International Journal of Learning, Teaching and Educational Research
Vol. 23, No. 2, pp. 203-226, February 2024
https://doi.org/10.26803/ijlter.23.2.10
Received Oct 25, 2023; Revised Jan 17, 2024; Accepted Jan 21, 2024

Aligning Preservice Teachers' Experiences for ICT Integration in Education in the School of Education at the University of Technology in South Africa

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Abstract. The poor correlation between fieldwork and the preservice teachers' coursework for technology integration has been observed since the introduction of technology as a teaching and learning tool in education. The quantity and quality of the preservice technological experiences as part of the teacher education program have a significant impact on how new teachers use technology. This paper highlights how the educational programs and the fieldwork experiences of the preservice teachers should be aligned to integrate technology in teaching and learning. To gain insight into the current practices in the School of Education at the University of Technology in South Africa, the embedded mixed method approach, was utilised. For quantitative data, a TPACK questionnaire was distributed to 480 preservice teachers. Observation, interviews, an open-ended questionnaire and document analysis were employed for qualitative data. To analyse quantitative and qualitative data, the Statistical Package for Social Sciences (SPSS) and Atlas.ti were employed, respectively. The findings revealed a lack of synergy between the preservice teachers' coursework and the fieldwork for technology integration in education. It was recommended that for the preservice teachers to thrive in integrating technology in teaching practicals and in their future workplaces, the School of Education should ensure the development of programs that involve coursework and fieldwork in the school context.

Keywords: Pre-service teachers' experiences, teaching practices, ICT integration, coursework and fieldwork., School of education

1. Introduction

Currently, the ability to integrate Information and Communication Technologies (ICTs) in ways that harness preservice learning affordances and that enhance the students' digital literacies is widely acknowledged as a requirement for the Preservice Teachers (PSTs) (Brianza et al., 2023; Akayoglu et al., 2020). These authors assert that effective ICT integration in the classroom is difficult because it calls for a sophisticated use of technological, pedagogical, and content knowledge. Furthermore, they advocate for the provision of university learning experiences and professional placements that enable the PSTs to develop capacities which are also a major challenge for the lecturers. It is asserted that a system of education is effective if it produces graduates who are prepared for the future and can continue to learn after graduation with the ability to handle life's challenges and adapt to a changing environment and society (Ng & Wong, 2022; Neumann et al., 2021).

Munna and Kalam (2021) argue that effective teaching leads to effective learning. Furthermore, it is asserted that for the PSTs to be proficient and effective in their future workplaces, it is crucial that they be capacitated with the relevant skills and knowledge (Oubibi et al., 2022). These authors argue that the PSTs must be taught how to teach using technologies and they must be afforded the opportunities to apply knowledge that is gained in the field before they are in their actual workplaces. In that case, Oubibi et al. (2022) postulate that there are more possibilities of the PSTs using the technologies in industry if they were familiar with them during the course work.

This study was motivated by the observed PSTs' inability to integrate technology during the practicals. Comparable research on the experiences of the PSTs has been carried out, including analyses of what is important for preservice training (Tondeur, 2018). However, Habibi et al. (2023) and Kuru Gönen (2019) indicate that there is a scarcity of studies investigating how the PSTs' experiences impact the incorporation of technology in their teaching practices. Hence this paper also responds to that call, and it reports on the alignment of the PSTs' experiences on technology integration in their teaching practices.

In the Study University, the PSTs were taught using traditional teaching methods, hence, the PSTs encountered difficulties when utilising newly installed emerging technology in the schools. This was confirmed by one of the schools where the preservice teachers were deployed, as they drew the attention of the Study university by indicating that the PSTs refused to use the installed technology in the classrooms.

To gain an insight on the experiences of the PSTs for ICT integration, this paper, commences by providing a literature review on the six strategies for capacitating the PSTs for technology integration.

2. Literature review

It is purported that for the PSTs to be competent and proficient in incorporating technology in teaching, they need to acquire Technological, Pedagogical and Content Knowledge (TPACK) (Koehler & Mishra, 2009). To support the PSTs'

acquisition of TPACK, Tonduer et al. (2012) developed a Synthesis of Qualitative Evidence (SQD) model that entails six strategies that can be utilised to provide the PSTs with a conducive environment to enrich their experiences for technology integration in their practices. To ground these strategies in this study, constructivism was employed. This theory advocates for a conducive environment, as well as for a Zone of Proximal Development (ZPD) for knowledge construction (Vygosky'1978).

From a constructivist perspective, modelling is PSTs-centred as the PSTs are allowed to observe and mimic the lecturers. Reflection affords the PSTs to critically think by comparing the pre-existing knowledge with the new and construct concepts to apply them to problematic situations. Learning by design allows the development of their own ideas. Collaboration affords them the opportunities to work with knowledgeable others and peers. Authentic experiences present opportunities to apply the gained knowledge in the classroom and feedback allows the PSTs to consider errors as opportunities for learning (Connolly & Begg, 2006).

2.1 Role Modelling

The role modelling strategy refers to the demonstration of teaching using technologies where the PSTs are afforded the opportunity to observe and witness the ICT use for teaching and learning (Ellis, Alonzo, & Nguyen, 2020). The term constructivist refers to role modelling as the scaffolding by the knowledgeable other (Piaget & Inhelder, 1969). This implies that if there is a lack of exposure to the use of technology, where the lecturers are still grappling with the use of technology integration themselves, the PSTs may not benefit (Oubibi et al., 2022). Concequently, the PSTs tend to apply the observed use of ICTs out of context (Tondeur, 2018). Bladergroen and Chigona (2019) report that their research study on the experiences with the ICTs, indicated that there is a lack of lecturers who are role models to demonstrate how the ICTs can be utilised. In teacher education, the lecturers can serve as role models for the successful use of technology in the subject teaching. Then, the educators can coach the pre-service teachers in incorporating technology into their subject-matter instruction or serve as role models for them while they are practicing in a particular school (Wetzel et al., 2014). In a study conducted by Admiraal et al. (2017) on preparing preservice teachers to integrate technology teaching, the PSTs insisted that they needed more models. The extent to which the PSTs are exposed to technology in the classroom has an impact on their future use of technology. Consequently, for the lecturers and the teachers to successfully demonstrate the integration of technology into teaching and learning, they should possess pedagogical skills, content skills, design skills, technological skills, management, and institutional skills, as well as interpersonal and conversational abilities (Albrahim, 2020).

2.2 Reflection

Reflection entails discussing and reflecting on the benefits and limitations of using ICT in education (Ching, Yang, Baek, & Baldwin, 2016). This view aligns with constructivism which purports that the learners can reflect on their pre-existing knowledge to solve the encountered problem using the available ICTs (Connolly & Begg, 2006). In this strategy, the PSTs would be allowed opportunities to

critically evaluate the materials and experience incorporating the digital technologies in the classroom (Gudmundsdottir & Hatlevik, 2018). Furthermore, it is argued that for the learners to be actively involved in the knowledge construction, the environment should be engaging, motivating and challenging (Boz & Cetin-Dindar, 2023). Allowing the PSTs to integrate the ICTs into the curriculum materials includes giving them an opportunity to evaluate and select the appropriate ICTs for instruction and acquire the necessary pedagogical, technological, and content knowledge (Qui et al., 2022). Additionally, it is stated that the PSTs' comprehension of the advantages and the risks that are associated with using ICT for teaching and learning enhances their preferences as their knowledge should be beyond computer literacy (Koehler & Mishra, 2009; List, 2019). In higher education institutions, there is frequently a lack of time for the PSTs to attend technology integration training and integrate ICT into their lesson practices (Habibi et al., 2020). Hence, these authors suggested that the preservice teachers must be afforded longer periods in the schools to experience the integration of technology.

2.3 Learning by Design

Learning by design is when the PSTs are given an opportunity to select and design the learning materials using digital technologies (Alayyar & Fisser, 2019). These authors assert that the designing skills involve cooperating with the production team to design learning activities and to select appropriate tools and techniques to organise and present the learning materials in different formats. This aligns with the constructivists who opine that in a conducive learning environment, the lecturers become facilitators and they create learner-centred activities as well as guide the PSTs to collaborate and design their own material for resolving the presented problems (Paparozzi, 1998). In this case, the PSTs would use ICTs to design learning activities and present them through the relevant ICTs. Moreover, the literature reveals that a lack of relevant resources prohibits the PSTs from developing and designing a technology rich environment which stresses the acquisition of flexibility, efficacy, efficiency, engagement, adaptability, and reflectiveness in learning (Tonduer et al., 2018; Cheung et al., 2021). Therefore, if the environment is not resourceful, the PSTs may not have the opportunity to develop models on their own.

2.4 Collaboration

Constructivism argues that collaborating with others allows the reconstruction of the pre-existing knowledge that results from the exchange of ideas (Le et al., 2018). In this case, collaboration refers to allowing the PSTs to work in groups incorporating the ICTs for teaching and learning. Moreover, knowledge construction results from effective collaboration (Alayyar & Fisser, 2019). Working in groups mitigates the feelings of insecurity when working using the ICTs (Hämäläinen, 2022). Furthermore, it is asserted that the university can train a mentor to guide the preservice teachers during field placement (McGarr & Gallchóir, 2020). In addition, these authors argue that the lack of a formal partnership with the schools creates a significant variation in the way that the PSTs use technology. In intercultural online collaboration, the PSTs are given more opportunities for real-world collaboration and an increased comfort level of working with international partners (Hurrt al., 2020). According to Mee Mee et al.

(2020), gamification is a developing approach for increasing the students' motivation and engagement. This approach integrates content area instruction, literacy, and 21st century learning skills. The growing popularity of gamification stems from the belief in its potential to foster motivation, behavioural changes, friendly competition and the collaboration in different contexts (Manzano-León et al., 2021).

2.5 Authentic experiences

Authentic experiences imply that the preservice teachers should use the ICTs in a real setting where they can apply the technology skills (Ellis et al., 2020). It is asserted that incorporating authentic learning experiences into the curriculum requires adapting to changing the teaching and learning demands. For the PSTs to have the necessary knowledge and experiences to use technology in their particular subject areas, it is postulated that they integrate the technology skills throughout the curriculum. Authentic experiences have been shown to help the PSTs to become more confident in designing curricula integrating ICT (Hsu & Lin, 2020). Vygotsky (1978) advocates for the employment of real-life situations and concurs that the PSTs could acquire the required knowledge and skills for incorporating ICT through real-world experiences in which they actively participate, engage, and reflect on some of the core practices. (Tunç -Pekkan et al., 2023). This implies that the lecturers should not only model but create authentic tasks for the PSTs to engage in technology integration.

Facilitating online discussions is intended to facilitate participation for knowledge construction and it includes creating a dialogue as the most important component in any educational process (Kostadinovich & Bondareva, 2020). A dialogue could be a PSTs' discussion with the lecturer's guidance and feedback, the student-to-student discussions and the feedback as well as the guidance from the other students. It is argued that dialogues enrich the learning environments with experiences and distributed intelligence (Hu et al., 2023).

Alexander (2020) asserts that the five principles that can stimulate effective dialogues relate to collective, reciprocity, alternative viewpoints, culminative and purposeful criteria. The author argues that as a collective, the lecturers and the students address the learning tasks together. Reciprocity relates to the students and the lecturers listening to each other, sharing ideas and considering alternative viewpoints. Supportive criteria is about the students articulating and freely sharing their ideas and assisting each other to achieve common understanding. In cumulative criteria, the students build on their own as well as on each other's ideas and they link them to be coherent with each other's lines of thinking and enquiry. Lastly, the teacher purposefully plans and steers the discussion with specific learning goals in mind.

2.6 Feedback

Vygotsky (1978) refers to feedback as a scaffolding strategy in the lecturer-student relationship to motivate the students to assume greater accountability for incorporating technology into their lessons. For the lecturers to provide corrective feedback, they need to be competent in the use of technology for teaching. They must also understand how the PSTs' digital competence develops and the kind of

issues the PSTs encounter when using digital technologies (Tonduer, et al., 2012). To support the PSTs, feedback could be given through discussions, questionnaires, interviews, and observations (Ellis et al., 2020). However, it is argued that feedback should be timely. The peer and the lecturers should also provide feedback on the use of ICT for teaching and learning (Hsu & Lin, 2020). The lecturers' active participation in queries and in discussions by providing feedback and posing conflicting views will provoke the students' thinking or reflection. In this case, the lecturers should contribute at least 10% of the discussion postings (Shank, 2001; Martin et al., 2019). The literature reveals that in discussion boards where the lecturers are more involved, the students respond with more enthusiasm and regular participation (Fehrman & Watson, 2021).

3. Research question

The aim of this paper was to report on the correlation between fieldwork and the preservice teachers' coursework for technology integration in the School of Education at the University of Technology in South Africa. To gain insight on this issue, the main research question that was posed is, ***To what extent are the PSTs' experiences aligned for technology integration in teaching and learning?*** To address this question, some sub-questions were created.

3.1 Sub-Research questions

- **RQ1:** To what extent were the PSTs afforded the opportunities to experiment with the ICTs in the School of Education?
- **RQ2:** How were the preservice teachers empowered to integrate technology in teaching and learning?
- **RQ3:** To what extent were the PSTs affected by using the ICTs during practicals?

4. Methodology

To answer the research question, an embedded mixed method approach was employed. For the quantitative data, a TPACK survey questionnaire was adapted as the permission to use it was granted by the authors. The TPACK survey questionnaire consisted of seven subscales relating to Content Knowledge (CK), Technological Knowledge (TK), Pedagogical Knowledge (PK), Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK) and Technological Pedagogical Content Knowledge (TPCK). The TPACK questionnaire was adapted by adding the biographical data as Section A of the questionnaire (See Appendix 1, p.17). The scale used the following ratings: Strongly Agree - 1 and Strongly disagree – 5. It is worth noting that this paper reports on a fraction of results from a thesis, therefore, to answer the sub-question, *How are the student teachers empowered to integrate technology in their teaching practices* in this paper, three items of one subscale, TK was utilised (See Table 2).

For qualitative data, open-ended questionnaires, focus group interviews, and observations were used. These instruments assisted in responding to the RQ1: *To what extent were the PSTs afforded opportunities to experiment with the ICTs in the School of Education?* RQ2: *How were the preservice teachers empowered to integrate technology in teaching and learning*? and RQ3: *To what extent were the PSTs affected*

by using the ICTs during practicals? It worth noting that this paper reports on a fraction of a thesis. Therefore, only the data and the categories that are relevant to the sub- research question in this paper were incorporated.

4.1 Participants

For quantitative data, stratified sampling was employed to select the respondents. The sample consisted of 230 in Phase 1 and 250 PSTs in Phase 2 for the test retest. The biographical information of the students who took part in Phases 1 and 2 of this work is displayed in Table 1. It is important to note that 230 students (100%) revealed information regarding the biographical data during Phase 1. There were 57.8% more female students than male students. Based on age, the findings showed that 82.2% of the participants were between the ages of 17 and 24. 99.1% of the students were of African descent. AD-4 accounted for more than half (57.8%) of the student body. The provinces from which the students originated are indicated in the table: Gauteng accounted for 30% of the total, closely followed by Mpumalanga (29.1%) and KwaZulu-Natal (27%).

In phase 2, 250 students (100%) revealed their biographical information, according to the results in Table 1. More than half, or 52% of the pupils, identified as female. Based on the age distribution of the participants, 83.6% of them were between the ages of 17 and 24. A total of 97% of the pupils were African. Of the pupils, over half (55.2%) were from the AD-4. Table 2 shows that with respect to the province from which the students originated, Gauteng accounted for 36.4% of the total, closely followed by Mpumalanga (30.4%) and KwaZulu-Natal (20%).

Table 1: **Students' biographical data (%) in both Phase 1 and Phase 2**

		Phase 1 [N = 230] (%)	Phase 2 [N = 250] (%)
Gender	Female	133 (57.8)	130 (52.0)
	Male	97 (42.2)	120 (48.0)
Age	17 years – 24 years	189 (82.2)	209 (83.6)
	25 years +	41 (17.8)	41 (16.4)
Race	African	228 (99.1)	244 (97.6)
	White	0	2 (.8)
	Coloured	2 (.9)	3 (1.2)
	Indian	0	1 (.4)
Department*	AD-1	60 (26.1)	89 (35.6)
	AD-2	37 (16.1)	8 (3.2)
	AD-3	0	15 (6.0)
	AD-4	133 (57.8)	138 (55.2)
Province	Gauteng	76 (33.0)	91 (36.4)
	Mpumalanga	67 (29.1)	76 (30.4)
	Kwa-Zulu Natal	62 (27.0)	50 (20.0)
	Limpopo	23 (10.0)	26 (10.4)
	North West	0	4 (1.6)
	Northern Cape	0	2 (.8)
	Western Cape	0	1 (.4)
	Free State	2 (.9)	0

To select the participants for qualitative data, convenient purposeful sampling was employed. Convenient purposeful sampling is selecting a group of

participants due to accessibility and possessing certain attributes (Creswell & Creswell, 2017). In this case, the sample consisted of 95 PSTs who were aware of the use of ICTs in education, interested and available to participate in this research project. It was convenient to collect data from them as they were students where the researcher was working. The participants were second year PSTs from four different departments in the School of Education.

4.2 Data Analysis

Data analysis is the process of describing the collected data and identifying meaningful patterns within it (du Plooy-Cilliers et al., 2014). Because the study produced both qualitative and quantitative results, the analysis was carried out independently. To analyse the quantitative data, Version 25 of the SPSS was employed. Frequency distributions with percentages were utilised to analyse the participant biographical data (Section A) and the TPACK items (Section B).

To analyse the qualitative data, a computer program, Atlas.ti was used (Friese, 2014). Atlas.ti contains the mechanisms for data analysis to be done in the program itself, mediated by the researcher, who continues to play the primary role in the analysis process as the critical thinker. It also gives capabilities to centralise all the information that is required for organising one's research (Friese, 2014). Following its collection into categories, the data was arranged into themes based on the research sub-questions (Friese, 2014).

4.3 Reliability, validity and trustworthiness

To establish the reliability of the scores from the students' TPACK, the Cronbach's (1951) alpha values for the seven subscales and the full questionnaire were calculated to determine the reliability of the students' TPACK scores. The TPACK values were determined to be internally consistent, that is, dependable for both phases, with a=.94 (Phase 1) and a =.95 (Phase 2).

For trustworthiness, credibility, dependability, transferability, and confirmability were used to ensure the accuracy of the qualitative data (du Plooy- Cilliers et al., 2014). To establish credibility, a variety of data sources, including open-ended questionnaires, focus group interviews, and observations, were employed. Triangulation was utilised to guarantee dependability where the findings from the employed instruments were compared. To ensure transferability, the study can be used by any higher education institution or for comparable setting involving lecturers and the PSTs. To ensure confirmability, peer debriefing before administering the instrument and after data capturing using the external auditor was employed.

5. Results

The subscale, TK of the TPACK questionnaire was used to respond to RQ1, which sought to answer whether the PSTs were given opportunities to experiment with the ICTs. The TK items including TK3, TK4, and TK6 assisted in gaining knowledge of the frequency of ICT use, the PSTs' familiarity with various ICTs, and the availability of adequate opportunities to experiment with ICT use, respectively. The PSTs were required to respond to the instrument using a 5-point

Likert-type rating scale, with 1 being strongly agree and 5 being strongly disagree (See Table 2).

Table 2: **PSTs' frequency distribution of Technological Knowledge**

Scale	Strongly agree	Agree	Not sure	Disagree	Strongly disagree
Technological Knowledge (TK) [N (%)]					
TK1	94 (19.3)	172 (35.4)	131 (27.0)	52 (10.7)	37 (7.6)
TK2	97 (20.0)	187 (38.5	124 (25.5)	50 (10.3)	28 (5.8)
TK3	66 (13.6)	157 (32.3)	131 (27.0)	82 (16.9)	50 (10.3)
TK4	59 (12.1)	134 (27.6)	174 (35.8)	72 (14.8)	47 (9.8)
TK5	83 (17)	191 (39.9)	159 (32.5)	53 (10.9)	0 (0)
TK6	51 (10.5)	158 (32.5)	124 (25.5)	104 (21.4)	49 (10.1)

RQ1: To what extent were the PSTs afforded the opportunities to experiment with the ICTs in the School of Education?

In terms of (TK3), the PSTs had to indicate if they frequently experimented with different software. From the results, it can be seen in Table 1 that 45.9% of the PSTs agreed with the assertion. This indicates that more than half of the PSTs did not frequently experiment with different software.

About – (TK4), the PSTs had to answer whether they knew a lot about the different digital technologies. It may be observed from the table that 39.7% of the student teachers agreed with the statement whilst 35.8% were not sure whether they knew different digital technologies. This implies that more than a quarter of the PSTs were familiar with the various digital technologies.

For (TK6), the students had to respond whether they had sufficient opportunities to work with different digital technologies. It may be seen from the results that 43% of the PSTs agreed with the statement. This means that more than a half of the PSTs did not have enough opportunities to work with various digital technologies.

6. Findings

The findings in this paper are a small portion from the thesis where qualitative data was uploaded in the Atlas.ti software for data analysis. This software assisted in creating codes, and categories, where similar categories were grouped into themes. It is worth noting that only the categories that respond to RQ1, RQ2 and RQ3 in this paper are discussed.

Theme 1: The PSTs' perceptions on the opportunities afforded to experiment with the ICTs in the School of Education

To respond to **RQ1**: *To what extend were the PSTs afforded the opportunities to experiment with the ICTs in the School of Education***?** The open-ended questionnaire, interviews and observations were instrumental. From the open-ended questionnaire, four categories relating to, the *availability of technologies for interaction, the sufficient computer laboratories on the campus; the availability of the internet in the classrooms; and* the *availability of Wi-Fi for the students to access were*

discussed. From the interviews, *the adequate hardware and software in the lecture halls and the availability of technologies for interaction were raised.* For observations, the *PSTs accessibility to ICTs in the lecture hall, compared to schools.*

About Category 1, which is the *availability of technologies for interaction*, it was uncovered that the technology was only accessible to the lecturers. In this case, Mpesa indicated, "*… The technology that is there favours lecturers only.…*". Kgodi also stated.*…only lecturers use technology during lectures.…*".

Regarding Category 2, which is the *sufficient computer laboratories on the campus*, the findings demonstrated that they were not enough to accommodate all of the students on campus. In this case Ludwe indicated, "*… there are not enough computer laboratories … Sometimes we have to wait for hours for others to finish before we can do our work ...*". This was a view that was also shared by Pule and Kuhle. For example, Pule pointed out, "*… there are obviously more students than available computers … This means there are times I may not access a computer lab, because there are few computers …*". Meanwhile Kuhle said "*… every time I need to use a computer, I have to wait for those who were there before me … Sometimes I even go to the lab late at night, which is the time I am likely to work without waiting...*". This implies that the computers that were available in the School of Education were not enough to cater for all the students.

Concerning Category 3, the *availability of the internet in the classrooms*, the findings revealed that the internet was not available in the classrooms but only in the computer laboratories, despite occasional disruptions. Pule indicated, "*… we do not have computers to work with in our classrooms so there is no internet either … We do get internet in the labs … I must admit ...*". Monareng said, "*… yes we do get internet … sometimes it is frustrating because sometimes there is a problem, and we wait for days without internet before it is fixed ...*".

In terms of Category 4, the *availability of Wi-Fi for the students to access*, it was found that there was no Wi-Fi in the classrooms. However, Eduroam was available in hotspots outside the lecture halls. About this Pule stated, "*… no, no there is no Wi-Fi in the classrooms …*".

Regarding Category 5, the *adequate hardware and software in the lecture hall* in focus group interviews, it was found that most lecture halls did not have adequate hardware and software. In this case Bheki indicated, "*… as far as I know there are only a few classes that have some form of technology ...*". It was also stated that some lecture halls did not even have electricity. About this, Buyi stated, "*… there are classes with technology and others with no technology … The problem for me is that there are classes with no electricity, so no technology …*". Along the same lines of thought, Anna and Annelise highlighted other related challenges. For example, Anna said, "*… you know what, some classes do not even have data projectors ...*" Annelise meanwhile said, "*… for me it is disappointing … To me, our lecture halls do not even deserve to qualify to be in the University of Technology*".

About Category 6, the *availability of technologies for interaction*, in focus group interviews to follow up on the responses from the open-ended questionnaire. It

became apparent that the PSTs could not access the technology in the lecture halls. For example, Palisa stated, "*… all I know is that the technology found in lecture halls is only suitable for lecturer use … we only have the manuals and the books…*". It was discovered that some of the lecture halls were completely devoid of technology. In this case, Mondli argued, "*… I find it strange that some lecture halls do not have technology at all...*".

For Category 7, the *PSTs accessibility to ICTs in the lecture hall, compared to schools,* it was also observed that the students were not afforded access to the ICTs available in the lecture halls but only in the computer laboratories for computer related subjects. There were podia, data projectors and screens in some of the lecture halls whilst some were just normal classrooms without electricity, still using black boards only. On the other hand, smartboards and tablets were available in schools for teaching and learning.

Theme: The PSTs' perceptions on the development programs for ICTs integration in their practices

Concerning RQ2: the PSTs had to answer how they were capacitated for ICTs integration in their practices. The open-ended questionnaires yielded three categories, including, *orientation on IMFUNDO, other technologies they were empowered to use, taught to use technology for teaching* and *programmes or subjects on the emerging technologies.* From the interview, two categories were created relating to *taught to use technology for teaching* and *programmes or subjects on the emerging technologies.*

For Category 1 orientation *on IMFUNDO*, the findings uncovered that most PSTs were not oriented on the IMFUNDO learning management system. For instance, Palisa's responded, "*… sorry, I have never attended any orientation on IMFUNDO ...*". It was also discovered that some of the PSTs were unaware that orientation had occurred. In this instance, Munye stated, "*… I was not aware that an orientation was organised on IMFUNDO … If it did take place, it must have been on a day, I was absent …*". On the other hand, some of the PSTs revealed that they participated in the orientation on IMFUNDO. In this regard, Gugu indicated, "*… I was actually there when they introduced IMFUNDO during the orientation day ...*".

About Category 2, *other technologies* on which the PSTs were oriented, the findings revealed that most of the PSTs were trained in a variety of technologies. For example, some were introduced to Dropbox's capability for storing, sharing, and backing up data. In that case, Pat indicated, "*… I am fortunate because I was introduced to programmes like Dropbox, the ITS and Compasses ...*". Similarly, Bongani said, "*… I attended training on the I-centre, computers and the ITS...*". There were a few PSTs who indicated that they were not inducted in any other technology.

Regarding Category 3, *taught to use technology for teaching,* the findings revealed that, while most of the PSTs did not receive training to teach using technology, some of them were taught to use technology for teaching, in the schools where they were deployed for teaching practice by the mentors at the host schools. In that case, Vuyo reported "*… on the very first day I arrived for teaching practice, my*

teaching practice mentor told me that they use a smartboard for students' learning materials … she proceeded to teach me how to turn it on as well as how I could load teaching material that I wanted to use and for students to access … It was so wonderful".

For Category 4, *taught to use technology for teaching*, in an interview, some of the students indicated that they learned to use the technology by mimicking others and then tried on their own. In this instance, Palisa indicated, "*… to be honest, I taught myself how to use technology ... when I realised that others already knew how to use technology, I simply observed them and practised on my own ... gradually I got it right … I am so proud of myself …*". The others, on the other hand, stated that they were never trained to use technology in the classroom. Tshidi merely stated, "*… I was never taught to teach using technology …*".

Concerning Category 5, *programmes or subjects on the emerging technologies*, the findings from the interviews revealed that most of the students were not aware of the programmes or subjects on the emerging technologies. Some of them, however, identified the Computer Application Technology (CAT) as the subject in which emerging technologies were taught. For instance, Pule pointed out, "*… I have not come across any programmes or subjects on emerging technologies except for CAT".*

Theme 3: Perceptions of the PSTs on the effects of the ICTs integration during practicals

In terms of RQ3, open-ended questionnaires yielded two categories: *competence in the use of technology during practicals and confidence in the use of technology during practicals.* While focus interviews resulted in one category, *the impact of the PSTs' ICT integration experience* and observations produced one category relating to *confidence and competence in using ICTs during practicals.*

Pertaining Category 1, *competence in the use of technology during practicals*, the findings revealed that most preservice teachers were not competent in using the smartboard, but they were still learning (See Figure 1). However, some of them indicated that it became easy with the support of the mentors. In that case, Papi argued that "*yes, with the support of the mentor it is easy to use the technology recently installed".* Whilst Palisa added that "*the mentor where she was deployed taught her to use smartboard".* However, Mangi indicated that he "*taught himself.*" On the other hand, Thato and others posited that "*they were still learning to use the* smartboard." Muntu indicated that "*I am not used to this technology".*

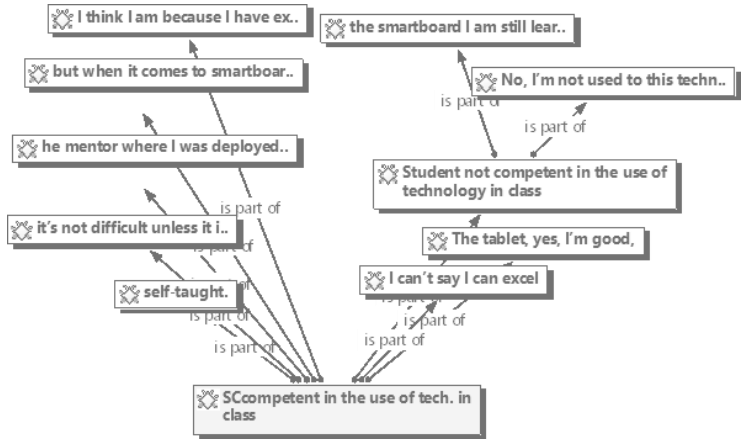

Figure 1: Competence in the use of ICT during practicals

About Category 2, *confidence in the use of technology during practicals*, it was revealed that some PSTs were confident while others were not. Lulo and Tom were among those who were confident. In this regard, Lulo indicated "*… yes, I am confident about using technology during practicals … Most of this comes from attending Computer Application Technology…*". In turn, Tom pointed out, "*… I am confident in using technology during practicals because I learnt about how to use a smartboard …*". Themba and Kena's responses exemplified those who lacked confidence who said, "*… I won't say I am confident, because I have never used technology before, for that...*". In a similar response, Zethu said, "*… I must admit, it is embarrassing … I am in a university of technology, but I cannot use most of the technology we have …*". Figure 2 illustrates the PSTs confidence in the use of ICTs.

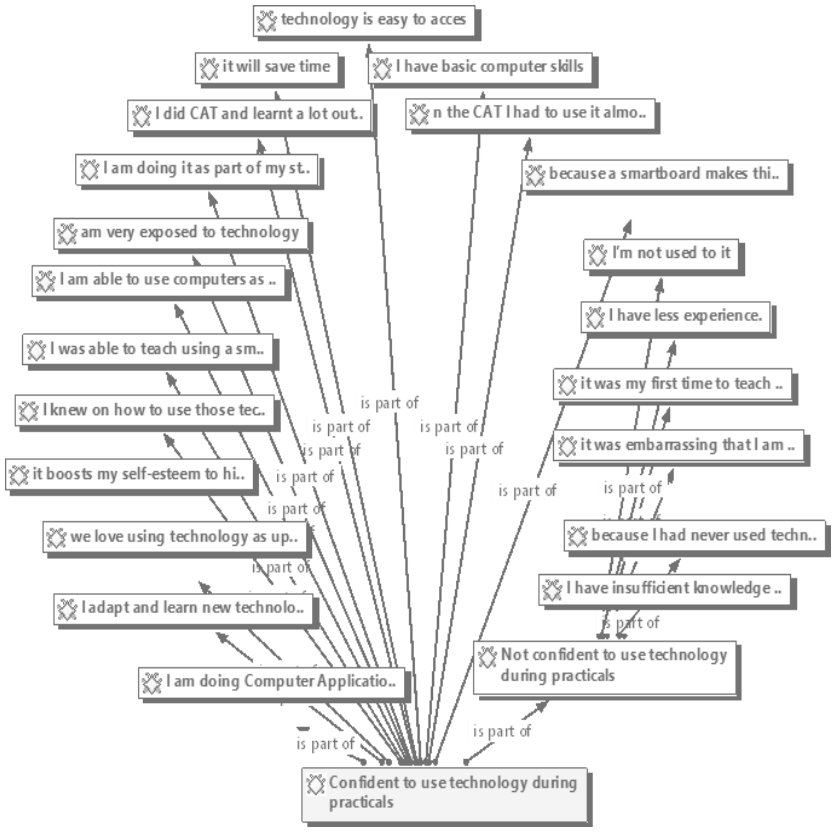

Figure 2: Confidence in the use of technology during practicals

About Category 3, *the impact of the PSTs' ICT integration experience*. During the focus interviews with the PSTs**,** most of them indicated that they had bad experiences. For instance, Thato stated "*my experience was negative because the mentor asked me in front of the learners whether I knew how to use a smartboard*." She went on to say that "*the students made fun of me, and I felt embarrassed*". Eziel as well, claimed that it affected her negatively because when she was supposed to teach, they had to show her how to use the smartboard first before she could teach, and sometimes during the lesson, she was making some mistakes. Khumo also discussed her embarrassment during teaching practice, stating "*I needed to erase, and I could not locate the tool on the smartboard until one of the students came and showed me*, and *I felt embarrassed*". However, not all the students had bad experiences as they indicated that their background as computer applications Technology students assisted, whist others indicated they received assistance from the mentors. It may be deduced that the PSTs experiences in the use of technology in their practices were diverse.

Concerning Category 4, *the PSTs' confidence in using technology during practicals,* it was observed that most PSTs were not confident. For instance, there were students that were utilising the technologies in a narrow manner. A typical example was the use of a Microsoft Word document to present content. Although some of the PSTs used PowerPoint, it was not interactive instead it had disturbing animations and transitions.

It was observed that the PSTs' competence levels varied in the use of technology in the classroom during practicals. While some of them could use the smartboard with ease, others avoided using it. Peter was able to use the smartboard but, he was not competent as he was not able to find the document he intended to use in his lesson in the smartboard. Zandi was using the smartboard in a narrow way using the Word document to present. On the other hand, Themba was avoiding the smartboard and used the whiteboard instead.

7. Discussion

The aim of this paper was to report on the alignment of the PSTs experiences for ICT integration in teaching and learning. It was established that less than half (45.9%) of the PSTs frequently experimented with different software. This implies that more than half of the PSTs did not frequently experiment with different software. These results corelate with less than half (43%) of the PSTs who had opportunities to work with different digital technologies. These results are consistent with slightly more than a quarter 39.7% of the PSTs who were knowledgeable about the digital technologies. This suggests that more than half of the PSTs were neither experimenting with different software frequently, nor had opportunities to work with digital technologies and hence they were not knowledgeable about the different digital technologies. In that case, Oubibi et al. (2022) asserted that the extent to which the PSTs are exposed to the use of technology in the classroom affects the use of technology in the future.

Furthermore, the findings revealed that the technology installed in the lecture halls was not accessible to the PSTs, but by the lecturers only. This is consistent

with the observation findings which demonstrated a lack of technology to enhance the interaction between the lecturers and the PSTs during lectures. It was also unearthed that the available computer centres were very few as such the students would wait in long queues to access them or visit them late at night. It may be argued that this was due to the unavailability of computers, the internet and Wi-fi in the lecture halls as they were in hot spots outside the lecture halls, computer centres and laboratories. Moreover, it was unearthed that some of the lecture halls had podia, data projectors, document cameras and screens whilst the others were void of any form of digital technology not even electricity. However, it was established that there were smartboards and tablets in schools.

The degree to which the PSTs were empowered to integrate ICTs into their work varied. Very few PSTs received training on the School of Education's learning management system, IMFUNDO. Additionally, ITS was introduced to a few PSTs so they could view their test results, Dropbox was used for data storage, sharing, and backup, and Compasses was used for tests. A minority of the PSTs stated that they had not had any training in other technologies. Despite not receiving training in technology education from the School of Education, some PSTs received mentoring in the schools where they were placed for their practicals, while others learned by emulating and observing their peers. But some of them never received training on how to use technology in the classroom. Except for Computer Applications Technology, which is offered to enrolled students, the PSTs were unaware of any other program or subject for integrating technology into the classroom. To support the PSTs during the field placement, the university can collaborate with the schools and train mentors to guide the PSTs on the use of ICTs during practicals (McGarr & Gallchóir, 2020). The PSTs should be capacitated with the 21st-century skills and knowledge (Qui et al., 2022). The outcomes of the acquired skills would be demonstrated during their presentation when they incorporate technology in their practices, and they would be able to design lesson that would meaningfully engage the learners in authentic task (Kent & Giles, 2017).

The PSTs were not competent in the use of ICTs as others indicated that they were still learning and depended on the support of the mentors during their practicals to succeed, whilst some of the PSTs had to teach themselves to use the smartboard. Those who were competent in the use of the available ICTs such as smartboard, were confident and indicated that they learnt from the Computer Application Technology class. On the other hand, those who could not use the recently installed ICTs such as smartboards, faced embarrassment from mentors and learners. They had bad experiences during their practicals as their incompetence in the use of ICTs was exposed in front of the learners and they made mistakes while using the installed ICTs. Some of the PSTs believed that they were competent in the use of the smartboard, however, it was observed that they used it in a narrow manner by presenting using a Word document and PowerPoint presentations which were not interactive with destructive transitions and animations.

The competence in the use of the installed hardware in the schools of deployment, including the smartboard was also varied but most of the PSTs indicated the inability to utilise these ICTs. These findings suggested that the PSTs did not have opportunities to experiment and observe in the School of Education. For instance, the findings revealed that the recently installed smartboards and the tablets in the schools were not available at the School of Education. It may be argued that there was a lack of collaboration between the university and the schools of deployment in capacitating the PSTs to incorporate technology into their practices. The lack of a formal partnership with the schools also leads to significant differences in how the pre-service teachers use technology (McGarr & Gallchóir, 2020). For the PSTs to be able to integrate technology successfully in their practises, they should possess the seven TPACK (Sherab, et al., 2022).

8. Conclusion

It was found that while some lecture halls at the institution had podia, data projectors, document cameras, and display screens, the others had no digital technology at all, not even electricity. Furthermore, the PSTs could not interact with their lecturers or with one another using the existing technology; as only the lecturers had access to them. As a result, more than half of the PSTs lacked experience with a variety of digital technologies since they were not frequently experimenting with different software, and they did not have the opportunities to engage with digital technologies. The unavailability of the internet and wi-Fi in the lecture halls was also concerning.

Not every PST received training on IMFUNDO. Moreover, there were differences in the PSTs' empowerment on other ICTs as some received training on ITS, Dropbox, and compasses, while others received none. Additionally, there was no evidence that the ICT programs were in place to train the PSTs in integrating the ICTs into their teaching. The diversity of the capacities that the PSTs possessed for integrating technology in their practices serves as evidence of the disparities in the opportunities that they encountered.

The ability to use the installed hardware in the schools of deployment, including the smartboard, varied, but most of the PSTs reported an inability to use these ICTs. The data revealed that the PSTs in the School of Education did not have equal opportunities to explore and observe. The findings, for example, revealed that the recently installed smartboards and iPads in the classrooms were not available in the School of Education. It may be argued that there was a lack of collaboration between the university and the deployment schools in preparing the PSTs to integrate technology into their activities. Because there is no official collaboration with the schools, there are substantial disparities in how the pre-service teachers use technology.

It may be concluded that there was no synergy between the PSTs' coursework and the technology integration fieldwork in the School of Education. The lack of emerging ICTs in the study university's classrooms, such as the smartboards and tablets, had a negative impact on the PSTs' experiences since the students were

unable to view or experience these devices in operation prior to the placement in the schools.

9. Recommendations

It is recommended that the School of Education in the study university, install the technologies that are employed at the schools for the PSTs to be afforded authentic experiences through practicals and observations of the modelled technology use by the lecturers. Mentoring in the schools where the PSTs are deployed should be a standard practise to support them in the use of technology. Furthermore, the university programs for technology integration should be informed by the technologies that are installed in the schools. To impact the future use of technology for teaching and learning in the workplaces, the university and the schools should collaborate to develop and support the PSTs to acquire TPACK. It is therefore crucial that the coursework must be aligned with the fieldwork to enrich the PSTs' experiences to successful integrate technology in their practices.

10. Limitation of the Study

The data in this study was collected in one university. A similar study may be conducted but incorporate more than one institution. Furthermore, it may be worthwhile to pursue more research on the university and the schools' collaboration program for coordinating the PSTs programs to ensure successful technology integration.

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Appendix 1: TPACK Survey questionnaire

Section A - biographic information

(*Circle the number of the relevant response*)

1.	Gender	Male	1
		Female	2
2.	Age	17 - 24	1
		25 - 30	2
		31 - 35	3
		36+	4
3.	Race	African	1
		White	2
		Coloured	3
		Indian	4
		Other (Please Specify) _____	5
4.	Department	TVE	1
		EF	2
		PE	3
		MSBT	4
			5
5.	Select the province where you were deployed for the practicals	Gauteng	1
		Eastern Cape	2
		Northern Cape	3
		Mpumalanga	4
		North-West	5
		Limpopo	6
		KwaZulu-Natal	7
		Free State	8
		Western Cape	9

SECTION B: TPACK QUESTIONNAIRE

This section seeks to assess eight knowledge basis relating to Content Knowledge (CK), Technological Knowledge (TK), Pedagogical Knowledge (PK), Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK) and Technological Pedagogical Content Knowledge (TPCK) for technology integration in T&L.

Please, select the relevant level regarding your knowledge with each the following items on a scale of 1= Strongly Agree (SA), 2 = Agree (A), 3 = Not Sure (Not Sure), 4= Disagree (D), 5= Strongly Disagree (SD).

Items		I have knowledge in	SA	A	NS	D	SD
Content Knowledge [CK]							
CK1	**2**	I am confident in the subject I teach	1	2	3	4	5
CK2	**22**	I am familiar with the language, notation and procedures that are unique to the subjects I teach.	1	2	3	4	5
CK3	**11**	I am able to improve content knowledge about the subject areas I teach.	1	2	3	4	5
Pedagogical knowledge [PK]							
PK1	**9**	I know how to assess student performance in a classroom.	1	2	3	4	5
PK2	**15**	I can adapt my teaching based upon what my students currently understand or do not understand	1	2	3	4	5
PK3	**8**	I can adapt my teaching style to different learners.	1	2	3	4	5
PK4	**6**	I can assess student learning in multiple ways.	1	2	3	4	5
PK5	**1**	I can use a wide range of teaching approaches in a classroom setting.	1	2	3	4	5
PK6	**17**	I am familiar with common student understandings and misconceptions.	1	2	3	4	5
PK7	**13**	I know how to organise and manage classroom learning.	1	2	3	4	5
Technological Knowledge [TK]							
TK1	**19**	I can find my own solutions to most technical problems when working with digital technology.	1	2	3	4	5
TK2	**20**	I learn new digital technologies easily.	1	2	3	4	5
TK3	**23**	I frequently experiment with different software.	1	2	3	4	5
TK4	**12**	I know about a lot of different digital technologies.	1	2	3	4	5
TK5	**4**	I have the technical skills to use digital technology in my teaching.	1	2	3	4	5

TK6	**25**	I have had sufficient opportunities to work with different digital technologies.	1	2	3	4	5
Pedagogical Content Knowledge [PCK]							
PCK1	**14**	I know a variety of teaching methods that are suitable for teaching subject content.	1	2	3	4	5
PCK2	**21**	I can adjust my teaching to make it more inclusive.	1	2	3	4	5
PCK3	**16**	I know how to develop effective lessons that match syllabus defined learning outcomes	1	2	3	4	5
PCK4	**18**	I know how to develop efficient lessons that will help to ensure that all topics are completed in the required time.	1	2	3	4	5
Technology Pedagogical Knowledge [TPK]							
TPK1	**26**	I know how to select effective teaching approaches to guide student thinking and learning in my subject areas.	1	2	3	4	5
TPK2	**27**	I can create opportunities for students to use digital technology for individualized learning.	1	2	3	4	5
TPK3	**28**	I can create opportunities for my students to participate in online discussions.	1	2	3	4	5
TPK4	**29**	I can create opportunities for students to collaborate online to produce project work.	1	2	3	4	5
TPK5	**30**	I can create online activities that provide immediate feedback to students.	1	2	3	4	5
Technology Content Knowledge [TCK]							
TCK1	**31**	I am familiar with computer simulations and models that may help students to understand subject content.	1	2	3	4	5
TCK2	**34**	I am familiar with animations or videos I can use to help students understand concepts in the content to be learned.	1	2	3	4	5
TCK3	**32**	I am familiar with mind mapping or concept mapping software that help students to learn about relationships between concepts and ideas.	1	2	3	4	5
Technology Pedagogy Content Knowledge [TPCK]							
TPCK1	**7**	I can choose a combination of pedagogy and technology to match the content, I want to teach.	1	2	3	4	5

TPCK2	**10**	I can choose technologies that improve the quality of the content of a lesson.	1	2	3	4	5
TPCK3	**33**	I can create technology-enhanced lessons that are student centered.	1	2	3	4	5
TPCK4	**24**	I can create lessons that allow students of different abilities to be able to learn with content that is at the right level of difficulty.	1	2	3	4	5
TPCK5	**35**	I can create technology-enhanced lessons that allow students to learn at their own pace	1	2	3	4	5
TPCK6	**5**	I use digital technology in my lessons to ensure that students have opportunities to be active rather than passive learners.	1	2	3	4	5
TPCK7	**3**	I can use digital technology to create lessons that use less time than traditional lessons to achieve learning outcomes.	1	2	3	4	5
TPCK8	**36**	I can use technology to create rehearsal and practice classroom activities that provide computer feedback to students.	1	2	3	4	5