstroCódigo) and overall enjoyment were examined. This evaluation addresses RQ4 and RQ5.

All participants stated that they agreed that using serious games can be beneficial to drive technological competencies and indicated that they mainly allowed them to acquire knowledge and skills related to ICTs, and computational thinking development. Participants view serious games as a new teaching and learning strategy. They valued the methodology of the sessions. These assessments coincide with the ones obtained in the study of Kroustalli and Xinogalos (2021).

In terms of difficulty, even though problem solving scenarios were increasingly difficult as the study progressed, participants showed increased confidence and expertise in using the game as the scenarios went by, which indicates a good learning curve. The first scenario requires some additional support to know how to resolve the challenge. This can be appreciated in statements such as: "…even though it may seem illogical, it was easier for me to solve the last scenarios than the first two, because I was getting acquainted with the game".

As regards comfort, participants found the game to be interesting and attractive, they seemed to be motivated (Juzeleniene et al., 2014), and they highlighted the interactive features of the game, its entertaining and dynamic nature and its ease of use as aspects they observed throughout their sessions using the game; these aspects are similar to those found by Sánchez and Emin-Martínez (2014) as well as Sanchez, Emin-Martínez and Mandran (2015).

As for enjoyment, they stated that it was linked to challenge. That is, they found that having new challenges in each scenario was an important component for enjoyment. This result could be important for the design of future serious games.

Participants stated that, during the study, they felt motivated and worked on some competencies that were required to implement methodological strategies and educational activities that incorporate ICT resources (Petcu et al., 2013), in particular, serious games. They valued the methodology that was implemented during the sessions with AstroCódigo. Similarly, they considered that the interaction with AstroCódigo allowed them to improve their analysis, reasoning, and critical thinking skills, as well as how they structure knowledge and resolve the challenges. They valued the possibility to try and fail, coinciding with what was expressed by Sanchez et al. (2014).

Overall, 96.43% of the participants indicated that they are interested in participating in training activities in relation to the acquisition of technological competencies, through the use of serious games.

Below are some results obtained in interviews with the directors of the institution. The development of technological competencies and how these competencies are being approached by the institution was analyzed. The interviews showed that there is a lack of institutional strategies to help academics develop technological competencies, as well as a lack of appropriate institutional decisions. Following some of the directors' opinions when asked: are there any strategies or projects in this branch of the Institution related to the training of faculty on the pedagogical use of TIC's? None of the 5 directors were aware of any project, which was evident in a response such as this one:

> *"As a well-structured Project, I would say no. I think there could be efforts and initiatives, but if we are referring to strategies or projects at the branch level that establish goals and indicators clearly defined, not that I am aware of."; "As far as I know, as of to date, there is no Project …"*

Similarly, the directors (5) were thoughtful in relation to identifying the factors that positively affect technological acceptance. They were specifically asked about serious games and the subsequent development of their competencies, and they mentioned factors related to institutional support, availability of technological resources and participants interest level. They also mentioned some negative factors, usually related to fear of change, age range, delayed technological access and perceived ease of use. These aspects are in line with those expressed by all the participants.

Finally, they stated that they did not know about the use of serious games as part of the academic activities carried out by academics at the institution. However, all of them said that they would support any initiatives to favor the acquisition and development of technological competencies by participants through the use of serious games. For instance, one of the directors stated: *"Yes, I would be willing to support anything related to improving technological skills. I must say that it worries me if the implementation of these Serious Games implies an additional budget from the one we manage…however, we have to continue working in improving faculty's technological competencies and we will have to use other areas to look for budget …"*

6. Conclusions

In this work, a study related to the use of serious games for the development of technological competencies in higher education academics was presented. The article contributes to knowing the barriers and possibilities in the use of serious games, according to participants´ beliefs and opinion, for their training in digital competencies, as well as their intention to use them for their integration into their own educational practices.

The results allow us to affirm that participants show a high acceptance of this type of games for the development of digital competencies. In this sense, they indicate some factors that they believe can affect the acceptance and use of the serious games, previous to the experience. After the study, some slight modifications on these beliefs were observed. However, participants considered that there might be certain factors that could negatively affect ICT use and acceptance, including highest academic qualification obtained, seniority in the job, and professional training. They also believe that the ease of use of the game and its perceived usefulness affect their intention of use. This was also supported when analyzing previous research related to TAM, where this model proved to be effective in different countries in measuring the level of acceptance of digital technologies. In this specific research, enabled the answer to different research questions (RQ2, RQ3, and RQ4) related to the level of technological acceptance and also to identify from the participants' perspective the factors that influence their attitude towards the use and acceptance of digital technologies, particularly through the use of serious games. The level of acceptance shown by the participants during the study with AstroCódigo was high, although it should be considered that from the pre-test there was a good approach, shown by participants, to the use of certain digital technologies, and they had a good attitude towards their use in the educational scenario.

Also, it is important to consider that the participants mentioned that they did not use serious games for their educational practices, so the study shows participants how to use serious games for training and development in digital competencies. They were interested in using this type of games and they were open to training in the development of digital competencies with the use of serious games. Also, AstroCódigo was found useful and easy to use, and some of them were interested in using games to work with their students, recognizing the importance of the methodology used to plan their integration. This also coincides with the investigations related

with the technological acceptance model, where the perceived ease of use and utility are related to the intention of use.

Finally, serious games were presented as an innovative, creative, and fun educational resource that allowed participants to learn, reason and develop their digital competencies. The academics of the study were motivated by the use of the game AstroCódigo, which allowed to put into practice analysis, reasoning, and critical thinking skills to resolve the challenges. The possibility to try and fail was valued by participants, which also coincides with other works mentioned in the literary review. One of the aspects mentioned about the game was the increase in the level of challenges that was related to enjoyment. This can be useful for the design of serious games.

This work opens the door to deepen in the use of serious games for the development of digital competencies for academics. As lines of future work, it is proposed to continue this research by applying the use of serious games in other scenarios for the development of digital competencies in academics. It is also proposed to address the design of serious games specifically for this purpose, considering the aspects found in this research.

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Competing interests

The authors declare no competing interests.

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