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Towards A Sustainable Post COVID-19 Higher Education Era in Zimbabwe: The Compatibility of Online Teaching and Learning Platforms with Courses in the Built Environment

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***Abstract*—An upsurge in the use of online teaching and learning in higher education in Zimbabwe was triggered by the outbreak of the pandemic, as a necessity to anchor the survival of higher education. While there are several online teaching and learning platforms available, a need therefore existed to understand how they can reliably enhance sustainable teaching and learning especially in the Built Environment, where no similar studies were previously carried out in Zimbabwe to the knowledge of the researchers. In a structured questionnaire survey, a combination of purposive, stratified and convenience sampling were used to collect data from Built Environment departments in four major higher education institutions in Harare and Bulawayo. A total of 176 lecturers and students successfully participated. Inferential statistics were used to analyse the data. The chi-square test established that the online teaching and learning platforms identified in this study are significantly implemented in higher education in Zimbabwe, and that they are also significantly effective for enhancing student learning abilities. From the Kruskal-Wallis ranking test, WhatsApp was the most implemented as well as the most effective, potentially owing to its antecedent, widespread use as a social media platform, coupled with its ability to offer sustainable cost solutions to online teaching and learning. Google Classroom was the second most implemented of the online teaching and learning platforms, as it was also perceived by lecturers and students as the second most effective in enhancing student learning abilities. YouTube and video conferencing platforms were also perceived to be effective in enhancing student learning abilities. The study advocates for a transformation to blended learning to harness the advantages of online teaching and learning. Acquisition of cost-effective systems and technologies by higher education institutions is encouraged to equip lecturers and students and empower them for participation in online teaching and learning.**

***Keywords*— Built Environment, Higher Education, Online Teaching and Learning, Zimbabwe.**

I. INTRODUCTION

The internet is playing a huge role in peoples' lives today, dictating how people live, socialize, teach and learn, and has become a normal part of many university's teaching and learning programmes (Sadiku et al., 2018). Hinging on the power of the internet is online learning, whose use in teaching and learning in higher education is rapidly improving. Online teaching and learning refer to the use of a wide range of a wide range of programmers that use the internet to provide instructional materials and facilitate interaction between educators and students and in some cases, among students (Bakia et al, 2012). Developed on the contemplation that the traditional, on campus, face to face learning is not for everyone due to the need for work and family commitments, online teaching diverges from the former in terms of pace and delivery, though being similar in content (Sadiku, Adebo & Musa, 2018). Online teaching and learning encompass a wide range of technologies delivered over computer networks to impart education (Dhull & Sakshi, 2017). Even in Zimbabwe, online teaching is indispensable in higher education today. However, Zimbabwe had been slow in the transformation process and higher education has continued to be highly dependent on campus-based teaching and learning (Kujeke et al., 2014).

While the outbreak of the Coronavirus pandemic (COVID-19) in December 2019 disrupted traditional, face to face forms of teaching and learning (Maphosa, 2021), higher education institutions had a rapid adaptation response through a switch to exclusively online teaching and learning. Being cautious of the power of online teaching and learning in transforming the quality of education, Karakose (2021) argues that the COVID-19 crisis actually offered significant opportunities to redesign higher education as well as develop and implement effective teaching and learning strategies. Peimani and Kamalipour (2021) concur that the relevance of online teaching and learning will extend beyond the COVID-19 era, as it shed light on the transformation towards the implementation of adaptive teaching and learning environments through innovative technologies for sustainable higher education Internationally and regionally, the findings of other several studies, who include Crawford at al (2020); Boss and Krauss (2022); and Hidayat (2021), generally tally behind an appreciation of the relevance of online teaching and learning in improving both quality and productivity in higher education. Because the rapid ascendency of online teaching and learning as an adaptation technique to the forced lockdown caught the higher education sector unprepared, the need for deeper understanding of online teaching and learning in higher education is imminent

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considering the availability of a variety of online teaching and learning platforms. It is therefore imperative to get a deeper insight into the implementation and the effectiveness of the different online teaching and learning platforms in higher education. In the Built Environment, a field of academics which offers teaching and learning programmes and courses for the planning for, erection, maintenance and management of man-made, built structures in which people live, very few, if any, such studies have yet been carried out to the knowledge of the researcher.

II. ONLINE TEACHING AND LEARNING PLATFORMS

Online teaching and learning refer to education that takes place over the internet, as opposed to traditional face to face, classroom interactions (Sadiku et al., 2018). The internet originated from efforts to make interconnected networks created for government, academic and defense establishments more easily accessible to the wider public (Freyberg & Rand, 2022). Online teaching and learning are one of the most exciting forms of distance education, which is an alternative or complementary form of instruction in which students have an opportunity to learn away from campus (Ispas, 2021). Open, flexible, distance learning methods attracted unprecedented interest in the face of the COVID-19 pandemic as their affordances of time, place and pace flexibility have experienced new-found importance across the education sector (Naidu, 2022). While the COVID-19 pandemic triggered the use of online teaching and learning platforms, its relevance in the education system is will remain even after the pandemic.

Several platforms that are supported by the internet are in suitable for teaching and learning in higher education. The use of the different online teaching and learning platforms in higher education are summarized in Table I and discussed as follows:

TABLE I. ONLINE TEACHING AND LEARNING PLATFORMS.

Online teaching and learning platform	Sources
Zoom	Crawford, et al (2020); Tiangco et al. (2021); Ferdiánová et al. (2021).
Microsoft Teams	Boss & Krauss (2022); Chauhan, et al (2018).; Chauhan et al., (2018).
Google Classroom	Chawinga (2017); Muderedzwa & Chilumani (2017). Zinyemba et al. (2021
YouTube	Farley, et al (2015), Li & Tsai (2017); Schwarz & Caduri (2016)
WhatsApp	Maphosa, Dube & Jita (2020); Mhindu (2020), Tarisayi & Munyaradzi (2021)
Facebook	Fleischmann (2019); Kim (2019), Duncan & Barczyk (2016)
LinkedIn	Assami (2018); Yu et al. (2019); Zhao et al. (2016)

A. Zoom

Zoom is a very popular teaching and learning platform that is currently being utilized by many educational institutions around the globe (Crawford, et al., 2020). Zoom is a preferred platform for numerous online educators, as it provides students with a more engaging experience. Zoom offers access to increased educational resources, flexibility for the learner, valuable global interchange, and equal opportunities for students and teachers regardless of location (Arkorful & Abaidoo, 2015). Sharing can easily be done to share slides, files, or videos with students as you teach. Students on attachment or internships can communicate with lectures as a means of assessment. The student attachment supervisor and lecturer discuss the students' performance via zoom (Omar, 2021). However, zoom platform is disadvantageous as it lacks the personal connections that students can have with the teachers, and it also limits certain course activities, class involvement and attendance, as well as presenting challenges to access to a readily available internet connection (Tiangco et al., 2021). Further, security concerns are an issue if the host does not enable the password (Yu et al., 2019). Further, practical courses can be challenging to teach via zoom online and teaching platform (Ferdiánová et al., 2021).

B. Microsoft Teams

Microsoft Teams provides a digital space that brings conversations, content, assignments, and apps together, enabling students to take full control of their own learning. It is easy to use and encourages collaboration between teachers and students for higher education (Boss & Krauss, 2022). Within Microsoft Teams, educators can quickly converse with students, share files and websites, and distribute and grade assignments. Built-in OneNote Class Notebooks and end-to-end assignment management allow educators to organize interactive lessons and provide effective and timely feedback (Chauhan, et al., 2018). Microsoft Teams streamlines work and saves time, hosts more effective video meetings at the set times, makes conversations and connections more meaningful and keeps everyone informed on the topics being discussed (Matuk., 2016). However, Microsoft Teams platform is also not practicable for practical courses (Arkorful & Abaidoo, 2015). In addition, Microsoft Teams is not widely used as it is fairly new and requires training for use (Hawkridge., 2016).

C. Google Classroom

Google Classroom is a learning management system that aims to simplify creating, distributing, and grading assignments and engaging students in learning online or remotely (Hidayat, 2021). Many college and university programs now require students to enrol in Google Classroom, as it provides students with exposure to an online learning system. Exposure to Google Classroom may help students transition into other learning management systems used in higher education such as Gmail, Google Drive, Google Docs (Mishra et al., 2020). Google Classroom, among other online teaching and learning platforms, has been adopted in higher education I Zimbabwe, despite some drawbacks that hinder its implementation (Muderedzwa & Chilumani, 2017). Whilst there is no much literature on the implementation of Google Classroom in higher education in Zimbabwe, Santos (2021) concurs that it has not been much adopted in many, especially developing, countries. Google Classroom is accessible from all devices that many students use individually, enables effective communication and sharing for the higher education to go on (Chawinga, 2017). Zinyemba, Nhongo and Zinyemba (2021) note that on Google Classroom gives so much convenience to the educators that their work go on as usual, as the students are able to interact with the students, post assignments and give

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learners feedback. Google Classroom saves time since all of the files are located in one place allowing educators time to focus on lesson planning, rather than on administrative work. Going paperless makes assessing and grading quick and hassle-free (Mali, 2017). Google Classroom makes announcements and submissions easy, and accomplishment of tasks quicker (Santos, 2021). Google Classroom gives the lecturer permission to set the time due for required assignments and these affect students' marks for all those that hand-in late or after the set time as low marks are given. However, Google Classroom is not compatible with some gadgets, especially phones, which disadvantages all those who cannot login with the gadgets they have.

D. YouTube

Accessing and viewing videos is popularly part of online teaching and learning in higher education (Li & Tsai, 2017). YouTube gives students an opportunity to watch videos which not only helps them learn complex concepts but also helps them improve writing, listening and punctuation skills. YouTube is highly optimized for mobile devices and the majority of students are already using it (Farley, et al., 2015). On another hand, teachers can focus more on students' learning abilities instead of spending more time explaining complex concepts and topics. YouTube has proven to be an effective educational tool as it connects academicians, educators and researchers from all over the world and provide interesting, knowledgeable and engaging content which has added a new dimension to education by making it innovative as well as creative (Sharma & Sharma, 2021). Lectures can create effective videos of demonstrations, more quickly and easily with minimal video equipment. With many students using smart phones, video is a great platform to reach them. Once YouTube video has been uploaded it stays uploaded for a while and it can be accessed even after a number of years, as long as the uploader has it to stay on there. An example of such are learning tutorials that students can even download on YouTube for later use and applications of information in higher education (Lee et al., 2017). Unlike Google Classroom and zoom apps where students are able to communicate with lecturers on a face to face basis, YouTube lacks this kind of communication and has individualism with no further explanations if there are questions from students. This may also create a sense of isolation, whereby everyone learns in their own manner. Advertisements on YouTube disrupt the learner and this requires self-discipline as they are eye catching to the student. Online learning requires additional training for instructors to teach effectively (Jung & Lee, 2015). If YouTube is not used correctly, it can lead astray as all content can be uploaded. Using YouTube, there is need for specific channels for a particular educational discipline courses and sharing of proper links for all students (Schwarz & Caduri, 2016). YouTube users have a tendency of seeking capital rather than publishing educational information (Fyfield et al., 2021).

E. WhatsApp

WhatsApp is widely used in conjunction with face-to-face, in-class discussion in regard to completing course activities (Barhoumi, 2015). In higher education in Zimbabwe, WhatsApp became a common teaching and learning tool after the enforcement of lockdown on 20 March 2020, due to its low data consumption (Maphosa., 2020). The authors note that the easy transition was necessitated by the fact that WhatsApp had been previously relied on as an alternative lecture delivery platform. despite that very few had appreciated its role as a sole lecture delivery method. Beyond the purpose of communicating social issues, WhatsApp has become a channel through which academic knowledge is shared, and teaching materials are distributed, assignment questions are discussed on the WhatsApp groups in higher education in Zimbabwe (Mhindu, 2020). WhatsApp enhances interaction between students and lecturers, and also enhances interaction amongst students. It increases teaching and learning intimacy between lecturers and students and also amongst students as continuous discussions about learning is done throughout the academic years (Veytia-Bucheli., 2020). WhatsApp is user-friendly, can share live location which benefits both the lecturers and students when it comes to authenticity of the schooling (Nedungadi., 2018). Audio and video calling are enabled when using WhatsApp, this is beneficial to the lecturers and students for online teaching and learning to go on in higher education in Zimbabwe (Tarisayi & Munyaradzi, 2021). However, using WhatsApp, some students share information to impress the facilitator without actually learning about it, which leads to unproductivity as information should just be understood right in time and some students tend to lag behind in their learning due to this reason (Chauhan, et al., 2018). Further, huge amounts of learning at once makes the learning confusing. Too much learning brings disorder to capturing information and hence advance studying should be done to get more things done (Ferdiánová et al., 2021).

F. Facebook

Lecturers can create a class Facebook page and invite students to "like" the page so that they receive announcements, current events news, and updates on class projects. Students can engage with the lecturers and with their peers through posting comments and replies on the page (Fleischmann, 2019). Research findings show that Facebook provides students with a somewhat more positive community of practice, greater sense of learning and sense of connectedness (Duncan & Barczyk, 2016). The advantages of Facebook are that it is easy to use, an email address is required and details of the user in order to login and sign in so as to get access to the pages of Facebook (Lijadi & Van Schalkwyk, 2015). Facebook enhances career opportunities for students in higher education since once they are done, they require links and connections from Facebook to advance in their career paths. Facebook is a learning platform where they can retrieve academic sources easily and share them with their classmates for intellectual discussion (Zhao et al., 2016) . On the other hand, the disadvantages are that you may get addicted to Facebook and that there is limited privacy. Facebook also leads to addiction while attending to some other material, leading to too much screen time which causes health issues on eyes (Kim, 2019). Security on accounts has to be obtained in order to keep and not lose any data (Kim, 2019). Facebook is a platform where a request is done for more information on the academic pages therefore the admins of the groups created should be readily available to accept students into the group to prevent delays

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(Lijadi & Van Schalkwyk, 2015). Facebook just like any other social media platform, can be hacked and all data can be lost due to this, therefore a backup hard drive is a must to store the data in case it is lost (Duncan & Barczyk, 2016).

G. LinkedIn

LinkedIn learning is an online learning platform that combines high-quality content from Lynda.com with personalized course recommendations and a more intuitive learning experience (Assami et al., 2018). LinkedIn Learning courses are taught by industry experts and cover thousands of technology, business, and creative skills. This is beneficial to the education system of higher education in Zimbabwe (Arshad et al., 2018). Advantages of LinkedIn include the following; courses with high-quality content, access to a wide variety of courses, curated, it is an interactive, social, learner-centered approach (Assamiet al., 2018). Having a LinkedIn account as a student proves that you are dedicated to pursuing a career. By being specific in your summary and connecting with people in the field that you'd like to end up in, you prove that you're putting in the time and effort required to succeed in your chosen career (Arshad et al., 2018). LinkedIn also has its downfalls such as the required investment of time in making good use of all the learning opportunities on the platform (Crawford, et al., 2020). Not everybody is actively engaged in LinkedIn, therefore awareness has to be made for the higher education students to fully participate on the Built Environment courses held on the platform (Yu et al., 2019). Privacy concerns are an issue, due to publication of occupation, and other personal details which might be misused by intruders (Zhao et al., 2016). Your reputation is put on the line if the information on your personal profile is not proper or not the right type of information required for educational purposes (Assami et al., 2018).

III. METHODOLOGY RESEARCH

Quantitative research was adopted to collect numeric data that can be quantified (Saunders, 2009). A survey was adopted as it suits the quantitative research choice (Saunders et al, 2009), and to allow the collection of a large amount of data from a large population, and is also easy to explain and understand (Creswell, 2013). In Zimbabwe, the data were collected from Harare and Bulawayo, which are the two biggest provinces. The data were collected from the University of Zimbabwe, the National University of Science and Technology which are the two biggest universities. Further, the study also targeted Harare Polytechnic and Bulawayo Polytechnic, which also both offer several courses from National Certificate, National Diploma and Higher National Diploma levels. Data was collected from departments offering courses in the Built Environment field in higher education in Zimbabwe. These include architecture, quantity surveying, civil engineering, landscape architecture and real estate development and management. The data were purposively collected from lecturers and students who are involved in teaching and learning in courses offered in departments in the Built Environment field in higher education in Zimbabwe. First year students were, however, excluded from the study due to their limited, technical experience in the subject area, in order to increase reliability and validity of the findings. In order to increase the sample's statistical efficiency and to provide adequate data for catering for the inter-strata differences within the sub-populations and thereby increase the reliability of the findings, stratified sampling was further used to group the respondents into lecturers and students and into the different programmes within each faculty/department in the Built Environment in higher education in Zimbabwe as shown in Table II (Cooper and Schindler, 2014).

Due to difficulties encountered in quantifying the sampling frame, convenience sampling was used to select unrestricted numbers of lecturers and students within each stratum due to the advantages of convenience, low cost cheap and ease it offers, and to enjoy freedom to arbitrarily and subjectively interview participants with a pattern or scheme in mind, as they find them available on site. (Cooper & Schindler, 2014). Since the study population was not known, and Saunders et al (2009) affirm that using non-probability sampling, there are no rules in selecting the sample size, at least 30 respondents were considered, whose number is adequate for inferential statistics (Berkowitz, 1988). However, a large number (250) was targeted, to reduce systematic variance and sampling error (Saunders et al, 2009). However, of the 250 distributed questionnaires, 179 were successfully returned. Of the 179 successfully returned questionnaires, 3, which were partially completed were discarded as this presented doubt on the commitment of the respondents in providing reliable responses in the context of the study. Resultantly, 176 successfully returned questionnaires were included in the data analysis. A high response rate of 70.4 % was therefore obtained which was very good, reliable and valid for the generalization of the findings in the context of the population under study (Saunders, 2009).

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TABLE II. SAMPLING FRAME

IV. RESEARCH A

Higher Education Institution	Department/Department	Programmes/Courses from which the data was collected	Level of Study
University of Zimbabwe	Faculty of Engineering and the Built Environment	Construction Engineering and Quantity Surveying	Honours Degree
		Architecture	Honours Degree
		Civil Engineering	Honours Degree
		Real Estate Management	Honours Degree
National University of Science and Technology	Faculty of the Built Environment	Quantity Surveying	Honours Degree
		Construction Management	Honours Degree
		Architecture	Honours Degree
		Property Development and Estate Management	Honours Degree
	Faculty of Engineering	Civil Engineering	Honours Degree
Harare Polytechnic	Civil Engineering	Architecture	National Diploma Higher National Diploma
		Civil Engineering	National Diploma Higher National Diploma
		Quantity Surveying	National Diploma Higher National Diploma
Bulawayo Polytechnic	Civil Engineering	Architecture	National Diploma Higher National Diploma
		Civil Engineering	National Diploma Higher National Diploma
			National Diploma Higher National Diploma

II. RESULTS

A total of 32 lecturers and 144 students successfully participated in the survey. The demographics of the respondents are summarized in Table III.

TABLE III. DEMOGRAPHICS OF RESPONDENTS.

	Number of respondents									
	Experience in teaching/learning in the Built Environment					***Experience in online teaching/learning in the Built Environment***				
Number of years	1	2	3	4	5+	1	2	3	4	5+
Number of lecturers	2	4	2	3	21	5	20	5	2	0
Number of students	30	61	25	28	0	38	94	8	4	0
	Lecturers' educational background				***Students' programme of study***					
	National/Higher National Diploma	Honours Degree	Master's Degree	PhD	Architecture	Quantity Surveying	Civil Engineering	Other		
Number of lecturers/ students	5	9	13	5	29	56	27	32		

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The data were analyzed using SPSS version 25. Interrater reliability was tested using the Cronbach's alpha, getting an

The respondents were further asked to rate, from their experiences and/or perceptions, the level of effectiveness of the online teaching and learning platforms in higher in enhancing student learning abilities.

For all the results on the implementation and the effectiveness of the online teaching and learning platforms, in order to decide on the use of either parametric or non-parametric tests, both the Kolmogorov-Smirnov and the Shapiro-Wilk normality tests were run, at a 5% significance level, to test the null hypothesis that there is no significant difference between the scores in the sample and a normally distributed set of scores, having the same mean and standard deviation (Das & Imon, 2016). In both tests, a sig value of 0.000<0.050 was obtained, as shown in Table IV and Table V, leading to the rejection of the null hypothesis and the conclusion that the data is not normally distributed. This therefore led to the adoption of non-parametric tests (Cooper & Schindler, 2014).

At a 1% level of significance, the Pearson chi-square independence of association test was run to test the statistical significance of the implementation as well as the effectiveness of the online teaching and learning platforms in enhancing students learning abilities. In both tests, large chi square values at p=0.000<0.001 were obtained as shown in Table IV. The Kruskal-Wallis test was further run for ranking the online teaching and learning platforms in terms of their level of implementation and their level of effectiveness in enhancing student leaning abilities. The ranking results are summarized in Table IV.

TABLE IV. ONLINE TEACHING AND LEARNING PLATFORMS..

Kolmogorov-Smirnov sig. value = 0.000	*Shapiro Wilk sig value = 0.000*	*Cronbach's alpha = 0.990*		
Online teaching and learning platform	*Chi-square test= 573.577, p=0.000*		*Chi-square= 346.836, p=0.000*	
	Cronbach's alpha= 0.990		*Cronbach's alpha=0.990*	
	Kruskal-Wallis mean rank			
	Level of implementation	Rank	Level of effectiveness	Rank
Zoom	551.64	4	562.88	4
Microsoft Teams	518.70	5	528.93	5
Google Classroom	846.11	2	812.52	2
YouTube	581.69	3	677.11	3
WhatsApp	991.94	1	890.91	1
Facebook	443.10	6	415.60	7
LinkedIn	382.32	7	427.56	6

V. DISCUSSION

A.Response rate and demographics of respondents

Of the total of 250 questionnaires distributed, 179 were returned. Of the 179 successfully returned questionnaires, 3 which were partially completed were discarded as this presented doubt on the commitment of the respondents in providing reliable responses in the context of the study. Resultantly, 176 successfully returned questionnaires were included in the data analysis. A high response rate of 70.4 % was therefore obtained which was very good, reliable and valid for the generalisation of the findings in the context of the population under study (Saunders, 2009). The distribution of respondents in terms of their professions, relevant technical experience in online teaching and learning, as well as their academic background was important for the reliability and validity of the findings, and is summarised in Table 3.

All the 32 lectures were teaching courses in programmes offered in the Built Environment, in Quantity Surveying, Architecture, Civil Engineering and other academic programmes in the Built Environment. As shown in Table 3, in teaching in the Built Environment, most (69.63%) of the lecturers had at least 5 years' experience and a total cumulative experience of 181years (average of 5.65years). In using online platforms in teaching in the Built Environment, most (84.38%) of the lecturers had at least 2 years' experience and a total cumulative experience of 62 years (average of 1.94 years). The lecturers were therefore, adequately experienced in their direct involvement in online teaching in the Built Environment in higher education in Zimbabwe, which guarantees reliability and validity of the findings. The lecturers were also asked to state their highest educational qualifications. Table 3 also shows the educational background of respondents. Most (84%) of the lecturers were holders of at least a university degree, through Master's degree up to PhD degrees, which further guarantees the respondents' adequate technical understanding of the subject under study, and therefore reliability and validity of the findings.

All the 144 students who responded in this survey were learning towards academic programmes offered in the Built Environment, with well representation in Quantity Surveying, Architecture, Civil Engineering and others, as shown in Table 4. First year students were purposively omitted from the study because of their limited experience in online learning in the Built Environment in higher education in Zimbabwe, in order to improve reliability and validity of the findings. As shown in Table, 3, 79% of the students who responded had at least 2 years' experience of learning in the Built Environment. 74% of the students had at least 2 years' experience of using online teaching and learning platforms in learning courses in the Built Environment. It was further noted that the students had a total cumulative experience in learning in the Built Environment of 354 years (average of 2.46 years) and a total cumulative experience in using online teaching and learning platforms in teaching in the Built Environment of 257 years (average of 1.78 years). These statistics show that all the students were directly involved in the use of online teaching and learning platforms in learning in the Built Environment in higher education in Zimbabwe, further guaranteeing reliability and validity of the findings.

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B. Reliability test

The Cronbach's alpha test was computed to determine the inter-observer reliability among the statements of all the 176 respondents in their responses throughout the questionnaire (Liao et al (2010). a Cronbach's alpha value of 0.990 was obtained. For interpreting Cronbach's alpha coefficients, Jain and Angural (2017) provide the following criterion: ≥0.90- Excellent; ≥0.80- Good; ≥0.70- Acceptable; ≥0.60- Questionable; ≥0.50- Poor, and <0.50- Unacceptable. An alpha value of 0.990, as indicated in Table 4 and Table 5, was obtained, which indicates excellent consistency among the responses given by the 176 lecturers and students, thereby guaranteeing reliability and validity of the findings.

C.Implementation of online teaching and

Using a 5-point Likert scale summated rating arrangement, lecturers and students in the Built Environment were asked to rate, from their experience, the level of the implementation of the online teaching and learning platforms identified from the literature in the Built Environment in higher education in Zimbabwe. The following scale measurement points were used: 1= Not at all; 2= Limited, 3= Moderate; 4= Fair; 5= Extensive. At a 1% level of significance, the Pearson chi-square independence of association test formed to test the significance of the relationship between the online teaching and learning platforms identified in thus study and their level of implementation in higher education in Zimbabwe (Wegner, 2013). The results are shown in Table 4. By comparison of observed and expected frequencies, at 24 degrees of freedom, a large chi-square value of 573.577 was obtained at $p=0.000<0.001$, indicating statistically significant implementation of the online teaching and learning platforms in higher education in Zimbabwe.

Kruskal-Wallis mean ranks (MR), summarised in Table 4, were using to determine the distribution of the level of implementation across the online teaching and learning platforms. WhatsApp, having the highest MR of 991.94, was the highest implemented online teaching and learning platform, in agreement with Maphosa, Dube & Jita (2020) and Mhindu (2020). The high levels of implementation of WhatsApp in online teaching and learning in higher education in Zimbabwe can be attributed to its widespread use in social networking. The advantages of low data usage, compatibility with cheap electronic gadgets and user-friendliness led to its prior adoption in the higher education system before the outbreak of the COVID-19 pandemic, which in-turn led to a shift from its use as an alternative to a sole lecture delivery method to a during the COVID-19 pandemic. Considering the financial challenges that educational institutions face in providing teaching and learning resources to lecturers and students and parents face in funding their students' higher education in Zimbabwe, WhatsApp proffers a sustainable solution that lowers the cost of online education, and is therefore the most favourable among other online teaching and learning platforms.

The second highest ranking on the implementation of online teaching and learning platforms was Google Classroom, with an MR of 846.11. The results are in consensus with Muderedzwa and Chilumani (2017), who witness evidence of the use of Google Classroom in online teaching and learning in higher education in Zimbabwe even some years before the outbreak of the pandemic. However, the absence of much literature on the use of gle classroom in higher education in Zimbabwe can be an indicator that it has not been significantly adopted as is the case in other developing countries, as noted by Santos (2021). The results therefore are possibly an indicator of the ascendency in the use of online teaching and learning platforms (Karakosa, 2021), intensified by its ability to simplify work in creating, distributing, and grading assignments and engaging students in learning online or remotely (Hidayat, 2021) as well as its ability to save time (Mali, 2017) and give convenience to the lecturers and students (Santos, 2021; Li & Tsai, 2017).

The third highest implemented online teaching and learning platform in higher education in Zimbabwe was YouTube, with an MR of 581.69. The results agreed with Li and Tsai (2017) and Farley et al (2015) who allude that viewing videos is very popular part of online teaching and learning in higher education. The fourth highest implemented online teaching and learning platform was Zoom, with an MR of 551.64. After Zoom followed Microsoft Teams (MR=518.70), Facebook (MR= 443.10) and Linkedin (MR= 582.32) in that order. The results concur with Zinyemba, Nhongo and Zinyemba (2021) who note that most Zimbabwean educators use Google Classroom, Zoom, Microsoft Teams and Google meet for online teaching and learning. The results are potentially a result of the adoption of online teaching and learning during the outbreak of the COVID-19 pandemic, which gave the higher education institutions room to adapt to the new era of complete and later partial reliance on online teaching and learning platforms. While the results show evidence of implementation of online teaching and learning platforms in higher education the Built Environment in higher education in, Zimbabwe, an enlightenment on their effectiveness in enhancing student learning abilities was also desired, as discuss below.

D.Effectiveness of online teaching and learning platforms

Lecturers and students in the Built Environment were asked, from their experience, to rate the effectiveness of the online teaching and learning platforms in enhancing students' learning abilities using 5-point Likert scale summated rating arrangement, with the following rating distribution: 1=Not Effective; 2=Of Little Effectiveness, 3=Somewhat Effective; 4=Effective; 5=Very Effective. At a 1% level of significance, by comparing observed versus expected frequencies, at 24 degrees of freedom, a large Pearson chi-square value of 346.836, at $p=0.000<0.001$ established that the online teaching and learning platforms identified in this study are effective for enhancing student learning abilities.

The Kruskal Wallis test were further used for the ranking of the online teaching and learning platforms and the effectiveness of the sub-categories of the online teaching and learning platforms, as summarised in Table 4 (Green and Salkind, 2008). WhatsApp was found to be the most effective (MR=817.23). This potentially emanated from its low data consumption Barhouni (2015) and its ability to increase

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teaching and learning intimacy between lecturers and students and also amongst students through continuous discussions throughout the learning period (Veytia-Bucheli, Gómez-Galán, & Vergara, 2020). The second most effective online teaching and learning platform in enhancing student learning abilities was Google Classroom (MR=812.52). This was potentially because of the ability of Google Classroom to simplify creating, distributing, and grading assignments and engaging students in learning online or remotely as noted by Hidayat (2021) and its ability to ensure effective communication and sharing (Chawinga, 2017). The results further concur with the findings of Zinyemba, Nhongo and Zinyemba (2021) who note that Google Classroom gives so much convenience to the educators that their work go on as usual out of the physical classroom interactions, as the students are able to interact with the students, post assignments and give learners feedback. The third most effective online teaching and learning platform was YouTube (MR=677.11). This was potentially a result of the ability of YouTube to effectively teach complex concepts through videos, resultantly giving teachers room to focus more on students' learning abilities rather than spending time explaining concepts (Farley et al ,2015). The fourth most effective online teaching and learning platform was Zoom (MR=562.88). This was potentially because of the ability of Zoom to provide students with a more engaging experience (Crawford, et al., 2020) and to offer access to increased educational resources, flexibility for the learner, valuable global interchange, and equal opportunities for students and teachers regardless of location (Arkorful & Abaidoo, 2015). The fifth most effective online teaching and learning platform was Microsoft Teams (MR=528.93), with the sixth being Linkedin (MR=427.56), and the least effective of the online teaching and learning platforms identified in this study being Facebook (MR=415.60).

V. CONCLUSION

The study aimed to find ways in which the use of online teaching and learning platforms in the Built Environment in higher education in Zimbabwe can be enhanced. On the foundation of existing literature on the subject, data was collected and analysed to determine the extent and effectiveness of the online teaching and learning platforms identified in this study.

A. Study findings

From the data analysis, the study came up with the following findings:

1.The study established that the most implemented of the online teaching and learning platforms in higher education in Zimbabwe is WhatsApp, followed by Google Classroom, followed by video watching on YouTube. In addition to the above, online teaching and learning in the Built Environment in higher education in Zimbabwe is also widely assisted through virtual classroom interaction on Zoom, Microsoft Teams and Google Meet.

2. It was established that the online platforms identified in this study are effective in enhancing student learning abilities. The study further established that the most effective of the online teaching and learning platforms in enhancing student learning abilities was WhatsApp, followed by Google Classroom, followed by YouTube and video conferencing platforms.

B. Conclusions

The study concludes that cost effective platforms are the ones that are most compatible with teaching and learning in higher education in Zimbabwe. Solutions that are compatible with cheap gadgets and which consume less data offer convenience to both lecturers and students in higher education in Zimbabwe, are the most favourable as they conveniently allow teaching and learning activities to continue even when the students are away from campus.

C. Conclusions

The scientific inquiry aimed at coming up with ways of improving sustainability in higher education in Zimbabwe through improving the use of online teaching and learning platforms in the Built Environment. Utilisation of the inevitable adaptation acquired from the COVID-19 era is recommended, for transformation to sustainable higher education in the Built Environment that does not solely depend on the traditional, campus based, physical classroom interactions, but rather also appreciates and taps from the potential positive augmentation of online teaching and learning, and harness it as a supplement into blended learning. A higher education system in the Built Environment in which students learn online, off campus and then come to the campus later during the learning period when necessary is envisaged, as it is more sustainable, cost and resource efficient, and more affordable to both to higher education institutions and to parents and guardians. On the online component of blended learning, the study therefore recommends the maintenance of the implementation of WhatsApp, due to its ready availability with almost every student and lecturer as a social media platform, its compatibility with affordable devices as well as its low data usage. Further, the convenience offered by Google Classroom is indispensable and should continue to manage online classroom activities. YouTube, Google Meet, Microsoft Teams, and Zoom should continue to be used for both synchronous and asynchronous online lectures. However, any practical components within course content of the courses are better reserved for on-campus, physical classroom interactions. Courses with almost 100% practical content such as Architectural/ Civil Engineering Drawing and Measurement of Construction Works are better scheduled for physical classroom interactions as learning them online will only do very little justice.

For a sustainable future in higher education in Zimbabwe, greater innovativeness by higher education institutions is needed to encourage and increase the level of implementation of the use of online teaching and learning platforms. Further and continual research on the latest, sustainable and cost-effective technological solutions to online teaching and learning should be sought in higher education in Zimbabwe. Partnering with international organizations in this regard will potentially yield more effective and sustainable solutions. Higher education institutions and guardians are encouraged to equip higher education lecturers and students with the necessary resources, in the form of electronic gadgets, reliable internet services and data bundles to promote convenient

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access to online teaching and learning platforms. The building of relevant infrastructure, provision of electricity and internet, and the adoption of latest innovative technologies that enhance online teaching and learning is recommended. The study has concluded that while on-campus, classroom-based interactions are indispensable in higher education, online teaching and learning is also, to a very great extent, compatible with online teaching and learning. A combination of the two is therefore most useful. A problem centred approach has been adopted, to proffer solutions to enhance online teaching and learning in the Built Environment in higher education in Zimbabwe whilst being cognisant of the existing challenges.

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