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Teacher Educators' Application of Learning from Technology Professional Development: A Case Study

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ABSTRACT

This study explored teacher educators' application of learning from technology professional development (TPD). Participants were drawn from a teacher training college (TTC) and a Non-Governmental Organization (NGO) implementing an educational technology programme. The NGO case served as a snapshot to draw lessons that might be useful for teacher educators' TPD in public teacher education institutions (TEIs). The findings showed that while teacher educators confirmed their application of learning through student teachers' performance, they reported work environment conditions and individual characteristics as obstacles to application of learning. The findings point to individual motivation, needs, and obstacles concerning teacher educators' TPD in Malawi.

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Introduction

The growth of using various Information Communication and Technology (ICT) tools to transform the quality of teaching and learning and widen access to education is evident in many education institutions in Africa (Muianga, Hansson, Nilsson & Moundale, 2013; Barakabitze, Lazaro Andey, Ainea, Mkwizu, Maziku, Matofali et al., 2019). However, more still needs to be done to achieve ICT-enabled education quality and access on the continent. Kunyenje and Chigona (2019) observe that, despite having elaborate ICT policies since early 2000s, most countries in Africa still feature poorly on ICT development indices. On the one hand, teachers' low levels of essential ICT competencies (e.g. UNESCO, 2018) is one of the barriers to successful implementation of ICT in education (Muianga et al., 2013; Barakabitze et al., 2019). This underscores the need for continuous technology training for teachers (Muianga et al., 2013), which is in this paper labeled as technology professional development (hereinafter, abbreviated as TPD) to mean professional development focusing on instructional technology as content. Instructional technology means the "…ethical practice of facilitating learning and improving performance by creating, using, and managing appropriate technological processes and resources" (AECT, 2008, cited in Reiser & Dempsey, 2018: 5). On the other hand, there is a need for further research to contribute to a better understanding of effective TPD activities unique to the context of education institutions in Africa. Currently much of the available research is confined to specific regions such as Anglo-Saxon countries because of the bias toward English language publications (Lidolf & Pasco, 2020).

This paper focuses on Malawi, where higher education institutions are under pressure to increase student intake in order to widen access. For example, the National Council for Higher Education's harmonised selection report of 2018 showed that less than 30% of those who qualify to be enrolled in universities have access to higher education (Malawi Government, 2020). While the pressure to increase access has also led to large classes in universities in the country, technology is seen to have potential to promote access despite limited classroom spaces (Chawinga & Zozie, 2016; Zozie & Chawinga, 2018). The potential of technology in Malawi's higher education institutions has become prominent especially following the COVID-19 pandemic. In 2020, the Malawi government directed that education institutions be closed to mitigate the spread of the virus. In response, higher education institutions resorted to Emergency Remote Teaching (ERT) using various technologies to ensure continuous learning during school closures and setting new modes of education delivery so that school calendars should not be affected. Despite the increasing prominence of technology to

address access to and quality of higher education in Malawi, capacitating faculty members remains one of the major needs (Chawinga & Zozie, 2016; Zozie & Chawinga, 2018).

This study explored teacher educators' experiences of TPD, answering the question: How do teacher educators apply their learning from TPD in their practices with student teachers and in-service teachers? This question was premised on the consideration that, although professional development participants are expected to apply their learning in their work, such learning transfer does not always occur (Jaramillo-Baquerizo, Valcke & Vanderlinde, 2019). In this paper, teacher educators refer to all who actively facilitate the learning of student teachers and teachers. Study participants were drawn from a public TTC, and anNGO implementing a digital education technology programme in Malawi. The NGO staff members were included because, unlike teacher educators working in schools and colleges of education (traditional teacher educators), little is known about those who work outside these spaces (non-traditional teacher educators) (White, 2019). The definition of TPD draws upon the meaning of professional development as "the process whereby people's professionalism may be considered to be enhanced, with a degree of permanence that exceeds transitoriness" (Evans, 2014: 183).

The paper reports part of the findings of a larger study that explored TPD for teacher educators in Malawi. The study was conceptualized in view of the Ministry of Education's observation that little is known about how teacher educators in Malawi use what they learn from professional development activities they undertake (Ministry of Education, Science and Technology (MoEST), 2018). Specifically, why have teacher educator practices with technology not changed despite teacher educators undergoing various TPDs? The case study provides insights into this question by exploring teacher educators' experience of applying learning from the TPD activities they undertake. Exploring application of learning was based on a related research question focusing on teacher educators' TPD activities. Findings in the larger study showed that teacher educators in Malawi learn from a mix of formal (such as workshops and upgrading programmes) and informal (such as getting input from colleagues and engaging in academic activities) TPD activities.

Overview of TPD for Teacher Educators

Lack of technology training is one of the major factors that hinder teacher educators' use of instructional technology, which is further compounded by the challenge of applying TPD learning to their practice. Despite the prominence of instructional technology in many countries, teachers' use

of instructional technology is behind expectations, partly because teachers and student teachers have often reported as being underprepared. Teachers' concerns that they are underprepared to use instructional technology prompts the question of how technology is approached in teacher education programmes. In teacher education, teacher educators play a crucial role in developing teachers' instructional technology knowledge domains such as selection and evaluation of technology tools suitable for delivering specific content (Tondeur, Van Braak, Sang, Voogt, Fisser & Ottenbreit-Leftwich, 2012; Tondeur, Aesaert, Prestridge & Consuegra, 2018). Amongst others, teacher educators demonstrate appropriate use of instructional technology by using and modelling technology competencies "in ways that positively impact the development of all teacher candidates" (Parrish & Sadera, 2019: 439). However, teacher educators in many countries still fall short of appropriate use of instructional technology, partly because they lack technology competencies such as designing instruction that utilizes content-specific technologies to enhance teaching and learning (Foulger, Graziano, Schmidt-Crawford & Slykhuis, 2017; Uerz, Volman & Kral, 2018). This underscores the importance of TPD aimed at developing teacher educators' technology competencies.

The literature shows a growing body of knowledge about what characterizes effective TPD for teacher educators, and what and how teacher educators learn from various professional development activities (Uerz et al, 2018; Parish & Sadera, 2019; Lidolf & Pasco, 2020). Despite considerable research progress on TPD for teacher educators, there are calls for further studies to address questions about how TPD can support teacher educators in their specific professional roles (Uerz et al., 2018). Teacher educators' specific professional roles include teaching, research, curriculum development, and broking or mentoring (Lunenberg, Dengerink & Korthagen, 2014). Moreover, much of the available research is confined to specific regions (Lidolf & Pasco, 2020), suggesting the need for similar research in other contexts such as Africa because the issues might be different than in research which is done outside Africa.

Context of the Study: TPD for Teacher Educators in Malawi

Although TPD for teacher educators in Malawi is under-researched, some case studies can illustrate prevailing TPD practices, challenges, and opportunities. The first case is a United States Agency for International Development (USAID)-funded five-year partnership between Virginia Tech (USA) and Mzuzu University (Malawi), implemented from the year 2000. The programme was designed to prepare faculty to help spearhead instructional technology initiatives in Malawi (Perkins, Gwayi,

Zozie & Lockee, 2005). The lecturers from Mzuzu University enrolled at Virginia Tech for a master's in Instructional Technology. After successful graduation from the programme, the lecturers returned to Malawi to implement an instructional technology postgraduate programme meant to prepare primary and secondary educators via open and distance Learning. Both the master's and the postgraduate programme revealed challenges faced by teacher educators as they attempt to use instructional technology in Malawi. For instance, while the programme was initially meant to be web-based, it was later delivered via print materials because of unreliable and sometimes unavailable computers to support web-based delivery (Perkins et al., 2005).

A second example is that, in 2014/2015, the University of Malawi in partnership with the University of Strathclyde, with funding from the Scottish Government, implemented a Master of Education (primary) programme designed to upgrade primary teacher educators' qualifications from a BEd. to an MEd (Mtika & Hau, 2016). The programme was not specific to instructional technology but had a component on preparing teacher educators in the use of ICT. Indicative content of the module, called ICT in Education, included the following topics: development of educational technology, teaching and learning using emerging technologies and research in ICT in education. Evaluation of the programme revealed how teacher educators had benefited from the ICT module. According to Mtika and Hau (2016), the graduates reported that they benefited from peer support through learning new ICT skills. The faculty involved in the programme also felt that the graduates gained skills of using ICT in teaching, for example, through use of PowerPoint presentations. Despite some benefits reported by graduates, the faculty members suggested that future programmes should include more ICT or internet-based teaching and learning (Mtika & Hau, 2016).

Another example concerns teacher educators' experiences in a distance education mode of training secondary school teachers at Domasi College of Education (Chakwera & Saiti, 2005). The programme started in 1999, initially supported by technical experts from the Commonwealth of Learning, and later funded by the Canadian International Development Agency (CIDA) to implement the distance education programmes. One major concern was that the project operated within an existing staff establishment that was meant for face-to-face programmes. Moreover, there had been no training to the level of professional specialization in distance education at the college. The authors narrate the experience of professional development activities that were meant to support teacher educators' implementation of distance education as follows:

> …the short-term training workshops focusing on materials development only provide the technical know-how without professional grounding in a theoretical framework.

> Yet governments and Cooperating partners are quick to invest in short-term workshops for their immediate potential rather than in long-term studies (19).

According to Chakwera and Saiti (2005), developing distance education professionals by shifting from short-term workshops to long-term training plans would guarantee programme sustainability and staff commitment, as well as increase people's vision for the development of distance education in Malawi.

The above examples show that there have been TPD activities focusing on, among others, supporting teacher educators with specific technology skills such as using computers or tablet technology in teaching and learning and using technology for open and distance learning. However, the overall literature on teacher educators' experiences with TPD in Malawi seems to be limited in scope and weak regarding the inferences one can draw about what makes a difference.

Conceptual Framework: Application of Learning from TPD

The goal of TPD for teacher educators is to develop their technology competencies, as well as "using and modeling those competencies in ways that positively impact the development of all teacher candidates" (Parrish & Sadera, 2019: 439). Lidolf and Pasco (2020) also argue that the student teachers' success is the ultimate goal of TPD for teacher educators. Generally, the success of professional development is expressed through participants' application of learning, which is the application of the knowledge acquired in professional development activities (Jaramillo-Baquerizo et al., 2019). Application of learning can be expressed in many ways, including changes in teaching practices such as framing teacher educators' pedagogies toward a more student-centered constructivist approach, redesigning of curriculum, and perceived impacts on students (Lidolf & Pasco, 2020; Hennessy, D'Angelo, McIntyre, Koomar, Kreimeia, Cao et al., 2022).

The literature reports three main variables that enable or hinder application of learning: design of a professional development intervention, work environment, and characteristics of professional development participants (De Rijdt, Stes, Van der Vleuten & Dochy, 2013; Jaramillo-Baquerizo et al., 2019). Amongst others, effective professional development designs consider relevance of the TPD content to the work of teacher educators, embed active learning, are ongoing, are inquiry-driven (de Vries, Swennen & Dengerink, 2020), and employ collaborative strategies for enhancing educators' knowledge and practices (Borg, Clifford & Htut 2018: 48). Collaborative learning can mean teacher educators learning with and from student teachers. Well-designed TPD activities are also related to

teacher educators' work context, respond to teacher educators' needs and engage teacher educators in reflective practice (Uerz et al., 2018).

Another variable is considering the characteristics of professional development participants, in this case teacher educators. A participant decides whether to apply learning, and therefore is one of the most influential factors in applying learning from professional development (Jaramillo-Baquerizo et al., 2019). This makes sense when the teacher educators are positioned as learners, which requires addressing their technological needs, engaging them in authentic experiences and in problem-based projects (Lidolf & Pasco, 2020: 4). As an example of teacher educators' learning needs and characteristics, Schols (2015) conducted design-based research to develop an instrument for measuring teacher educators' technology learning preferences. The study found that teacher educators preferred more than single learning methods when acquiring technological knowledge and skills. Schols (2015: 132) concluded that "professionalisation programmes that are tailored to the particular concerns and needs of the teacher educator might contribute to sharing these acquired technology knowledge and skills with others".

The other variable is the work environment, especially institutional support for teacher educators' TPD (Uerz et al., 2018). Institutional conditions enable or constrain educators' attempts to learn and apply their learning acquired from TPD. A supportive TPD atmosphere provides teacher educators with opportunities to engage in reflective conversations about their existing practices concerning technology use in education (Lim, Chai & Churchill, 2011). Lim et al. (2011) add that it also involves supporting teacher educators to manage their own professional development trajectory, monitoring their development, examining student teachers' technology competencies, and a holistic approach towards teacher educators' professional development. Support also means providing resources in terms of finances, time release, and other physical assets that are necessary for teacher educators' TPD. According to Schols (2015), education institutions should support teacher educators' experimentation with technologies to fulfil the teacher educators' learning preferences and needs. In this study, the above-highlighted markers of a successful TPD and variables that influence application of learning helped to make sense of teacher educators' experiences of applying their learning from TPD. For example, student teachers' success as a marker of a successful TPD helped to analyze and interpret teacher educators' responses to the question of how application of learning became visible in their work. Additionally, teacher educators' expressions of challenges such as "lack of technology resources" were interpreted using "work environment" as a variable that constrain teacher educators' application of learning.

Methods: Qualitative Study Research

The larger study from which the findings reported in this paper were drawn employed a qualitative case study design (Yin, 2009), focusing on three public TEIs and an NGO as instrumental cases for exploring teacher educators' TPD. An instrumental case aims at understanding a specific issue, problem, or concern using a case or cases (Creswell, 2013). Since a case study explores a contemporary phenomenon, focusing on questions of how and why (Yin, 2009), it was suitable for investigating teacher educators' application of learning in their real life contexts. In Malawi, teacher education as a subsector of higher education can be categorized by institutional type, level of education, and ownership arrangement. In terms of institutional type, there are TTCs, Universities, and Colleges of Education. Regarding level of education, the TTCs prepare primary school teachers, while secondary school teachers are trained at the faculties of education in public and private colleges and universities. TEIs can be viewed as public (state-funded), religious, or private (Jamu, 2017). At the time of this study there were 14 public TEIs, of which two institutions were purposively selected. Due to space limitations, the findings reported in this paper are drawn from only two cases: a public TTC and an NGO. These institutions were selected because of, among other factors, their age and that they were typical cases. In terms of age, public TEIs in Malawi are relatively older than private or religious institutions; thus, they could be informative cases.

Case studies and participants

Case A is one of 8 public TTCs that offer the Initial Primary Teacher Education (IPTE) for a period of two academic years within a structure called 2 IN-2 OUT-2 IN. The structure means the student teachers are in college for the first two terms, then in the following two terms out in teaching practice at schools and in college again in the last two terms of the training. The IPTE course is delivered in modules consisting of academic subjects such as English, Mathematics, Education Foundation Studies, Agriculture, and Social Studies. On completion, students are awarded with Primary School Teacher Certificates by the Malawi National Examinations Board (MANEB). At the time of data collection, Case A had 46 teacher educators—of whom 20 were males and 26 were females. As presented in Table 1, seven teacher educators were invited to participate in semi-structured face-to-face interviews which took about 30 minutes to one hour per interview.

Table 1: Characteristics of Study Participants, Case A

ID	Years of experience	Sex	Highest qualification	Subject specialization	Age
ATE1	11	M	BEd.	Mathematics	56
ATE2	8	M	MEd.	Expressive arts and English	48
ATE3	31	M	BEd.	Literacy	52
ATE4	10	M	MEd.	Languages	52
ATE5	24	F	MEd.	Languages	47
ATE6	9	F	MEd.	Literacy and language	43
ATE7	15	F	MEd.	Mathematics	41

The study also involved members of staff of an NGO that is implementing a digital education technology programme in various primary schools across Malawi. The purpose of involving an NGO, hereinafter Case B, was to establish application of learning from TPD by teacher educators who do not work in schools or colleges of education. The programme implemented by the NGO uses tablet technology to improve core competencies of reading, writing, and mathematics for primary school children in the early grade section. Teacher training in the programme takes place at the TTCs, where the curriculum has incorporated the use of tablet technology. The NGO also conducts training at school level, including ongoing refresher training. NGO staff members, called Education specialists, coordinate these teacher training activities. Two project male staff members participated in this study, reporting a highest qualification of BEd.; had work experience of three-six years; and an age range of 32 to 40.

Data collection

This study utilized interviews with teacher educators, including the following questions: How do you implement what you learn from multiple TPD activities? Does this implementation become visible in your work? If yes, in what way? What challenges do you face when you try to put into use what you learn from different professional development activities? Responses to these interview questions were categorized based on variables that mediate application of learning presented in the previous sections of this paper. Following the constructivist paradigm—which is to understand the world in which individuals work or live (Creswell, 2013), the interview questions were open ended to allow teacher educators to construct the meaning of TPD, drawing upon their experiences in their work context.

Data analysis

Audio-taped interviews were transcribed, and then the analysis of textual data combined deductive and inductive approaches (Fereday & Muir-Cochrane, 2006). The researchers read the transcript several times with a critical eye approach to identify chunks of texts that related to the categories of data to answer the research questions. Then, data was displayed utilizing matrices created in Microsoft Word, as illustrated in Table 2. While labels of most data categories were based on concepts from the literature, other labels were generated from the participants' actual words. Building of themes involved combining categories of data that carried similar meaning.

Table 2: Coding Scheme

Category	Remark	Definition or Example
Visibility of TPD learning application	Teacher educator activities	Application of learning becomes visible through teacher educators' activities as they practice using technology before using it with students
	Student performance	Application of learning visible in the students' performance during, after, or in their reaction to the instructional activities implemented by a teacher educator

Ethics

The study complied with the ethical requirements of social science and humanities research by obtaining ethical clearance from the University of Malawi Research Ethics Committee (UNIMAREC), PROTOCOL NO. P.12/19/07. All participants were requested to voluntarily participate in the study.

Findings

Case A

Teacher educators were asked whether application of learning from TPD was visible in their work. Responses have been grouped into student performance and the teacher educators' activities as ways in which application of learning becomes visible. Student performance refers to cases where application of learning is visible in the students during, after, or in their reactions to the instructional activities implemented by a teacher educator. Teacher educators also saw application of learning through their own activities, especially as they attempted to practice with a technology before using

it on students. Overall, interview data suggested that application of learning from TPD can be seen when student teachers are involved in authentic tasks or hands-on experiences with technology. Table 3 presents these findings.

Table 3:

Teacher educators' application of learning

Application of learning	Significant quotes
Student performance	"when I go to class, I try to use it for my students to use the same method…when I see my students using it effectively to me it is a message that I transferred successfully to my students" (ATE5) "I check performance…something observable their score to notice how my new knowledge may have affected their learning. Of course, only teacher educator can judge. They may have no information that I went through a PD but it's me who can tell. (ATE2)
Practice (trial) before using instructional technology	"I practice on my own, yeah like every day I do practice. I usually practice using my phone since it is the most immediate thing and it is about the classrooms I insert it in my lessons" (ATE6) "For me I use to practice those things. Through practice you discover new things…the way I use computer is not the way my friends use. After getting any training/PD I use to practice that ...that's my normal life" (ATE4)

The quotes presented in Table 3 provide insights into teacher educators' views of successful TPD. The goal of TPD is not only to improve teacher educators' competencies, but also the technology competencies of student teachers (Parrish & Sadera, 2019; Lidolf & Pasco, 2020. Similarly, the above findings show that teacher educators connect their technology professional learning to student teachers' learning.

Factors hindering application of learning

Although teacher educators showed interest in developing their knowledge of instructional technology, they reported numerous challenges in their efforts to implement what they learn from TPD activities. The following remark represents teacher educators' major concern with inadequate resources: "when we talk of using these gadgets…most of these require having enough internet. If the college has failed to purchase, then we fail to use the gadgets to get the information. The number of computers is also difficult; the lab is not well equipped" (ATE4). Also, "the main challenge

is that we are lacking gadgets that students can use ...some students can have phones, but they may not have or may not have bundle for them to be able to make use of the internet" (ATE3). It can be claimed that teacher educators in this case study perceived inadequate support towards their efforts to learn or apply what they learn from TPD activities. Interview data showed also that the unavailability of technology resources is further compounded by large classes which teacher educators handle. The following teacher educators' remarks illustrate this observation: "it is really a hard thing to implement what we learn … we have overcrowded classrooms" (ATE6) and "there is also the issue of large classes sometimes that also affects learning when everyone has to practice with his or her own computer" (ATE7). Similar challenges have been previously reported as affecting teachers' use of what they learn from professional development in Malawi (Selemani-Meke, 2013). Another challenge was about contradictions and gaps in the teacher education curriculum. For instance, in language and literacy, student teachers were discouraged from using ICT because "the mode of training does not allow them… we need their own handwriting…We need them to practice writing…they will be expected to plan or to fill schemes by writing" (ATE4). Also, it is difficult to assess ICT activities "because it (ICT) is practical so if anything, the practice which you do is just that continuous assessment so students don't work as hard since they know they will not be assessed on MANEB level" (ATE7). This suggests that student teachers' attitudes towards and knowledge of instructional technology affect teacher educators' application of learning. Related to this, study participants felt that the use of instructional technology is time-consuming. Teacher educators need time "to get organized so that it is digestible by students…so because it eases my work that's when I just use it, I don't have to bother" (ATE5) or "to demonstrate the things so that the learners get to understand" (ATE2).

Furthermore, some teacher educators raised concerns about the content of technology workshops they undertake. ATE7, who held a management position and was responsible for monitoring professional development of teacher educators, observed that:

> Sometimes even the implementation others have come out to say we got trained but the experience was just on the ground maybe it was too ideal, so we get such comments from the lecturers so sometimes maybe those are some of the challenges because they still go back to the old ways.

The above quote displays lack of hands-on experience during workshops as a challenge for teacher educators to apply their learning from TPD. This underpins the importance of embedding practice within technology workshops, as suggested in the literature that design of professional development affects application of learning (Jaramillo-Baquerizo et al., 2019). In particular, aligning theory and

practice is just as important for teacher educators as it is for student teachers' technology professional learning (Tondeur et al., 2012).

In summary, participants in case A saw their application of learning through student teachers' performance. However, the teacher educators expressed challenges they face within the institution and teacher education programme as they attempt to apply their learning from the TPD activities they undertake. They reported challenges such as poor internet, lack of training on instructional technology, and unavailability of technology resources to support their TPD. This underscores the importance of a TTC environment that provides adequate resources for teacher educators to implement what they learn from TPD activities.

Case B

From the interview data, NTE2 mainly saw his application of learning through the performance of teachers or teacher trainers that he supported. He also confirmed that the essence of professional learning is in the ability to apply what has been learned.

> You need to apply what has been learnt...if it works you can share it with others…For me, sometimes you may feel that you have learnt the idea or the skill itself, but you appreciate that you have indeed learnt it when you go to school you apply then it works…from there you congratulate yourself (NTE2).

There are also exchange visits, where teachers share best practices in the implementation of the intervention at district or national levels. From such learning opportunities, the education specialists can adopt their approach and support the intervention in the schools.

At programme level, application of learning was positioned within the programme evaluation framework. According to NTE1, education specialists are evaluated based on set key performance indicators. The results are based on what is delivered within the framework of evaluating the teacher training component of the programme. The unique feature of the programme is that it involves many stakeholders who sometimes feature in a 'community of practice' (NTE2).

Factors hindering application of learning

As already noted, one of the challenges in transferring learning is the limited access to the internet to try out what has been learnt. While appreciating the need for constantly updating oneself

because the technology keeps on changing, NTE2 expressed that teacher resistance to change is another challenge.

> I feel bad when most of the times I visit the schools, try to teach people about this new concept...digital education technology is new in Malawi and then you try to explain how best it can be used in teaching and learning. And then I meet resistance. It really brings me down…it does demotivate me. It does frustrate me anyway. Addition to that you would also see that they would accept something but when you visit them another day you find them not using what you taught them.

NTE1 also commented on the readiness of teacher trainers to embrace digital educational technology:

> Some of the teacher trainers are afraid of using ICT; they have never used it before. By and by they can ably understand… Most lecturers' ability to handle digital education technology is very low. We have been struggling to identify district based technical people so that we can train them as trainers of trainers, but it seems even those at TTC have very low understanding and can struggle to handle it.

Additionally, NTE2 observed differences between younger and older teacher trainers in terms of embracing digital education technology: "Most people, especially older generations struggle much on that aspect…Maybe the older ones struggle because that's not how they were trained" (NTE2). This remark suggests different experiences of technology use between old and younger generations of teacher educators. As for teachers, "One of the drawbacks is that you transfer a certain form of learning; some teachers easily forget about concept/idea and so, they would demand another meeting or workshop. Organizing refresher training is not always easy at times because of budget constraints".

Clearly, learner characteristics were the most prominent challenges that participants from case B faced in their effort to apply learning from TPD. However, challenges related to the work environment were also reported, especially concerning limited technology resources in the schools and TTCs.

Discussion

This study explored teacher educators' application of learning from TPD in their practice with pre-service and in-service teachers. Viewed from De Rijdt et al's (2013) lens of variables that influence application of learning, i.e., work environment, learner characteristics, and design of a professional development activity, this research was able to characterize different aspects of teacher educators' application of learning from TPD. The interviews accorded participants the opportunity to define TPD

by describing situations where they felt they had learned about instructional technology. Overall, the interviewed teacher educators viewed their application of learning through student teachers' performance. Seeing the application of learning through student teachers' reactions shows teacher educators' understanding of a successful TPD. This insight confirms findings in the international literature and the policy context in Malawi, suggesting that student outcomes are an important marker of a successful TPD. To illustrate, at national policy level, in Malawi student teachers are an important stakeholder for understanding how teacher educators implement what they learn from professional development activities (MoEST, 2018). At institutional level, evaluation of faculty teaching effectiveness also involves students' feedback, which then feeds into design of faculty professional development activities. Meanwhile, although a successful TPD should enhance student teachers' practices with instructional technology (Lidolf & Pasco, 2020), it is also important that the causality between TPD and student teachers' outcomes is hard to determine (Hennessy et al., 2022). However, teacher educators reported challenges during application of learning. The case study findings display work environment factors as obstacles to teacher educators' application of learning.

For example, in Case A, teacher educators reported limited access to technology resources such as computers. They also cited large classes that they handled. Yet institutional support in terms of access to resources is one of the critical factors for the successful integration of technology in teacher education (Tondeur et al., 2012). A supportive professional atmosphere provides teacher educators with opportunities to engage in reflective conversations about their existing practices concerning technology use in education (Lim et al., 2011). It also demands making technology resources available for teacher educators to experiment with technologies, as well as providing the time and support necessary to fulfil the teacher educators' learning preferences and needs (Schols, 2015: 129).

The above-noted challenges confirm that institutional conditions can enable or constrain teacher educators' attempts to learn and apply their learning from TPD (Tondeur et al., 2012). Amongst other issues, creating institutional conditions that are supportive for TPD would include committed leadership that prioritizes TPD by making resources available. Without support in terms of resources, any professional development opportunities might not lead to improved use of instructional technology by the teacher educators. On the other hand, while context barriers seemed to be prominent, the study also found individual level factors such as teacher resistance. For example, in Case B, a participant reported teachers' resistance to embracing digital technology, which in turn

negatively affected his efforts to implement what he had learnt from his professional development activities. This is consistent with findings reported in international literature.

Meanwhile, findings of this case study can benefit education officials and other stakeholders interested in teacher education and capacity building of teachers in higher education institutions in the use of instructional technology. Generally, the insights confirm recent trends on TPD literature, especially characteristics of effective professional development, which is a growing field of study (Hennessey et al., 2022) and how teacher education programme contexts shape the work of teacher educators (Schols, 2015). The uniqueness of this case is the effort to describe TPD for different categories of teacher educators. Specifically, the study included an NGO case as a snapshot for understanding TPD for non-traditional teacher educators. In comparing the two cases, it is observed that both sets of teacher educators report similar challenges and perspectives of how application of learning becomes visible in their work. This suggests that features of TPD for non-traditional teacher educators should be akin to those for traditional teacher educators.

Furthermore, participants from the NGO case reported a "community of practice" involving teachers, teacher trainers, and other education stakeholders as they reflect on implementing digital education technology in primary schools in Malawi. Since the literature shows community of practice as one of the most promising professional development activities for building technology teacher educators' competencies (Parrish & Sadera, 2019; Lidolf & Pasco, 2020), it can be said that the NGO exemplifies one best practice that can be implemented in public TEIs in Malawi. This assertion is inferred from the literature showing that NGOs can capacitate TEIs with finances, training for teacher educators and student teachers, and development of teacher education curricula (Kieu & Singer, 2018). However, further research is required to understand how an NGO implements community of practice and how the participants benefit from the activity. This is because data utilized in the present study does not permit conclusions of how the community of practice is operationalized. Further research can also focus on understanding how teacher educators apply learning from specific TPD activities.

Despite the above-presented contribution of the study, one limitation is that the findings relied on teacher educators' self-reports, which certainly weakens evidence of what works in the TPD of teacher educators (Uerz et al., 2018). Thus, it is necessary to identify other methods of measuring teacher educators' application of learning. Such methods can include "observations of actual changes in the teacher educator practices, and following from that, learning effects of the (student)

teachers of the participating teacher educators" (de Vries et al., 2020). As the literature demonstrates models of effective TPD (Parrish & Sadera, 2019; Lidolf & Pasco, 2020), future studies can build upon the insights from this case study to identify reliable methods of measuring how teacher educators benefit from TPD.

Conclusion

TPD that can help teacher educators improve their practice by applying learning can mediate the realization of technology-based education in Africa. There is an abundance of research on the application of learning, especially responding to questions such as why educators apply or fail to apply new knowledge gained from professional development into their practice. However, the literature on TPD is confined to specific regions. This study, therefore, sought to provide insights into what, how, and why teacher educators in the context of Malawi learn about technology. Specifically, the study was motivated by a lack of understanding of how teacher educators in Malawi use what they learn from TPD. Findings showed that while teacher educators confirmed their application of learning through student teachers' performance, they reported environmental conditions and individual characteristics as obstacles to application of learning. These findings point to individual motivation, needs, and obstacles concerning TPD for teacher educators. Recently, these professional development aspects have attracted much research interest in the field. A focus on TPD in specific context is crucial because such context largely shapes what is possible or not possible with technology in education, as demonstrated by research in low- and middle-income countries (Hennessey et al., 2022). This observation certainly extends the transferability of the findings reported in this paper.

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