Evaluating STEM Lecturers 'Experiences with Digital Assessments and Continuity of Digital Transformation in Higher Education

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Article

Evaluating STEM Lecturers 'Experiences with Digital Assessments and Continuity of Digital Transformation in Higher Education

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Abstract: There are understandable signs that the COVID-19 pandemic has had a straining impact on the higher education sector in South Africa and the far reaches of the world. However, the necessary preparation and skills of lecturers and students are considered a major problem when integrating online education into teaching. The aim of the paper is to examine (Science, Technology, Engineering, Mathematics) STEM lecturers' experiences with digital assessments and perspectives on the continuity of digital transformation in the higher education sector in the post-COVID-19 era at one of South Africa's rural universities. In 2022, a survey of ten (10) lecturers was conducted and the reports were also consulted by four (4) e-learning practitioners to obtain their views on the use of online learning and contact courses in the post-pandemic period. A qualitative research approach was used to understand the puzzling issues faced by STEM lecturers at a previously disadvantaged institution in Limpopo Province. The results of this study show that there is a puzzling conundrum that hinders the integration of effective online learning. Furthermore, online education as the new normal in the post-COVID-19 era seems unattainable due to extremely complex and difficult-to-understand mathematical symbols. Software and tools proved to be limitations in terms of establishing an interactive learning environment for students and lecturers on online learning platforms. Lecturers' use of learning and teaching platforms deteriorated due to numerous unknown challenges, but also the tightening of COVID-19 restrictions. Furthermore, the results showed that science and mathematics lecturers believe that contact learning remains irreplaceable across generations and eras as some are not technology enthusiasts. This paper recommends that the lack of technological systems as well as technological resistance and reluctance to adopt transformative pedagogy and innovative practices should not be viewed as a thorny issue to end the dominance of online education in STEM courses.

Keywords: connectivism; learning management systems; affordances; technological resistance; moodle; transformative pedagogy

1. Introduction

In these uncertain times of the Fourth Industrial Revolution (4IR), faced with advanced technological changes, globalization, digitalization, and decolonization of curricular approaches in higher education, the question of what comes next in the The higher education sector is likely to require calculated speculation and some risk-taking initiatives. It is important to note that the COVID-19 pandemic has not onlycreated significant financial and operational challenges for higher education institutions in the short term but has also magnified the impact of demographic, financial, technological, and political structures that

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have been long-standing challenges in higher education sector. While lecturers remain committed to their institution's core mission in the face of these challenges, the lessons of COVID-19 have left a legacy that every institution must rethink the core values of the teaching and learning community. This paper has prepared this report to help institutions navigate the uncertainties ahead. The new urgency for online or blended learning in higher education institutions worldwide and in South Africa caused by the COVID-19 pandemic has created an opportunity to rethink and reexamine the higher education sector. Globally, this has laid the foundation for institutions such as higher education structures, university councils, and public and private education-related professional associations to design and adopt policies to accelerate blended learning practices to support teaching and learning post-pandemic. With some academic programs in higher education being delivered entirely online in 2020 due to the COVID-19 pandemic, major changes have been required in the academic staff who design and present the programs, as well as the students who deliver them. The change and adaptability to change have been somewhat challenging for both the teacher and the learner, with less training on some Learning Management Systems (LMS) offerings during the pandemic. In a sense, both lecturers and learners learned how to navigate online platforms to initiate learning and teaching activities. Traditional on-campus, face-to-face instruction will most likely return as the pandemic subsides, providing the sociocultural elements of the instructor, learning environment, technology, learning activities, and peers that support effective student engagement in undergraduate education. Crosling et al. [1] the development of students' higher-level skills such as critical thinking skills and technical skills. It is interesting to note that during the pandemic, students' preferences for online compared with traditional face-to-face learning and teaching activities shifted worldwide. This might have been due to some flexibility toward their studies rather than having a fixed and predetermined teaching and learning pace. Kandri et al.[2] argued that about 78, 83, and 78% of tertiary students in Malaysia, Canada, and China, respectively, indicated a preference for online learning dependent on the program tuition fees if were to be reduced accordingly. Generally, it is expected that an online program should cost less than a blended or full contact program. Evident to Kandri et al. [2] who highlighted that globally institutions of higher learning saw online learning as the solution to advance teaching and learning during the pandemic. Alammary et al. [3] attested that the Singaporean Government deemed it a general requirement of the education sector to conduct their teaching and learning online. Alammary [3] and Zitha et al. [4] argued that it is expected that post-COVID-19 there will be new educational models, policies, and learning methods to emerge or be adopted by institutions of higher learning. The likely teaching and learning method to be adopted is a blended learning method, which melds face-to-face teaching.

with online tools, or institutions going fully online for their teaching and learning activities. Zitha et al. [4] argued that blended learning has become immensely integrated in contemporary times owing to the emergence of COVID-19. Furthermore, they stressed that blended learning is an effective approach to meet the accelerated demands of the diverse student population in universities and colleges. Emerging from an in-depth study of the uses and perspectives of academic staff with Blended Learning in a Singaporean HEI [5], the science, technology, engineering, and mathematics (STEM) lecturers seemed to experience challenges in online learning platforms as learning and teaching activities and all forms of assessments were to be given and graded on the Moodle LMS. Technically, the institution prescribed LMS was not intensively explored on its affordances and was used before the COVID-19 pandemic. Learning and teaching activities by then were conducted on traditional face-to-face and paper-based learning. Henceforth, the instant shift from minimal use of the Moodle LMS to being the core tool used to enhance learning and teaching within the institutions brought about challenges to both lecturers and students.

Moreover, the academics at one of the South African rural-based and historically disadvantaged universities constantly raise concerns regarding the Moodle platform in

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mathematics and science-related modules due to unduly accommodation in the assessments uploaded on the platform. The institution encourages academics to extensively use Moodle over other platforms to integrate online classes and assessments.

Moreover, the assessments are mostly not easy to mark on the platform. The LMS affordances to STEM subjects seem lacking, which had a negative impact and vast challenges to teaching practitioners as well as to students when they attempt some of their assessment and module core competencies tasks.

2. Purpose of the paper

The aim of this study is to evaluate STEM lecturers' experiences with digital assessments and the continuity of digital transformation in the higher education sector in the post-pandemic period at one of South Africa's rural universities.

3. Research questions

- What experiences have STEM instructors at a rural university had with digital assessments in the COVID-19 era?
- How do STEM lecturers perceive the continuity of online learning as the new norm in higher education?

4. Theoretical framework

Connectivism is a well-known theory that became popular in published articles in 2005, for which there were two publications: "Siemens Connectivism: Learning as Network Creation" [5] and "Downes an Introduction to Connective Knowledge" [6]. The current digital and e-learning space focuses on teaching and learning activities and cognitive theoretical foundations based on connectivism, which is a departure from constructivism. Considering connectivism and its technological implications,

modern teaching and learning activities are based on this learning theory, which is based on a change in technology and the mandated LMSs by higher education institutions. Furthermore, this theoretical framework is used in this article as it focuses onunderstanding education in a period of digital transformation. It then emphasizes how Internet technologies such as web browsers, search engines, wikis, online discussion forums, and social networks relate to current ways of learning. The affordabilityof technology has enabled academics to acquire skills and share knowledge across the World Wide Web and with each other in ways that were not possible before the transition to digital transformation.

Learning does not simply happen in an individual, nevertheless, it is across the networks. Connectivism comprehends knowledge as a network and learning as a process of pattern recognition. The phrase "a learning theory for the digital age" indicates the emphasis that connectivism provides to technology's effect on how people live, communicate, and learn. In relation to this paper, connectivism becomes an integral part of establishing the interconnectedness between the lecturer and students with transformative principle-based pedagogy where the emphasis is on the joint construction of knowledge in a community of students through the aid of e-learning education systems and platforms.

5. Material and methods

In this study, the researchers used a qualitative research method in which the survey questionnaire was later quantified to determine the degree of the problem and the prevailing problems and challenges from the researchers' responses. Miles et al.[8] and Kuper [9] demonstrate the importance of using qualitative data collection approaches in the social sciences extremely effectively for the study of areas such as education, sociology, and anthropology. Most significantly, the use of this approach has increased in the health professions and education sectors. This method was used to obtain descriptive and empirical

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data from participants. This included frequency counts and percentages to identify the most common perspectives and challenges related to the questions. The researchers used a purposive sampling technique as the participants were interested in interest of the researchers' criteria as they used technological devices and navigated the online space during the hard lockdown period. The sample included a total of ten (10) STEM lecturers from different departments of the Faculty of Science, Engineering, and Agriculture and four (4) e-learning practitioners from the rural university in Limpopo Province, all of whom were scheduled to participate in the study, by first signing the ethical review consent form and later completing the questionnaire and narratives. However, only ten (10) academics and four (4) e-learning practitioners from the entire population of science lecturers responded to the questionnaire. This survey aimed to assess lecturers' experiences with digital assessments while enabling online lectures on various platforms. The data collected for this study were analyzed using thematic coding and descriptive statistics, with researchers carefully going through responses to classify the data by themes and academics' perspectives on the use of technology beyond the COVID-19 era in higher education institutions in rural area to better understand based universities. The researchers analyzed publicly available data, and surveys and interviewed lecturers and e-learning practitioners from rural universities in the South African higher education sector to large public flagship universities.

6. Results and discussion

6.1. Sociodemographic data of the participants

The population comprised six male academics and four female academics who are lecturing the science modules shown in Figure 1, wherein there is an integration of Moodle LMS. Subsequently, it was quite difficult to mark digital assessments for STEM courses and provide timely feedback to the students. The four male e-learning practitioners were interviewed to report on their observations and challenges encountered by the academics in the different faculties within this institution.

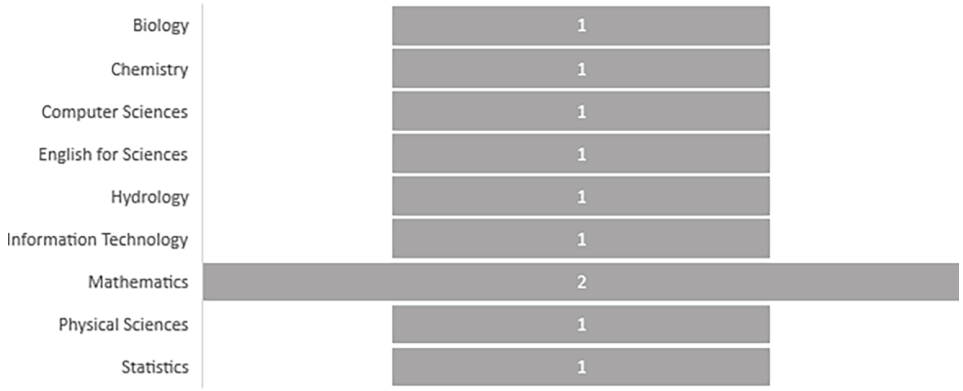

Figure 1. Science modules taught by the ten academic participants.

The responsibilities of the three e-learning practitioners focused mainly on supporting staff academics with mitigation of conundrums faced during the digital engagements and grading assessments for STEM courses (Figure 2). On the other hand, challenges around digital learning and teaching are not encountered by academics only, however, students are affected and therefore one of the participants was responsible for the provisioning of academic support to students (Figure 2).

 doi:10.20944/preprints202312.0069.v1

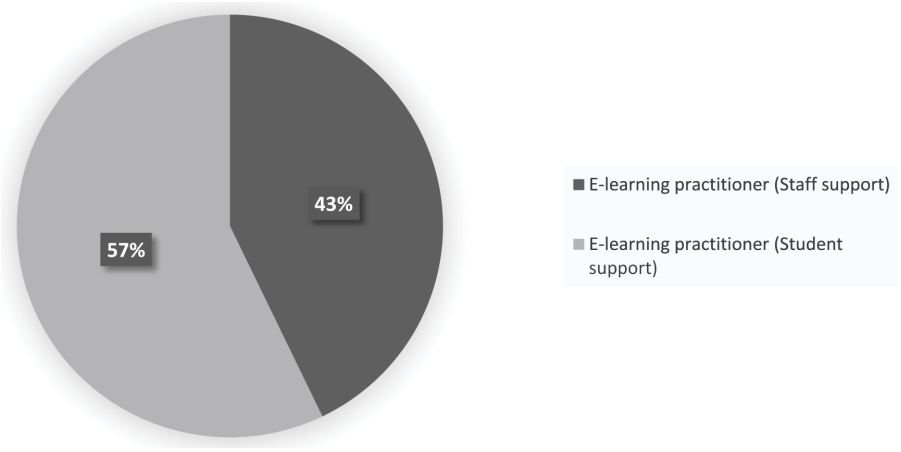

Figure 2. Accountabilities of e-learning practitioners.

Moreover, the data were collected through interviews among the lecturers in thescience-related courses. Subsequently, the consultation of the report was facilitated 03 by the e-learning practitioners to obtain the data for comprehension of the challenges observed through the teaching and learning activities. The students whom the lecturers taught were at the first-year level in the Science Foundation, Earth Sciences, and Mathematical and Computational Sciences departments at one of the rural-baseduniversities in South Africa. The findings of this study exhibit that there are significant issues and challenges that many academics and e-learning practitioners are encountering regarding the integration of blended learning as the new norm even in the post-COVID-19 era in higher education. Technological continuity as a new normal in the post-COVID-19 era seems to be unattainable.

6.2. Moodle LMS adoption

The table titled "Moodle Adoption Report" shows the active and inactive academics in line with the minimum online presence policy within the four faculties namely, the Faculty of Science, Engineering, and Agriculture, the Faculty of Health Sciences, the Faculty of Management Commerce and Law, and the Faculty of Humanities, Social Sciences, and Education. Moreover, the report further indicated the percentage of adoption within the four faculties in the university. The Faculty of Science, Engineering, and Agriculture recorded 29, 57%, the Faculty of Management, Commerce, and Law recorded 29, 09%, the Faculty of Health Sciences recorded 10, 62%, and the Faculty of Humanities and Social Sciences reported 26, 76% in relation to the Moodle LMS usage. Nevertheless, this study focused on participants from the three departments of the Faculty of Science, Engineering, and Agriculture (Table 1). Interestingly, the results of the report clearly illustrated a total of 16 online active academics out of a total of all teaching staff members of the three participating departments. Frankly, this notion resulted in an enormous number of 40 online inactive academics within these departments. The usage of Moodle LMS has deteriorated, and the adoption is quite cumbersome in terms of the percentage of academics who are actively integrating blended learning. Moreover, the continuity of digital education seems to be questionable based on the current realities of usage. As such, some of the lecturers indicated that the assessments will forever need a physical setting, not an online space, particularly in rural-based and historically disadvantaged institutions where connectivity infrastructures seem to be a major conundrum for students from remote areas. Some honestly indicated that they are reluctant to undergo proper training for Moodle and other online platforms and their students were mostly unable to engage in the ongoing discussion during the session.

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Table 1. Moodle adoption report.

Faculty	Online active staff	Online inactive staff	Staff total	Percentage adoption
1.SCI_ENG_AGAIC	55	131	186	29.57%
2. FMCL	32	78	110	29.09%
3. HUMAN_ SOC_SC	12	101	113	10.62%
4. HEALTH_SC	19	52	71	26.76%
11. Active with no faculty	28	0	28	100.00%
12. TEACH ASSISTANT	80	0	80	100.00%
A. Faculty of science mathematics and engineering				
Dept: Department name	No of activestaff	No of inactive staff	Total no	% Adoption
1.Dept: AGRICULTURAL_ ECONOMICS_AND_ AGRICULTURE	1	2	3	33.33%
2. Dept: ANIMAL_ SCIENCE	3	3	6	50.00%
3.Dept: BIOCHEMISTRY AND_MICROBIOLOGY	2	12	14	14.29%
4.Dept: BIOLOGICAL SCIENCES	6	12	18	33.33%
5. Dept: CHEMISTRY	3	13	16	18.75%
6. Dept: EARTH_ SCIENCE	5	11	16	31.25%
7.Dept: FOOD_SCIENCE_AND_ TECHNOLOGY	2	5	7	28.57%
8. Dept: FORESTRY	1	4	5	20.00%
9.Dept: GEOGRAPHY AND ENVIRONMENTAL SCIENCE	9	7	16	56.25%
10.Dept: INSTITUTE FOR RURAL DEVELOPMENT	0	5	0	00.00%
11.Dept: MATHEMATICAL_ AND_COMPUTATIONAL_ SCIENCES	9	26	35	25.71%
12. Dept: PHYSICS	1	12	13	07.69%
13. Dept:PLANT AND SOIL_SCIENCE	6	6	12	50.00%
14.Dept: SCIENCE_ FOUNDATION	2	3	5	40.00%
15. Dept: URBAN_AND_REGIONAL_ PLANNING	3	7	10	30.00%
16.Dept: AGRICULTURAL_AND RURAL_ ENGINEERING	2	3	5	40.00%

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A high percentage (70%) of some academics narrated that face-to-face is better than online since one can monitor students who attend the classes while on the platform, it is difficult for the academics to trace the students who are actively engaging in the content and those who are only available for compliance (Figure 3). Hwakoh [11] concurs with the difficulties of student online engagement when students show no interaction during the online lecture. On the other hand, 30% of academic participants thrived with learning the usage of the Moodle platform (Figure 3). These lecturers realized the significance of LMS usage as it brings up an improvement in terms of the quality of teaching [12]. Over and above, the online preference of some academics resulted from the LMS benefits such as interacting with students through assigning essay assignments, testing *via*

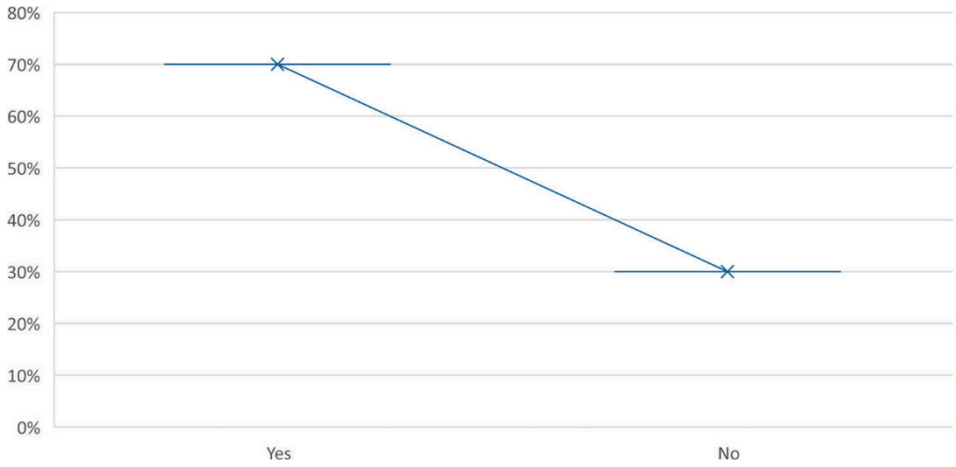

Figure 3. Lecturers' face-to-face preferences.

The multiple-choice questions, provision of presentation slides prior to lecturers [13], and detecting of students' participation through the online participation register. Furthermore, the results of this study indicate the preferred platforms (WhatsApp, Moodle, Microsoft Teams, and Google Teams) shown in Figure 4 that WhatsApp is more used than the other platforms due to students' data challengesas they are presently not receiving incentives from the institution. Moreover, the computer labs were not accessible to the students, and they had problems with the lack of devices for online classes. Students supported the use of WhatsApp while considering their financial circumstances and lack of technological devices to attend online classes and network connectivity problems in the comfort of their learning space. The lecturers provided feedback on students' assessments using these platforms, while interaction between the lecturers and students was quite unsatisfactory due to the network connectivity. This resonates with Tay et al. [14] articulated in their study that online learning depends on the technologies used at the time and the curriculum that is being taught. The researchers suggest that the platforms and different approaches should be integrated to achieve maximum learning.

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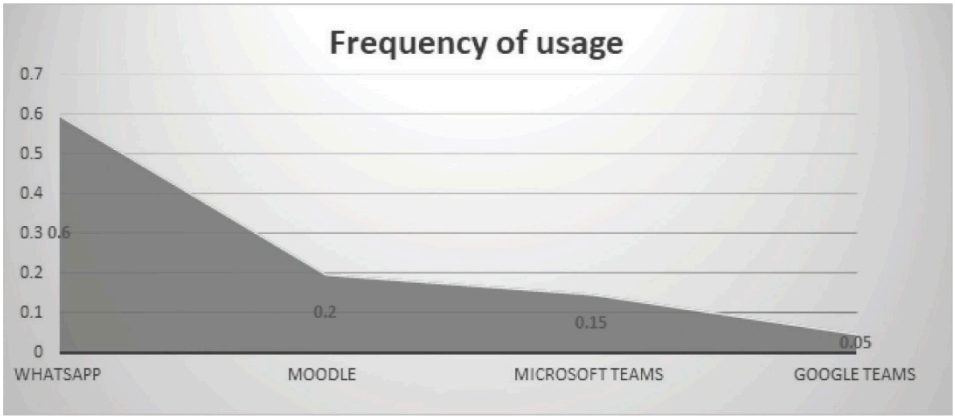

Figure 4. Frequency of use of online platforms by lecturers.

of studies conducted in this area, the findings of this study report that the digital competence of the users may be a solution to online learning.

6.3. Usage of the Learning Management System between students and academics

The e-learning practitioners expressed their concerns and major conundrums during their training, observations of minimum online presence, and daily consultation with the academics and students. The students' daily consultation had common problems, which among others encompass network connectivity, struggling to log into the Moodle LMS, and inaccessibility to the assessment activities uploaded by their module lecturers. Furthermore, e-learning practitioners further elucidated that academics have challenges concerning marking assessments and providing feedback on the platform due to inadequate mastery of the platform operation and navigation skills. This study is validated by the findings of Karuppiah et al. [15] who elucidated that it is imperative to recognize the type of student enrolled in the course to design a suitable interaction system that enables the students not only to learn but even to interact among themselves. Therefore, LMS's affordances come in handy in any prescribed learning and teaching e-platform as it determines and prescribes efficacy through use in learning activities within a course.

6.4. Complacency in the online setting

The findings of this paper reported that the biggest problem among others is complacency in the online setting and the academics tend to think that the online platform is conformable to constantly facilitate online classes while many students are mostly not participating and only available for compliance and procedural record keeping. Over and above, online classes have proven not to be solely independent due to the higher number of students who are not capacitated, and this poses an academic trajectory in many institutions. This study concurs with Dhawan [16] who pinpointed that face-to-face teaching has received dedicated support from students at all levels and has been viewed as more effective than online interaction as the lecturers and students tend to experience challenges. Lai et al. [17] argued that within a learning and teaching setup, its deliverables are on a web-based Learning Management System, results showed that students' frustrations were found in three folds:

(i) Lack of prompt feedback from the lecturer

Lack of prompt feedback denotes that STEM students were impeded from receiving proper guidance and timely feedback on learning and teaching progress. This ultimately relates to a lack of guidance, which, eventually, puts students at risk of not mastering concepts and not passing the module.

(ii) Ambiguous instructions on the Web

 doi:10.20944/preprints202312.0069.v1

Learning and teaching instruction must be explicitly stated and directed to students, however, in an online platform, students find that teaching and learning activities with competing deadlines may have ambiguous instruction and it is practically not viable to continue with the task until such time the lecturer ma clarify the instructions.

(iii) Technical problems

Amid online learning and teaching activities, STEM students raised concerns about technical problems they encounter on and with the LMS platforms.

These challenges cannot be resolved as expeditiously as needed; they may be escalated to e-learning support personnel. This could be frustrating to students as they may be facing an immediate need to use and participate in learning and teaching activities but fail to do so because of technical problems they encounter. Therefore, students find online support from technical at a later stage and this pose learning challenges with respect to the submission deadlines.

6.5. Fixed mindset and expectation

In this study, it was mainly reported that the transformative and flexible strategies and approaches were reluctantly considered by the academics in their attempts to adapt to the new normal. Furthermore, the findings revealed that most academics believed that contact learning remains irreplaceable throughout generations and ages as some are technophilic. This study is incongruent with the findings of Lai et al.[17]. The study outlined that face-to-face learning is irreplaceable and a cornerstone of any learning institution, even if the current discourse and technological revolution require the use of e-learning. Attard [18] further highlighted in comparison to a program that is run online and one that is not, students who are attending their course online face a few barriers to their full participation in coursework units. Henceforth, face-to-face learning is more powerful in terms of student engagement and participation than online learning. Moreover, online learning was and is still an effective approach to meet the accelerated demands of the diverse student population in universities and colleges.

6.6. Resistance to using technology.

The e-learning practitioners who were interviewed about their perceptions and perspectives on the continuous usage of technology in the higher education sector in the post-COVID-19 era indicated that the academics deteriorated the use of blended learning in their respective programs. This has been necessitated by the adjustment of COVID-19 regulations imposed on the indoor gathering capacity wherein there is a resurgence in COVID-19 cases. Subsequently, the findings of this study are consistent with Attard [18], which articulated that a major challenge for online learning is the one-size-fits-all approach, which does not do justice to student differences. This is further validated by the authors in Orlando and Attar [19] elucidated that emerging and experienced academics are reluctant to adapt to the digital transformation in their teaching practices and approaches. The researchers suggest that online learning should be integrated with contact sessions to mitigate decontextualized teaching classrooms while technical support ought to be provided to the academics who are unable to effectively use blended learning in their teaching.

6.7. Lack of technological skills

Based on the findings of this study, this aspect of technological deficiency has largely been in the responses of both academics and e-learning practitioners. Most lecturers stated that they are not well equipped with the technological devices usually used for online teaching and learning environments. Academic institutions were impelled by the COVID-19 pandemic to integrate technology when facilitating lessons. However, academics made use of social media platforms to compensate for their incompetency with Moodle utilization. Nevertheless, this

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strategy did not yield positive results as the students were unable to comprehend the feedback on their assessments owing to the unsatisfactory interaction with their lecturers. Significantly, there is a need for academics to be well-trained to use technology and LMS affordances skillfully and excellently. Unfortunately, Orlando and Attar [19] posit that the online environment presents several challenges for both academic staff and students who increasingly require higher levels of technological competency and proficiency on top of their regular academic workload. This should be done to ensure that they have the necessary competencies and proficiency to use the prescribed LMS to aid their academic activities. This study corroborates with Khoa et al. [20] whose findings exhibited that lecturers and students are mainly not thoroughly trained to navigate the Moodle platform affordances. Moreover, it attests to Khoa et al. [20] espoused that technology is expected to improve access to education, reduce costs, improve the cost-effectiveness of education, and maintain the competitive advantage in recruiting students in higher education.

7. Conclusion

In keeping with the purpose of this study, it is clear that the continuity of technology and digital learning still appears to be a difficult puzzle, as the STEM academics who participated in this study were completely unwilling to adopt transformative pedagogies and adapt to the online learning environment. Furthermore, the full realization of technology as the new norm in the post-COVID-19 era seems virtually unattainable due to the challenges and issues expressed by STEM academics and e-learning specialists. This is a prevalent area of concern as the COVID-19 pandemic state of emergency has exacerbated teaching and learning challenges due to distanced interaction. Conversely, it is important to note that the online space has been viewed as a temporary learning environment as most lecturers do not seem to welcome blended learning beyond the strict COVID-19 restrictions. Even though there is a change in basic assumptions in teaching and learning approaches. Most academics believe that contact learning remains irreplaceable across generations and ages as some are technology enthusiasts. Most academics used social media platforms to compensate for their inability to use Moodle.

8. Recommendations and implications for practice

To increase the acceptance of the use of the Moodle LMS by STEM lecturers in lectures, some business aspects should be considered, for example, the establishment of some guidelines. The policy needs to be implemented for the minimal online presence of academics and students to improve the use of the platform. Moodle training should be mandatory for both students and academics to provide them with the basic skills to use it. In addition to the training sessions, user-friendly manuals for STEM students should be developed to guide LMS users. Additionally, it is important to promote the utility of the platform by recognizing and rewarding instructors who use the platform effectively and imaginatively in the teaching process. Recognition and reward can be determined by clear criteria for assessing the quality of students' pass rate or outcome after acceptance by lecturers. Another useful indicator would be to compare student scores before and after using the LMS, as well as student satisfaction reports before and after implementing the LMS.

In addition, the formative assessments should be submitted in each module on the online platform every semester. The Moodle platform should be used to track students' active participation on the platform and impose penalties on those who do not actively use the assessment and learning tools. Lack of access to devices should not be used as a barrier to consider e-learning as a viable option to discontinue learning. The connectivity challenge in rural areas should not be used as a reason to ignore the significant potential of e-learning as an enabler to access and advance education. The digital learning challenge should be prioritized to encourage the lecturers to use it always, while all academics should be advised to conduct at least 30% of their assessments on the online system to increase the usage of blended learning.

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