Science Pre-service Teachers' TPACK, Readiness, Self-Efficacy, and Challenges Toward Online Teaching Internship

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Abstract

This embedded mixed method research study examined the pre-service teachers' (PST) technological, pedagogical, and content knowledge (TPACK) towards their readiness and self-efficacy considering their foresight challenges in online Science teaching internship. It is revealed that PSTs have adequate levels of expertise in TPACK, ranging from moderate to ample in all areas, interconnected with their reflected moderate levels of readiness and self-efficacy. The results of partial least squares-structural equation modeling (PLS-SEM) showed that out of all areas of TPACK, only the pedagogical knowledge (PK) manifested a significant relationship with the PSTs' readiness and self-efficacy in the online teaching internship. PSTs were challenged by their issues, uncertainties toward teaching training, complicated roles of teacher interns, concerns on TPACK, and external threats. In conclusion, the PSTs are proficient and prepared enough to perform an upright Science lesson delivery and have excellent classroom management skills, albeit with some challenges as teachers in online education. Moreover, a pre-service science teacher who is well-oriented and well-prepared is already on the journey to meet accomplishment and proficiency. Training on online pedagogies and mentorship is recommended.

Keywords: TPACK, Readiness, Self-efficacy, Challenges, Online science teaching internship

INTRODUCTION

Becoming a science teacher is undeniably complex, as aspiring teachers handle and manage many things despite their complete challenges and excitement in teaching—which mainly focuses on achieving practical and quality learning. To ensure teacher quality, the pre-service teachers (PSTs) must take a semester of full-time teaching internship. They are usually engaged in the actual teaching process, a significant aspect of teacher education with its primary objective of providing hands-on teaching experience for would-be teachers. However, the rise of the global pandemic made teaching internships questionable, thus making university instructors and researchers offer compensation for the practicum's loss by pursuing it online.

Little is known about e-practicum or online science internships, a significant change due to the pandemic (Sanchez et al., 2021; Goles et al., 2024; Olvido et al., 2024). The case of an e-practicum or online training is the latest concept in teacher education in the Philippines. This online practicum enhances the evolution of education, signifying how practice-based courses are being integrated with online components. The study by Ersin et al. (2020) revealed that pre-service teachers showed positive attitudes regarding e-practicum in which they have acquired much experience and made them realize that online internship is achievable. Benefits such as the ability to deal with technical problems, the advantage of digital integration, and the feasibility of the e-practicum itself made the PSTs think that online practicum can also be done in facilitating the teaching-learning process, thus compensating for the practicum's loss and helps overcome fears on online teaching. As the Commission on Higher Education (2020) emphasized, teacher education institutions (TEIs) and cooperating schools must continue to find innovative and flexible ways to prepare the next group of educators to teach and give service in the post-pandemic, new normal environment. Because of this advancement, they pressured TEIs to mold and develop the PSTs and produce many quality teachers (Ramos et al., 2020).

On the side of the PSTs, competence in teacher knowledge areas reflects their level of technological, pedagogical, and content knowledge (TPACK). Developing TPACK in teaching internships is a complex undertaking that the PSTs may call for to expose and experience a broad scope of learning engagements and opportunities to maximize their growth (Papanikolaou et al., 2017). With this, PSTs should

know how to deal with science learners, select instructional strategies and technologies, conduct assessments, and examine the science curriculum and its content to be fully equipped.

Several studies about teaching internships only pointed out the status, situation, and readiness of the PSTs toward this experiential course in a physical setting. Although teaching online is a new challenge and opportunity for teacher interns to explore first-hand experience in online teaching, which can help them to be more creative and resourceful, it cannot be denied that they still have inadequate training in the pedagogical approaches for online teaching knowing that the teaching principles, strategies, approaches, methods, and techniques being taught to them that are set on a face-to-face class setting become blurred (Peñeda et al., 2021). The essence of TPACK, on the other hand, includes several kinds of literature about expanding technology integration, ICT skills, perceptions, beliefs, and confidence, and curricular and instructional innovations and models involving pre-service and in-service teachers (Morales, 2019). Implementing flexible learning, including the online learning modality, eventually triggered what seemed to be a taken-for-granted matter within the educational boundary of the PSTs. This learning modality is a novel area to investigate, which focuses on examining the PSTs' level of TPACK, which can be a predecessor to their readiness and self-efficacy in an online teaching internship.

This study aimed to seek the readiness and self-efficacy of the would-be science teachers. It linked it with their level of TPACK, which is paramount in determining their general situation regarding teaching internships in an online setting. Investigating these important components helps to address future science teachers who exhibit a vivid comprehension of their combined impacts as effective educators with good teacher knowledge, readiness, and a higher sense of teaching efficacy (Gonzales, 2018). On this foundation, creating an Online Teaching Internship Guide Handbook (OTIGH) was deemed necessary and vital in guiding pre-service science teachers through nearly every situation and scenario possible in any teaching internship practice.

METHOD

The study utilized an embedded mixed method design to assess the PSTs' TPACK, readiness, self-efficacy, and challenges toward science teaching internships in an online setting. Mixed method design is a rigorous procedure that features analysis and mixing of both quantitative (close-ended) and qualitative

(open-ended) data into a sole study to recognize and respond to research problems (Creswell & Creswell, 2018).

The study was conducted in a teacher education institution in Cebu City, Philippines. It is a state and a research university that aims to sustain excellence and cultivate significance in advanced and higher education. The research participants of this study involved third-year pre-service teachers enrolled in the Bachelor of Secondary Education degree program, majoring in Science (BSEd-Science). Through Slovin's formula and simple random sampling, 108 pre-service teachers participated in the study. These participants were females (76.9%) and mostly aged 21 years old (74.1%), came from poor-to-low-income families (75.0%), and had cellphones (97.2%) and prepaid Internet subscriptions (65.7%). Twelve of the participants took part in the interview.

The research instruments included the demographic profile sheet, TPACK questionnaire adapted from Schmidt et al. (2009) and Valtonen et al. (2017), readiness questionnaire adapted from Veloo et al. (2015), and self-efficacy questionnaire adapted from Schwarzer and Jerusalem (1995). A semi-structured interview guide was used to obtain qualitative responses from the interview participants.

Before the instruments were administered, the researchers obtained ethics certification (784/2021-04 Espinosa) from the Research Ethics Committee, secured permission from the college dean, and asked for informed consent from the participants for their voluntary participation. After confirming these research permissions, the quantitative tools were administered online via Google Forms. The semi-structured interviews were also conducted and recorded online through Google Meet. The quantitative data were analyzed for descriptive statistics (i.e., means using Jamovi) and inferential tools (i.e., partial least squares-structural equation modeling). The proposed SEM of the study is shown in Figure 1.

The model in Figure 1 underwent three analysis stages: measurement, structural, and predictive models using Smart PLS. This analysis was conducted at a 95% confidence level. All p-values less than .05 are considered significant.

On the other hand, Braun and Clarke (2006) analyzed the qualitative data through a six-step thematic analysis. This analysis started with data familiarization and code generation, followed by theme search, review, and naming, and ended with the write-up.

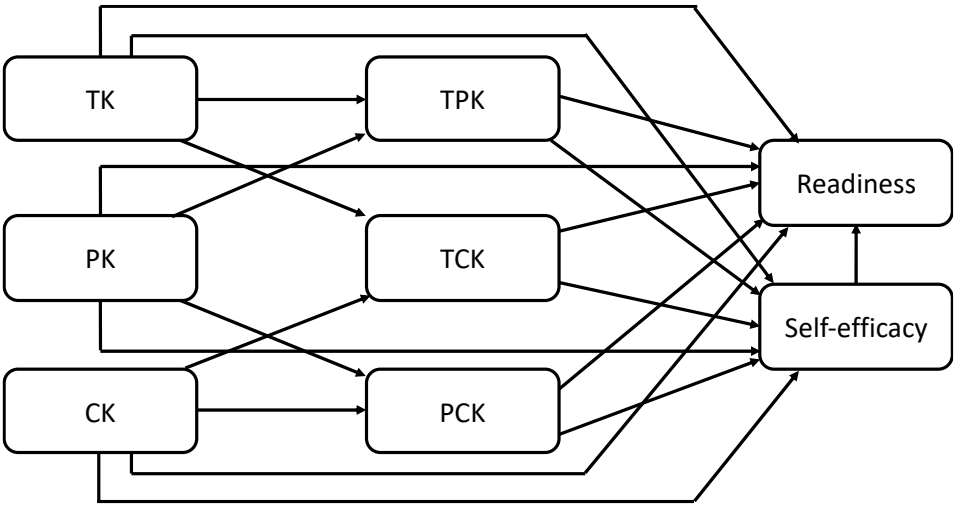

Figure. 1. Proposed SEM of the Study

RESULTS AND DISCUSSION

Pre-service Science Teachers' Level of TPACK

The extent of pre-service teachers' TPACK in the six dimensions is presented in Table 1. Based on Table 1, the PSTs have high TK, CK, TPK, TCK, and PCK, indicating they have the required knowledge to use technology to teach Science to their students in their online internships. This finding could be attributed to their teacher preparation, which provided them with the content and the use of appropriate technology and strategies in teaching. PSTs should be adept with the subject matter and technology, integrated to deliver engaging and innovative Science instructions (Anud & Caro, 2022; Gonzales et al., 2023). Higher levels of TPACK can result in more advantages in teaching and learning opportunities, such as accurate content and ICT use in practice teaching (Aktas & Özmen, 2020).

Table 1. PSTs' Level of TPACK

Dimension	Mean	Description
Technological (TK)	3.57	High
Pedagogical (PK)	3.31	Moderate
Content (CK)	3.45	High
Technological pedagogical (TPK)	3.60	High
Technological content (TCK)	3.63	High
Pedagogical content (PCK)	3.63	High

Legend: 1.00-1.80 (Very low), 1.81-2.60 (Low), 2.61-3.40 (Moderate), 3.41-4.20 (High), 4.21-5.00 (Very High)

However, the PSTs only have a moderate level of PK, signifying that they have average levels in teaching Science. This finding could be explained by the fact that the pandemic affected their teacher training journey, limiting

their exposure to face-to-face and online teaching opportunities. In other words, the PSTs were exposed to general pedagogies, which may not be tied to technology, and they needed to be ready to teach and engage with their students in online settings (Altawalbeh & Al-Ajlouni, 2022). This limitation should be addressed as pedagogical knowledge is essential to prepare their skills in planning, implementation, and assessment (DeCoito & Estaiteyeh, 2022; Boholano et al., 2022). Enhancement of the PK, for instance, through lesson study can ensure that teachers become fully equipped to excel in all teaching aspects, with or without technology (Conceição et al., 2022; Sierra et al., 2023). Upskilling is needed in PK and other knowledge levels to offer quality Science teaching that integrates content, pedagogy, and content (Akun & Mohamad, 2020).

PSTs' Level of Readiness and Self-efficacy for Online Teaching Internship

Readiness and self-efficacy are two factors that can impact the PSTs' online teaching internship. The extent of these two factors is shown in Table 2.

Table 2. PSTs' Level of Readiness and Self-efficacy for Online Teaching Internship

Factor	Mean	Description
Readiness	3.31	Moderate
Self-efficacy	2.78	Moderate

Legend: 1.00-1.80 (Very low), 1.81-2.60 (Low), 2.61-3.40 (Moderate), 3.41-4.20 (High), 4.21-5.00 (Very High)

As shown in Table 2, the PSTs have a moderate readiness level for online teaching internships. This result suggests that the PSTs needed more proper preparations to incite confidence in online practicum. The PSTs, and even in-service teachers, were required to prepare for the online class; they underwent technological shock and teaching adjustments to provide quality education amidst remote Science learning (Hermoso et al., 2022). Due to this, they require support and guidance, particularly in using digital tools and online teaching platforms, resources, and strategies, to facilitate active learning approaches in Science (Cirkony et al., 2022). Readiness for online internships is crucial because it entails teaching-learning opportunities (Ardinayansah, 2021; Mafugu, 2022) and personal and professional growth (Hora et al., 2021).

Similar to readiness, PSTs also have a moderate extent of self-efficacy for online internships, indicating that they manifest some persistence, enthusiasm, and commitment toward their practicum. This moderate efficacy could be attributed to the unfamiliarity of the online teaching media, that they become anxious if they can deliver their lessons effectively and efficiently (Hermoso et

al., 2022; McPherson & Pearce, 2022). Teaching internships denote individual teaching sessions; due to this, the PSTs should believe in themselves to accomplish these sessions with quality and efficiency (Yildiz & Ürün, 2021). With this, they need to be provided with supportive environments, mentoring, and practical experiences to boost their teaching confidence (Mafugu, 2022). They must become efficacious online teachers to further develop their capabilities, individual skills, and classroom managerial competence in teaching Science (Yildiz & Ürün, 2021; Asare & Amo, 2023).

Impact of TPACK on the Readiness and Self-Efficacy of Online Internships

PLS-SEM was conducted to explore the impact of TPACK components on the PSTs' readiness and self-efficacy toward online internships. The measurement model results signify acceptable values for the factor loadings (0.704-0.895), average variance extracted (0.609-0.745), and composite reliability (0.886-0.973). The discriminant validity (heterotrait-monotrait ratio less than 0.90) also showed acceptable matrix results (Vinzi et al., 2010; Henseler et al., 2015; Sarstedt et al., 2021).

Table 3. Significant Relationships in the Model

Relationship	t-value	p-value
CK → PCK	2.641*	0.009
CK → TCK	2.558*	0.011
PK → PCK	4.881*	0.000
PK → Readiness	2.459*	0.014
PK → Self-efficacy	2.769*	0.006
PK → TPK	5.487*	0.000
TK → TCK	6.228*	0.000
TK → TPK	3.669*	0.000

*Significant at p<.05

With these measurement model values, the model is robust and reliable for analyzing the survey data and testing the relationships among the constructs of TPACK, readiness, and self-efficacy.

The structural model was formulated after ensuring its reliability. Table 3 highlights the significant relationships. Four findings can be derived from Table 3.

CK and PK impact PCK. PSTs with a strong foundation in subject matter and pedagogies contribute to teaching science content effectively to students. PCK integrates the “what” and “how” of teaching, which are essential aspects of any teaching-learning activity, including practice teaching (Shing et al., 2015).

CK and TK impact TCK. PSTs with a robust understanding of the subject matter and proficiency in using

technology can effectively enhance their ability to use technology in specific lessons in science. Like mathematics teaching, the teachers' use of appropriate technology to represent the content is essential to provide effective instruction (Listiawan et al., 2018).

PK and TK impact TPK. PSTs with profound knowledge of teaching strategies and technological skills can implement effective teaching strategies in a technology-rich teaching-learning environment. Heintink et al. (2017) and Sanchez et al. (2023) indicated that teachers use ICT to facilitate teaching and foster learning, including active education, classroom management, and inclusive instruction.

PK impacts readiness and self-efficacy. PSTs with a strong background in teaching strategies can positively affect their preparedness and self-efficacy toward online teaching internships. PK is essential for making decisions about teaching, managing the classroom, and engaging students, all of which are critical to being confident and ready to teach Science online. Mai and Hamzah (2016) attributed high self-efficacy to the science teachers' high pedagogical knowledge.

The predictive model can establish the nature of the SEM (Hair et al., 2019). Based on the results, the Q^2 differences between SEM and linear model (LM) are positive, while the RMSE, MAE, and MAPE differences are negative. These results indicate that the SEM path model is more reliable than LM (Shmueli et al., 2019). In this study, the SEM generated lower prediction errors, proving to be a more fitting model to predict PCK, readiness, and self-efficacy toward the online internship of PSTs.

Ultimately, the observed model for the study is highlighted in Figure 2.

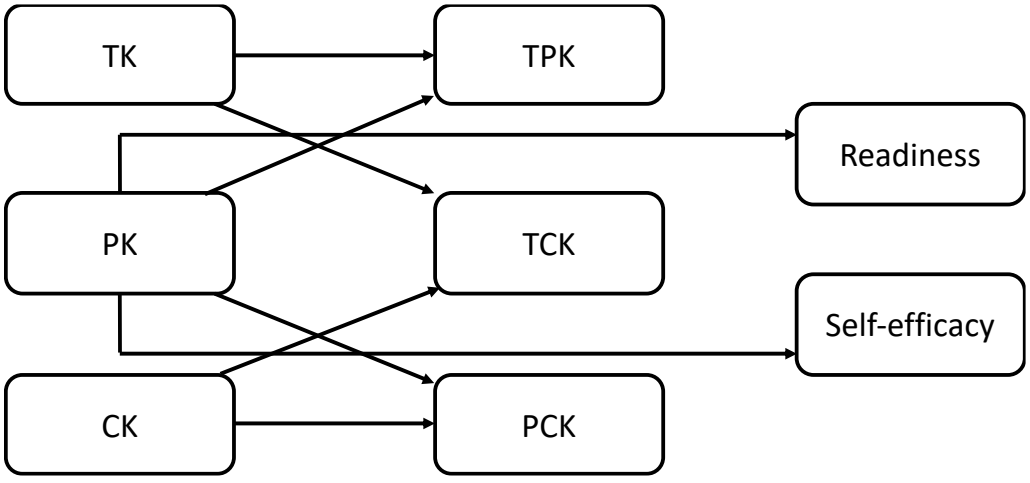

Figure 2. Observed Model of the Study

The observed model in Figure 2 demonstrates that CK and PK considerably impact PCK, highlighting the significance of subject-matter expertise and pedagogical tactics in successful teaching. Additionally, CK and TK favorably influence TCK, underscoring the importance of subject knowledge and technological competence in incorporating technology into teaching. Moreover, PK and TK favorably impact TPK, highlighting the importance of pedagogical expertise and technical proficiency in instructional strategies. Furthermore, PK affects readiness and self-efficacy, highlighting its contribution to building confidence and readiness for online teaching. Overall, this model offers insights into the connections between TPACK, readiness, and self-efficacy, assisting in developing effective online teaching practices.

PST's Challenges Toward Online Teaching Internship

Five themes were generated from the thematic analysis of the interview results.

Personal issues with being a teacher-intern. PSTs' Development of TPACK, readiness, and self-efficacy was highly affected and challenged by their remarks and total well-being as teacher interns. These include PSTs' difficulties in realizing and conceptualizing an intern identity necessary to teach. The vulnerabilities of PSTs, such as their lack of confidence, demotivation, and discomfort, might be an adverse effect of expecting to gain new experiences in an online teaching internship (Symes et al., 2023).

Uncertainties towards teaching internship. PSTs' doubts and ambiguities were vulnerable to posing a hurdle in their growth and Development as teacher interns. It can be stated that the multifaceted questioning of PSTs on their abilities and effectiveness was a significant challenge given that it could consequently trigger and relate to the affective and cognitive domains, explaining the presence of dubious feelings and the worries of attaining not enough knowledge about teaching internship overall (Gorospe, 2022).

Challenging roles of teaching interns. Teacher interns' ambiguity of role mastery, specifically in an online setup, could stimulate difficulties in developing PSTs into teaching interns. Participants were still figuring out how to fit into the various responsibilities expected of a teacher intern, which could be challenging at times. This scenario also implied that many still anticipated conducting the internship face-to-face. Everyone was insistent despite being coerced into the available reality (Takaoglu, 2017; Bansiong, 2021).

Some concerns on TPACK. The issue of insufficient knowledge had something to do with how these pre-service teachers explored learning during the beginning of their college years. This concern can also be associated with how these participants are affected by the paradigm shift from learning in a traditional setup to learning online. It should still be emphasized that having sufficient content knowledge is advantageous for the teacher interns to respond to any needs of any particular classroom, whether it may be a physical classroom or a virtual one. While some technological and professional competencies may be ignored during teaching preparation, it is essential to note the need to pay more attention to practical aspects of technology integration into the teaching-learning process (Ismaeel & Al Muhim, 2022).

Threats of external factors to student interns in online teaching. Since the shift to a new mode of learning points to having online classes, teaching in an online environment poses a significant threat to the teacher interns' ability to implement their lessons properly. Since an online teaching internship implicitly demands other resources (e.g., laptop) to smoothly demonstrate teaching, it can be linked to how this demand affected the financial standing of the PSTs, thus leading to any financial burden. Environmental factors should also be considered inevitable disruptions, such as unwanted noise and unannounced power interruptions, which might happen during online teaching. Technological, economic, and environmental factors are some external threats to online teaching (Peneda et al., 2021; Sumalinog, 2022; De Leon-Enanoza et al., 2023).

Teacher education programs can better prepare PSTs for the difficulties they might encounter during their online teaching internships by addressing these various problems and implementing valuable strategies and support systems. These programs can ultimately encourage their growth and Development as efficient online Science educators.

CONCLUSION

Despite the difficulties noted, the study emphasizes the general proficiency and potential of PSTs in successfully incorporating technology into science instruction. Their high TPACK, readiness, and self-efficacy are solid platforms for successful online teaching internships. Teacher education programs can further improve PSTs' preparedness and confidence by addressing the stated problems and providing the appropriate assistance, ensuring they are well-equipped to handle the rigors of online Science teaching.

SUGGESTION

Education institutions should consider including specialized training in online pedagogy in teacher education programs, offering hands-on experience in online teaching, and setting up mentorship programs to assist PSTs during their internships. Other suggestions include enhancing PK development, providing targeted training, fostering collaborative environments, addressing personal challenges, and providing technical support and resources.

The researchers recommend using the crafted OTIGH to assist PSTs in their teaching internship journey. The handbook includes listings of roles and behaviors expected of an online teacher and myriad examples of online tools, technologies, principles, and practices necessary for developing TPACK and providing quality learning. This handbook also features various adaptable lesson plan templates, signposts to further reading, and helpful web links containing varied materials relevant to students, including links that offer classroom resources for teachers and students.

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