Sustaining the Integration of Technology Pedagogies in Higher Education after the COVID-19 Pandemic

Sithulisiwe Bhebhe[*] (ID)
University of Eswatini & Central University of Technology

Schlebusch Luzaan (ID) **and Schlebusch Gawie** (ID)
Central University of Technology

Abstract. This study sought to determine the support provided to lecturers from selected universities in Southern Africa in sustaining the integration of technology pedagogies to train in-service teachers after the COVID-19 pandemic era. The study used a multiple case study design and a qualitative research approach as part of an interpretive research paradigm. The study was carried out at two Southern African universities that were conveniently chosen by the researchers as their places of work. A purposive sample of lecturers in the faculties of education that train in-service teachers was selected. Data were gathered through the analysis of documents considered relevant to the study from the studied universities. A focus group discussion was held with 12 lecturers, an open-ended questionnaire was completed by 9 lecturers and open-ended interviews with 6 HODs in the faculties of education were conducted. Data obtained from the participants and the documents examined were analysed using thematic analysis. The study's findings reveal that lecturers from both universities initially had limited knowledge as they were still transforming from face-to-face teaching pedagogies and needed to be knowledgeable about integrating technological pedagogies in training in-service teachers. Findings also show that the universities provided some internet connectivity for lecturers to use especially when they were on campus, but internet access was limited when they moved off campus premises. Institution A failed to give lecturers data for off campus usage, while institution B gave lecturers data for off campus usage, but load-shedding (regulated power outages) took a toll in the country where institution B is situated. The study concludes that lecturers received support from the universities where they work to enable appropriate technology pedagogy integration in the preparation of in-service teachers.

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[*] Corresponding author: Sithulisiwe Bhebhe; email: sithulisiwebhebhe@gmail.com/sbhebhe@uniswa.sz

1. Introduction

The COVID-19 pandemic compelled people to undertake more activities from home, including learning. As a result, education systems created online learning policies that were also applied to in-service teacher training programmes at higher education institutions (Ali & Kaur, 2020; Karma et al., 2021). Notably, the COVID-19 pandemic pushed education systems to reconsider the most effective teaching and learning pedagogies in light of the global health challenges experienced (Peters et al., 2022). The COVID-19 pandemic was a global problem that crippled economies everywhere also affecting the educational sector. Disruptions in the education system, which affected national growth, were brought about by the pandemic (Onoshakpokaiye, 2020). To lessen the negative impact of this pandemic, education systems moved toward e-learning globally. In particular, developing nations were faced with the challenge of switching from the conventional teaching style to online learning (Adeoye et al., 2020) and lecturers required support in the shift from face-to-face to online learning. This study explored the support given to lecturers by two selected universities in Southern Africa to integrate technology pedagogies in training in-service teachers.

Integrating technology pedagogies in in-service teacher training was one strategy for higher education institutions in Southern Africa to continue teaching and learning during the COVID-19 pandemic and for at least a few months post-pandemic (Mishra et al., 2020). Initially, most lecturers only used technology to design instructional materials or deliver lectures but did not effectively integrate technology into in-service teacher training processes (Gunuç & Babacan, 2018). Thus, it is important for higher education institutions to support lecturers to ensure that there is integration of technology pedagogies in in-service teacher training even after the COVID-19 pandemic era.

The World Health Organization (WHO) set regulations of social distancing individuals during the COVID-19 pandemic. This compelled higher education institutions to switch quickly to the use of technology in instructional delivery in the education system worldwide (Prokes & Housel, 2021). The use of technology-based pedagogies profoundly changed instruction in higher education institutions (Marcelo & Yot-Domínguez, 2019). Integrating technology in the teacher training process made it simpler to transition to a student-centred learning model where the lecturer no longer has entire control of the learning process, but students are leading in their own learning (Surtees et al., 2021). Learning management systems (LMSs) are currently a crucial part of the instructional process for higher education students (Turnbull et al., 2021). The transition from face-to-face to technology-based pedagogies required an unprecedented institutional resource commitment, which included buying synchronous web conferencing software like Zoom, lending hardware and software licences, and exponentially increasing the use of LMSs (Bass, 2022).

Prokes and Housel (2021) emphasise the importance of integrating technology pedagogies in higher education instruction for flexibility in situations where

learning is disturbed by natural disasters, distressing societal occurrences, or societal changes. By integrating LMSs, synchronous technologies, and other tools into their teaching methods, lecturers can adapt the educational process to the fourth industrial revolution (Xing & Marwala, 2017). During the COVID-19 pandemic higher education institutions switched to the technology pedagogies to ensure that technology was integrated in in-service teacher training.

University lecturers had to integrate technology pedagogies in in-service teacher training when millions of students in higher education were forced to attend their lessons from home due to the COVID-19 pandemic as there was closure of educational facilities around the world (Jena, 2020). This move emphasised the need to re-examine discussions about how technology and education interact, as well as the benefits of using digital resources to improve the education processes (Selvanathan et al., 2020). The findings of a study conducted in Malaysia by Henriques et al. (2021) reveal that when lecturers were forced to change their pedagogies and incorporate technology into their instruction because of the closure of institutions owing to the COVID-19 pandemic, higher education institutions had to purchase the appropriate technology tools for teaching and learning.

A study conducted by Pete and Soko (2020) in three sub-Saharan African countries, Kenya, Ghana and South Africa, revealed that laptops and cell phones were more commonly used in the latter two countries while Kenya used desktop PCs more than laptops and cell phones. According to Mishra et al. (2020), e-learning platforms that support the use of video, such as Canvas LMS, Moodle, Mahara, and open EdX, as well as platforms that adhere to certain standards for content storage, processing, management, and publication, were made available to lecturers in universities.

To use technology pedagogies in New Zealand higher education institutions during the COVID-19 epidemic, lecturers had to be trained to come up with original and creative solutions to integrating technology pedagogies in training teachers (Thomsen et al., 2021). In their study, Henriques et al. (2021) highlight the significance of training, as well as the difficulties and important considerations that come with the integration of technology pedagogies in higher education, as well as the opportunities provided by a post-pandemic educational reality. To maintain technology pedagogies even after the COVID-19 epidemic phase, training is thus one essential support that lecturers in higher education institutions need.

After the COVID-19 pandemic, blended learning policies saw a resurgence and began to trickle back into the education system (Bordoloi et al., 2021). Policies assisted in ensuring inclusivity in the education process. In an Indonesian study of teachers' use of the internet during the Covid-19 pandemic, Tamah et al. (2020) found a need to plan for online learning that matches the needs of each student in order to avoid escalating inequality and social divides. As a result, higher education institutions may need to support lecturers for the sustainability of technology pedagogies in training in-service teachers after the COVID-19

pandemic. Thus, this study explored the kind of support selected higher education institutions in Southern Africa put in place to sustain technology integration after the COVID-19 pandemic era.

2. Statement of the problem and objectives of the study

Many obstacles still prevent lecturers in Southern African universities from integrating technology pedagogies in the training of in-service teachers appropriately (Ziphorah, 2014). Universities in Southern Africa were forced to abruptly switch from face-to-face instruction to online learning during the COVID-19 outbreak, and it is anticipated that universities will continue to integrate technology pedagogies in the wake of the COVID-19 pandemic (Maphosa, 2021). According to Donnelly and Boniface (2013), lecturers need three to six years of consistent practice to integrate technology fully in the classroom. Lecturers had limited time to learn how to integrate technology into the classroom, to learn how to utilise technology, to develop instructional activities and to apply them in the classroom (Vrasidas & Glass, 2007). In this light, this study aimed to explore how universities in Southern Africa support lecturers in sustaining the integration of technology pedagogies in training in-service teachers after the COVID-19 pandemic era to promote pedagogy sustainability. As such the objectives of the study were to:

- Determine what support is given by the selected universities in Southern Africa to lecturers to integrate technology pedagogies in training in-service teachers;
- Identify the challenges lecturers have in sustaining the integration of technology pedagogies in training in-service teachers after the COVID-19 pandemic era;
- Suggest what the universities in Southern Africa may do to sustain the integration of technology pedagogies in training in-service teachers after the COVID-19 pandemic era.

3. Literature review

This section reviewed literature related to this study. Literature was reviewed under the subheadings of technology integration in higher education and theoretical framework.

3.1 Technology integration in higher education

Finding efficient means of supporting university lecturers in the process of integrating technology into their classrooms is crucial as access to technology becomes more common in higher education institutions (Ali, 2020). The COVID-19 pandemic created a shift in the global higher education community to online instruction and learning that requires a specific level of pedagogical content knowledge (PCK), particularly when it comes to planning and structuring improved learning experiences and developing unique learning environments with the aid of digital technology (Mishra et al., 2020). This meant that lecturers of different ages and backgrounds suddenly had to prepare and deliver their classes from home, frequently while most of them were without the required technical support (Hodges et al., 2020). Additionally, a major obstacle for university lecturers was their lack of the PCK required for online instruction (Ali,

2020). There is a need to consider the best ways to support lecturers' integration of technology into their lectures as higher education institutions extend access to and encourage the integration of technology pedagogies in in-service teacher training post-pandemic (Goh & Sigala, 2020).

The results of a study by Lai and Widmar (2021) in the United States of America (USA) demonstrate that lecturers teaching in rural-based institutions face challenges with the internet since they frequently have slower internet speeds and less reliable internet services. While many countries provide technology support for educational institutions, there is a need for higher educational institutions to support lecturers to gain technology knowledge in order for them to integrate technology appropriately in in-service teacher training (Green, 2017). According to another study by Dysart and Weckerle (2015) in the USA, while institutions offer centralised support for lecturers to use technology, there are not many opportunities for centralised professional development that simultaneously work to increase lecturers' technological, pedagogical, and content knowledge (TPACK) in higher education institutions because it is assumed that since lecturers are able to use technology, they already know how to incorporate technology into their lessons. Through centralised assistance for creating TPACK, Dysart and Weckerle (2015) devised a model for ongoing professional growth that enables lecturers to use technology effectively in their teaching strategies.

A study conducted by Almaiah et al. (2020) with 31 lecturers from six universities from Jordan and Saudi Arabia revealed concerns about lecturers' abilities to use technology pedagogies in higher education as they lack important information related to pedagogy and content. A study conducted in Canada by Ali (2020) points out that lecturer readiness, confidence, and motivation play important roles in integrating technologies in higher education. Ali (2020) also suggested that lecturers should employ technology and technological gadgets to improve learning, but did not specify how this may be sustained.

Akram et al. (2021) found that lecturers in Pakistan have a favourable attitude toward the use of virtual learning environments. The challenges lecturers encounter that prevent them from providing successful teaching and learning include their limited experience applying technology-based pedagogies and their need for a suitable ICT infrastructure to manage the associated technical challenges. The results of a study by Adeoye et al. (2020) reveals that in the Nigerian education sector the integration of technology pedagogies in higher education is challenged by the institutions' different levels of preparedness, a lack of infrastructure, a lack of resources, and problematic policies. Similarly, a study conducted by Ifinedo et al. (2020) reveals that in Nigeria three constructs have a direct impact on technology integration: perceived technological knowledge, instructors' knowledge, and perceived knowledge for integrating technology. In Tanzania, a study conducted by Mtebe and Raphael (2018) reveals that lecturers had a moderate level of trust in all TPACK components while using technology. In the same study, it was found that lecturers had high levels of confidence in their content knowledge, pedagogical expertise, and PCK but not with integrating the knowledge components. Thus, there is a need to ensure a suitable ICT

infrastructure for lecturers to use, appropriate resources and knowledge on how to integrate technology, content and pedagogies as well as support for the integration of technology in in-service teacher training through well-structured policies in higher education institutions.

In South Africa, Zhuwao (2017) points out that ICT strategy and the drive for an outcome-based education (OBE) model of instruction can both be realised with the adequate use and awareness of technologies and technology pedagogies. Khoza (2021) points out that higher education institutions in South Africa were compelled by the COVID-19 pandemic to transition to a digitalised curriculum (DC). The DC is a strategy for or of education driven by digital technology. Universities were forced to relocate to a DC in order to finish the 2020 academic year due to the WHO restrictions that advocated social distancing which led to closure of the campuses. Khoza (2021) indicated that there was migration to technology integration in higher education institutions by using WhatsApp, Facebook, Skype, and Zoom video conferencing technology (ZVCT). The migration started by fostering societal identity while maintaining professional identity by utilising Moodle.

3.2 TPACK theoretical framework
The Technological Pedagogical Content Knowledge (TPACK) theory guided this study as it outlines the types of knowledge necessary for a systemic integration of technology into in-service teacher training (Mishra, 2019). The emphasis in modern teacher education is on general pedagogical teaching methodologies, as opposed to the traditional focus on subject matter knowledge or content that lecturers have (Howard & Milner, 2021). Fernandez (2014) emphasised the value of teachers' methodological and topic knowledge in the late 1980s in order to provide a new viewpoint on teaching and learning. The relationship between lecturers' pedagogical and content knowledge for instructing in-service teachers in a university context is reflected by Fernandez's (2014) perspective on PCK. Effective teaching relies on well-integrated knowledge from several knowledge domains, despite the fact that it was anticipated that PCK would have the biggest influence on lecturers' activities in in-service teacher training (Gasteiger et al., 2020). Technological knowledge is another area of knowledge that has lately emerged and has to be addressed (Botha et al., 2014). Figure 1 shows the TPACK diagram.
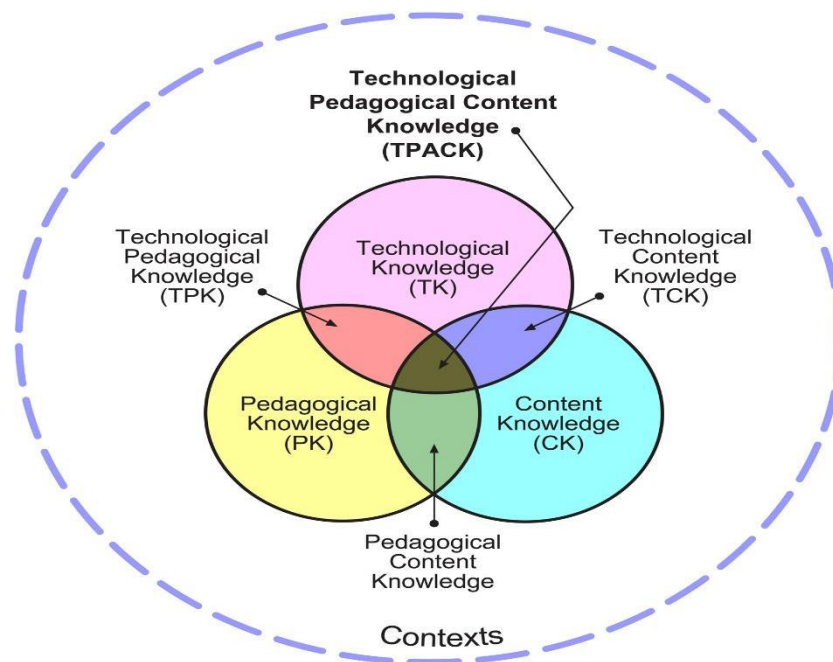
Technological Pedagogical Content Knowledge (TPACK)

Technological Pedagogical Knowledge (TPK)

Technological Knowledge (TK)

Technological Content Knowledge (TCK)

Pedagogical Knowledge (PK)

Content Knowledge (CK)

Pedagogical Content Knowledge

Contexts

Figure 1: TPACK framework (Adapted from Koehler & Mishra, 2009, p. 63)

Although it was expected that lecturers in higher education had picked up technological and pedagogical skills along the way, this may not always be the case. Before entering the field, lecturers were not necessarily exposed to formal training in these areas (Oleson & Hora, 2014). The four separate domains formed by the intersection of the three knowledge domains that make up the TPACK framework are shown in Figure 1: technological pedagogical knowledge (TPK), technological content knowledge (TCK), pedagogical content knowledge (PCK), and finally technological pedagogical content knowledge (TPACK) are required by lecturers in higher education. Each of these domains denotes a knowledge base needed by lecturers to integrate technology successfully into in-service teacher training (Koehler & Mishra, 2009).

Using TPACK as the theory guiding this study offered a useful strategy to ensure the integration of technology pedagogies in in-service teacher training, as TPACK reflects the space of the three categories of knowledge, technology, content, and pedagogy, in teaching (Cui & Zhang, 2021). TPACK can direct lecturers to employ particular technological tools, hardware, and software applications to aid in the learning of content by differentiating between the three categories of knowledge (Mishra & Koehler, 2006). The necessity for teachers to combine their understanding of material, pedagogy, and technology is also made more apparent by TPACK (Jiawei & Zuhao, 2021). Therefore, TPACK is commonly considered as a powerful analytical tool for integration of technology pedagogies in in-service teacher training.

4. Research methodology
The study used a multiple case study design (Halkias & Neubert, 2020) and a qualitative research approach as part of an interpretive research paradigm (Scotland, 2012). The study was carried out at two Southern African universities

that were conveniently chosen by the researchers as their places of work (Mudavanhu, 2017). A purposive sample of lecturers in the faculties of education that train in-service teachers was taken (Tapala et al., 2021). Data were gathered through the analysis of documents considered relevant to the study from the studied universities. A focus group discussion was held with 12 lecturers, an open-ended questionnaire was completed by 9 lecturers and open-ended interviews with 6 HODs in the faculties of education were conducted, making a total of 27 participants (Arving et al., 2014). The open-ended interviews with HODs were done via the internet. This allowed participants to provide information while remaining in the privacy of their offices.

A well-designed questionnaire includes question items that are relevant to the study's research topics and may include lists, brief replies, or long narratives. To give information needed to answer the research questions, all purposely sampled lecturers were emailed open-ended questionnaires to complete. However, generating data from an open-ended questionnaire in this study was a challenge as the term "in-service teachers" was commonly used in one of the institutions. The researchers then advocated for a focus group discussion with the participants who responded well to the call. This was effective as the information needed from the participants was obtained.

In this study, the lecturers who had not managed to answer the questionnaire were invited to a focus group discussion that consisted of lecturers from both higher education institutions under study. Six participants fully attended the focus group discussion from institution A, while out of the 6 participants from institution B one left a few minutes before the end of the discussion to attend a lecture but after significantly contributing to the discussion. Focus group discussions also assisted triangulation of data collection methods, such as virtual interviews, questionnaire and document analysis used in the study. Nyumba et al. (2018) state that focus group interviews generate data for a study in order for the researcher to better understand the subject. In this study, focus group interviews confirmed the information obtained from document analysis and questionnaires completed by lecturers.

Document analysis was utilised in this study, together with open-ended interviews and open-ended questionnaires, to collect data from the study participants on how they integrate technology pedagogies in teacher education. We double-checked the authorship of the documents to ensure that they were genuine and trustworthy. We were able to determine the state of the documents by checking their legitimacy. Documents were also checked for credibility. The credibility of the materials examined in this study was reviewed to ensure that they were free of errors or distortions. This was accomplished by comparing the dates of the documents to the activities they detailed. For example, it was confirmed that the author was present at the events described. Data generated from the participants and the documents examined were analysed using the thematic analysis.

5. Results of the study

The results in this study on the support given to lecturers for technology integration in training in-service teachers were presented under the themes: support through training of lecturers, supporting lecturers through technological tools, support through policies and support through data provision and connectivity.

5.1 Support through training of lecturers post COVID-19

Technology requires training and support to be successfully utilised. The participants were asked if the institutions had supported the lecturers with technology use in the training of in-service teachers.

In institution B a document from the Centre for e-Learning and Educational Technology (2022) states that its aim is: "*To provide and manage e-learning and educational technology initiatives for academic staff and students to support teaching and learning*". This is affirmed by the HOD from institution B who stated: "*The University does provide some kind of training with technology to use these online platforms for instance, to make sure that lecturers integrate technology pedagogies in training in-service teachers.*" On the same note Lecturer 2 from institution A revealed: "*The university has made efforts to train lecturers to integrate technology pedagogies and we have support staff who assist us for instance with regards to the Moodle platform, there is ongoing training that the university offers through the Centre for Excellence in Learning and Teaching.*"

Lecturer 1 from institution B also indicated: "*Our faculty has technologists who are trained in IT and continue to support staff with the use of technology, learning management system and tools used in integrating technology pedagogies in training in-service teachers.*" Similarly, Lecturer number 3 in a focus group discussion mentioned: "*We also have technicians and administrators who assist with the various technologies that can be used when one wants to integrate technology in their teaching.*" Similarly, Lecturer 4 from institution A stated: "*As lecturers we are currently being trained in online pedagogies using the university internet connectivity and getting knowledge on data projection equipment*". Again Lecturer 1 from institution B in the open-ended questionnaire pointed out*: "The University has supported us by providing ongoing training on technology integration to staff … we really appreciate what the university is doing.*"

HOD2 from institution A stated: "*What I do is to encourage the lecturers in the department to attend workshops on integrating technology into teaching and learning.*" Similarly, the document from the Centre for e-Learning and Educational Technology in institution B states: "[The Centre] *trains and supports lecturers in the development and implementation of blended and online learning.*" HOD3 from institution A stated: "*The lecturers make sure they attend the workshops that the institution of Distance Education and the Centre for Excellence for Teaching and Learning organise for training lecturers in integrating technology pedagogies.*"

Lecturer 5 from institution A also revealed:"*The University has an opportunity through the Institution of distance learning to organise facilitators from different parts of the world to give workshops where lecturers are trained on how they can integrate technologies in their teaching.*" In a focus group discussion Lecturer 3 from

institution B pointed out: *"During the COVID-19 pandemic, there was this drastic shift, I had to get some training from the institution, into using the Learning Management System (LMS) to teach."* HOD4 from institution A also said: *"Now some lecturers also in the department have been trained to use LMSs and can integrate technology into their teaching. We ask some of those lecturers to assist those that are still struggling in integrating technology in their teaching."*

The data generated from the research participants reveal that lecturers from both studied institutions are receiving training in integrating technology pedagogies in training in-service teachers. Apart from peers assisting each other, support comes from the different sources in the universities, while universities also get external support from facilitators organised by the responsible departments in that university. The participants also revealed that the universities have technical staff who assist lecturers with technology knowledge that they use in the quest to integrate technology pedagogies in training in-service teachers.

5.2 Supporting lecturers through technological tools

The participants were asked about the technological tools support they were received in their universities. The document on Web Services Support in institution B revealed*: "The unit enables staff to perform their duties by ensuring that staff and students have access to the information they require at all times via their desktop computers"* (ICT Services, 2022). This was confirmed by the HOD from institution B who mentioned: *"Every lecturer has a desktop in our institution and internet for them to access information, prepare for lectures and provide feedback to the students."* HOD5 from institution A stated*: "We have desktops which are connected to the university internet. We also have a small laboratory with desktops which are accessible to in-service teachers and these desktops were donated to the department by the Ministry of Education."* Lecturer 2 from institution A in a focus group discussion confirmed sentiments from HOD5 that in institution A: *"We did get a donation of computers from the Ministry of Education. I think we got about ten (10) computers from the Ministry of Education, to help us in that area."* Similarly, Lecturer 4 from institution A said: *"We buy our own laptops."* Lecturer number 2 from institution A also said: *"If any lecturer needs a desktop, a budget is made to buy them a desktop computer, but the university process of buying is long. The university has never bought us laptops but has bought us projectors that we share as departments."* On the same note HOD3 from institution A commented: *"The only thing that we have in our offices is just computers-desktops which were provided by the university…the only thing that I have in this office is just this desktop and nothing else without even a connection to Wi-Fi. That is how difficult it has been. So practising or trying out some of the suggestions that we get from the workshops that we attend is highly impossible."*

Similarly, HOD1 from institution A indicated: *"We agree with the university in principle, that they have to provide us with all the necessary technology like webcams for instance, in order to teach on Moodle and also the computers as well as laptops that we need to do this and many other gadgets but unfortunately the university has been very slow, but they always promised that they are working on it."* On the same note HOD3 from institution A mentioned: *"We have not done enough as an institution. The level of acceptance is very flat. It is like the institution was caught unaware. This is why the institution is always meandering between face to face and online lesson delivery.*

Consequently, members of staff don't see the need and the pressure to fully committee themselves on using technological pedagogies." HOD2 from institution A concurred saying: *"The University has never supported us with technological tools. We only have desktops and we also have a TV. Just one TV and it is used by the faculty, but as a department we sometimes get to use it more especially when our students are presenting peer teaching, but then we also have a few projectors."* Similarly, HOD4 from institution A mentioned: *"The University has only provided some lecturers with desktops while some are using outdated desktops that are not user friendly as a technological tool used in training in-service teachers."* Contrary to the view by HOD4 from institution A, Lecturer 5 from institution B said*: "The University has provided us with desktop computers to ensure that lecturers' access information at all times. We also are supported in online tools, like similarity check software and online survey software."*

Participants in this study revealed that lecturers from both universities received support from the universities through desktops. While participants from institution A mentioned that the university has never provided them with laptops to work away from the institution, participants from institution B mentioned that they also are supported in online tools, like similarity check software (Turnitin) and online survey software (QuestionPro) as a way to enhance the integration of technology pedagogies in in-service teacher training.

5.3 Support through policies
The participants were also asked about policies in the universities that guided the integration of technology in the training of in-service teachers. The participants revealed that there are policies that recommend the use of technology in instructing in-service teachers. HOD1 from institution A noted: *"Currently, after the COVID-19 pandemic the university has advocated for a blended learning policy and they are nurturing the policy through training staff currently."* Lecturer 1 from institution B also mentioned that during COVID-19 the institution delivered classes through e-learning but currently there is blended learning. This view is confirmed by the document from the Center for e-Learning and Educational Technology (2022:1) in institution B which points out that the centre is mandated to: *"train- and support- lecturers in the development and implementation of blended and online learning."* Similarly, the Centre for Excellence in Teaching and Learning (2022:1) in institution A has started to pursue *"the goal of shifting the university to remote delivery."* On the contrary HOD3 from institution A stated: *"Currently, we have a policy that the institution is using blended learning. I think we need to have sound policies that govern the integration of technological pedagogies in the instructional process. We also need a strategy of how to implement and that would include getting the tools ready. We need to have a committee that will look into how the policies set are implemented. We need to have proper guidance on how to integrate technology pedagogies in training in-service teachers."*

On support through policies, the participants in this study revealed that both institutions were now using blended learning as the policy after the COVID-19 pandemic. Institution A is aiming at shifting the university to online learning in training in-service teachers, while institution B is aiming at using blended learning and online learning in training in-service teachers. However, participants

in institution A still view the policy as not really clear as to how the integration of technology pedagogies in training in-service teachers should be done.

5.4 Support through data provision, connectivity and challenges experienced

The researchers asked the participants how the universities supported the lecturers' connectivity to the internet. The ICT services (2022, p.1) in institution B are mandated to: *"Provide effective network availability and connectivity to ensure optimal functionality and productivity of employees."* This was confirmed by Lecturer 2 in institution A who stated: *"Our university provides us with data to use even when we are off campus."*

On the contrary Lecturer 4 from institution A described a challenge: *"We buy our data. Sometimes we use our own internet, Wi-Fi gadgets, just to pick up the university internet when it's weak."* Similar to the view by Lecturer 4 from institution A, HOD2 from institution A complained: *"Some of these computers that we have are not connected to the internet."* Lecturer 3 from institution A elaborated: *"Most of our offices in this university use the plug-in internet, but some old desktops are not compatible with the plug-in internet and are not connected.* Lecturer 1 from institution A pointed out another challenge: *"There are also very few spots in the university that have WIFI but most of the areas do not have Wi-Fi. Mine for example is not connected to the internet."*

On the same note HOD1 from institution A said: *"The university has never provided data to lecturers nor the in-service teachers under training to ensure that there is teaching and learning online. They just tell us that we can teach from home because the students are on Class Boycott or most importantly COVID-19 or whatever, but no laptops nor data provided. They just assume we have our own gadgets and our own data and they expect us to use our own data."* Lecturer 1 from institution B described the problem: *"Connectivity is a challenge because of insufficient internet due to load shedding that has been implemented in our country. So as much as we want to be effective, but now, the integration of technology is distracted by unavailability of electricity in some instances."*

Participants in this study revealed several problems experienced in their institutions regarding the integration of technology pedagogies. The participants revealed that problems with internet connectivity and data provision. In institution A, the institution cannot afford to have a wider internet broadband to cover all campus areas for lecturers and students and lecturers rely on the plug-in internet. Some lecturers have desktops that are not even connected to the plug-in internet. Institution A also cannot provide lecturers with data to use off campus, while institution B has it all but suffers from electricity power cuts.

5.5 Suggestions on how to sustain the integration of technology

Participants in this study were asked to suggest what could be done to sustain the integration of technology pedagogies in training in-service teachers in their institutions. HOD3 from institution A stated: *"The university should purchase the correct gadgets smart for integrating technology in teacher education"*. HOD2 from institution A concurred with HOD 3 from the same institution and stated: *"I would like to see the university providing the lecturers with the gadgets that they need. So that the technology may be appropriately integrated in training in-service teachers."*

Lecturer 4 from institution A pointed out: *"The university should purchase laptops for example, for individual lecturers, so that each lecturer has their own projector and webcams, microphones, speakers, cameras for lectures."* Similarly, Lecturer 1 from institution A pointed out: *"The university should provide data or Wi Fi so that lecturers may be in a position to effectively make use of technology when they're teaching in and outside campus."* HOD4 from institution A stated: *"I would want to see all teachers being catered for in the in-service training. Currently, our in-service department is science oriented. So that leaves out subjects."* HOD3 from institution A stated: *"The university should continuously facilitate the training of lecturers so that they are better able to use these technologies and train trainee teachers in how to actually use those technologies in the schools. Also, I think that a course for technology integration in teaching training may be advocated for as a bridging course between undergraduate and postgraduate teacher training in universities."* On the same note Lecturer 2 from institution A suggested: *"All subjects currently offered in the education system need to be explored on how to integrate technology in their teaching."*

Participants in institution A recommended that the university purchase smart devices such as projectors, webcams, microphones, speakers, and cameras to incorporate technology in teacher education. The participants also suggested that the university furnish the lecturers with the devices they require for integrating technology pedagogies in training trainee teachers. The participants also suggested that the university should supply data or Wi-Fi so that lecturers use the technology to its full potential both within and outside of the university. Participants also agreed that universities ought to provide ongoing training in all disciplines for all trainee teachers in order to keep the entire education system up to date with the integration of technology.

6. Discussion of findings

The findings of this study were discussed against the literature reviewed. The results of the study reveal that in both the studied universities there was a shift from the traditional face-to-face teaching as COVID-19 heightened to the use of technology in training in-service teachers. This finding is in line with the views from Adeoye et al. (2020) as well as Almaiah et al. (2020) who reveal that the entire education system shifted to e-learning to mitigate the effects of this pandemic.

In the TPACK theory there are four knowledge bases: technological pedagogical knowledge (TPK), technological content knowledge (TCK), pedagogical content knowledge (PCK), and finally technological pedagogical content knowledge (TPACK) that lecturers must possess in order to successfully integrate technology pedagogies into in-service teacher training (Koehler & Mishra, 2009). The results of this study also showed that lecturers from both of the institutions under study are receiving training in integrating technology pedagogies in in-service teacher training. This finding is in line with the views from Thomsen et al. (2021) who point out that to integrate technology pedagogies in teaching and learning, lecturers have to be trained to develop innovative and imaginative solutions to the teaching process. Training lecturers in integrating technology pedagogies in in-service teacher training highlights the three categories of knowledge, technology, content, and pedagogy in teaching as represented in TPACK. TPACK

highlights the need for lecturers in higher education institutions to combine their expertise in subject matter, pedagogy, and technology.

The study also reveals that there are some lecturers who despite the training they go through remain struggling with integrating technologies in their teaching such that they end up asking their peers to assist in integrating technology pedagogies in training teachers in the universities under study. This view is reflected by Koehler et al. (2014) who reveal that in training lecturers for effective technology integration, higher education institutions concentrate on professionally developing lecturers to independently apply TPK to their subject areas. Therefore, providing technical knowledge to lecturers in higher education institutions is not enough (Schlager & Fusco, 2003) as the issue is in having the four domains of knowledge in the TPACK complementing each other in successful integration of technology pedagogies in training in-service teachers in the studied higher education institutions in Southern Africa.

The TPACK theory advocates for ensuring the three knowledge circles meet in the integration of technology pedagogies in teaching. This study's findings reveal that universities have technical staff who provide lecturers with technical knowledge, which they use in their efforts to integrate technology pedagogies into the training of in-service teachers. This finding is in contrast to the assertions made by Dysart and Weckerle (2015) that instructional technologists with limited subject-matter expertise frequently oversee the training of lecturers in institutions. Similarly, Koehler et al. (2014) argue that in higher education institutions the training that lecturers go through is meant for them to gain technology knowledge (TK). Thus, having lecturers equipped with technology knowledge by the university technical staff, without the knowledge of how to integrate content knowledge and technology knowledge is contrary to the expectations of the TPACK theory of knowledge integration in practice.

In the TPACK theory TK is twined with pedagogy knowledge, thus there is TPK. In the studied universities lecturers receive support from the universities through desktops as digital devices to use to integrate technology into in-service teacher training. This finding is contrary to findings from a study by Pete and Soko (2020) that revealed that two of the three studied nations in Sub Saharan countries mainly used laptops and smartphones while one used mainly desktop computers and minimal laptops and smartphones; moreover, this is not congruent with the TPACK theory. Notably, the provision of digital tools in the form of desktops, smartphones and laptops which is technological knowledge should be coupled with pedagogical knowledge in the integration of technology pedagogies in training in-service teachers in the studied higher education institutions.

Content knowledge is a component of the TPACK theory. This study revealed that participants from institution B are supported in online tools, like similarity check software (Turnitin) and online survey software (QuestionPro) to enhance the integration of technology pedagogies in in-service teacher training. This is in line with Mishra et al. (2020) who argue that lecturers in a university may be supported through the provision of open sources or e-learning platforms which

support the use of video like canvas LMS, Moodle, Mahara and open Edx and platforms that meet certain requirements in higher education institutions. The support given through provision of software and online survey software is in line with the requirements of the TPACK theory as the software is meant to check on the knowledge.

7. Conclusions

The problem identified in this study was that there are still obstacles that restrain the integration of technology pedagogies in the training of in-service teachers in Southern African universities. The findings in this study revealed that lecturers receive support from the universities where they work to enable appropriate technology pedagogy integration in the training of in-service teachers even after the COVID-19 pandemic. Lecturers were supported through training, provision of technological tools, policy formulation and support through data provision and connectivity. The study concludes that although the higher education institutions provided support of the lecturers in the integration of technology in in-service teacher training, some lecturers face difficulties using the latest tech tools and restricted broadband internet services. The study also concluded that the support given to lecturers is university wide support where some components of knowledge domains from the TPACK theory are not twinned to assist in integrating technology pedagogies in training in-service teachers.

8. Recommendations

Based on the findings of the study, it is recommended that the higher education institutions studied in Southern Africa should provide lecturers with ongoing training on the use of technology tools, software updates and new features of the sophisticated but requisite digital LMS used to train in-service teachers. This study also recommends that higher education institutions provide enough internet coverage in the institutions and provide electricity generators to provide electricity during power cuts. Furthermore, the support given to the lecturers should consider the use of all the knowledge domains that would assist in the integration of technology pedagogies in training in-service teachers. Likewise, the universities under study should decentralise the support to subject areas so that lecturers are equipped with knowledge on how to integrate technology pedagogies in their own subject.

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