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# Preparing Pre-Service Teachers for Teaching in the Digital Age

*By Orhe Arek-Bawa* & Sarasvathie Reddy±*

At the onset of the COVID-19 pandemic, many traditional contact higher education institutions, such as the institution where the study was based, transitioned abruptly to remote online learning. Students in the School of Education at the institution who are predominantly from the lower end of the socioeconomic digital divide in South Africa had no choice but to navigate digital technologies to further their education. The extent to which their digital learning experience fostered the requisite TPACK (Technological, Pedagogical, and Content Knowledge) and other cross-functional skills needed for the 4IR classrooms remained uncertain. Framed by the TPACK Model, this paper employed a mixed-method approach to understand students' online learning experiences and how their digital learning experiences prepared them for their future teaching practices. Data generated from questionnaires randomly distributed to undergraduate students, followed by a focus group interview with twelve purposively sampled students across the five undergraduate clusters of the school, was used to address the research objective. The findings revealed that it is unlikely that their virtual learning experience could have prepared them for teaching in the digital age. Insights from this paper will benefit academics in their online pedagogical engagements and curriculum design while informing policy directions at the institutional level.

*Keywords:* digital learning, pre-service teachers, 4IR classroom, TPACK, students' experiences

## Introduction and Background

In an era of rapidly advancing technologies, the talents of the future workforce are expected to be digitally competent and possess other cross-functional skills to be employable (Äma & Emetarom, 2020; World Economic Forum (WEF), 2020a; 2020b). The same applies in teacher education, where pre-service teachers are expected to acquire cross-functional skills in addition to Technological, Pedagogical, and Content Knowledge (TPACK) in the course of their undergraduate programme (Kroon & Gravett, 2022; Astuti et al., 2019) to be ready for the 4IR classroom that awaits them. In the rapidly evolving world of the 4IR, Kroon and Gravette emphasize the need to engage teachers with tasks that require "complex thinking, metacognition, and problem-solving; are engaging; and allow for social interaction, experimentation, and curious exploration" to enable deep learning (2022, p. 12). That way, pre-service teachers develop these skills/competencies, which they can, in turn, transfer to their learners.

*Post-doctoral Fellow, School of Education, University of KwaZulu-Natal, South Africa.
±Senior Lecturer, School of Education, University of KwaZulu-Natal, South Africa.

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At the start of the pandemic-induced lockdown, the institution where this study was based capacitated the academic community to transition to online remote learning. For most of the student body in the School of Education (SoE) who are from poor socioeconomic backgrounds, remote online learning commenced in rural South Africa since they had to leave their university residences before transitioning to the online learning mode. In the current context, irrespective of the mode of engagement, teachers are expected to develop relevant TPACK and other cross-functional skills to be employable in the digital age (Atibuni, Manyiraho, & Nabitula, 2022). However, the extent to which the students from the SoE engaged digital learning and fostered the requisite TPACK (Technological, Pedagogical, and Content Knowledge) and other cross-functional skills needed to teach in their 4IR classrooms remains uncertain. As such, this study aimed to explore pre-service teachers' experiences of digital teaching to determine the extent to which they felt prepared to teach in the digital age:

1. What are pre-service teachers' experiences of digital teaching at the SoE in a South African (SA) university?
2. How did the digital learning experiences of pre-service teachers at the SoE in an SA university prepare them to teach in the digital age?

The paper proceeds with a review of relevant literature, an explanation of the theoretical framework, and the research methods engaged. Next will be the data presentation and discussion sections before the conclusion.

## Literature Review

Pre-service teachers are students who are enrolled in teacher education departments, faculties, or schools within institutions of higher learning, training to become future professional teachers (Ardiyansah, 2021). To teach in SA schools, pre-service teachers can either complete a Post-Graduate Certificate in Education (PGCE) programme for one year based on their undergraduate qualification or pursue a Bachelor of Education (BEd) degree for four years (Kroon & Gravett, 2022; Department of Basic Education (DBE), n.d.; Maringe & Chiramba, 2022). The later programme makes room for pre-service teachers to study discipline-specific courses (core modules) and teaching method modules in the first three years before integrating the education disciplines in year four (Maringe & Chiramba, 2022; Arek-Bawa & Reddy, 2022).

Stemming from a segregated apartheid past, teacher education in SA continues to produce teachers for a divided society (Maringe & Chiramba, 2022), as socioeconomic and political inequities still shape tertiary and basic education environments. Schools are divided into five categories, referred to as quintiles, ranging from 1 to 5 (Hall & Giese, 2009). Quintiles refer to the ranking of schools based on weighted poverty indicators, including the community's income level and infrastructure (Lekhu, 2023; Dass & Rinquest, 2017). Irrespective of the ranking and the environment,

the National Policy Framework for Teacher Education aims to enable "high standards for teaching and learning" (Lekhu, 2023, p. 114).

The SoE offers both BE(d) and PGCE programmes to pre-service teachers to prepare them to teach in SA schools. The SoE is organised into six disciplinary clusters of which five provide undergraduate training. Most of the student body is from poor socioeconomic backgrounds, as they attended schools in the SA Basic Education system's lower quintiles (1 and 2) (Le Grange et al., 2020). Although the SoE went all out to equip staff and students with devices and data bundles to support digital learning, connectivity, electricity, and infrastructural issues which are rife in the SA context continues to hinder virtual education (Arek-Bawa & Reddy, 2022; Şenel & Şenel, 2021). It is thus imperative to assess how the digital learning journey of these pre-service teachers prepared them for their future 4IR classrooms that await them after graduation.

Drawing from the work of Shulman (1987), Kroon and Gravett identified five categories of a well-designed teacher education programme: "content knowledge; general pedagogical knowledge; curriculum knowledge; pedagogical content knowledge; knowledge of learners and their characteristics; and knowledge of educational contexts." (2022, p. 4). These categories can be synthesised into disciplinary content knowledge and pedagogical knowledge. In addition, teachers should be digitally literate and proficient in using digital technologies and artificial intelligence in education (Kroon & Gravette, 2022) to be competent in this digital world (Lestari & Santoso, 2019; Bingimlas, 2018). Thus, emphasising the need for pre-service teachers to be TPACK competent.

Further, today's pre-service teachers are generally called digital natives because they were born into the digital world (Chen et al., 2010). However, the (Chen et al., 2010) study suggests a gap in their everyday use of digital technologies and their use in teaching and learning/ content creation as they rarely engaged these tools for academic purposes. Since today's pre-service teachers will influence future generations of learners, academics have a duty to equip pre-service teachers with skills that make them comfortable with engaging digital technologies in teaching (Kivuyani, 2013; Chen et al., 2010). This is even more pertinent considering that transferring Information Communication and Technology (ICT)skills from everyday use into teaching and learning is not automatic (Chen et al., 2010). It is, therefore, imperative that teacher development should incorporate these skills into their programmes.

Besides the study by Chen et al. (2010), other studies on pre-service teachers' competence and preparedness for teaching have resulted in mixed outcomes. Earlier studies appear to agree with Chen et al.'s outcome. Kivuyani's (2013) study emphasized producing pre-service teachers who can engage digital technologies. Failure to do so will result in a mismatch between the teaching approach and the learning style of a digitally savvy generation of learners. Premised on TPACK, based on qualitative interviews with 11 students, Chigona and Chigona's (2013) study revealed that SA pre-service teachers were under-prepared to teach with ICT because of the instructional methods used by academics in teacher education. They further emphasised a need for quality and digital age-appropriate instructions in teacher training programmes. More recently, Ardiyansah's (2021) study of pre-

service teachers' readiness for online international teaching internships concluded that they felt fully equipped to teach online despite the contextual obstacles they encountered. Dorsah (2021) also found that pre-service teachers had a high sense of readiness for online learning. Still, aspects such as learner control and self-efficacy in using devices, the internet, and communications were low. In 2023, Lekhu's research in the Free State Province of SA revealed the need to improve pre-service teachers' pedagogical content knowledge while calling for a teacher education programme responsive to the socioeconomic context in addressing the 4IR workplace requirement. The mixed outcomes further emphasise the need to ascertain the preparedness of pre-service teachers of the SoE to promote quality education when they take up professional teaching positions.

## Cross-Functional Skills (4 Cs)

In this digital age, teachers should possess four competencies (4 Cs) to adapt to the exponential technological advancement associated with a 21st-century education. These include Critical thinking and problem-solving, Creativity and Innovation, Communication, and Collaboration (Kroon & Gravett, 2022, p. 9; Astuti et al., 2019) allied to the skills required of the 4IR workplace. Notably, these skills are affiliated with higher-order thinking attributes and soft skills that are not easily automated (Teo et al., 2021; Astuti et al., 2019; Anderson et al., 2001).

Drawing from the work of other scholars, Ülger (2016) describes critical thinking as the ability to identify and focus on a problem to understand and judge the situation logically. It focuses on analysing the information and logical decision-making. Simply put, it means "finding solutions to problems" (Äma & Emetarom, 2020, p. 438). Creativity and innovation are crucial to discovery as students exhibit the "ability to develop, implement, and provide new ideas to others, as well as being open and responsive to different new perspectives" (Astuti et al., 2019, p. 7). Collaborative attributes enable pre-service teachers to work in teams, show leadership, empathise, and respect the views of others, while working productively with them (Astuti et al., 2019). Communication, which is embedded in interpersonal skills, paves the way for individuals to readily "persuade others to activate global citizenship" in an increasingly interconnected world to build more inclusive economies (WEF, 2020a, p. 8).

Many researchers such as (Teo et al., 2021; Peled, 2020; Äma & Emetarom, 2020; Astuti et al., 2019; Ülger, 2016; Stanley & Marsden, 2012; Loveless et al., 2006) have considered the 4 Cs for many years. Teaching approaches usually endorsed for developing the 4 Cs are predominantly learner-centred and stem from active pedagogical practices (WEF, 2020a; Äma & Emetarom, 2020; Ülger, 2016). Active pedagogical approaches involve learners as "active searcher[s] in the process of knowledge building and application of knowledge and skills" (Mocinic, 2012, p. 96), resulting in more efficient education, especially in the digital age (WEF, 2020a). Such approaches entail active student involvement in the process of authentic learning. Amongst other characteristics, active teaching strategies enable varied learning styles, encourage cognitive collaboration with others, advance higher-

order thinking processes, foster reflective and metacognitive practices, and integrate intellectual and practical activities (Mocinic, 2012). All these align with the competency-based curriculum disposition where academics facilitate learning using diverse strategies to promote collaborative learning in communal spaces (Khoza & Mpungose, 2020; Chisholm, 2019; McKenna, 2003). This curriculum is tailored toward producing cross-functional skills required in the current and future workplace (Khoza & Mpungose, 2020).

Active teaching strategies comprise problem-based activities, questioning, collaborative and interactive learning, case studies, self-reflective journals, and blended learning, amongst others (Teo et al., 2021; Peled, 2020; Äma & Emetarom, 2020; Astuti et al., 2019; Ülger, 2016). In this research, the extent to which the participants felt equipped with the 4 Cs from their online digital learning experiences was assessed to determine their preparedness to teach in the digital age.

## Theoretical Framework

The Technological Pedagogical and Content Knowledge (TPACK) model proposed by Koehler and Mishra (2009) is a suitable framework for understanding pre-service teachers' self-assessed TPACK competence in their digital learning journey. It is borne out of the belief that teaching is a complex task that draws on multiple knowledge (van Wyk & Waghid, 2022; Koehler & Mishra, 2009) and skills, especially in the digital age. The three domains (Technological Knowledge [TK], Pedagogical Knowledge [PK], and Content Knowledge [CK]) indicate the core knowledge that teachers must possess to be competent in the 21st century (Lestari & Santoso, 2019; Bingimlas, 2018). Rather than considering these domains independently, Koehler and Mishra (2009) advise that the overlapping rings be regarded as interdependent sections of a larger, more complex knowledge composition.

CK relates to subject-matter knowledge in any discipline (Irwanto et al., 2022), which is deemed a fundamental prerequisite (Mpungose, 2020, cited by van Wyk & Waghid, 2022) in the teaching profession. PK acquaints pre-service teachers with an awareness of varied strategies used in teaching and learning, in addition to learner characteristics. TK refers to the ability to use information technology effectively for "information processing, communication, and problem-solving," as it goes beyond basic computer literacy to cover digital literacy (Koehler & Mishra 2009, p. 61). Pedagogical Content Knowledge (PCK) is foundational in teaching and describes how teachers transform certain content via different representations to enable learning (van Wyk & Waghid, 2022; Koehler & Mishra, 2009). Knowledge of how technology can be used to influence content translates into Technological Content Knowledge (TCK), while knowing how technology aids the teaching and learning process is described as Technological Pedagogical Knowledge (TPK) (Bingimlas, 2018; Koehler & Mishra 2009). Finally, TPACK is "an understanding that emerges from interactions among content, pedagogy, and technology knowledge" (Koehler & Mishra, 2009, p. 66), resulting in meaningful teaching with technology.

*Figure 1.* The TPACK Framework

*Source:* Koehler & Mishra (2009, p. 63).

Even though the TPACK model is critiqued for its complexity and unclear construct distinction theoretically (Graham, 2011), it has become "a required area of expertise for teachers" (Joo, Park, & Lim, 2018, p. 48) and is widely used in understanding teaching in a technological environment (Martin, 2015; Schmidt et al., 2009). Previous studies have investigated the pre-service teachers' TPACK with mixed results. On the one hand, Erdogan and Sahin (2010) concluded that student teachers in the secondary school programme in Turkey were less competent in their TPACK domains than those in the primary school programme. Kivunja (2013) emphasised the need for higher education to prepare pre-service teachers to teach effectively in the digital age. Chigona and Chigona (2015) reached a similar conclusion that new teachers in the Western Cape (SA) institution were under-prepared to teach with ICT because of "the quality of instruction they receive during their training" (2015, p. 478). More recently, van Wyk and Waghid (2022) confirmed that pre-service teachers could not implement ICT tools successfully due to infrastructural issues, school culture, and the inability to integrate 4IR pedagogical practices into teaching and learning. On the other hand, Irwanto et al. (2022) investigated pre-service teachers in Indonesia and concluded that their TPACK abilities were generally high. These mixed outcomes provide further impetus for investigating pre-service teachers' TPACK in the SoE, which this study aimed to address.

## Research Methodology

This study adopted a mixed-method research approach based on a case study design popularly used to understand issues about complex real-life situations in specific contexts (Harrison et al., 2017) or institutions such as the SoE. In addition

to enhancing the validity of our study, a mixed-method approach enables triangulation of the data that strengthens the conclusions reached (Schoonenboom & Johnson, 2017). Located in a pragmatic paradigm, the study offers a broad understanding of pre-service teachers' virtual learning experiences (Kivunja & Kuyini, 2017) to ascertain their preparedness to teach in the digital age. Since the primary objective of this study is exploratory, Morse and Niehaus (2009 cited in Schoonenboom & Johnson, 2017) contend that the theoretical drive is inductive. As such, the "core" component is qualitative, denoted by QUAL + quan (Schoonenboom & Johnson, 2017, p. 112). The first four letters of the core component (in this case, qualitative) are written in upper cases, while those of the supplementary component (quantitative) are in lower cases. Thus, the study employed a convergent parallel strategy to interpret qualitative and quantitative findings while drawing on the former to explain pre-service teachers' preparedness to teach in the digital age (Hafsa, 2019; Schoonenboom & Johnson, 2017).

In mixed-method research, data can be generated quantitatively and qualitatively (Schoonenboom & Johnson, 2017). This research generated quantitative data via survey questionnaires on Google Forms forwarded to all the students (about 4,500) in the SoE. Qualitative data was generated from Focus Group (FG) interviews with students across all clusters and levels of study. However, the survey instrument disseminated to all students in the SoE via the university notice system yielded zero responses even after repeated distribution. As the COVID-19 restrictions eased, two research assistants were hired to distribute physical copies or send the links to others, depending on their preference. The researcher also sought permission from some students before sharing links with them. After five months, 46 print responses were received, with 27 online responses totalling 73. While 73 responses may be deemed small compared to the estimated sample requirement of 354, data collection via survey was extremely problematic and tiring. That said, being an exploratory QUAL + quan research, scholars (Morse & Niehaus (2009) cited by Schoonenboom & Johnson, 2017) argue that the emphasis should be on the dominant QUAL findings. Nonetheless, both sources generated data that corroborated one another. In addition, the qualitative findings explained the quantitative results and guided the conclusions reached.

The initial plan was to generate qualitative data from 20 individual interviews across all levels and clusters – 4 levels of study by five undergraduate disciplinary clusters. This also met with challenges in locating willing participants within the stipulated period, leading to a change in the data source for FG discussions. In the end, 13 students across all levels of study participated in the FGD. Still, the contributions of one post-graduate participant were declared invalid, leaving a balance of twelve for further analysis. The number of participants falls within the threshold (five to fifty) deemed adequate to achieve trustworthiness in qualitative research (Vanover et al., 2022). The discussions were audio recorded with the participant's permission, transcribed, and sent back to one participant as a member check to aid the credibility of the data.

## Data Presentation and Discussion

In line with the concurrent parallel mixed-method design, both the quantitative and qualitative data were generated during the same period. This section presents the quantitative data and discussions, followed by the qualitative findings before the overall interpretation.

### Quantitative Data Findings and Discussion

*Table 1.* Demographic Information

| | | |
|---|---|---|
| **Gender** | | |
| Men | 32 | 44% |
| Female | 40 | 55% |
| Prefer not to say | 1 | 1% |
| | 73 | |
| **Level of Study** | | |
| First-year | 13 | 18% |
| Second-year | 12 | 16% |
| Third-year | 16 | 22% |
| Fourth-year | 32 | 44% |
| | 73 | |
| **NSFAS Funding** | | |
| Yes | 65 | 89% |
| No | 8 | 11% |
| | 73 | |
| **Accommodation during Lockdown** | | |
| Home with family | 44 | 60% |
| Accommodation near School | 24 | 33% |
| Residence of friends or other relatives | 5 | 7% |
| | 73 | |
| **Preferred Mode of Study** | | |
| Blended (Online and Face-to-face) | 37 | 51% |
| Online | 22 | 30% |
| Fact-to-Face | 14 | 19% |
| Grand Total | 73 | |

The survey instruments predominantly comprised of closed-ended questions were broken down into three sections – Section A sought to gather demographic data such as gender, level of study, funding, and accommodation during the lockdown. Section B comprised two sets of Likert Scale questions – one focusing on students' digital learning experiences, including their perception of their TPACK competence (22 items adapted from the work of Zhou and Zhang, 2021 and

Baticulon et al., 2021) and the second question focused on their perception of their cross-functional skills (8 items adopted from Oliveira and Souza, 2022). The survey adopted a five-point Likert scale ranging from strongly disagree (1) to strongly agree (5) for section B and part of section C. The other part of section C elicited their success experiences (7 items)/barriers (10 items) encountered on their digital learning journey.

As seen in Table 1, most respondents were females (55%), while one student preferred not to disclose their gender as the institution's policy allowed. Respondents cut across all levels of study but skewing more in favour of the 4th (44%) and 3rd (22%) year student cohorts who had experienced face-to-face, online, and hybrid learning modes during their stay in the SoE. Nonetheless, the perspectives of the 1st and 2nd-year students enriched the data generated. Further, almost 90% of the respondents were funded by NSFAS, depicting their low-income family status. Many had to return home at the start of the pandemic-induced lockdown, where digital learning commenced.

*Table 2.* Pre-Service Teachers' Experiences of Digital Teaching

| | **Mean** | **Standard Deviation** | **SD** | **D** | **N** | **A** | **SA** | **Total** |
|---|---|---|---|---|---|---|---|---|
| Mental readiness | 2.86 | 1.15 | 10 | 16 | 28 | 12 | 7 | 73 |
| Training support provided by SoE | 3.34 | 1.04 | 3 | 12 | 25 | 23 | 10 | 73 |
| Access to the required technology | 3.62 | 1.21 | 3 | 15 | 9 | 26 | 20 | 73 |
| Taking responsibility for own learning. | 3.85 | 0.98 | 2 | 3 | 20 | 27 | 21 | 73 |
| Working through material at own pace | 3.96 | 1.06 | 3 | 4 | 12 | 28 | 26 | 73 |
| Engagement with lecturers synchronously | 3.81 | 1.06 | 2 | 7 | 16 | 26 | 22 | 73 |
| Confident in applying concepts / handling complex tasks online | 2.84 | 1.11 | 7 | 25 | 19 | 17 | 5 | 73 |
| Conducive Home Set-up for Online Learning | 2.85 | 1.40 | 16 | 17 | 14 | 14 | 12 | 73 |
| Electronic communication with my lecturers was helpful. | 3.75 | 1.00 | 1 | 6 | 23 | 23 | 20 | 73 |
| Infrastructure/resources to support OL. | 3.70 | 1.06 | 2 | 9 | 16 | 28 | 18 | 73 |
| Comfortable navigating Moodle | 3.86 | 1.03 | 3 | 4 | 14 | 31 | 21 | 73 |
| Comfortable with online assessments via Moodle. | 3.90 | 1.06 | 2 | 5 | 17 | 23 | 26 | 73 |
| Online assessments were credible/fair. | 3.78 | 1.06 | 3 | 8 | 8 | 37 | 17 | 73 |
| Interacted confidently with other students. | 3.58 | 1.12 | 2 | 11 | 22 | 19 | 19 | 73 |
| Library services were accessible | 3.10 | 1.16 | 8 | 13 | 24 | 20 | 8 | 73 |
| Access to relevant learning resources (e-Textbook, database, software) | 3.42 | 1.01 | 4 | 8 | 22 | 31 | 8 | 73 |
| | **3.51** | | **71** | **163** | **289** | **385** | **260** | **1168** |

The outcome of the survey on pre-service teachers' digital learning experiences is presented in Table 2. Strongly Agree is denoted by SA, Disagree (D), Neutral (N), Agree (A), and Strongly Agree (SA). Based on the extent to which they agreed /strongly agreed with the item questions, pre-service teachers scored the experiences of digital learning relatively high, with an above-average weighted mean score of 3.51. From the Bar graph (Figure 1), many attested that digital learning allowed

them to work through materials at their own pace (3.96), which was considered one of their successful experiences. As such, it can be inferred that their virtual experience spurred them towards independent learning, deemed a key attribute for success in the online learning environment (Chorrojprasert, 2020, cited in Dorsah, 2021). This is followed by their satisfaction with online assessments (3.9). Contrary to the fears of many academics, participants were quite comfortable negotiating digital learning via the learning management systems (3.86), which may not have been unconnected with the fact that they are all digital natives.

*Figure 1.* Digital Learning Experiences of Pre-service Teachers in the SoE

While the high mean scores mainly depicted positive digital learning experiences, some participants were not mentally ready to transition to online learning, which they regarded as a barrier in their studies. Others found their home set-up unconducive for digital learning. At the same time, some had difficulties applying concepts learned and tackling complex tasks, probably due to the inability to seek/access clarification as and when required. On average, their self-assessed online learning experience was pleasing as the majority opted for Hybrid as their preferred mode of learning (51%), followed by Online mode at 30%.

Regarding their TPACK, participants judged themselves highly, as seen in the graphs below (Figures 2 to 5). With 68% agreement, they felt that the content knowledge acquired from their online learning journey would enable them to teach in the digital age. Similarly, they were confident that the pedagogical knowledge and skills acquired during the same period would be helpful in the future classroom, with 70% agreement. Of all the three TPACK domains, participants

felt least confident in their ability to teach with digital technologies in their future classrooms based on an agreement level of 65%. This outcome, which aligns with prior studies (Li et al., 2022; Irwanto et al., 2022), is not unexpected because some of them are first-time users of digital technologies who "Lack[ed] … knowledge to use the computer". Nonetheless, with an overall agreement of 74%, participants were assertive that their online learning experience prepared them for teaching in the digital age.

*Figure 2.* Self-Assessed CK

*Figure 3.* Self-Assessed PK

*Figure 4.* Self-Assessed TK

*Figure 5*. Self-Assessed Digital Teaching Readiness

While the overall outcome of this study contradicts the work of previous scholars (Erdogan & Sahin, 2010; Chigona & Chigona, 2013; Kivuyani, 2013; van Wyk & Waghid, 2022) who concluded that pre-service teachers were underprepared to teach effectively in the digital age, other authors (Ardiyansah, 2021; Irwanto et al. 2022) concluded that their TPACK abilities were generally high. The mixed outcome makes room for further studies in this area.

Besides acquiring TPACK, pre-service teachers should possess other cross-functional skills or 4 Cs to adapt to the 21st-century education system (Kroon & Gravett, 2022; Astuti et al., 2019). Regarding cross-functional skills (4 Cs), the participants generally judged themselves competent, as seen in Figure 6.

*Figure 6.* Self-Assessed Cross-Functional Skills

On a scale of 1-5, participants were quite confident in their cross-functional skills. The participants' perceptions of their cross-functional skills could be attributed to the COVID-19 pandemic. The high mean scores in independent (4.05), Problem-solving (3.85), and analytical thinking (3.89) could have resulted from the need to figure out things on their own due to social distancing and the lockdown. This could have been compounded by the inability to easily reach their lecturers and

peers due to power cuts, poor connectivity, financial, and other domestic constraints. For the same reason, they interacted less as group activities were minimized. This could have impacted their social skills, as seen in the lower mean scores for teamwork (3.66) and communication (3.55), which aligned with the conclusions reached by Peled (2020) and Dorsah (2021), respectively. However, many digital platforms such as Zoom and Microsoft Teams make room for interaction, discussions, and group activities via breakout rooms. As such, opportunities exist for these digital natives whose lives revolve around digital platforms (Chen et al., 2010) to collaborate comfortably if needed. The onus is, therefore, on the academics (du Preez & le Grange, 2021; Ama & Emetarom, 2020; Waghid & Waghid, 2016) to implement digital pedagogies that will engage students, facilitate communication and socialization while furthering independence and active learning.

## Qualitative Data Findings and Discussion

The FG discussions occurred while the student community was responding to the survey. Data generated from FG interviews with selected participants across the four undergraduate levels of the B.Ed programme helped to explain and strengthen the research outcomes (Table 2). Pseudonyms were assigned to participants to protect their identity so they could freely express their views. Even though 13 participants were involved in the discussions, the views of the post-graduate student were excluded because of the focus on the BE.d programme.

*Table 3.* Focus Group Participants

| Participants | Gender | Year of Study | Specialisation |
|---|---|---|---|
| Student 1 | Male | 1st Year | Social Sciences |
| Student 2 | Female | 1st Year | Social Sciences/languages |
| Student 3 | Female | 3rd Year | Life/Natural Science & Technology |
| Student 4 | Male | 3rd Year | Languages / Social Sciences |
| Student 5 | Female | 2nd Year | Foundation Phase |
| Student 6 | Female | 2nd Year | Foundation Phase |
| Student 7 | Male | 4th Year | Social Science |
| Student 8 | Male | 1st Year | Physical / Natural Science |
| Student 9 | Male | 4th Year | Languages / Social Sciences |
| Student 10 | Male | 2nd Year | Social Sciences |
| Student 11 | Female | 3rd Year | Languages / Social Sciences |
| Student 12 | Female | Masters | Teacher Development |
| Student 13 | Female | 2nd Year | Social Sciences |

All participants agreed they could **teach with digital technologies,** although some experienced initial hiccups. "*I come from rural areas where we are not used to these online learning … since we were used to learn[ing] or to writ[ing] in hard copies, it is very problematic to adapt to writing online and scan. All that requires enough time*." (Student 8). For this category, the problem would have been exacerbated by the fact that they received limited training on online learning, and the first-year computer literacy programme was not very helpful, as noted by all

the participants. Student 5 *"didn't receive any training with online learning, especially with the zoom thingy. You just had to figure it out yourself. Nobody told you what to do".* While student 4 stated that the first-year computer literacy programme "*sort of gives you an idea of how to use device*s," student 7 disagreed, saying that- "*I'm a mentor. You find that the student is coming from deep rural area and the student is not exposed to these things… they end up registered in the wrong modules because … they are not equipped."*

Regarding **cross-functional skills,** literature (WEF, 2020a; Ama & Emetarom, 2020; Ülger, 2016) suggests these skills are mainly acquired in an active pedagogical environment. To this end, the interview sought to ascertain the dominant teaching approaches adopted by their lecturers. Student 4 found interaction with peers restrictive, but Student 1 preferred interacting with them because he found "*the information … given by the lecturers … hard to understand… With our peers, because they are very patient with us, they give us that time*". In some large classes, lecturers "*just post the slides. And then that becomes a problem because sometimes you just don't understand with all those big words and all, so you want to interact with the lecturers and ask questions so you don't have that"* (student 6). The situation was not different in synchronous classes which were mainly "*teacher-centred where they… would read the slides, … try and explain them better, they inform them [students] of what to expect next, they end the class. They come back tomorrow and do the same*" (Student 9). Student 11 had a similar experience with his lecturer, who adopted a teacher-centred approach to teaching *"over PowerPoint,"* making it "*difficult to understand geographical terms."* Student 4 questioned the practice adding that, reading through a PowerPoint presentation "*was something I could have done in my own time.*" Even when the question and answer strategy was used to determine whether students understood the course material, the level of interaction was minimal as "*everyone has a choice to just switch off their mics and just keep quiet. Maybe for the [session], one person is answering – maybe two*" (Student 9). A similar view was shared by students 6 and 7, while student 3 stated that the discussion strategy was used. In all, many of the students stated that the approach adopted by their lecturers in their digital learning journey was predominantly teacher-centred, with limited student engagement and interaction opportunities.

From the above discussions, it appears that the experiences of participants hardly align with the characteristics of active pedagogical practices (Mocinic, 2012) discussed in the literature review section. The teaching approaches were not varied enough to cater to pre-serve teachers' diverse learning styles, contrary to the expectations of active pedagogy. In addition, opportunities for interaction were inadequate. For instance, participants who found materials uploaded online difficult could not seek clarification from their lecturers, while others hardly engaged in synchronous class meetings. As such, it is unlikely that deeper levels of learning could have been attained. Furthermore, evidence of collaborative learning strategies in communal spaces was also limited as passive, teacher-centred pedagogical practices prevailed. Rather than the competency-based curriculum, these passive approaches align with a performance-based curriculum that is judged inadequate in fostering cross-functional skills and preparing teachers for the 21st-

century classroom (WEF, 2020a; Ama & Emetarom, 2020 Khoza & Mpungose, 2020; Chisholm, 2019). Thus, the extent to which the digital pedagogies of academics in the SoE equipped pre-service teachers with the requisite skill set to teach in the digital age becomes debatable.

On the other hand, could the skill set that the teacher-centred approaches failed to deliver have been stimulated/acquired by the peculiar circumstance of some pre-service as they engage digital technologies in their academic pursuits? Below are the views of pre-service teachers on their cross-functional skill set.

> Student 4 - *With problem-solving, I think it helped because it got problems, and you independently find your way around these problems.*
> Student 3 - *Yes, we do. Because it's either you solve a problem, or you fail. So, in a way, you were forced to be creative so that you can pass. It's more like we were given an opportunity to explore our creativity so that we can develop them.*
> Student 10 - *As I majored in creative arts, it allows us all to be creative. I remember this semester, we were supposed to recreate Sarafina scenes as our major assignment.*
> Student 11 – *For me, communication was effective during online learning because, firstly, we were able to communicate with our lecturers through emails, through WhatsApp.*
> Student 5 - *Yes, it did help me to [be] independent. Because I remember first semester, for a month or two, I was alone at home because of COVID, so I didn't have anyone to ask or refer to. So, I had to learn on my own. It did push me to be independent.*

Given the participants' responses above, it would appear that the contextual limitations associated with experiences of online learning fostered the development of some cross-functional skills in them. For example, as untrained students from deep rural South Africa with no prior encounters with technological devices grapple with digital learning, they would have developed strategies to survive academically. This could have entailed delving into their creative recesses to formulate strategies to solve the peculiar problems they encountered in their learning journey. In the process, some of them may have mistakenly registered for the wrong modules. Still, somehow, they learned independently, thought creatively, and solved problems partially or wholly in their studies. After all, individuals adapt to changing situations by becoming "creative out of necessity and motivated out of desperation" (Allen & Gerras, 2009, p. 78). As such, it can be insinuated that the digital learning experiences of some pre-service teachers enabled the development of critical thinking, creativity, problem-solving, and independent learning abilities, as alluded to by previous studies (Susanto et al., 2022) and the quantitative survey. Although an earlier study by Astuti et al. (2019) surmised that pre-service teachers judged themselves low on problem-solving and critical thinking, the forced transition to "online learning is an excellent opportunity" for developing cross-functional skills (Susanto et al., 2022, p. 85). In terms of communication skills and other collaborative attributes, the limited interaction and lack of group work strategies could have hindered the development of these skills, as indicated in the low mean score from the survey, which aligned with prior studies (Peled, 2020; Dorsah, 2021) even though the FG participants thought otherwise.

In terms of teacher competence, the focused group discussions also inquired about pre-service teachers' perceptions of the **pedagogical, content knowledge,** and other attributes acquired in the digital learning journey. Their perceptions were mixed, with most of them confident that they were ready to teach:

> Student 1 - *Yes, I think I can say that I have the qualities of a teacher. Because in the module called TP, as a first-year student, … we are receiving various feedback … Yes, I can be a great teacher.*
> Student 7 - *I am a person who never misses class. I think everything that was given to me has given me enough skills and has prepared me for the real world.*
> Student 4 - *I just want to make a comment and say I think that most of the attributes since it was online learning that we need to acquire has to be self-motivated.*
> Student 13 – *Yes, I think they [do]. I will make an example with TP. The lecturers, they give us notes, and they assess us on the teaching strategies, and they give us feedback on how we should correct ourselves and how we can improve ourselves.*
> Student 9 – *I believe that most of us we haven't. Because just to be honest, I don't know how far this thing is going to go and where it is going to be published, but to be precise, I don't think I have acquired such skills and knowledge and all that. … Because I for one, maybe out of a hundred classes I've had from the day online learning began, maybe I've attended five. …I have people who come to me on a daily basis saying I'm failing to study this module; how can I do it? So I'm feeling as if once you don't understand any module that you are doing, you are bound to not have those values and those beliefs because these modules they guide your beliefs and your way of thinking as a teacher towards being a professional. So by virtue of you not attending and just arriving anytime and writing in groups and writing together, I don't believe you can actually achieve those attributes that we have spoken about.*

The above excerpts from the FG discussions also indicated that many participants believed their digital learning experiences prepared them for future teaching. However, a voice cautioned that the acquisition of those had to be self-motivated, while a lone voice categorically said he did not. Irrespective of the views held by the majority, evidence from the FG discussions casts doubts on the participants' preparedness to teach effectively. A learning environment blurred by the screen, with limited engagement, where students can choose to "*switch off their mics and just keep quiet*" (student 9); some "*go to the bathroom and miss the most important thing about the whole session*" (student 4); and others "*enter the zoom class and sleep*" (student 13) would hardly foster the knowledge and skills expected of a professional teacher. Irrespective of the mode of engagement, interaction is important in the learning space (Mocinic, 2012). Coupled with the predominant passive pedagogies employed, it would appear that the digital learning experiences of the participants lean towards the performance-based curriculum that is found wanting in preparing graduates for the digital age (Atibuni, Manyiraho, & Nabitula 2022; WEF, 2020; Ama & Emetarom, 2020). The situation was further compounded by their unhappiness with online assessments due to poor quality feedback besides time constraints. No one was pleased with the quality of the feedback because "*we just get marks, you don't know what you did wrong"* (Student 4). Based on the above, the authors tend to share the views of the lone voice that the digital learning experiences of the participants are unlikely to have prepared

them to teach in the digital age, except for those who would have been self-motivated. What, then, is the way forward?

Even though some may argue that "*South Africa as a country is not on a level of online learning* "(Student 9), given the contextual difficulties (load shedding, connectivity, in addition to the digital divide exacerbated by the pandemic), it is clear that digital learning has come to stay. Irrespective of these difficulties, the benefits of digital learning to the students and the institution abound. Besides contributing to enabling students with the skill set of the digital age (Susanto et al., 2022), the institution and the community benefit immensely from increased access as physical capacity constraints and the associated costs are minimized. The theory aspects of the courses in the SoE can run online with provisions for shared spaces for the practical components. Cost savings derived from this approach can be redirected to other areas of growth and sustainability, while the "missing middle" benefits from reduced fees. This realization may have contributed to the institution's adoption of the current Hybrid learning mode. The participants from the survey and the FGI also opted for Hybrid learning as their preferred mode of education, followed by a fully online mode. However, to effectively prepare teachers for the digital age, there is a need to improve the quality of the digital offering.

While the participants considered the digital infrastructure in the SoE adequate, there were support issues, as broken laptops remained unrepaired for up to six months, pointing to the need to strengthen the ICS's human resources. Although participants judged themselves competent in navigating digital technologies for learning and teaching, they bemoaned the lack of training support to prepare them for virtual education. Since many students are from underprivileged backgrounds and some are from deep rural areas, the need for training in digital technologies cannot be overemphasized. Such training could be incorporated into the first-year orientation programme and the year-long academic support programme with mentors equipped to assist them. Besides aiding the holistic development of pre-service teachers, providing such training is also necessary to avoid a deficit in the instructional process for future generations and close the digital divide (Peled, 2020).

Academics must be trained to employ digital pedagogical approaches in virtual classrooms. This will engage students and keep the class meetings exciting (Mishra, Gupta & Shree, 2020) while aiding the development of cross-functional skills. Incorporating new teaching methodologies into teacher training programmes would likely enhance the effectiveness of pre-service teachers in their future classrooms (Lekhu, 2023). While students can choose to switch off their mics or sleep off, the onus is on the academics to incorporate activities that will elicit students' active participation and interest such that:

> *Someone feels like they are missing out from not being in the class. Create a positive environment where I feel by myself when I walk outside that I want to run in the house so that I can get to my PC and get into the class. The lecturers, it's not their duty to entertain us, but they could put a little more effort to make sure the class is interesting.* (Student 4)

Academics must, therefore, delve into their creative reassesses to activate a form of transformative agency that furthers learning in the light of context-specific conditions and other factors, as Damşa et al. (2021) observed.

### Summary of Findings

In response to the first research question, the quantitative findings revealed that pre-service teachers learned to work independently during their virtual learning experience, probably due to their limited interaction opportunities with their peers and lecturers. They were also happy with online assessments, which they judged credible as they comfortably navigated online platforms in their digital learning journey. However, many were less confident in applying learned concepts or handling complex tasks online, probably due to the inability to access required guidance. Some found their home setting unconducive for online learning, which may not be unconnected with their predominantly poor socioeconomic background, while others were not mentally ready for virtual education. The survey further revealed that pre-service teachers were confident they had acquired the requisite TPACK and other cross-functional skills needed to teach in the digital age. The qualitative interview clarified these findings and offered more details that answered research question 2.

From FG discussions, this paper argued, on the one hand, that the limited interaction opportunities could have spurred independent learning, creativity, and problem-solving skills as pre-service teachers had to find creative ways to learn on their own. On the other hand, limited interaction emanating from the predominant passive teacher-centred approaches, inadequate student engagement in synchronous class meetings, and difficulties in accessing lecturers to clarify problems hindered learning. These, coupled with minimal/non-existent feedback on assessments, could have constrained the application of learned concepts and the handling of complex materials, thereby stalling deeper levels of learning. Thus, this paper further argued that the online pedagogical experience of pre-service teachers is unlikely to have enabled the skill set needed to thrive as teachers in the digital age.

## Conclusion

As part of a more extensive study on digital transformation in the SoE, the paper explored pre-service teachers' experiences of digital teaching to determine the extent to which they felt prepared to teach in the digital age. The findings from this mixed-method research were somewhat mixed. The quantitative results suggest that many pre-service teachers felt their digital learning journey equipped them with the requisite TPACK and cross-functional skills to teach in their future classrooms. Pre-service teachers' views from the qualitative FG discussions were not too different. However, they experienced initial hiccups venturing into digital learning without training and limited prior engagement with digital technologies. Their peculiar circumstances and restrictions compelled them to devise strategies to solve their problems and learn independently, thereby facilitating the acquisition

of some cross-functional skills. The discussions also indicated the dominant use of passive instructional approaches allied to the performance-based curriculum, which is less likely to further the skill set required to teach in the digital age. Coupled with the limited interaction and poor-quality feedback, the extent to which they acquired the requisite TPACK and cross-functional skills becomes unjustifiable.

As the institution adopts a hybrid mode of education, the need to enhance online pedagogical practices to ensure quality education becomes imperative. A critical factor that came out strongly in this study was continuous training. Academics must be trained to keep abreast with interactive online methods to further meaningful learning while enabling the development of cross-functional skills. Training in digital technologies will not only ease the virtual learning experience of our supposedly digital natives but also position them to engage as global citizens in an increasingly borderless world. Irrespective of our contextual difficulties, digital pedagogies hold strong promises for increased access to quality education for all (United Nations Educational, Scientific and Cultural Organisation (UNESCO) by Miao et al., 2021) needed to build more resilient knowledge economies and foster true democracy. As such, the institution must continue strengthening its digital pedagogical practices to produce teachers fit for the digital age while contributing to national good/imperative.

Being case-based, the study's findings may be limited in applicability. Nonetheless, sufficient details were provided to enable possible replicability by interested scholars. They may also consider increasing the scope of their study to include teacher education programmes in an entire state or country to obtain a more robust outcome. An interesting comparison between the views of pre-service teachers from underprivileged and privileged backgrounds could also be done in future research. While the authors acknowledge the limitations posed by the low response to the survey, it is a QUAL + quan study. Data from the FG discussions helped to explain the quantitative responses and enriched the conclusions. Other scholars may expand the scope quantitatively to attain a more generalizable outcome. Nonetheless, the study promises valuable insights to academics who seek to advance quality digital engagements at teacher education institutions that aim to produce holistic teachers for the digital age. It also guides policy decisions on digital education, training, and the acquisition of resources for meaningful transformation in the light of the 4IR while contributing to scholarship in digital pedagogies, particularly in poor socioeconomic contexts.

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