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CONTEXT MATTERS: SCIENCE, TECHNOLOGY AND MATHEMATICS EDUCATION LECTURERS' REFLECTIONS ON ONLINE TEACHING AND LEARNING DURING THE COVID-19 PANDEMIC

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Abstract. *To limit the spread of the COVID-19 virus conditions of lockdown were enforced by countries globally. Universities and schools revised the mode of delivery from contact teaching to online teaching and learning. This qualitative research was conducted at one university in South Africa and explored STEM discipline lecturers' reflections on the use of online technologies and the factors which enable or constrain online teaching and learning. Three lecturers from STEM disciplines involved in online teaching were purposively selected to participate in this study. Data were generated via semi-structured interviews and reflective journals. The findings reveal that lecturers supplement the use of Moodle and Zoom with WhatsApp, the factor that enabled online teaching was the availability of data to lecturers and students. In contrast, the factors that constrained online teaching and learning were the technical training received for online teaching, the mismatch between pedagogy and students' learning styles, the pressure of balancing work-home life and assumptions made about the availability of conducive home environments for learning, connectivity, and availability of devices for online learning. These findings have implications for professional development for online teaching and recommend that universities adopt WhatsApp to be a formal platform for online teaching and learning.*

Keywords: *learning style, online teaching and learning, pandemic, reflections, WhatsApp*

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Introduction

The COVID-19 pandemic has disrupted and altered the way of our lives. Globally people are experiencing the new normal of staying at home, social distancing, wearing a mask and sanitising (Oprysko, 2020). To flatten the curve and contain the spread of COVID-19 countries across the globe enforced conditions of lockdown on their citizens. To save the academic year and ensure that no student is left behind, HEIs have had no choice but to offer remote online teaching and learning.

Globally, at educational institutions, the shift to remote teaching and learning is undergirded by many assumptions about favourable living conditions and access to technologically advanced devices (Lederman, 2020). Within the South African context, the reality is that many families live in conditions not conducive for online learning (Siegler, 2020; Winberg, 2020; Woolley et al., 2020) thereby intensifying the educational and digital divide for students who come from disadvantaged and rural backgrounds. Thus, the transition to remote and online teaching poses challenges for both lecturers and students.

Literature Review

Training

A review of literature on online teaching reveals that there is critique of institutions that provided inadequate training to academics (Islam et al., 2015). According to Jackson and Fearon (2013), these criticisms include insufficient training, training of poor quality, lack of hands-on activities to practice with technologies, lack of exposure on how to create online teaching and learning materials and an absence of exposure to the various pedagogies that can be used in online teaching. In other words, the training did not

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foreground the pedagogical requirements needed to engage in online teaching. Moreover, Maboe (2017) and Balaji (2010) emphasised that for students to engage in online learning they also need training on the use of the various technologies. In the absence of such training for students the responsibility to assist them, invariably falls on academics.

Learning Style and Cultural Challenges

Every student learns in her or his own way, which is referred to as her/his learning style. A student's learning style is her/his signature way of perceiving, processing, storing, and recalling information when engaging with a learning activity (Donahue & Glodstein, 2013). This means that the learning process is not homogenous for all students, in terms of how information is accessed, and the level, depth and quality of information processed. When a student prefers a particular learning style, it becomes problematic to learn in any other way (Bhagat et al., 2015). When lecturers are able to identify and understand the students' learning styles, it allows for the development and modification, of instruction as well as activities to support learning preferences in order to increase academic achievement (İlçin et al., 2018). Knowing the students' learning styles is beneficial for both the lecturer and student. It helps the lecturers to design lessons and activities to match their students' learning styles and get to know their students' strong and weak points, make learning more enjoyable, increase motivation for learning and learn how to strengthen students' innate abilities and skills (MacDonald et al., 2017). It benefits the students as it enhances their learning ability, increases their self-esteem and self-confidence, and students find out how to study in an ideal way and gain good grades on activities. Therefore, identifying students' learning styles is a critical step in understanding how to improve the learning process (Sywelem et al., 2012). According to Paullet and Pinchot (2014) unlike in face-to-face teaching, online students, do not have the affordance to the interactive discussion between the lecturer and other students. Thus, the online learning experience can be isolating. Therefore, in an online learning platform it is important for lecturers to be aware of the diverse learning styles of their students in order to facilitate learning and ensure that all students achieve academic success. Moreover, Zajac (2009) asserted that the success of online education is dependent on the alignment among learning materials, teaching methods and students learning styles.

Use of Online Technologies

Studies by Bates (2018), Basitere and Mapatagane (2018) as well as Bovermann et al. (2018), as well as Luk et al. (2018) on formal online learning platforms available for disseminating of the university curriculum to university students, Moodle is the most popular as it is free (and is zero-rated) and is used to download module outlines, readings, doing quizzes and slides. These above studies also indicated that the discussion forum on Moodle was not user friendly as it did not allow for active robust engagement between student and student as well as student and lecturer. To overcome the lack of effective engagement on the Moodle platform Khoza and Mpungose (2018), recommended the use of social media platforms like WhatsApp to compliment the use of Moodle. Similarly, to help prevent student isolation during remote teaching and learning Annamalai (2019) and Sayan (2016) called for WhatsApp, Facebook, and Twitter to be a part of online learning platforms at learning institutions.

Pedagogical Challenges with Online Teaching

Pedagogy entails using teaching methods that encourage and support learning, therefore, it is considered the cornerstone of any online-teaching and learning platform (Morley, 2010). It was in 2010 that Morley asserted much more than ICT skills are required for teachers to changeover from contact teaching to online teaching. Morley further explicated that it is vital for the content to be properly designed for online learning. In other words, it is not simply a case of moving content from face-to-face teaching onto the online platform. Teaching that foregrounds the transfer of contents or facts from teacher to students, has little or no room for students' active participation during the learning process as co constructors of knowledge (Uiboleht et al., 2018). The content focused approach to teaching favours the surface approach to learning among students (Lindblom-Ylänne et al., 2018). Instead of just transmitting knowledge to student, Roddy et al., (2017) urged teachers to subvert teacher centeredness in favour of student centeredness, by displaying expertise that facilitates student learning processes with them rather than for them. Moreover, online teaching approaches ought to foreground active student engagement in the learning

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process, where interaction between the teacher and the students as well as student and student are critical elements of teaching and learning.

Studies by Ertmer et al., (2010) and Makoe, (2013) elucidated the multiple anxieties teachers encounter when they have to include the use of technologies in their teaching, such as lack of training, lack of expertise, teacher beliefs, school ethos, fear of change and lack of training. Ertmer et al., (2010), further suggested that teachers need a paradigm shift to adjust their traditional pedagogic practices. Lack of time to plan and lack of practical experience in the use of technologies, is an obstacle that prevents teachers in the United Kingdom from integrating technology in their teaching (Haydn, 2011). Contrary to the above findings, Makoe (2013) study highlighted that within the South African context (more so in rural communities) most teachers are worried about an intensified workload. The complexity associated with online teaching requires teachers to question or reflect on their practices for their own professional development to improve, and to increase learner performance.

Theoretical Framework

Since this research reports on the reflections of STEM lecturers with regard to their experiences of online teaching and learning during the COVID-19 pandemic, the theoretical framework that undergirds this study is Schön (1983) notion of reflection on action and reflection in action. Schön (1983) touted reflection is a complex process during which teachers re- examine their teaching practice in terms of pedagogy, content knowledge, skills, student factors, and contextual factors that impact their teaching and learning environment. The purpose of reflection is to get a new perspective on practice, in this case online teaching and learning. As alluded to already by Khoza (2017) reflection is a process whereby teachers are cognisant of their actions at all times at three levels, namely professional, societal and personal to improve their practice. Thus Schön (1983) notion of reflection on action and reflection in action is applicable to this study.

Problem Statement

Literature is replete with studies (Awang et al, 2018; Beer et al., 2015; Islam et al.) on barriers to online blended learning under normal circumstances including studies on online distance learning. There is a paucity on studies exploring online teaching and learning during pandemics and conditions of lockdown.

This research therefore reports on the reflections of Science, Technology and Mathematics education (STEM) lecturers, at one university in KwaZulu-Natal, concerning their experiences of online teaching and learning during the COVID-19 pandemic. According to Loughran (2002), reflection involves thinking about one's teaching practice and establishing how it might be altered to enhance and promote learning. Khoza (2017) elaborated that during reflection teachers think deeply about their teaching at three levels, namely professional, societal and personal, in order to improve both teaching and learning.

Research Aim and Research Questions

This research responds to paucity on studies exploring online teaching and learning during pandemics. The aim of the study was to explore lecturers' reflections on the use of online technologies as well as factors that enable or constrain online teaching and learning. The research questions guiding this study were:

- What are lecturers' reflections on the use of online technologies?
- What factors enable or constrain online teaching and learning?

Research Methodology

General Background

This research which explored Science, Technology and Mathematics Education lecturers' reflections on the use of online technologies as well as their reflections on the factors, which enable or constrain online teaching and learning, adopted a qualitative approach. Cohen et al., (2018) state that qualitative researchers aim to explore the inner experiences of participants, and how they make sense of their context. The research embraced the critical paradigm. Cohen et al. (2018) explain that those that work in the critical paradigm venture beyond the scope of

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understanding a phenomenon, by seeking to change, emancipate and empower individuals. This "empowerment of individuals" is integral to critical enquiry (Kincheloe & McLaren, 2005, p.305). This study engaged Science, Technology and Mathematics Education lecturers in deep reflection about the use of online technologies and the factors that enable and constrain online teaching and learning, to create spaces for them to articulate changes that they wish to see to benefit both lecturers and students.

Study Context

This research was conducted at a teacher training university: Westwood University (pseudonym), in the province of KwaZulu-Natal. The university has a diversity of students in terms of context, cultural and economic backgrounds. Most of the students enrolled at Westwood University come from previously disadvantaged schools that lack basic resources.

Sample and Sampling

The participants in this study were purposively selected. Purposive selection entails the intentional selection of participants based on their ability to contribute to the phenomenon explored. The criteria for the selection of participants were that they had to be permanently appointed lecturers in STEM disciplines, namely Science, Technology and Mathematics Education lecturers, who were engaged in online teaching during semester one at Westwood University. Three permanently appointed lecturers, one from each of the above-mentioned STEM disciplines, formed the sample of this study.

Ethics

The autonomy of the participants was guaranteed using informed consent letters. Permission to conduct this research was obtained from the pertinent structures at Westwood University. Pseudonyms were used to protect their identity. Participants selected their pseudonyms. The three pseudonyms were Newton, Pythagoras and Ada.

Data Generation

Data were generated in two stages. During stage one of data generation, semi-structured interviews were used to obtain data from 3 lecturers. The interviews focused on technologies used during teaching, the training received for online teaching, the technologies they preferred to use and factors that enabled and/or constrained online teaching and learning. The interviews which were approximately 45 minutes in duration were audio recorded to facilitate the simple transcription of data.

The lecturers maintained a reflective journal during the second stage of data generation focusing on their online teaching and learning practice. The reflections were used to gain deeper insights into lecturers' practice in terms of online teaching and learning. The reflective journals' entries were juxtaposed with data obtained via the interviews to validate the findings.

All audio recordings were transcribed verbatim. Transcripts were sent to participants for member checking. According to Creswell, J.W. and Creswell (2017), member checking enhances the credibility of the study. Member checking allows participants the opportunity to read individual interview transcripts to ensure data were captured correctly on the phenomenon being explored and to avoid misrepresentation by the researcher due to the possibility of mishearing what had been said.

Data Analysis

Data were analysed using conventional content analysis. Conventional content analysis allows for codes and categories to emerge directly from the data obtained from participants without imposing preconceive categories or codes. According to Cohen et al. (2018), qualitative data analysis through conventional content analysis is appropriate because it allows the researcher to examine patterns of communication systematically, organise the data into categories, make sense of the patterns among categories, summarise findings and produce a written report. In this research, coding was used to categorise the data that had been collected via the semi-structured interviews

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and reflective journals. Coding is the process of identifying concepts or themes that are in the data (Creswell, J.W. & Creswell, 2017). It involves noting similarities and dissimilarities in the data (De Vos, 2004). In this research, open coding was used, it entailed breaking down, examining, comparing, and characterising data. The researchers read and re-read all the transcripts several times, noted codes that emerged from the data, searched for convergence and divergence in the transcripts, and thereafter assigned a term or phrase that described the meaning of the text or segment (Nieuwenhuis, 2016). The transcripts were read horizontally to group similar codes into themes and to respond to the research questions posed. The data were engaged with critically, and links within the data were established. The themes and categories for each research question are reflected in Table 1 that follows.

Table 1
Codes, Categories, and Themes

Codes	Categories	Theme
Moodle, video, quiz, discussion forums, WhatsApp	User-friendly technologies that facilitate online teaching and learning	Reflections on the use of technologies
Data from university, in touch with students, care, flexibility	Enablers of online teaching and learning	Reflections on what enables and constrains online teaching and learning
Training, Pedagogy-learning styles, the pressure of balancing work-home life, assumptions on connectivity, home life conditions and devices	Constraints of online teaching and learning	

Research Results

Reflections on the Use of Technologies

One category emerged on the use of technologies, namely user-friendly technologies that facilitate online teaching and learning.

User-Friendly Technologies That Facilitate Online Teaching and Learning

All three lecturers concurred that Moodle and WhatsApp are a central part of their online teaching, as is evident in the excerpts that follow:

> *I enjoy using Moodle, students submit their work online, I mark online, there are no problems with hardcopies being misplaced, it reduces time spent tracking student submission*, to keep *in touch with my students and address their queries I use WhatsApp.* Newton (Interview).
> *What I like most about online teaching, is that I do not have to be physically in Mathematics lecture room, I upload onto Moodle the module outline, readings, assessment tasks, rubrics for the task, audio-recorded power points, U-Tube videos and students can access them at any time at their convenience. I find WhatsApp to be an excellent, effective, fast and cheap way to communicate with students. I have created WhatsApp support groups for my students so that they are not left behind and are on par with learning, submission of assessments.* Pythagoras (Interview).

Similar sentiments were expressed in the reflective journal:

> *Moodle and WhatsApp do not use as much data as Zoom, Moodle is beneficial to students, especially those that engage in online quizzes and the discussion forums. The discussion forums allow students to express their ideas, critique ideas and collaborate. I have been using WhatsApp in my face-to-face teaching, and still use it now, to compliment the universities online*

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> *platform, WhatsApp allows me to conduct my Technology module as an extended conversation between all my students and me, especially during problem-solving and case studies it allows me to respond to queries and provide feedback to the student individually and in* groups. *I do use Zoom, for demonstration of practical work, in this way I ensure that Technology students are engaging with content, tutorials and practical work.* Ada (Reflective journal).

In the above excerpts, the technologies and their specific use during online teaching become visible. Moodle and Zoom are part of the university's formal online platform. Moodle is used mainly for content dissemination, student discussions, online quizzes, and submission of tasks. Ada reflects on using Moodle to allow students to share their ideas about technology, which suggests that Ada attempts to involve students in the online learning process. Zoom is used as an avenue to engage students in practical work through demonstrations, which suggests it is used to develop science process skills in students. WhatsApp is not a part of the university's formal online platform, but lecturers are reliant on WhatsApp to facilitate online teaching and learning. WhatsApp is used to address student queries, especially during problem-solving, dealing with case studies and it is also used to track student learning and provide feedback as well as create a community of support for students. The excerpts illuminate that lecturers used the technologies available to their students during online learning to engage students in all aspects of the module, namely content, tutorials, and practical work. Further, lecturers are aware of data usage associated with each of the technologies.

Reflections on What Enables Online Teaching and Learning

Lecturers considered the availability of data as an enabler. All three lecturers were grateful for the data that was available for online teaching and learning as is visible in the excerpts below:

> *The issuing of day time and night time data bundles to staff and students is truly welcome as it allows math students to engage in online learning daily, and not to fall behind in their studies, students can access these posts at their convenience, I post tasks thrice a week for my students to engage with problem-solving in Math, for me it is important that my students know their math content*. Pythagoras (Interview).

Data from the reflective journals concur with the idea that the availability of data is an enabler of online teaching and learning.

> *I'm just so glad the university provided data to our students. The majority of our students come from rural and disadvantaged backgrounds and do not have money for data. When students participate on Moodle, Zoom and WhatsApp, it allows me to keep in touch with my students, exercise virtual pastoral care over them, these are difficult times and we need to reach out to them, check if they are ok, be flexible with deadlines and assessments*. Ada (Reflective journal).

From the above excerpts it is conspicuous there are two very different reasons why data is considered as an enabler for online teaching and learning. The first, as alluded to by Pythagoras, is for teaching and learning purposes, which is for equitable and inclusive access for all students to keep abreast with their studies so that they are not left behind academically. This reason also links to the university's broader goal to save the academic year. The second reason, as mentioned by Ada, relates to the ethics of care for students, where compassion and emotional support are considered as the cornerstone of teaching and learning. The virtual pastoral care is seen as leverage to empower as well as reach out to students who are now working autonomously in remote areas. It is a means to ensure students feel valued, have a sense of stability and normality, have a positive experience of online learning, and are cared for during the COVID-19 pandemic, which has altered all aspects of the students' lives. Students are struggling to cope, and this raises serious questions about how we support our students through this severe crisis. Furthermore, the virtual pastoral care signals a shift in teaching priority from student excellence to student wellbeing and the need for flexibility with assessment, and to address what students need most to cope with the pandemic. Moreover, pastoral care is an aspect that encourages students to log onto the online learning platform, motivates them to attempt learning even though the pandemic and isolation is overwhelming. The impact of the pandemic on human lives is ubiquitous especially during the lockdown period, therefore care and support serve as a lifeline to the student.

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Reflections on What constrains Online Teaching and Learning

Training

All three lecturers concurred that the training received for online teaching and learning was more technical in nature than pedagogical.

> *The training was more on how to use zoom, Moodle and Kaltura to embark on online teaching and learning, the trainers assumed that the face-to face materials and its accompanying teaching strategy could be transferred directly onto the online platform. Online teaching and learning is not as easy at that, I found out the hard way … at first my Science students just didn't participate in the Zoom lectures, I was disappointed and devastated, you need different skills for online teaching, I'm concerned about how students are experiencing this isolation during online learning.* Newton (Interview).

Data from the reflective journal captures the above sentiments:

> *I attended every training session for online and remote teaching and learning organised by the university hoping to learn how to adapt my technology education module learning outcomes, content, assessments tasks, and gain insights on teaching strategies that could be used with the different technologies on the online platform. While my technology literacy skills improved my pedagogical skills were unaltered.* Ada (Reflective journal).

The above excerpts bring to the fore the University's training for online teaching and learning as well as lecturers' deeper pedagogical concerns about the training they received for online teaching and learning, which focused on technical up-skilling on how to use the various technologies. Lecturers in this research were at the coalface of online teaching, and they realised that they ought to be equipped with unique pedagogical content knowledge to provide a better learning experience for learners. Lecturers are deeply concerned about maintaining academic rigour and ensuring that learning outcomes are met. Lecturers concede that creating material for online teaching is extremely challenging as it goes beyond transitioning face to face material onto the online platform. As indicated by Newton, unique competencies are required for online teaching success which differs from that of face-to-face teaching. Lecturers were deeply concerned with how to initiate and sustain student rapport in an online context. Active engagement with academic material, lecturers and peers are core components of successful learning for students. If this rapport is absent, it will be a barrier to student success in the online learning process. Therefore, lecturers construed the training for online teaching and learning to be a constraining factor as it did not support the online delivery mode.

Pedagogy and Learning Styles

STEM discipline lecturers acknowledged the mismatch between their pedagogy and students' learning styles during remote online teaching and learning as is noticeable in the excerpts below;

> *My face-to-face maths lectures are very student centred, I know my students' strengths and weakness in processing and making sense of topics in math, I set a variety of tasks to cater for their different learning styles so all students can achieve success and remain motivated. Due to the technical nature of the training, we received for online teaching and learning, I find that my online teaching is teacher-centred and does not allow for much student participation and I am not happy with grappling by myself in trying to resolve this issue. Also, the quality of my online teaching is not assured.* Pythagoras (Interview).

Likewise, Ada expressed similar sentiments about pedagogy and learning styles in her reflective journal;

> *I haven't learnt how to adapt my face-to-face teaching strategies for online teaching, and I can virtually see my students struggling with the content presentation and assessments. I feel that my lack of pedagogical expertise for online teaching and learning is causing my students to be left behind…. many of them lack a background in high school science and a lot of the concepts in technology is related to science., I am finding it challenging to bridge this gap during online teaching. Another issue is the quality assurance of students work and, how to prevent cheating.* Ada (Reflective journal).

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According to the above excerpts, it is visible that the courses presented online are an emergency response to the COVID-19 crisis, it is education in crisis and that issues of quality or effective online teaching were not part of the training agenda for online teaching and learning. However, the lecturers in this study are concerned with enabling meaning, maintaining academic standard so that the qualification and their teaching are not compromised. Moreover, they are trying to pay close attention to the module design and delivery to align with students' learning styles. The lecturers are striving for high levels of expertise on the online teaching platform to make online learning relevant and cognitively accessible to their students. They are anxious about the quality of their online instructions and are not happy to replicate their face-to-face pedagogy and course design on the online platform. The carry-over effect that the constraining technical training lecturers received for online teaching contributes to dilemmas associated with (mis)matching pedagogy and students' learning styles during online teaching. With regard to the aforementioned points, it is worth noting that effective online learning is a by-product of careful and conscious design and mindful planning of instruction. The absence of the proper content design and instructional planning compromises the quality of online teaching and learning and impacts the time for students to migrate into emergency remote learning.

Pressure of Balancing Work-home Life

The rapid shift to online teaching and learning has placed tremendous pressure on both lecturers and students. In a short space of time, lecturers had to undergo training for online teaching, revised module templates for online teaching and set up tasks on Moodle. All these tasks were undertaken during conditions of lockdown, thereby depriving them of the opportunity of collaborating with colleagues. The excerpts below illuminate the blurring of boundaries between work-life balances for both lecturers and students;

> *Working from home is extremely difficult, you cannot have a clear demarcation between the work time and home time. It's a big blur if my child is crying, I have to attend to her while attending a zoom meeting or training. With online teaching my workload has increased twofold, there are so many administrative tasks that need to be completed by lecturers, I have to have lectures early in the morning or late at night as students have network and connectivity issues.* Pythagoras (Interview).
> *Students in my classes have complained that they are struggling to balance household chores with the time needed for academic work. They stated that their parents expect them to take care of their siblings as the university is closed and they (the students) are back home, they do not have the opportunity to discuss their schoolwork with peers* Ada (Interview).

Data from the reflective journal validate the ideas expressed above;

> *I am exhausted, online teaching is very taxing, in the face-to-face lectures we engage in team teaching, the isolation from collaborating with colleagues is nerve-wracking it is challenging trying to juggle teaching, the admin work, supervision, publishing and taking care of my home and family.* Newton (Reflective journal).

The pressure of coping with online teaching and learning, transforming course content for the online platform, the increased administrative workload, pressure to publish, supervision, juggling work-life balance while trying to cope with the new normal associated with the COVID-19 pandemic are seen as factors that impinge and constrain online teaching and learning. The home has now become the workplace in which home duties and work-related duties occur concurrently. Further, the COVID-19 pandemic and online teaching and learning platform have disrupted the work-life balance of students. Life is very different for students, as they must deal with competing factors such as family responsibilities, household chores, household rules and cultural norms that they did not have to deal with while living in student residences. Additionally, they are unable to physically engage with their peers in the lecture room, cafeteria, or shared spaces. Therefore, having to work from home disrupts the work-life balance and is regarded as a constraining factor that impedes online teaching and learning.

Assumptions about Home Life Conditions, Connectivity and Availability of Devices

The decision to embark on online teaching and learning was undergirded by a set of assumptions, namely students have conducive learning environments in their homes, they have access to mobile devices, and that they

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will have fast reliable network connectivity. These assumptions are factors that constrain online teaching and learning as is evident in the excerpts below:

> *I was saddened to see the living conditions of my students during my zoom lecture, I focused on one student who actively participates in my face-to-face lectures, I observed the tiny room in which she was in, she did not participate in the lecture, saying there was too much of noise, so she preferred to remain muted during the entire lecture.* Ada (Interview).
> *I saw a student sitting on a hilltop in a rural area during my zoom lecture, he told me he has connectivity issues daily, and has to move around until he is also to connect to the lectures. He also alerted me to the challenges on trying to connect to zoom using his cell phone as his laptop was stolen*. Newton (Reflective journal).

The inequalities and struggles students encounter with online learning are exposed via the above excerpts. The lack of infrastructure in rural areas such as limited bandwidth, lack of appropriate devices and poor living conditions, signals that we must move to an online teaching and learning platform that is asynchronous, bearing equity in mind as students share devices or do not have devices. The above finding illuminates first that online learning is reliant on technological devices and the internet, and second that students with bad internet connections and outdated technological devices could be denied access to online learning. This finding illuminates a new kind of under preparedness in students. Being at home, students had to cope with the lack of learning space and interruptions or intrusions to online learning. The above finding concurs with that of Roddy et al.'s (2017) study, which shows that for students from financially impoverished backgrounds, poverty levels set the ceiling for what is available to them in terms of living conditions, and access to internet facilities to embark with online learning. Therefore, it is easy for students from impoverished backgrounds to lag behind or experience multiple challenges with online teaching and learning.

The aforementioned assumptions which undergird online teaching and learning have implications for our online teaching, namely, we need to reduce students' anxiety by displaying high levels of flexibility with attendance, deadlines, methods of submission and communication. The above assumptions are hence regarded as constraints to online teaching and learning.

Discussion

Lecturers used the technologies available for online teaching and learning with ease, and used Moodle for the dissemination of content, online quizzes, and student discussion forums, while Zoom was used to engage students in a demonstration on practical work. The above finding pertaining to the use of Moodle concurs with that of Khoza (2017), which highlights that the Moodle platform is dominated by curriculum content because lecturers want to implement the prescribed module content. The findings from this study bring to the fore lecturers' reliance on WhatsApp to create a community of support among their students during online teaching and learning as well as the many benefits of using WhatsApp to complement the formal online platform of the university. The didact relevance of WhatsApp in supporting students who cannot access Moodle or Zoom is made explicit via the STEM lecturers' reflections. This particular finding signals the need for universities to incorporate WhatsApp to be a part of the university online teaching and learning platform.

The availability of data was considered as a factor that enabled online teaching and learning for two reasons. The first was that allowed all students access to the online platform for learning so that they could keep abreast with their studies. While this holds true, it is worth noting that Kapoor et al., (2018) asserted that accessing the online platform is dependent on network connectivity. The findings of this research illuminate that for a vast majority of students, who reside in remote rural areas with poor connectivity infrastructure, having data still did not grant them access to the learning platform. The implications are that alternative means must be found to ensure that students with connectivity challenges have equitable access to module materials and assessments so that they are not left behind academically. The second reason why data was considered to be a factor that enabled online teaching and learning was, it allowed lecturers an opportunity to embrace an ethic of care in their practice, especially during conditions of lockdown, when students are isolate, uncertain, overwhelmed by online learning. The finding from Noddings 2013 study, highlighted the importance of care during teaching and learning under normal circumstance is extrapolated to teaching and learning during pandemic conditions. The finding of this research is significant as it illuminates the need for further research into the kinds of care both students and lecturers need during the pandemic so that more knowledge is available on the nature of the care needed, and subsequent measure can be put

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in place to provide the care needed. The emotional cost of the pandemic on humans has not been established yet.

The following factors were considered as constraints to online teaching and learning, namely the training received for online teaching, the mismatch between pedagogy and learning styles of students, work-life balance pressure and assumptions about home life conditions, connectivity and availability of devices. Lecturers' criticism about the technical training they received for online teaching concurs with previous studies by Jackson and Fearon (2013) and Balaji (2010) which highlight the need to move beyond technical issues to address pedagogical challenges associated with online teaching and the obligation also to provide training to students to engage with online learning (Maboe, 2017). Lecturers were concerned about the lack of inter-person interactions on the online teaching and learning platform, and thus found it difficult to ascertain their students' learning styles on the online platform. The finding on lack of interpersonal interaction and engagement during online teaching and learning raises questions about student learning and social relationships during conditions of lockdown. Lecturers further questioned whether their pedagogy in use catered for students' learning styles. This particular finding coincides with that of Zajac's (2009) study which emphasises that the future of online education lies in the potential to craft various forms and methods of content delivery to provide students the affordance to choose online methods of instructions that match their learning style. Once again, the training lecturers received for online teaching is foreground in terms of pedagogy, knowledge of principles needed to design and facilitate online learning. Concerning work-life balance pressure, it is worth noting that both lecturers and students found it challenging to demarcate boundaries between work and home life, resulting in a blurring of boundaries with both lecturers and students experiencing feelings of being overwhelmed. This finding justifies the need for further research on working from home and how to maintain work-home life balance as not much is known on how to cope with working from home during conditions of lockdown. The lecturers noted the assumption made by the university about home life conditions of students, connectivity and availability of devices as impediments to online teaching and learning. These findings resonate with those of Lederman (2020) who also noted similar assumptions in the global north that impinged online teaching and learning under non- COVID circumstances.

Conclusions

This research explored STEM lecturers' reflections on the use of online technologies and the factors that enable or constrain online teaching and learning. At a methodological level, the findings of this research illuminated the value of critical reflection on and in action under conditions of crisis to gain new perspectives on online teaching and learning.

Furthermore, the finding of this research, with regard to training lecturers received to embark on online teaching, raises key questions about the pedagogical implication of the rapid shift to remote online teaching and learning. It is well established teaching requires a deep understanding of the curriculum, content knowledge, teaching strategies, assessments, students learning styles and learning context the above account hold true for online teaching as well. The mismatch between the technical training lecturers received for online teaching and the actual skills and expertise required in terms of pedagogy, planning, content design and assessment strategies to embark on online teaching was evident in the lectures' reflections. The technical training received for online teaching was an impediment for both lecturers and students as it subverted the initial goal of the university that no student should be left behind and compromised the quality of both teaching and learning. A recommendation arising from the above finding is for the university to provide professional development for lecturers in terms of pedagogy, content design and assessment for online teaching.

Lecturers reflections exposed the living conditions and the struggles students had with online learning due to the lack of proper infrastructure and the lack of alternative mechanisms in place to support students. If the pandemic prevails and remote online teaching and learning becomes the new normal, then consideration must be given to how the conditions of the lockdown intensify and further perpetuate existing social and educational inequalities, as vast majority of students who attend Westwood University are from previously disadvantaged backgrounds and many students come from rural backgrounds. The university has as it goals to address social and educational inequalities thus further reflective research is needed from the perspective of students, lecturers and all stakeholders involved in teaching and learning within the university sector on alternative mechanisms that could be put in place to support student with issues of connectivity, infrastructure, device and learning space.

Lecturers reflected that working from home was overwhelming as they were expected to engage with all their responsibilities such as lecturing, supervision, publishing, attending webinars, dealing with student queries,

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marking and developing online materials for teaching. Lecturers did not have time to deal with the impact of the pandemic on themselves. Consequently, they felt that they worked longer hours and could not demarcate boundaries to maintain a balance between home and work life. This particular finding raises questions on the impact working from home has on the quality of teaching and the time dedicated to preparation of materials and assessment of online tasks. Thus, it is recommended that more research and intervention is needed on how to balance work-life pressure when working from home during pandemic and lockdown conditions, and how to ensure quality in teaching.

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