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Teachers' ICT in pedagogy: A case for mentoring and mirrored practice

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Abstract
The rapid expansion of the knowledge society, due mainly to the ubiquity and access of information and communication technology (ICT), places a professional demand on teachers to acquire relevant knowledge to make use of technology in their classrooms. Thus, for teachers to effectively integrate ICT into their teaching repertoire, they must transform their pedagogical practices. In this regard, the quality of pre-service and in-service training is pivotal in preparing teachers for effective technology integration. Utilising a case study approach and Activity Theory principles as a theoretical lens, this study set out to explore the influence of ICT as a tool of instruction on the classroom practice of in-service teachers in Rwanda. Qualitative methods were employed to capture data through interviews, observations, and document analysis. Data was analysed using content analysis to understand in-service teachers' constructions about learning through ICT and how it influenced their classroom practice. The investigation of the influence of ICT as an instructional tool to in-service teachers yielded unique patterns of their ICT learning-teaching experiences. The findings were two-fold. First, the ICT learning experiences of the in-service teachers changed their perspective towards teaching and learning with ICT in their own classrooms. Second, the teacher participants vicariously mirrored their lecturers' use of ICT in their own classroom practice. This unintended experience created affordances for the in-service teacher trainees to not only learn 'about' ICT, but significantly 'how to teach' pedagogically with ICT. It is crucial for teacher trainees to experience the same type of learning environments they are expected to create in their own classrooms.

Keywords ICT · Pedagogy · Mirroring · Mentoring · Vicarious · Teacher training · Unintended outcome

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1 Introduction and background context

The changes brought about by the permeation of ICT into all human endeavours has translated into a total transformation of the 21st century workplace, which now demands a technology savvy generation of teachers. In this regard the preparation of learners for the digital era is hinged on teachers as the key players and change agents (Tan et al., 2017). Teachers must create learning environments that stimulate creativity and innovation and inculcate critical skills in their learners for the future workplace. Teachers are significantly positioned at the centre of all educational discourse regarding the appropriateness of their pedagogical skills and competences to meet the challenges of ICT infused teaching-learning spaces. Inarguably, teachers need to re-visit their pedagogical skills, competencies, beliefs, and attitude to meet the expectations of their learners and a constantly changing curriculum (Bhattacharjee & Deb, 2016).

Prior to the Covid-19 pandemic the effective use of ICT in education, when compared to other sectors of the economy worldwide, was less pronounced (Lim et al., 2013; Schrum et al., 2005). Covid-19 created an abrupt thrust to the need to continue education, and ICT was a means to this end. Thus, teachers should be pedagogically equipped with the best set of skills and competences, and this becomes primarily the responsibility of teacher training institutions. Hence, the onus is on teacher educators at higher education institutions to innovate and model the use of technology tools and pedagogies for teaching and learning. The integration ICT into the training of teachers serves as an avenue to expose and familiarise trainees with the pedagogical values of ICT tools and their usefulness within the classroom context. Research has emphasised that teachers as learners should be allowed to have quality technology experience in order for them to replicate the same in their classrooms (Brown, 2017; Voogt et al., 2013).

This empirical study not only explored the lived experiences of in-service teachers as they navigate learning in an ICT-enriched teacher training context, but more importantly whether this experience translates into changed classroom practices. The technology experiences and training provided in teacher preparation programmes is a critical factor for influencing the use of ICT in their future classroom (Agyei & Voogt, 2012; Drent & Meelissen, 2008; Stobaugh & Tassell, 2011; Tondeur et al., 2012). However, extant literature continues to highlight a lack of preparedness of teacher trainees in relation to the appropriation and integration of ICT for pedagogical purposes (Bakir, 2015; Instefjord & Munthe, 2017; Tondeur et al., 2017). Many previous studies that were conducted in developed countries seemed to focus primarily on pre-service teachers (Cuhadar, 2018; Sang et al., 2010; Svenssona & Baelob, 2014; Tondeur et al., Valtonen et al., 2015). This study augments the existing body of literature, enhances research novelty and accentuates the literature gap and thus make a new contribution to the body of knowledge. Accordingly, this study asks, how does the ICT learning experiences of in-service teachers translate into changed classroom practice?

2 Exploring the debates in the field

One of the many purposes served by in-service teacher training is to facilitate the initial training of unqualified teachers. Many teachers start to work without the basic qualifications required of them with the hope of acquiring a degree while they are working (Perraton, 2010). In-service teacher training in the context of this study is the training received or given to teachers already practicing in the classroom without the required qualification (Paul et al., 2013). Teacher training has evolved in recent years due to the changes that has occurred in the classroom over time. The last three decades has witnessed an increase in substantial investment in technology tools and resources in the schools and this naturally calls for teachers to use technology effectively for teaching and learning. Hence, the skills required of 21st century teachers have similarly changed, the debate has shifted from whether ICT should be used in the classroom to how ICT can enhance teaching and learning. (Kalogiannakis, 2010).

According to Tican and Deniz (2019), inculcating and developing the competencies required for 21st century teachers has become the focus of teacher training institutions. Liu (2016), opined that teacher training programmes should be structured to prepare teachers for the use of ICT in their classrooms. Teacher training programmes need to promote a robust ICT-based foundation to ensure that teachers cope with the seamless use of ICT in their classroom with minimal difficulty (Voinea, 2019). Research has advocated for different strategies of infusing ICT into teacher training experiences to facilitate the effective preparation of teachers for the use of ICT in their classrooms (Baran et al., 2019; Cuhadar, 2018; Divaharan, 2011; Hennessy et al., 2010). Some strategies suggest the infusion of ICT into all subjects across the teacher education curriculum, teaching of ICT as stand-alone subject, modelling of ICT use by teacher educators, and modifying the pedagogical approaches to reflect the integration of ICT into teacher preparation programmes, to mention a few. However, the effectiveness of these strategies were determined by factors such as context, access to ICT tools, policies, pedagogical approaches and structure of teacher education curriculums (Kalogiannakis, 2010).

Research has sustained the argument that teacher educators have an essential part to play not only in equipping trainee teachers with skills to deliver the curriculum, but also to function as role models in ICT-integrated teaching techniques by using digital tools for instruction (Amhag et al., 2019). A review of qualitative studies by Tondeur et al. (2012) on strategies that can be employed to prepare pre-service teacher for ICT integration identified six micro level strategies that can be used in teacher education programs to achieve this purpose. One of the most useful strategies identified in this study was role modelling. Mukuna (2013) posit that the extent of the knowledge and skills possessed by teacher educators for modelling the use of ICT in their own teaching practices is critical to the effective integration of ICT into teacher education.

However, the recent body of literature have shown that there is still a general lack of appropriate modelling of ICT use for pedagogical purposes by teacher educators. Research evidence suggest that teacher education programmes have not adequately modelled good practices regarding the pedagogical use of ICT for teaching and learning. Tondeur et al. (2019) found that pre-service teachers did not perceive teacher educators as role models on how ICT could be used to facilitate teaching and learning.

In the Rwandan context, researchers have given less attention to in-service teacher training. Hence, there is a dearth of literature on teachers as learners and their learning experiences particularly in an ICT-enabled environment and how this may affect their use of ICT in the classroom. This study attempts to fill this research gap.

3 Theoretical framework

Activity theory can be used to understand the process of transformation within a system such as a classroom as well as demonstrating how different systems interact with, and transform each other over time (Engeström, 1994). According to Activity theory ICT is assumed to be a cultural tool, thus it is imperative to ask questions related to how these tools facilitate teachers-as-learners and how lecturers model the use of ICT in their practice. In this regard, the analysis of the tenets of AT model becomes necessary as it provides an understanding of the complex nature of ICT integration into learning and teaching at the university and school contexts respectively.

The participant in-service teachers are *subjects* and the focus of this activity system (Wilson, 2014). The in-service teachers are characterised as the unqualified or under-qualified teachers already in employment in the education sector, who desired to further their education to obtain the requisite qualification. The in-service teachers sought to improve their subject knowledge and be 21st century curriculum relevant. The *object* as characterised by the Activity Theory model is the ICT mediated learning experiences of the in-service teachers. Olson (2015) posit that learning is a permanent change in behaviour as a result of acquired experience. The tools are the materials, objects, or artefacts used to accomplish an outcome activity. In the current study, *tools* were used by the in-service teachers in two different contexts, firstly tools for learning in an ICT-enriched higher education institution environment and secondly for teaching at the schools where in-service teachers practiced.

In this study (Fig. 1), the relationship between the subject (in-service teachers) and the community (the university environment and the schools) was mediated by certain *rules* and regulations. First was the participants' experience at the university. Horeb university had rules and regulations that guided teaching and administrative activities. These rules evidently supported both students and lecturers in an ICT-supported learning environment. Lecturers were expected to integrate ICT into their lecture either in the face-to-face or e-learning mode. Second was the experience within the school context which had rules and regulations that were restrictive, constraining and unsupportive of the use of ICT. Horeb university as a higher learning *community* comprised of lecturers, ICT support staff, students, administration and management. At schools, it was the teachers, head teachers, learners, and administrators that constituted the members of the school community. The lecturers employed ICT in their practice, and this significantly influenced the perspective of the in-service teachers on what effective teaching and learning should be, and the approaches to achieve teaching goals. In the current study *division of labour* was determined mainly by areas related to teaching and learning, policies, and professional development by the various stakeholders concerned. Within an activity system, the failure of any of the stakeholders to do their part directly or indirectly inhibits the optimum performance of the

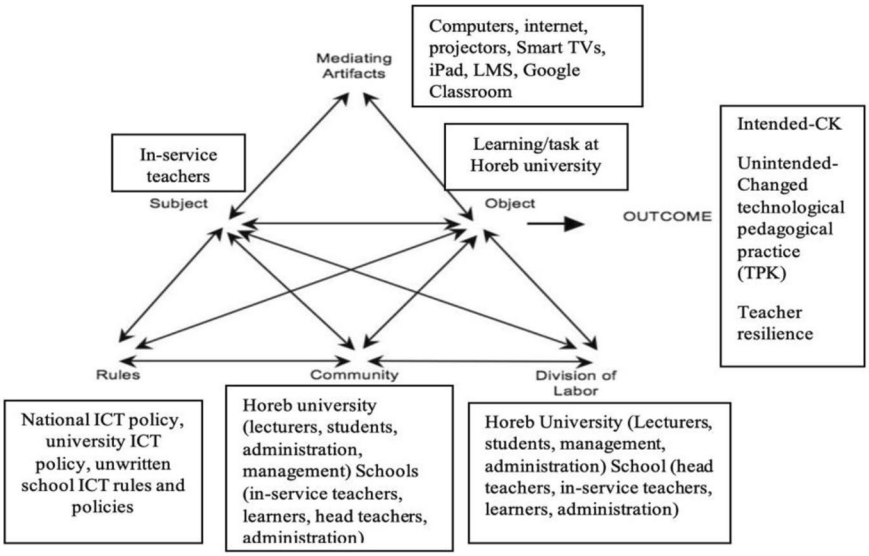

Fig. 1 *Activity Theory* (Engestrom, 1994)

system. This in turn determines the effectiveness or otherwise of the activity system. The interdependent nature of the system therefore calls for effective collaboration, cooperation, and synergy among the elements to guarantee optimum performance. Division of labour was well-defined, and each stakeholder accepted responsibility as expected. The lecturers at Horeb university also played a significant part as role models to the in-service teachers through the way they naturally and seamlessly integrated ICT into their practice. They unintentionally promoted pedagogical methods inherent in the various types of ICT tools used for teaching. The in-service teachers as students understood the significance of lifelong learning and played the part of remaining relevant by enrolling for further studies. During the learning process at Horeb university, the in-service teachers embraced the use of ICT for their learning activities.

4 Methodology

A qualitative exploratory research design (Baxter & Jack, 2008; Swedberg, 2020) was chosen for this study to gain in-depth understanding about how in-service teachers (Table 1) make meaning from their learning experiences as they navigate an ICT-enriched training context. Significantly, this study explored the influence of this experience on their classroom practice. To justify a qualitative case study methodology, we wanted the voices of the participants to be heard, to allow them to describe their lived experience and thoughts in their own words (Yilmaz, 2013) thus a constructivist paradigm was an appropriate qualitative methodology fit for this study. We acknowledge that potential biases may influence the study. However a researcher's

Table 1 Demographic information of in-service teacher participants

Participant	School	Age (y)	Gender	Teaching Experience (y)	Grades	ICT Skills	Teaching Subjects	Area of Study at Horeb University
Adeline	Upper Kanazi	23	Female	1	P5, P6	Intermediate	Science, and Elementary Technology	Economics Entrepreneurship
Daudi	Holiness	26	Male	4	P4	Intermediate	Science, and Mathematics	Economics Entrepreneurship
Oreofe	Success	27	Female	4	P5	Intermediate	Science, Mathematicsand English	English Literature
Longoria	Oaks	50	Female	6	P4	Basic	English and Literature	English Literature
Sylvester	Jambo	25	Male	3	S1, S2	Advanced	History and Geography	History Geography
Yvette	Lower Kanazi	25	Female	5	Nursery1	Basic	All subjects	Biology Chemistry
Nyansani	Lower Kanazi	27	Male	6	P4, P5, P6	Basic	Mathematics and Science	English Entrepreneurship
Divine	Peace Academy	30	Female	4	P5,	Basic	English	English Kiswahili

journal was used to bracket personal feelings and emotions in an attempt to mitigate against researcher bias.

Through an instrumental case study (Stake, 2005), we explored the phenomenon of in-service teacher participants' ICT learning experiences and how it translates into their teaching practice. The case was defined as in-service teachers studying through a blended learning approach encompassing both distance education modes and face-to-face learning at a teacher training institution. We selected research sites through purposive sampling which included six primary schools and one higher education institution in the city of Kigali.

The seven school research sites were identified through the in-service participants' schools in the province of Kigali, Rwanda. All the schools are equipped with ICT infrastructure, and teachers use them regularly albeit mostly for administrative purposes. This instrumental case study offers thick description of the school research sites, and participants.

Holiness school is a private primary school located on a hill in the Nyarugenge[1] district of Kigali, about two kilometres from the city centre. The school has twenty classrooms, a dining room and kitchen where meals are prepared for learners' breakfast and lunch. The ICT equipment for teaching-learning activities comprises of a smart television situated in the library, two computer laboratories with twenty-two desktop computers, two multi-media projectors, and a mobile projector screen for portability between classrooms. The school has twenty-six teachers and 660 learners in grades ranging from nursery to grade six. Lower Kanazi is a private primary school is located about four kilometres from the city centre. Most of the learners' educational needs and food are provided at no cost to the parents. There are twelve classrooms, an administrative section, a skills centre, and an ICT laboratory. ICT equipment for teaching and learning include fifty XO laptops, fifteen Chrome laptops, a multimedia projector and screen. The library is WIFI equipped with internet connectivity for the school. The school has a cohort of twenty teachers and 450 learners from nursery to grade six.

Success School is situated in the Gasabo[2] district of Kigali which is in the heart of the city and has both primary and secondary schools ranging from nursery to grade twelve. This school with 913 learners occupies a rented building; thus, some classrooms are small and poorly ventilated. The ICT laboratory is a small room with ten laptops and all thirty teachers have their own personal computers for the preparing learners' notes, record keeping and teaching. Teachers use their own modems to access the internet. Great Oaks school is a private primary school that is uniquely owned by a group of women to provide education to the Rwandan learners. The school is also located within the city and has ten child-friendly classrooms, an ICT laboratory, and a library that caters for nineteen teachers and a learner population of 435. Technology access includes WIFI internet, teachers' personal computers and learners are allowed to bring their own ICT devices. The fifth comprehensive school namely, Upper Kanazi is a public school with both primary and secondary school sections. The school comprises of twenty-four classrooms, fifty-three teachers and 2300

[1] Nyarugenge is a municipal district in Kigali.

[2] Gasabo is one of the municipal districts in Kigali.

learners. Technology access includes two hundred XO (OLPC) laptops and about fifty Positivo Laptops. This school function on a platoon basis of morning-afternoon teaching shifts.

Peace Academy is part of a group of private schools owned by missionaries from the United Kingdom. It is located in the remote Kicukiro[3] district of Kigali and accommodates both primary and secondary schools, with classes from nursery to grade nine. All twelve classrooms are equipped with data projectors and permanent whiteboards. The school has eighteen teachers serving 280 learners. The last of the seven research sites is Jambo Primary School which is a private school located in the eastern part of Kigali. It is owned by an educator with a vision of facilitated teaching and learning through the use of ICT. The school is equipped with six multimedia projectors, thirty laptops, three printers and one scanner. The school has 295 learners and fifteen teachers with grades ranging from nursery to grade six.

The purposeful sampling technique included the selection of teachers as participants. These participants were selected based on two primary criteria. First, they had to be permanent teachers at their respective schools and second, they had to be registered as students at a higher education institution (Horeb University) to further their studies. This scenario brings forth two different research site contexts (school as teachers and university as students). The study also employed convenient and maximum variation sampling in the selection of the eight participants (Patton, 1990). The data collection was a laborious process as it observed the participants' lived experiences across two varying contexts namely, the institution of higher learning and their respective schools. The rationale for maximum variation sampling was based on schools with varying technology access and infrastructure. The schools where the teachers were practicing were within the easy reach to conduct research and participants selection would yield richness of information to the research study (Kuzel, 1992). Criteria in the selection of participants was based on in-service teacher trainees, who were furthering their qualifications at Horeb University in Rwanda. The in-service teachers had to have basic ICT skills, being accessible within a geographical proximity and willing to participate in the study. In this regard eight in-service participants were selected comprising five females and three males (Table 1).

Qualitative research requires robust data collection techniques and the documentation of the research procedure (Bowen, 2009). By conducting interviews, classroom observations and document analysis as data collection techniques we were able to triangulate data. According to Yin (2003) more convincing data increases when several sources of information are used, thereby increasing construct validity.

This study engaged participants in face-to-face semi-structured interviews (Creswell, 2017) that afforded the in-service teachers an opportunity to comprehensively describe their lived experiences in their daily encounters as they learnt with ICT as teacher-learners and taught with ICT as in-service teachers. There were three phases of interviews. The first interview was an introductory interview to develop report with the participants (life history, demographics, career etc.). The second interview was based on their experiences of learning through ICT at a higher education institution (HEI). The third interview explored their classroom practices after learning at

[3] Kicukiro is a municipal district in Kigali.

a HEI. Interestingly, the initial interviews yielded poor data because the participants struggled with English as the language of communication. In the subsequent interviews conducted in Kinyarwanda (indigenous language of Rwanda, Kigali), participants were more at ease to converse.

The participants were also observed in their naturally teaching (classroom) and learning (Horeb University) settings as relevant data to gain better insight into their behaviour, interaction, teaching and learning with ICT. This study used document review as a data collection method to supplement other forms of data about the phenomena under study. Document reviews are used in research methods to triangulate data (Denzin, 2012). We reviewed documents prepared or created by the participants such as lesson plans or schemes of work. Below is a summary of data that was gathered through different methods (Table 2) namely semi-structured interviews, classroom observation and document analysis.

The analysis of the garnered data was achieved through content and thematic analysis (Neuendorf, 2018). We engaged in member checking, whereby participants were given an opportunity to supplement interview transcripts with any experiences that we did not capture. Codes were generated from the use of data analysis software (Atlas.Ti^{tm}) and subjected to continuous modification to accommodate new insights about the data. Through open coding, the extensive codes were further analysed *apriori* (Saldaña, 2021) to identify data related to the key constructs in the research question. The process was both reflexive and iterative in nature and produced extensive codes, categories and themes. Findings were then categorised according to the themes that emerged from the main data sources.

We considered transferability, credibility, dependability, confirmability, and authenticity as quality criteria to enhance research rigour. Ethical approval to conduct this study was obtained from a higher education institution (HEI).

5 Findings

The following table is a culmination of the analysis of the data yielding five main themes that emerged *apriori*. However, for the purpose and scope of this paper only the latter three themes as illusrated in the table below (Table 3) are discussed. Thus, the findings of this paper are limited to to three focused themes namely: ICT learning experiences of the in-service teachers, mentoring good ICT pedagogical practice by the HEI lecturers, and the resultant changed pedagogical practice of the in-service teachers.

Table 2 Summary of data collection methods, instruments, and recording

	DATA COLLECTION		
PARTICIPANTS	METHODS	INSTRUMENTS	DOCUMENTATION
In-service teachers $n=8$	Face-to-face semi-structured interviews	• Interview protocol • Audio recording device	Transcript
	Classroom observation (teaching)	• Observation schedule • Video recording device	Field notes Still images
	Document analysis	• Documents and image capturing device	Lesson plans

Table 3 Summary of main themes and subcategories

Themes
• **Teachers inevitable journey of self -reinvention**: The need to be "ahead of the curve"
• **Two Worlds Apart**: The influence of constrained school context on teachers' practice
• **ICT learning experiences of in-service teachers**: Navigating learning in a technology augmented learning milieu
• **Mentoring good ICT pedagogical practice**
• **Changed pedagogical practice**: Making an ICT pedagogical shift - Mirroring good ICT practice,

The learning experiences of the in-service teachers at Horeb University served as a catalyst to change their perspective about the affordances of ICT for learning. The in-service teachers were more convinced of the capability of ICT to add more value to their learning. Although learning through ICT was a new experience for Sylvester, a student with specialisation in History and Geography. He described his experience in one of the courses named "Introduction to Computer Applications." The use of ICT during the lecture presentation, engaged the students cognitively, and allowed them to be involved in learning activities. This aided faster comprehension of concepts taught as described below.

> I had a lecture of ICT(Computer Applications), we were learning about hardware devices, and the lecturer used a video to show us how you can connect all of the parts (hardware) to make it work. We watched it, and one of us was given computer hardware, she was told to join (assemble) all parts of a desktop to make it work ….so we watched the video from You Tube and she made it. (Interview Transcript: Sylvester)

Similarly, Longoria who specialised in English and Literature described a typical lecture session in a course, where a video documentary was used to explain a particular topic related to handling clients during counselling sessions. She was able to observe the facial expression, reaction, mood, and listen to the tones of voice of both the client and the counsellor during counselling sessions as depicted by the video. This implied that she learnt from real life scenarios of dealing with clients in counselling as facilitated by ICT.

> In Guidance and Counselling, we watched an online documentary about how you can treat people that you are counselling, because with some people it has to be between two people (individual), and how it can be done when you are dealing with more than two (group). Actually, it gives you a clearer picture on how to handle (real life situations). (Interview Transcript: Longoria)

Yvette who specialised in sciences also described her lecture room experiences. During lecture sessions in science subjects like Biology and Chemistry, watching YouTube videos and observing images supplemented with the verbal explanations from the lecturers, enabled her to construct knowledge based on what she had seen (Fig. 2). She found this exciting and described her experience.

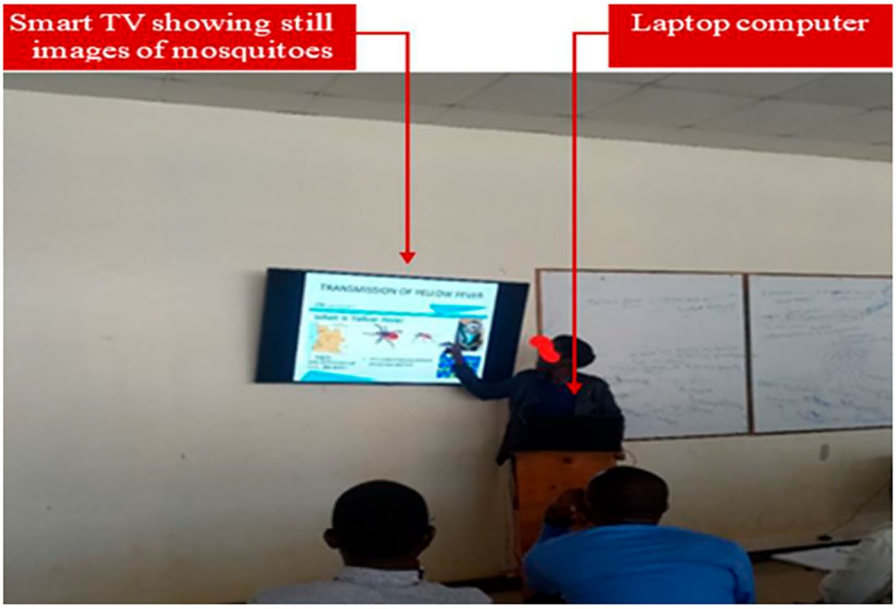

Fig. 2 General Entomology lecture facilitated with a smart screen

> We did have some images in those projections (on the smart television). In Biology, most of the topics we did we had those web-based graphical presentations on human systems, like respiratory, digestive, reproductive. The lecturers would show us what happens from this point to that point. When we studied topics on the Skin too, explanation was accompanied with videos for us to understand it better. It was really wonderful. (Interview Transcript: Yvette)

Divine echoed Yvette in describing her experience with ICT-infused lectures during face-to-face lectures. She explained that the use of ICT seemed to depend on the course being taught. Engagement with the materials and involvement in the learning process increased due to students' interaction with both ICT tool and the lecturers.

> For example, in Psychology, I remember the diagram that was showing us the levels of understanding. It was like a triangle that had five levels in…I think it was Bloom's Taxonomy…yeah diagrams like that and after, they (lecturers) asked us to describe what we have seen, that is a kind of activity, and we explain what we have seen or read on the screen. (Interview Transcript: Divine)

According to Nyansani, projecting of subject matter through the smart televisions while learning enabled him to concentrate, and listen with undivided attention. He felt that being able to read the displayed content as the lecturer explained allowed him to summarise the main points from the lecture enhanced his understanding.

> You see, the ICT (smart TV) is there on the wall. In Business Communication, he (the lecturer) brought his computer, and connected to the smart TV on the wall. Displaying what he is saying, which helps me to follow. Projection makes it simple to do summary, projecting the content while explaining. So, we see and learn, and we didn't miss any single word. (Interview Transcript: Nyansani)

The in-service teachers enrolled at the university with the usual expectation of a repeated cycle of the chalk-and-talk method of teaching. However, they found themselves in an unprecedented learning environment where teaching and learning demanded that they make constant use of ICT. Although learning in a technology infused environment at Horeb University presented a huge learning curve for the in-service teachers who had not used ICT to such an extent, they persevered by forming their own community of practice as a support-system to overcome this challenge. This also thrusted them to the development of new learning strategies such as 'learning how to learn' through self-directed learning.

5.1 Mentoring good ICT pedagogical practice

The ICT learning experiences of the in-service teachers at Horeb University consisted not only of their individual interaction with technology but also through their observation of their lecturers' use of ICT. Lecturers employed several types of ICT tools, devices and resources such as data projectors, PowerPoint presentations with embedded multimedia, YouTube videos, and documentaries for teaching. The in-service teachers expressed their opinions on the significance of creating a learning experience for their learners in the same way as they learnt. Sylvester explained that the observed methods of integrating ICT into teaching by lecturers such as videos to visualise abstract concepts enhanced his learning and, he felt a sense of responsibility to recreate the same with his learners. Reproducing the teaching method of their lecturers with regards to the use of ICT required the use of cognitive skills with which to select the appropriate materials and resources for teaching and learning in their classroom.

> When a lecturer is teaching us 'Volcanicity' it is hard to see it (a volcano) while you are in Kigali or in Eastern Province, but when you watch it (a video), you can say "if I ever come across a mountain which looks this way, I would identify this is a volcano". So, it makes sense, it provides me with enough knowledge to understand it, and when I teach a topic which includes a volcano, I use the same method the lecturer used, so you see it is shaping the way I teach. (Interview Transcript: Sylvester)

Adeline was quite enthusiastic about recreating the same experiences that she had with ICT with her learners, as she seized every teaching opportunity to use ICT in her classroom. She displayed her skills in a manner which we considered quite impressive during one of our visits to her classroom for observation.

> The way I see lecturers when they come into the lecture rooms using ICT tools while presenting and teaching, I come to apply it in my school. They guide us too on how to apply or integrate ICT in our teaching in the same way they do. I imitate my lecturer and then I come and put it to practice in my school, I apply the same methodology and techniques. (Interview Transcript: Adeline)

Similarly, Daudi excitedly recounted that observing the lecturers use ICT at the university motivated them to repeat the same with the learners in their classrooms (Fig. 3), having experienced the outcomes of the interaction with ICT themselves. This implies that the interest and attraction to use ICT in their own classroom originated from and increased with their experiences as students at the university.

> Yes! Actually…eerrm let me give you an example, what I do now in my class. The way lecturers behave, students copy them. So, as a lecturer comes and uses ICT in the class it influences us, we copy them as they do, and we go and make implementation of the same, helping our learners in the school. (Interview Transcript: Daudi)

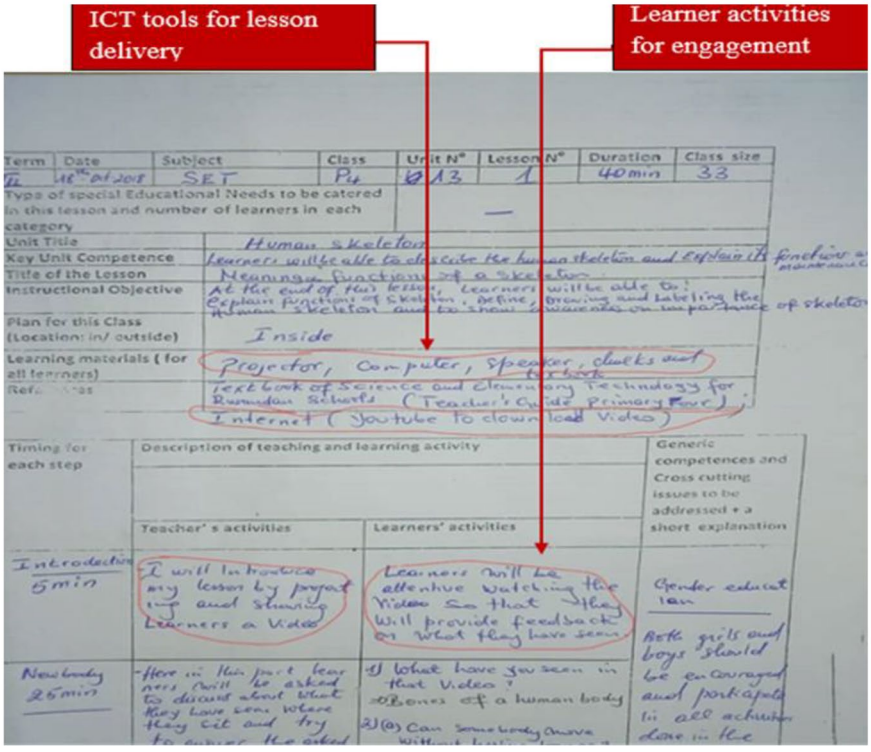

Fig. 3 Document analysis of Daudi's SET lesson plan (Integrated ICT activities)

Lecturers at Horeb University demonstrated the use of ICT for teaching through constant display of learning materials that aided further comprehension of curriculum content. Divine explained that she found this helpful to her, hence she was motivated to put in more effort to ensure that she employed ICT for teaching in her classroom.

> You see, when they (lecturers) are using ICT in the lecture rooms, it is like to give us the examples, good example to teach. Sometimes I feel lazy to use a projector, but because our lecturers are using it many times, me too I see the way it helps me in my classroom, I see that it helps my own learners where I teach, I have got a good example from them. (Interview Transcript: Divine)

Visualisation of various concepts through ICT made it easier for the in-service teachers to keep track and better comprehend the subject matter presented by the lecturer during learning. It also reduced the efforts made by the lecturers to ensure that learning took place. This served as motivating factor to Nyansani, as he adopted the strategy to similarly reduce the amount of energy, he used in explaining concepts in his class while teaching.

> Yeah, it is good projecting on the smart TV, that is one thing I picked, it reduces the talking for the teacher, that reason pushes me to use ICT in my class. The way they (lecturers) use it (ICT) motivates me to use it in my own class as well. (Interview Transcript: Nyansani)

The participants in the current study, whilst studying through the use of ICT and coupled with vicarious observation of lecturers' ICT integrated practices acted as a catalyst for changing their classroom practice. Participant teachers' learning experiences with ICT at Horeb University played a significant role in shaping their practice and transforming their pedagogy.

5.2 Changed pedagogical practice

The requisite changes in the pedagogical approaches of 21st century teachers are in response to the increasing presence of ICT in the classroom. Hence, teaching is being transformed into a more purposeful and engaging activity facilitated by the interaction between pedagogical and technological knowledge possessed by the teacher.

> I wasn't using ICT before joining Horeb University, but ever since I went through many classes (learning activities) where ICT was integrated, I have fully experienced how ICT boosts (increased) the rate of content delivery, and how it enlivens learning process when it is applied during lesson delivery steps and processes, I started to integrate ICT in my teaching (practice). (Interview transcript Adeline)
>
> When you are talking about pedagogy, you talk more about teaching methods, what we teach and the way of teaching them. ICT it helps us to prepare appropriate, and complete content. Then methods, many times, you may even not know how you can teach a certain lesson for example, but when you go and

> search the internet, you are advised on how to teach the lesson without frustrating the learners, starting from simple to complex. (Interview Transcript: Daudi)

Yvette explained that learning with ICT influenced her teaching methods. Acknowledging the fact that ICT skills evolves daily and so should teaching methods. She learned, through the internet, from the experiences of teachers from the other parts of the world and thereby employed the same teaching methods that worked for them. ICT helped her to effectively and easily combine different types of teaching methods that fostered the engagement of learners through all their senses. Additionally, she also used YouTube videos to improve her expertise and teaching approaches.

> It is a change, the first one is the method, the method that I used in 2015, I used to write on the board only, but now the method has been changed to listening, writing, and seeing, those are the three that go together at the same time. Also, I was unable to vary teaching techniques for my learners; giving them age-appropriate content but all of these areas of improvement I needed are now fixed. (Interview Transcript: Yvette)

Divine narrated how she used ICT tools to bring reality into her classroom. She accessed textbooks through the Rwandan Education Board (REB) educational portal for different subjects which is stored in an electronic format (Fig. 4). She described one science textbook which contained images and illustrations showing the different types of soil. These images made the lesson presentation more comprehensible as learners easily associated the images with what they had seen in the real life. Thereby enhancing easy transfer of knowledge.

> For example, I was teaching types of soil, but I could not easily find the clay soil. So, I got the soft copy book that described how a loamy soil is, how a

Fig. 4 Divine teaching English language with ICT

> clay soil looks like and how sandy soil is. They (learners) saw people that were doing the work of craft with the clay soil and the people that were building with sandy soil. When you are using ICT, you have access to many things (resources) therefore, the teaching aids you would display are well-shaped. So, you understand there is a big difference. (Interview Transcript: Divine)

The in-service teachers mirrored the good ICT practices of their lecturers at the university when they returned to their classrooms. The in-service teachers not only replicated their experiences with regard to how their lecturers' used ICT, but they also exhibited an inherent and professional desire model this experience. Lecturers at Horeb modelled appropriate ways of purposefully weaving ICT into their lectures and this motivated the in-service teachers to replicate similar methods for improved learner engagement through ICT-enabled teaching strategies.

6 Discussion of findings

The findings of the current study revealed that in-service teachers seemed to have changed their perspective on the importance of making a pedagogical shift in their teaching. The in-service teachers were prepared to embrace change and were enthusiastic about being abreast of the dynamic teaching and learning landscape to meet the needs of their learners and deliver the curriculum effectively. The in-service teachers through their learning experiences at Horeb university acquired both subject content knowledge and vicarious technological pedagogical knowledge. Though both knowledges occurred concurrently, the technological pedagogical knowledge was not an intended outcome for the in-service teachers or the Horeb lecturers. This finding has real-world applications of our research as it demonstrates that teachers, may positively change their teaching practice based not only on their beliefs and attitudes, but also if they are exposed to observing good teaching.

Teachers are developing their own ICT pedagogical integration skills, albeit slowly, but they often rely on traditional teaching strategies (Vandeyar, 2013). Mishra and Koehler, suggests that teaching is a complicated scientific practice that requires the thoughtful process of "interweaving of many kinds of knowledge" (2009, p. 61). Thus, the integration of ICT brings forth further complication to the classroom context, as it advocates for teachers to have pre-requisite knowledges namely, content knowledge, pedagogy knowledge and technology knowledge. To strike a good balance teachers must have these pre-requisite 'knowledges', to successfully integrate ICT into their practice. In the context of this study, teachers assimilated the technology pedagogical knowledge vicariously.

In the current study, a noticeable shift in the pedagogical practice of the in-service teachers occurred in their classrooms because of their learning experiences with ICT during their tenure as students at Horeb University. This experience significantly influenced choices of ICT tools, strategies and, learning activities in their teaching repertoire. Their experiences using ICT for learning as students translated into the exploration of new and more engaging teaching methods that placed the learner

at the core of all planned activities in their classrooms. This unintended outcome prompted a pedagogical shift that became evident in their practice after returning to the schools where they were employed. Technological pedagogical knowledge (TPK) cannot be isolated from content knowledge (CK) and general pedagogical knowledge (PK) due to the interdependent nature of these knowledges in integrating technology into teaching and learning. Research posit that content knowledge and the pedagogical competence of teachers are significantly connected to technological capabilities, hence the three knowledges (TPK, CK and PK) need to be seemlessly dovetailed for effective classroom practice (Voogt et al., 2013). Therefore, developing proper pedagogical knowledge and its appropriate application to ICT is considered as crucial as the technical ability of using ICT.

Seemingly, the mirroring of good practice by the in-service teachers in this study also emerged vicariously. Through observing lecturers' practice with ICT, the in-service teachers in this study realised the benefits of using ICT and were intrinsically motivated. The current study's participants reflected how they as students, experienced increased levels of engagement through the ICT enhanced teaching context. This "turning" encouraged them to make deliberate efforts to mirror the same pedagogical experience in their classrooms, to reconcile how they were taught at the university to how they taught at school. Evidently, appropriate learning experiences played a significant role in the acquisition of skills, knowledge, or competence for teaching at all levels. In the current study, lecturers acted as role models, and this significantly impacted on adding value to the in-service teachers' ICT pedagogical practice. Significantly absent in the extant literature (Cuhadar, 2018; Tondeur et al., 2019) is the current study's finding that the in-service teachers mirrored the good ICT practices of their lecturers, when they returned to their classrooms.

7 Conclusion

This study found that in-service teachers intending to improve their subject knowledge through studying at a HEI (Horeb university), made a pedagogical shift through vicarious observation and subsequent mirroring the ICT pedagogy modelled by their lecturers. In this regard, the modelled good practice enhanced the personal experience of the in-service teachers in their own classrooms and supported their professional relevance, expertise, and identity. Significantly, the vicarious learning experiences at the university led to a significant unintended outcome which was the inculcation and development of technological pedagogical knowledge (TPK). The in-service teachers did not envisage the rich ICT pedagogical learning experiences they had observed at the university. This steep learning experience at the higher education institution also contributed to the in-service teachers' mastery of new and requisite ICT skills necessary for coping in both an academic environment and in their classroom repertoire. This enriched learning experience allowed the in-service teachers to consciously *unlearned* the traditional teaching approaches, techniques and styles they were accustomed to in their traditional practice. They vicariously *learned* and *relearned* new and more effective strategies of ICT pedagogical practice as those modelled by their lecturers at the university.

This study contributes to and complements the body of literature which seeks to explore teachers' ICT pedagogical shift through the mirroring of good practice. Insights gained from this research suggests applications in real contexts namely, teacher training institutions may compel lecturers to demonstrate good pedagogical practice particularly through the use of ICT; district officials may also use expert ICT teachers to demonstrate good pedagogical practice at workshops. This study did not set out to generalise the findings, which is an inherent qualitative study limitation, but to elicit salient unique findings. Furthermore there are contextual issues and limitations which also negates generalising findings. It is suggested that future research may focus on incorporating more diverse sampling or quantitative measures, which may enhance the robustness and applicability of the findings of the current study. The study recommends that for real change in ICT integration in classrooms, teacher educators must mentor the authentic use of ICT in their own practice.

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Data availability The associated dataset of this paper is housed in a Research Data Management (RDM) repository at the University of Pretoria's UPSpace institutional repository. Furthermore the data that support this research can be made available through the Figshare repository.

Declarations

Conflict of interest None.

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