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Instructors' perspectives of TPACK in a vocational training classroom in Namibia

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ABSTRACT

Over time, vocational education has undergone a paradigm shift due to the integration of technology into teaching and learning. This change renders it necessary for vocational training instructors to have technological pedagogical content knowledge (TPACK) for effective technology adoption and integration into teaching and student learning. However, developing competence in the intersection of technology, pedagogy and content remains a challenge for many lecturers entering vocational education. Instructors' decisions to integrate technology depend on their perceptions of TPACK, which can influence their approach to integrating technology into teaching. This study is part of a longitudinal study that has been examining instructors' development of TPACK in vocational education in Namibia. Using a qualitative approach and the TPACK framework, data were collected through questionnaires and focus-group interviews. The data were analysed thematically using Nvivo software. The findings reveal that instructors' teaching experience expands their knowledge beyond technology integration, leading to a new understanding of TPACK constructs. In addition, the study shows that their disposition towards TPACK shifts with access to teaching technologies and that students' learning needs inform Instructors' TPACK. The study offers insights into the ways in which vocational education instructors integrate their teaching experience with technologies and relate that to the TPACK framework constructs.

KEYWORDS

Instructors, vocational training, technology, teaching and learning, TPACK, ICT

Introduction

Over the years, the integration of technology has caused significant transformation in vocational education. The use of information and communications technology (ICT) in particular has influenced the manner in which teaching is designed, as well as its subsequent learning outcomes. The literature suggests that vocational education and training (VET) instructors must innovate their teaching methods effectively (Karayel & Bozkurt, 2020). Gradually, traditional learning methods are becoming less preferred; in fact, most vocational students tend to believe that the methods used by VET instructors will not be applicable in their future workplaces. Notably, the increased availability and accessibility of ICT have redefined the skills that students in VET require in order to be employable (Deaconu et al., 2018; Tyagi et al., 2020; Jayalath & Esichaikul, 2022).

This change is complex and multifaceted; it is also influenced by other factors such as the generational differences among VET instructors, the availability of learning resources, and the specific traits of VET students. Therefore, it is necessary now for VET instructors to adapt and modify their teaching strategies in line with technological advancements – especially those in industry. The competence of VET instructors in today's teaching and learning processes should include familiarity with technology integration (Ramadan, Chen & Hudson, 2018; Jayalath & Esichaikul, 2022). Advancements in technology in VET have positive effects: improved accessibility, faster learning, and swift information updates (Sangmeister et al., 2018; Karayel & Bozkurt, 2020). The employment of technology in VET also enhances the learning environment, facilitating more effective knowledge assimilation (Ogundolire, 2020). In addition, it promotes stronger connections between teachers and learners during the educational process (Jayalath & Esichaikul, 2022). Scholars contend that understanding how technology can be used efficiently in education is crucial to instructors in the 21st century (Chuntala, 2019; Arifin et al., 2020). In VET settings, particularly, technology advancements shift instructors' perspectives, particularly with respect to creating and presenting content which helps students acquire and refine their practical skills. Therefore, it is vital for VET teachers to have a robust understanding of technology and to pass that knowledge on to their students.

To promote the integration of technology, the Namibian government has, in recent years, invested in ICT resources to foster technology integration in vocational education. This has been complemented by the implementation of numerous professional-development initiatives aimed at enhancing instructors' pedagogical skills. Despite a noticeable increase in ICT usage among instructors, though, empirical studies suggest that the technology's effective application for instruction enhancement and the facilitation of active student learning remains limited (Putro et al., 2020; Callan & Johnston, 2022). Many scholars suggest that possessing technological knowledge alone does not entirely equip these instructors to use ICT as an effective tool to enhance student learning (Mishra & Koehler, 2006; Falloon, 2020). Therefore, there is an increasing need for instructors to develop and possess a specific type of knowledge known as technological pedagogical content knowledge (TPACK). This knowledge enables them to incorporate technology seamlessly into their teaching methods so as to elevate student learning outcomes.

Mishra and Koehler (2006) suggest that for technology to be integrated successfully, instructors should be well versed in the seven key areas of professional knowledge. These include pedagogical knowledge (PK), content knowledge (CK), technological knowledge (TK), pedagogical content knowledge (PCK), technological pedagogical knowledge (TPK), technological content knowledge (TCK) and, certainly, technological pedagogical content knowledge (TPACK).

Understanding how technology, teaching methods and content interact is very important for VET instructors because technology can improve the quality of education. However, according to a study by Polikarpus et al. (2023), most research in the VET field has focused on technology adoption and integration but not specifically on the application of TPACK. O'Brien (2015) recommends that more research be conducted on the perspectives of instructors' use of technology in teaching and how TPACK manifests in VET. In addition, owing to the Namibian government's efforts at introducing educational technologies to VET, and the expectations that instructors will use these facilities, it is important to understand how these instructors perceive the reciprocal connection between technology, pedagogy and content knowledge (TPACK) in their teaching.

Instructors are a key stakeholder group in integrating educational technologies in VET. Prior to implementing any initiative, it is vital to thoroughly investigate and comprehend their perspectives on technology (Wang, 2009). Studies show that, to a considerable extent, an instructor's acceptance and use of technology in the classroom is influenced by their perspective on technology-integration knowledge. Consequently, this study is based on the assumption that knowing instructors' perceptions of TPACK is essential for its successful integration into vocational education processes. The goal of this study was therefore to investigate instructors' perspectives on, and comprehension of, TPACK and its relation to their use of ICT in teaching. The instructors involved in this research have access to, and incorporate, technological tools into their instruction. Their opinions were examined in the context of the growing use of educational technologies in VET and their perception of TPACK as an essential knowledge base for technology integration in teaching.

This article first reviews a broad range of the literature related to the subject in order to arrive at the objective matter. It also introduces a conceptual framework within which to drive the study. Following this, the research methodology, encompassing data collection and analysis, is thoroughly discussed. The findings are subsequently explored in detail. Finally, the study concludes with a presentation of the study's conclusions and recommendations.

Review of related literature

The significant value of technological knowledge cannot be overstated, particularly with regard to the competencies required by TVET instructors. Such knowledge serves to bolster innovative instructional methods in VET education. It has transcended being merely a tool enabling teaching processes, instead becoming a necessity and fundamental knowledge that all instructors must possess (Mishra & Koehler, 2006; Sánchez et al., 2020). Unfortunately,

the lack of technological knowledge among VET instructors is remarkably prevalent, leading to ineffective teaching and learning processes and practices and a lack of integration and cohesion in VET education, as reported in the study by Wang (2009). Wang concluded that it is crucial to investigate the fundamental reasons behind the limited use of technology in the teaching and learning process in VET.

Although VET education prioritises practical training, integrating technology so as to ensure that students grasp the practical learning outcomes is an increasing challenge. In this regard, instructors need to comprehend how to use technology effectively and develop practical teaching strategies. Previous research (Hanapi & Nordin, 2014; Hanafi & Wahidah, 2018; Frady, 2022) has shown that effective teaching is vital to producing quality VET graduates. Indeed, instructors need specific teaching abilities, especially knowledge of the materials and the teaching techniques (Cattaneo, Antonietti & Rauseo, 2022). In today's educational environment, though, learning should not be limited to content knowledge and pedagogy; specifically in the context of VET education, a stronger grasp of technology is called for. In addition, because technology can support the teaching process, it has become an essential tool in teaching and learning.

Mishra and Koehler (2008) highlighted the significance of technological knowledge by evolving a framework known as TPACK (technological pedagogical content knowledge). They suggested the integration of technological knowledge in educators' knowledge base, an idea originally derived from Shulman (1986). They advocated that instructors should possess essential knowledge in three areas: content, pedagogy and technology. The TPACK model underlines the importance of instructors understanding the relationships between content, teaching practices and technology in creating meaningful learning experiences (Fahrurozi, Budiyanto & Roemintoyo, 2019; Putro et al., 2020). Given the focus on technological use in VET, the TPACK framework offers a lens through which to evaluate VET instructors' competency. Many studies demonstrate the efficacy of this model in illuminating the intricate relationship between technology, pedagogy and content.

TPACK research has contributed to understanding technological teaching and learning (Baran & Uygun, 2016; Maor, 2017; Eutsler, 2022). In VET education, researchers use the TPACK model primarily to assess VET instructors' knowledge in implementing the curriculum (Chua & Jamil, 2014; O'Brien, 2015; Mutanga, Nezandonyi & Bhukuvhani, 2018; Torggler, Miesera & Nerdel, 2023). Despite these efforts, existing studies reveal that VET instructors' level of expertise has not reached an optimal level. Evidence from Chua and Jamil's (2014) study suggests that TPACK competency among VET instructors in public institutions is only moderate. O'Brien (2015) concurred, indicating a similar level of TPACK proficiency among VET instructors. This moderate skill level extends to technology-component knowledge, which has been found to fall below expectations (Chua & Jamil, 2014; O'Brien, 2015). Research by Mutanga et al. (2018) emphasises this further, finding that more than half of the surveyed engineering instructors were unsure about incorporating technology into their teaching. This suggests a persistent gap in VET instructors' TPACK.

The TPACK framework and its associated practices have not yet been employed in examining VET instructors' practices in Namibia. TPACK is instrumental in effective technology use in education, as suggested by research. However, studies have found several discrepancies. For instance, one study found that TPACK does not clarify the variance in the way teachers use technology (Torggler, Miesera & Nerdel, 2023). It also fails to explain why educators' perspectives and beliefs sometimes do not match their teaching methods (Shambare & Simuja, 2022; Shambare, Simuja & Olayinka, 2022). In addition, there are discrepancies between what teachers express and their actual classroom practices, and therefore merely enhancing TPACK may not be enough (Mutanga et al., 2018).

Some authors (Maor, 2017; Eutsler, 2022) have suggested expanding the TPACK framework to include varying perspectives and educational shifts in different environments. Maor (2017) argued that assessing TPACK should involve multiple perspectives for a full understanding of its complexity and in order to deal with discrepancies between teachers' attitudes and classroom practices. Similarly, Eutsler (2022) encourages studies that focus on technology-rich environments influenced by TPACK. The context of VET provides one such perspective. Therefore, studying VET instructors' perceptions of TPACK and its implementation in their practice can be beneficial. This is particularly important in the context of the increasing demand for TPACK research in VET in developing nations.

Theoretical framework

To better address the research question, What are instructors' perspectives of TPACK in vocational training schools in Namibia?, the authors of the present article adopted the TPACK framework developed by Mishra and Koehler (2006). The TPACK framework is an extension of Shulman's (1986) PCK. TPACK is widely considered to be a framework for teacher knowledge (Mishra & Koehler, 2006), and one that facilitates effective technology integration in teaching. The TPACK framework comprises six elements, as shown in Figure 1: technological knowledge (TK), pedagogical knowledge (PK), content knowledge (CK), technological pedagogical knowledge (TPK), technological content knowledge (TCK), and technological pedagogical content knowledge (TPACK) integrating into different teaching contexts. By examining the framework depicted in Figure 1, one can conclude that the TPACK model represents an intersection of three key knowledge domains: technological knowledge, pedagogical knowledge and content knowledge. The TPACK framework acknowledges the importance of understanding how these domains interact and overlap to promote effective teaching with the aid of technology. In other words, effective technology integration in teaching requires a balanced consideration of the way technology, pedagogy and content knowledge are interrelated rather than simply focusing on each domain in isolation.

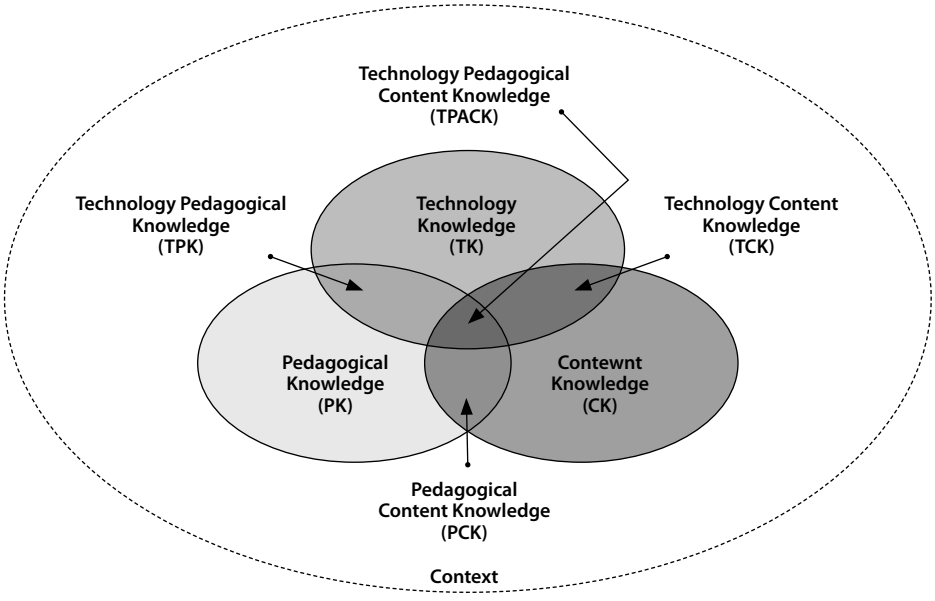

Figure 1: TPACK Framework (Koehler, Mishra, Kereluik, Shin & Graham, 2014)

The TPACK model defines its elements based on their significance in teaching. According to Mulyadi et al. (2020), content knowledge (CK) refers to the subject matter that is being taught, while pedagogical knowledge (PK) refers to the understanding of suitable teaching approaches for specific content (Shulman, 1986). Technological knowledge (TK) involves the use of technology tools for teaching. Moreover, Mulyadi et al. (2020) defined TPK as the ability to select an appropriate technological tool that is applicable to teaching, while TCK is the knowledge required to use technology so that teachers comprehend both the content and PCK.

While the TPACK framework is fundamental to efficient technology integration, it has shortcomings in clarifying why technology is used differently and why educators' views on technology may not align with practice. Furthermore, understanding the individual elements of the TPACK framework does not ensure the successful integration of ICT into education. Incorporating technology into the classroom setting is therefore multifaceted: other factors, such as the preparedness or suitability of ICT facilities in schools and students' proficiency in digital skills play a role in the application of this technology. The framework offers too little guidance on the selection of teaching content, instructional methods and relevant technologies. Consequently, TPACK falls short of assisting educators in identifying the appropriate content to teach regarding selected technology and methodologies. Some teachers need support in evaluating and choosing suitable technology for integration into their teaching, an area where the TPACK framework falls short. It also fails to guide teachers on the specific technology to use when teaching specific content.

TPACK is adopted in this study as a theoretical framework that aims to understand the perspectives of instructors on the knowledge necessary to integrate technology effectively (Vivian & Falkner, 2019; Eutsler, 2022). The analysis of data for this study uses the TPACK framework to challenge technocentric approaches that emphasise acquiring technology skills apart from pedagogy and content in favour of the idea that instructors possess knowledge that is complex and multifaceted. In this study, TPACK provides a useful framework for thinking about the knowledge instructors believe supports them in integrating technologies in teaching, and also about the ways in which they acquire this knowledge. The study acknowledges the distinct and interconnected roles that content, technology and pedagogy play in establishing authentic teaching and learning environments.

Methodology

This research adopted a qualitative case study approach (Rashid et al., 2019) that resorts within an interpretive philosophy (Burns & Peacock, 2019) in order to examine instructors' perceptions regarding the constructs of TPACK and in relation to their own integration of educational technologies in teaching in a vocational education setting. The study investigates the phenomenon of technology integration in teaching and learning as it relates to the potential perceptions of instructors' TPACK, making phenomenology the most suitable methodology. The qualitative enquiry is based on the notion that each instructor's perspectives of TPACK stem from their unique experiences of using a variety of technologies in their teaching. To access these experiences, the authors aimed to set aside their own perspectives and experiences as researchers in educational technologies, focusing instead on the participants' interpretations and perceptions. Consequently, the phenomenological research approach, which emphasises exploring conscious awareness by examining individual–technology relationships (Simuja, Krauss & Conger, 2016), was considered the most fitting choice.

As researchers adopting the phenomenological approach, we acknowledge several assumptions that could affect the study's results in capturing the desired perceptions. These assumptions include the notion that instructors ought to be seen as active and enthusiastic contributors who are mindful of their deliberate choice of technology use and who can formulate perceptions and beliefs about these technologies in their work settings. Furthermore, it acknowledges teachers' decision-making abilities and their capacity to consider and ponder their method of instruction. To comprehend the study's participants better, we were attentive to their individual and shared contexts, circumstances and experiences as instructors and students, both individually and collectively (Caena & Redecker, 2019).

The idea that teachers actively participate in their teaching and personal lives, engaging with and adapting to technology while seeking experiences, guided our research in this study. Like everyone else, instructors develop their own meaning and perspectives as they engage with the potential and constraints of technology. Therefore, this study's investigation, interpretation and examination of the phenomenon are based on a group of individual instructors'

experiences. After examining these insights, the research shifted from a personal perspective to a collective understanding of the cohort's unique lived experiences (Webb & Welsh, 2019).

To conduct the study, qualitative methods, including a semi-structured questionnaire and focus-group interviews, were employed. Although it was simple to identify the perspectives and primary goals of these methods for the type of knowledge sought, it was also more difficult to determine the scope of their application. To select the study participants, purposive sampling (Campbell et al., 2020) was adopted and questionnaires were emailed to all 21 instructors who participated in a two-week educational technologies training workshop in Windhoek in 2019. The training was part of the Namibian government's initiative to upskill vocational instructors by enabling them to acquire 21st-century teaching and learning knowledge. Of the 21 instructors who received the semi-structured questionnaires, 18 responded. Ten instructors were then purposively chosen for focus-group interviews (FGIs). Several criteria, including teaching experience, area of expertise and availability to attend an FGI, were taken into account in selecting the ten participants. The aim of this purposive selection was to obtain a rich and varied set of data for a comprehensive analysis instead of a random selection where certain unique viewpoints might have been overlooked. The chosen participants are instructors from two public vocational schools in the Windhoek district in Namibia.

Ethical clearance was obtained from our affiliated university's Ethics Committee and the two vocational schools, as this study forms part of the longitudinal study on working with vocational instructors to develop TPACK. No coercion or deception was used to get people to participate in the study; participation was entirely voluntary. Moreover, individuals were free to exit the study whenever they wished. Key ethical principles such as informed consent, credibility, anonymity, confidentiality and trustworthiness were consistently maintained and ensured in this study.

Data analysis

Before participating in the FGIs and responding to the questionnaire, all the participants voluntarily signed consent forms and were informed of the study's purpose. They were also made aware of their right to decline to answer any questions. Also, owing to the geographical dispersion of the participants, the questionnaires were emailed, as the authors could not personally reach all of the instructors. A concise questionnaire with 14 closed-ended questions was developed so as to capture all the relevant themes for responding to the research question. Open-ended, semi-structured interview questions were developed by the authors to capture all the pertinent themes for answering the research question.

To accommodate all the participants, the FGIs were conducted using Zoom conference technology, and the sessions were also audio-recorded for the purposes of transcription. This approach was taken in order to create a balanced atmosphere and establish a connection of trust with the participants (Kerasidou, 2019); in addition, the participants were empowered

and reassured before the interviews by informing them that the researchers' purpose was to learn from their experiences. Furthermore, each FGI was scheduled at a mutually convenient date and time for both the participants and the authors. The data-analysis process involved the authors using a thematic analysis approach, which aims to identify, organise, analyse and report on patterns or themes in the data (Lochmiller, 2021). Although the authors engaged in distinct processes such as transcription, organisation, coding, analysis and interpretation, the process was complex, iterative and reflexive rather than linear or systematic. Interpretation and analysis, for example, began during the FGIs as potential themes and codes emerged. Microsoft Word was used to transcribe the recorded FGIs.

The transcribed texts were analysed with NVivo (Version 22), a data-analysis software tool for organising and analysing various types of qualitative data. Each transcribed text was uploaded to NVivo and then analysed by categorising or thematically grouping participant responses. The responses of the participants were then coded according to the relevant themes that had been determined beforehand. Each relevant text was assigned to an appropriate theme during the coding process. The researchers used an inductive data-analysis approach (Natow, 2020), and the emerging patterns of themes served as the basis for the study's findings. Table 1 sets out the relevant information (biographical data) for the ten instructors who were chosen purposively.

Table 1: Instructors' background information

PSEUDONYM	AGE	GENDER	TEACHING EXPERIENCE (YEARS)
Annemarie	42	Female	7
Hilya	40	Female	12
Romeo	36	Male	5
Secilia	39	Female	4
Jacob	48	Male	10
Aloysia	38	Female	3
Selma	46	Male	2
Anne	40	Female	15
Angula	37	Female	5
Mate	45	Male	11

Validity, reliability and trustworthiness

The study's internal validity was ensured by prioritising its credibility. This was achieved by conducting a comprehensive literature review on the subject, which led to the selection of a theoretical framework. The questions in the FGI and the participant questionnaire were then

created in accordance with this framework. During the data-analysis process, the authors carefully examined texts with both common and differing meanings and developed themes accordingly, with the internal homogeneity and external heterogeneity criteria of the themes being carefully considered. In addition, just before each FGI and responding to the questionnaire, the participants were informed that their participation was voluntary and they were encouraged to provide sincere answers to the questions asked. After the FGIs, the recordings were transcribed and the participants were asked to review the transcriptions for confirmation of their authenticity (Natow, 2020).

Findings

The aim of the study was to investigate instructors' opinions and perceptions concerning technological pedagogical content knowledge (TPACK). All the instructors involved in the study have access to and integrate technologies in their teaching. The perspectives were examined in the context of the growing prevalence of educational technologies in vocational education and the instructors' views on TPACK as essential knowledge for integrating technologies into teaching. The study adhered to ethical norms and protected the participants' identities by consistently using pseudonyms for the instructors. The primary data used for this research came from questionnaires with open-ended questions and from group discussions. Table 2 provides a breakdown of the instructors' responses to the questions in the questionnaire.

Table 2: Responses from the semi-structured questionnaire

	AGREE	STRONGLY AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE
1. ICT tools are readily available at the school.	–	100%	–	–	–
2. I am aware of the constructs of technological pedagogical content knowledge.	20%	60%	20%	–	–
3. I can choose topics that combine the content with technology and teaching methods.	–	100%	–	–	–
4. I can choose technologies that make it easy for students to understand concepts.	70%	–	30%	–	–
5. I know how to use specific technologies to teach specific trade concepts/ topics.	100%	–	–	–	–

	AGREE	STRONGLY AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE
6. I know which technologies are best suited for my teaching.	70%	30%	–	–	–
7. I have the technical skills to use a variety of technologies in teaching.	100%	–	–	–	–
8. I have knowledge about technologies that I can use to better understand subject content.	40%	60%	–	–	–
9. I can use technology that promotes pedagogical approaches in my lessons.	70%	–	20%	10%	–
10. I am familiar with the subject content as prescribed by the VET curriculum.	–	100%	–	–	–
11. I know how to use technology to assess students' performance in the classroom.	50%	20%	–	30%	–
12. I have sufficient subject knowledge for all my VET trades.	100%	–	–	–	–
13. I can select technologies to use that strengthen my subject content and pedagogies and support students' learning.	–	90%	–	–	10%
14. I know how to change my teaching styles to suit both theoretical and practical lessons.	–	100%	–	–	–

The semi-structured questionnaire consisted of closed-ended questions, with responses given on a five-point scale: (1) Agree, (2) Strongly agree, (3) Neutral, (4) Disagree, and (5) Strongly disagree. According to the results in Table 2, eight participants (80%) reported being aware of the constructs of technological pedagogical content knowledge (TPACK). The participants' responses suggest that instructors' teaching experience has broadened their knowledge beyond technology integration to encompass a new understanding of the reciprocal relationship between technology, pedagogy and content knowledge. In addition, the study findings indicate that all instructors (100%) have access to ICT tools, as they are

readily available at the school and in the classroom. The specific ICT tools they have access to include learning management systems (Moodle), interactive whiteboards, laptops, projectors, digital educational content and specialised software for various subjects. Some participants revealed that they have access to context-specific tools, including mobile technologies, video-conferencing platforms (such as Zoom and Skype) and other means of digital collaboration.

This finding suggests that the availability of ICT tools is not a significant barrier to technology integration in teaching in VET in Namibia. However, the study also highlights the importance of providing appropriate support and training to help instructors use these tools effectively in their teaching practices. The study's results imply that the instructors' TPACK disposition can shift with access to technologies in teaching and that students' learning needs inform the instructors' TPACK. Specifically, the vocational education instructors connect their teaching experiences with technologies to the TPACK framework constructs, suggesting that their understanding of TPACK evolves as they apply technology in their teaching practice.

During the FGI, most of the instructors were able to relate to the TPACK framework, recognising the interplay between technological, pedagogical and content knowledge in the processes of integrating technologies into teaching. However, one participant, Jacob, mentioned not being familiar with TPACK as a framework, despite having an understanding of the relationship between technology, content and pedagogy. One possible reason might be that the knowledge in the three main components – technology, pedagogy and content – originates from distinct sources. From the FGIs, it appears that most instructors gained their pedagogical and content knowledge from their personal experiences as learners and workers. The majority of the instructors acquired technological knowledge on their own. In contrast, in other educational sectors, technological, pedagogical and content knowledge tended to be acquired through formal educational experience.

Moreover, another participant, Angula, expressed concern that the government's training programmes focused primarily on providing technological knowledge relating to the use of specific technology without emphasising how TPACK knowledge develops when using technology in teaching and content presentation. Angula expressed this as follows:

> … I was not aware that my teaching approach was related to TPACK. For instance, I store my teaching content and documents on Google Drive. Whenever my Head of Department assigned me lessons to teach, I made sure to consider the students' interests because [these] usually involved technology. I searched for appropriate websites to gather more information that could enhance my teaching.

This highlights the need for more comprehensive training and professional-development opportunities that go beyond basic technological skills to enhance instructors' understanding of TPACK and its role in integrating technology into teaching. All of the instructors in the study shared a belief that the TPACK framework is closely linked to enhancing content

presentation through the use of teaching strategies and technology. One instructor, Aloysia, exemplified this viewpoint by stating:

> By combining my content knowledge with my pedagogical knowledge and technological skills, I have been able to create more engaging and interactive learning experiences for my students. One example of this is when I used a virtual welding simulator to teach my welding students. By using this technology, I was able to provide my students with a safe environment to practise their welding skills without the risk of injury or the need for expensive materials. Additionally, the simulator provided real-time feedback on their technique, which allowed me to give targeted feedback and improve their skills faster.

In contrast to Aloysia's perspective, Hilya viewed the TPACK framework primarily as 'part of method planning lessons' to use technology for presenting concepts or content. This perspective highlights the flexibility of the TPACK framework and how it can be adapted to fit different instructional contexts and teaching styles. Aloysia gave an example of her teaching:

> … I was planning a lesson on electrical wiring ... . I first considered the materials to use in the lessons, then how to teach this material effectively, and some of the technologies we have in our laboratory in Section B of the upper campus. ... I decided to use an interactive digital whiteboard to present diagrams and schematics of electrical wiring. This allowed me to engage students visually and interactively, breaking down complex concepts into more manageable pieces that were easier to understand.

The instructors also emphasised that the TPACK framework allows them to align content and technology, especially since various technological tools are available. Annemarie states: 'In my opinion, this framework helps me to stay focused on the advantages and limitations of the technology that I use in my lessons.'

The instructors in the study highlighted the value of the TPACK framework in fostering creativity when integrating technology into pedagogy and content. This underscores the potential of the TPACK framework to inspire innovative approaches to teaching that leverage technology so as to engage students and improve learning outcomes. Jacob stated that the TPACK framework promotes creative ways of '[keeping] up with students' needs and [determining] what they are interested in, as it relates to the VET curriculum'. Mate pointed out that some of the colleagues at the vocational school recognise the importance of having technological knowledge, as it helps them choose and use appropriate technologies to meet the unique needs of their students.

All of the participants in this study, while acknowledging the TPACK framework as a valuable methodological guide, expressed their appreciation regarding the prospect of integrating

various technologies into their classrooms in the future. However, they also recognised that the framework is not static and context-free, and may require adjustments to better suit the VET context. The participants also mentioned that learning to integrate technology into teaching and having the TPACK framework as a guideline was a valuable asset they were content to retain in their professional lives as instructors. Furthermore, most of the instructors agreed that they could help others understand and appreciate the relationship between content, technologies and teaching, and highlighted the potential of the TPACK framework in promoting a deeper understanding of technology integration into teaching practices.

Discussion of findings, and recommendation

According to Mishra and Koehler (2006), teaching with technology effectively is not simply a matter of learning how to use technology. Instead, they emphasise that instructors should understand the interconnections among technology, pedagogy and content knowledge rather than simply acquiring technical skills. The creative integration of content with different technologies should be a priority. Callan and Johnston (2022) agree with this finding, indicating that an instructor's perceptions of 21st-century learning can limit their belief in their students' capacity for creativity and critical thinking. Recent studies have highlighted that merely knowing how to use a specific technology tool does not automatically translate into knowing how to present a topic effectively with it (Paul & Jefferson, 2019; Lee, 2020). In the current study, the instructors possessed knowledge of some of the technologies used in teaching in the vocational education context. However, the findings suggest that preparing to use technology in teaching should also take into account the interplay between technology, pedagogy and content knowledge rather than solely focusing on learning how to use technological tools.

The participants' responses reveal the importance of recognising the complexity of integrating technology into teaching and the need to develop TPACK knowledge to leverage technology effectively in support of student learning outcomes. They recognised its potential to transform learning and expressed positive intentions to integrate technology more in the future. A presentation was made on the instructors' TPACK awareness, its conceptualisation, and best-practice examples in VET. The instructors indicated that quality teaching with technology should focus on delivering a positive learning experience for students. However, their minimal exposure to effective examples of teaching with technology limited their perceptions of best practices. It underscored the significance of pedagogical and content knowledge in integrating technology. The implication of this is that applying this framework to VET instructors' practice may require modification if it is to suit the vocational context better.

The FGI with the instructors revealed that they not only identified all the available technological tools, but also recognised the elements of TPACK in the VET context. This acknowledgement of the linkages between the elements of the TPACK framework aligns with the work presented by Mishra and Koehler (2006). The findings of this study suggest that instructors must possess the required knowledge if they are to combine their expertise in technology, teaching methods and the subject matter. Crucially, they should effectively merge all these TPACK constructs

when using ICT in their teaching practices. Consequently, enhancing instructors' abilities to design learning experiences is vital for the long-term success of ICT integration in vocational education classrooms (Delcker & Ifenthaler, 2021). To this end, instructors should be given ample opportunities for professional development, enabling them to recognise technologies' potential in teaching. Instructors should also use technologies in suitable situations in order to create effective learning plans and scenarios in an actual classroom environment, thereby aiming to enhance their students' subject-specific learning. As technologies for education evolve alongside students' behaviour and thinking patterns, future vocational education classrooms will need to be dynamic. Therefore, to support their students, 21st-century vocational education instructors must adapt their instructional methods in varying contexts, based on an understanding of the capabilities of different digital tools and using ICT in education not as a supplement but as a meaningful and well-supported pedagogical approach.

Based on the findings of the study, it is recommended that professional-development programmes aimed at improving instructors' TPACK should include relevant training centred on designing lesson plans that effectively integrate technology, pedagogy and content knowledge. By focusing on the interplay between these domains, professional-development programmes can help instructors to develop a deeper understanding of the TPACK framework and its potential applications in their teaching practices. Moreover, the study suggests that TPACK can be an effective framework for professional-development programmes for teachers that are aimed at developing instructors' pedagogical reasoning about various information and communication technologies across the curriculum, at encouraging innovative thinking when using new ICT-based teaching methods, and at integrating these tools into their classrooms. By emphasising the role of TPACK in technology integration, professional-development programmes will be able to help VET instructors develop the skills and knowledge needed to leverage technology effectively in support of improved student learning outcomes.

Limitations of the study

Since the study relied on self-ratings to estimate knowledge and TPACK application, we acknowledge that these responses might be more indicative of perceived self-efficacy than actual expertise levels. Future research should therefore consider adopting a mixed-methods approach. The integration of self-ratings with classroom or lesson observations could provide a more comprehensive and accurate measure of VET instructors' TPACK proficiency.

Suggestion for further studies

The findings of this study indicate a need for more comprehensive research. Future studies should employ a stronger theoretical and methodological framework in order to examine instructors' perceptions on a larger scale, such as across Namibia's private and public vocational colleges. It would also be worthwhile to explore whether the perceptions of instructors regarding TPACK differ based on factors such as age, gender, qualifications and/or subject specialisation.

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