A global perspective on integrating technology into teacher education programs using measures of self-efficacy, attitudes and program experiences

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Abstract: This study examines technology integration in teacher education programs across multiple countries, focusing on pre-service teachers' self-efficacy, attitudes, and experiences with technology integration. Data from 791 participants were collected using validated instruments such as the Technology Proficiency Survey for Educators, Stages of Adoption of Technology, Synthesis of Qualitative Evidence, and TPACK Core measure. Results demonstrated that pre-service teachers had positive attitudes and moderate self-efficacy toward educational technology integration, but these did not always align with perceived integration abilities in the classroom. A unique contribution to the field is the large international data set. The study reveals the complex nature of technology integration in teacher education globally, suggesting areas for improvement such as increasing authentic experiences and enhancing feedback mechanisms. Future research explores gender, program and country-specific variations and factors contributing to effective technology integration in diverse educational contexts.

Keywords: teacher education, technology integration, TPACK, confidence, international, self-efficacy

Introduction

Preparing future teachers to integrate technology into their classrooms is an important goal for teacher preparation programs worldwide. Teacher educators from multiple international universities formed a research team to examine teacher preparation programs across multiple measures related to technology integration. The initial project team included leaders in the Society for Information Technology in Teacher Education (SITE) organization attending the annual conference. Collaborating on projects important to multiple teacher preparation programs worldwide was first discussed. Most teacher preparation programs follow some standards for teachers to effectively use classroom technologies. Each of these standards requires graduates to know how to use technology effectively in their (future) classroom. This paper will discuss the initial global findings.

Background

Teacher preparation programs are crucial in equipping graduates to effectively integrate technology into the classroom (Dawson et al., 2013; Tondeur et al., 2012). Research has shown that preparing preservice teachers (PSTs) to integrate technology leads to more skilled teachers with positive attitudes toward using technology (Spiteri & Rundgren, 2018), improvement on self-efficacy (e.g. Christensen & Knezek, 2008), gains in the stages of adoption of technology (Christensen, 2002) and increased knowledge about how to integrate technology, pedagogy, and content effectively (Technological Pedagogical Content Knowledge - TPACK) (Aktas & Ozmen, 2020: Green et al. 2023; Tondeur et al, 2020; Wang et al., 2018). Key elements of an effective preservice teacher education program include having teacher educators model technology integration and opportunities for PSTs as future teachers to practise these skills in real-world settings (Agyei & Voogt, 2015; Getenet et al., 2024; Kavanagh et al., 2020; Tondeur et al., 2016; Voithofer & Nelson, 2020). PSTs enter their education programs with no prior experience integrating technology into students' learning processes. Therefore, they do not have models to build their own visions of an integrated classroom. Therefore, teacher preparation programs must take the initiative to design and develop effective technology training/courses that will provide PSTs with the skills and knowledge required to design and develop technology-rich curricula for their future classrooms. Effective technology training must focus on more than basic technology skills and strive to provide PSTs with models that offer opportunities to practice skill application with a curriculum that can be adapted to their future classrooms. Allowing PSTs to design, reflect on, and receive feedback on technology-integrated activities fosters their growth and confidence in these abilities.

The study

Teacher educators from multiple universities involved in teacher preparation programs expressed an interest in participating in the international technology in PST education data gathering project. Those who expressed interest were added to a Microsoft Teams environment where documents regarding the project description, surveys, timeline and ethics approvals for two universities were shared. Universities choose whether to add their students to the larger data set or collect it on their own servers and then share it with the main research team. While 49 universities in 19 countries initially expressed interest, only seven countries could collect data within their programs for the first round of data collection, which ended on May 15, 2024. The invitation to co-author this paper was sent out to participants who provided data. Included in Table 1 are the frequencies of participants by country.

This research explores contextual differences in teacher education programs worldwide. This paper is part of a larger research program. The data for this paper explored the research question: How do technology integration experiences, self-efficacy, and attitudes toward technology integration emerge among pre-service teachers in various international teacher education programs?

Table 1. Participants by Country

Country	Frequency	Percent
Australia	115	14.5
Canada	16	2.0
Ireland	6	0.8
Italy	61	7.7
Japan	323	40.8
Portugal	182	23.0
United States	82	10.4
Other	6	0.8
Total	791	100

Context of Project Participants

This quantitative study builds on previous studies validated within a single university in the United States. It expands survey data collected beyond a single university or country, enabling researchers to explore technology integration of self-reported knowledge and skills globally. While each program that participated varied in the make-up of their PSTs, the context of the data is important to include for making better conclusions about the impact of technology integration in different programs. For example, some participants were in their program's first year, while others had already completed a degree and were returning for teaching credentials. The survey was administered on a voluntary opt-in basis. A brief description of the groups who provided data are below.

- Ireland – The participants were second-year undergraduate Bachelor of Education (preK-6) students. The participants had completed their creative technologies module.
- Australia (QUT) – K-12 pre-service education teachers, all years; Bachelor of Education and Master of Teaching (both initial teacher education degrees). Students in all courses are expected to complete a core pedagogy and technologies unit or subject of work that demonstrates their ability to use technologies effectively in the classroom.
- Australia (UniSQ) – K-12 pre-service education teachers, all years; Bachelor of Education and Master of Teaching (both initial teacher education degrees). The programs have one single course shared across Early Childhood, Primary/Elementary and Secondary. There is also an expectation that all discipline courses will model, teach and assess technology integration.
- Australia (Edith Cowan University) – The students were fourth-year undergraduate primary school pre-service education teachers. They completed the survey while studying their fourth-year education technologies course.
- Australia (University of Canberra) – Students were a combination of 2nd and 3rd year undergraduate pre-service teachers (primary and secondary) enrolled in a Design and Technologies unit.
- Italy (University of Padua) – During a mandatory Teaching Methodologies and Educational Technologies course, students were mostly 2nd-year undergraduate PSTs (Kindergarten-K8, pupils aged 3-12).

- Japan - K-9 education students (pre-service education teachers, third year of their four-year undergraduate course) from Gunma University and Utsunomiya University. The programs do not have an educational technology course in the curriculum. Some courses designated for specific subjects, such as social studies at the elementary school level, mandatory for all students, include a few hours on teaching social studies using digital tools.
- Portugal - The participants were PSTs attending the first year or the second year of Teaching Master's programs, coming from different institutions across Portugal. Most of them were attending the first year of the Master's.
- US (University of Houston-Clear Lake) – Most students were in their final semester of their bachelor program for initial teacher education degree in preK-12. The participants had previously taken a required technology integration course.
- US (University of Texas Dallas) – Most students were in their 4th year of a preservice bachelor program for initial teacher education degree in pre K-12. The participants have completed a required technology integration course. The data were collected as part of the course assessment.

As indicated in Table 1, participants included PSTs from multiple universities across multiple countries. As was typical in most teacher preparation programs, there were more females than males. For this set of data, there were 212 (26.8%) male and 564 (71.3%) female respondents, with 15 (1.9%) preferring not to answer. The largest percentage (59.7%) of participants were undergraduates in a teacher preparation program, 14.1% were graduates in another field returning for teacher certification, and 26.2% were in a Master of Teaching program (classified as initial teacher education students). The mean age of the participants was 24 years old.

Method

Ethics

Given the international nature of the project, each university required ethical approval from their university ethics committee before data collection could commence. Each university had different ethical application requirements and associated lead times. An approved ethics document from two of the organizing institutions was provided to all participants. For some participants, this provided an expedited review and approval. However, there were varying degrees of difficulty and delays in receiving approval for other institutions.

Instrumentation

Data were collected online from participants using five surveys. The data collection replicated data collected by Christensen (2021) for a single PST program in the US. The battery of surveys used for this international project has been previously validated - The Technology Proficiency Survey for Educators (TPSE) Survey Items (Christensen, 2021); Stages of Adoption of Technology (Christensen, 2002); Synthesis of Qualitative Evidence (SQD-Model) (Tondeur et al., 2016); Attitudes toward Technology (Christensen & Knezek, 2009) and TPACK Core (Voogt et al., 2013).

The Technology Proficiency Survey for Educators (TPSE) Survey has 22 items that have been found to measure three different constructs related to efficacy in using technology in education (Christensen, 2021). The three areas measure how well participants design, create and model learning with technology (F1), communicate and collaborate using technology (F2) and using technology to extend learning beyond the classroom (F3). Participants responded to statements on a 5-point Likert Scale (1 = Strongly Disagree, 5 = Strongly Agree). Sample questions from the 22-item survey included:

I feel confident I could….

- *use technology to improve my teaching practices.*
- *use educational technology research to inform and improve my classroom practices.*

The Stages of Adoption of Technology (Christensen, 1997) is a six-item survey in which participants select the stage that best describes how they are adopting technology. The six stages are: Stage 1 awareness; Stage 2 learning the process; Stage 3 understanding and applying the process; Stage 4 familiarity and confidence; Stage 5 adaptation to other contexts, and Stage 6 creative application to new contexts.

The Synthesis of Qualitative Evidence (SQD) survey was adapted from the SQD Model (Tondeur et al., 2016). The SQD includes six strategies related to experiences: Role Model, Reflection, Instructional Design, Collaboration, Authentic Experiences, and Feedback. Participants responded to statements on a 5-point Likert Scale (1 = Strongly Disagree, 5 = Strongly Agree). Items from the 24-item survey included:

During my pre-service training…

- *I have seen many examples of technology use in an educational setting.*

- *I observed sufficient technology use in an educational setting in order to integrate applications myself in the future.*
- *I saw good examples of technology practice that inspired me to use technology applications in the classroom myself.*

The Attitudes toward Technology survey (Christensen & Knezek, 2009) measured dispositions toward technology including: Interest in technology; Concern about technology's impact; Utility/usefulness for instruction; and Significance for student learning. Participants selected from an agreement 5-point Likert scale for 22 statements. Sample statements included:

- *I think that working with technology would be enjoyable and stimulating*
- *I want to learn a lot about technology*

The TPACK Core (Voogt et al., 2013) is an eight-item scale adapted from the original survey (Schmidt et al., 2009) that included items for each of the technology, pedagogy and content knowledge domains. TPACK Core was created to address the intersecting concepts of the TPACK Model (Koehler & Mishra, 2009) and is rated on a 5-point Likert Scale (1 = Strongly Disagree, 5 = Strongly Agree). Items from the TPACK Core included:

- *I know about technologies that I can use for understanding and doing in teaching my subject.*
- *I can choose technologies that enhance the content for a lesson in my subject.*
- *I can choose technologies that enhance the pedagogy of a lesson.*

Results

Table 2 shows Cronbach's alpha values, demonstrating the reliability of the various scales used in the study. The TPSE subscales show strong internal consistency (α= .761 to .910). The SQD scales show high reliability, with alpha values between .827 and .926. The attitude scales also exhibit strong reliability (α= .781 to .895). The TPACK core scale has the highest reliability (α= .936), confirming the robustness of the scales used in this study. Reliability estimates cannot be calculated for the Stages of Adoption as it is a one-item technology integration survey.

Table 2. Cronbach's Reliability Estimates for Measures

Scale	Items	Alpha
TPSE Subscale 1 Design, create and model learning with technology	10	.910
TPSE Subscale 2 Communicate and collaborate using technology	7	.855
TPSE Subscale 3 Extending learning beyond the classroom with technology	5	.761
SQD Role Model	4	.887
SQD Reflection	4	.827
SQD Instructional Design	4	.910
SQD Collaboration	4	.830
SQD Authentic Experiences	4	.845
SQD Feedback	4	.926
Attitude Interest in technology	5	.895
Attitude Concern about the impact of technology	4	.781
Attitude Usefulness of technology for instruction	8	.879
Attitude Significance of technology for student learning	5	.833
TPACK Core	8	.936

Descriptives

Descriptives were completed for each of the scales showing means and standard deviations. As shown in Table 3, the means for the five-point Likert scales ranged from a low of 2.82 for concern about the impact of technology on society (which is a positive finding) to a high mean of an attitude that technology provides significance for student learning. The mean for Stages of Adoption of Technology was 4.58 on a 6-point scale. The frequencies of the Stages are shown in Table 4 showing that there are still Stage 1 (awareness of technology) and Stage 2 (learning the process) meaning these participants are not at all comfortable using technology. Additional analysis was completed for each of the scales by stage. As shown in figure 1, it appears participants in stages 5 or 6 are the highest in all the other measures as well.

Table 3. Group Means for the Survey Scales

Scale	Factors	N	Mean	Std. Dev
TPSE	F1: Model and facilitate learning with technology	791	3.75	.686

	F2: Improve instruction with technology	791	3.76	.670
	F3: Collaborate, communicate, engage with technology	791	3.40	.751
Synthesis Qualitative Development (SQD)	Role Model	791	3.74	.888
	Reflection	791	3.63	.846
	Instructional Design	791	3.21	.983
	Collaborate	791	3.51	.865
	Authentic Experiences	791	3.39	.957
	Feedback	791	2.91	1.05
Attitudes	Interest in Technology	790	3.94	.817
	Concern about impact of technology (not reversed)	790	2.82	.889
	Useful for Instruction	790	4.01	.608
	Significance for Student Learning	790	4.22	.589
TPACK Core		790	3.63	.798
Stages of Adoption of Technology		556	4.58	1.16

Table 4. Group Frequencies for Each Stage of Adoption of Technology

Stage	Frequency	Percent
Stage 1 Awareness	9	1.1
Stage 2 Learning the process	16	2.0
Stage 3 Understanding and applying the process	82	10.4
Stage 4 Familiarity and confidence	107	13.5
Stage 5 Adaptation to other contexts	221	27.9
Stage 6 Creative application to new contexts	121	15.3
Total	556	70.3
System missing	235	29.7
Total responses	791	100.0

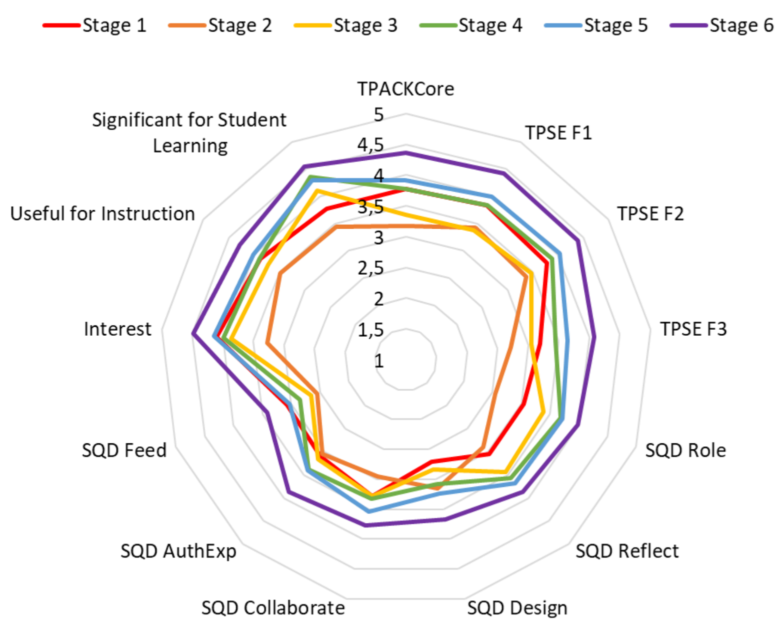

Figure 1. Measurement scales by Stage of Adoption of Technology

Relationships Among Measures

Pearson product moment correlations were completed to examine the relationships between variables (Table 5). As would be expected, the scales from the same survey were strongly related. However, additional strong relationships were revealed between TPACK Core and the three efficacy measures (TPSE) and moderately related to SQD Design, SQD Authentic Experiences, SQD Feedback and attitudinal interest in technology.

Table 5
Correlations of Technology Integration Scales

		Stages	TPACK Core	TPSE F1	TPSE F2	TPSE F3	SQD Role	SQD Reflect	SQD Design	SQD Collaborate	SQD Auth Exp	SQD Feed-back	Att Interest	Att_ Useful Instruction	Att_ Student Learning	Att_ ConcernNR
TPACK Core	Pearson Correlation	.433**	1	.726**	.698**	.630**	.383**	.394**	.503**	.463**	.526**	.509**	.562**	.426**	.439**	.093
	Sig. (2-tailed)	<.001		<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	.014
	N	467	702	702	702	702	702	702	702	702	702	702	702	702	702	702
SQD Role	Pearson Correlation	.224**	.383**	.396**	.379**	.332**	1	.666**	.661**	.661**	.640**	.566**	.306**	.372**	.297**	-.039
	Sig. (2-tailed)	<.001	<.001	<.001	<.001	<.001		<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	.304
	N	468	702	703	703	703	703	703	703	703	703	703	702	702	702	702
SQD Reflect	Pearson Correlation	.189**	.394**	.395**	.390**	.352**	.666**	1	.670**	.662**	.643**	.601**	.308**	.359**	.323**	.020
	Sig. (2-tailed)	<.001	<.001	<.001	<.001	<.001	<.001		<.001	<.001	<.001	<.001	<.001	<.001	<.001	.601
	N	468	702	703	703	703	703	703	703	703	703	703	702	702	702	702
SQD Design	Pearson Correlation	.242**	.503**	.465**	.426**	.426**	.661**	.670**	1	.744**	.733**	.745	.310**	.305**	.238**	.060
	Sig. (2-tailed)	<.001	<.001	<.001	<.001	<.001	<.001	<.001		<.001	<.001	<.001	<.001	<.001	.<.001	.112
	N	468	702	703	703	703	703	703	703	703	703	703	702	702	702	702
SQD_Collaborate	Pearson Correlation	.190**	.463**	.441**	.392**	.379**	.661**	.662**	.744	1	.727**	.678**	.340**	.351**	.259**	.008
	Sig. (2-tailed)	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001		<.001	<.001	<.001	<.001	<.001	.825
	N	468	702	703	703	703	703	703	703	703	703	703	702	702	702	702
SQD Auth Exp	Pearson Correlation	.215**	.526**	.478**	.415**	.422**	.640**	.643**	.733**	.727**	1	.767**	.318**	.323**	292**	.102**.
	Sig. (2-tailed)	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001		<.001	<.001	<.001	<.001	.007
	N	468	702	703	703	703	703	703	703	703	703	703	702	702	702	702
SQD Feedback	Pearson Correlation	.204**	.509**	.455**	.405**	.427**	.566**	.601**	.745**	.678**	.767**	1	.338**	.268**	224**	.102**.
	Sig. (2-tailed)	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001		<.001	<.001	<.001	.007
	N	468	702	703	703	703	703	703	703	703	703	703	702	702	702	702

Discussion

The Technology Proficiency Survey for Educators (TPSE) provided a score related to self-efficacy in using technology. The overall group mean for all TPSE areas was less than 4, with modelling and facilitating learning with technology, improving instruction with technology at 3.7/5, and collaborating, communicating, and engaging with technology even lower at 3.4. These results are concerning given that most participants had low levels of efficacy in using technology in education in that they did not agree or strongly agree to the statements. These results are much lower than the ones in research by Christensen and Trevisan (2023), who found that all elements post-learning were over 4/5 and two factors were over 4/5 before the learning intervention.

Stages of Adoption. The stages of adoption indicated the PST dispositions for technology integration. The overall group mean for Stages of Adoption of Technology was high (M 4.58/6, SD 1.2), with a large number of the PSTs selecting stage 5 (27.9%), where the pre-service teachers feel they can adapt their technology use for other contexts. The lowest selection was stage 1 (1.1%), where they are at the awareness stage. It was encouraging that the highest number of respondents were in the highest two stages, stage 5, adaptation to other contexts, and stage 6, creative application to new contexts. Du, Lyublinskaya, & Keller (2023) indicated that technology experiences over time can show growth of knowledge and conform in technology integration using both the stages of adoption and TPACK means. As expected, they demonstrated a constant improvement in PST stages of adoption during their learning in a technology integration courses.

Synthesis Qualitative Development (SQD). SQD measures six areas of experiences that PSTs encounter during their educator preparation program. Participants were asked to respond to four statements related to the each of the SQD strategies. The role model scale had the highest mean (M 3.74/5, SD .89) for the participants in this study. This finding aligns with other studies that also found Role Model is have the highest mean of the six (Knezek et al., 2023). Despite being the highest score, it is still below 4 (agree) which shows there is room for improvement in how role models demonstrate technology use in teaching. This aligns with evidence suggesting that role modelling is crucial in successfully adopting technology (Eutsler, 2021). The Feedback scale presents with the lowest mean (M2.91, SD 1.05), mirroring the descriptive statistics from the Knezek et al. (2023) study. This result indicates that teacher education programs need to provide more structured feedback mechanisms, possibly through peer review, mentor observations, and self-reflection activities that offer actionable insights.

However, it is disappointing that all descriptive statistics on a 5-point Likert scale are below 4, which does not indicate a level of agreement or strong agreement with those statements. Any result under three indicates low and very low agreement with the statements. As we move towards the beginning of the second quarter of the 21st century, this does not provide researchers, employers, parents and schools with an optimistic view that new pre-service teachers will be better prepared to use technology than previous generations.

TPACK Core. The mean TPACK Core score for the entire group indicates a moderately positive self-assessment among pre-service teachers (M 3.63, SD .80). However, there is notable variability in the responses, which could highlight country-specific characteristics in deeper analyses. Overall, these results do not provide strong evidence of the PST preparedness for the profession where technology integration is expected. The results are similar to the reported study by Greene et al. (2023) that found moderately positive TPACK scores among PSTs. This moderate level of self-assessment may indicate that while many teachers understand the value of technology integration, they struggle with applying it in practical settings, highlighting the need for better integration of technology into teacher education programs (Tondeur et al., 2012). Christensen and Trevisan's (2023) research found that the PST mean for TPACK Core improved from 3.52 - 4.65 post-learning intervention.

Comparing TPACK Core to the SQD scales, PSTs reported higher levels of experiencing role modelling (M 3.74, SD .89) and reflection (M 3.63, SD .85) than their overall TPACK Core score. However, the latter is reported to be higher than the levels of instructional design experiences (M 3.21, SD .98) and feedback (M2.91, SD 1.05). This could suggest a gap between observing technology integration and designing and receiving feedback on their technology-integrated lessons. This is possibly reflected in the higher attitudes expressed regarding perceived usefulness (M 4.21, SD .59) and significance (M 4.01, SD .61) compared to respondents' TPACK confidence.

The need for more emphasis on practical experiences, feedback, and integrated knowledge development (especially through instructional design) has also emerged as a need and a direction for teacher training referred to in other studies (e.g. Agyei & Voogt, 2015; Voithofer & Nelson, 2020). One apparent contradiction is that pre-service teachers responding to the survey considered themselves at advanced stages of technology adoption (M 4.58/6, SD 1.2). At the same time, their TPACK core and TPSE are significantly lower.

Recommendations, limitations, and future research

The internationalisation of the data should mean that we can make broader generalisations from the results with several implications for teacher preparation programs. The study used self-reported data, which may be relevant if any PSTs report their confidence based on perceptions. The data were collected from cohorts from different academic years, which may introduce variability in the responses due to the different levels of experience with technologies. A neutral response was used in the survey (i.e., those of 3 in a 5-point Likert scale), which can skew the data. Regarding the findings, the high mean scores on the TPSE_F1 and TPSE_F2 scales indicated that PSTs are generally and moderately confident in designing, creating, and modelling learning with technology and communicating and collaborating using technology. The lower score on TPSE_F3 suggests that PSTs are less confident in extending learning beyond the classroom using technology. This aligns with the SQD results, which show modest scores in instructional design, feedback, and authentic experiences. These findings suggest that while PSTs may be comfortable using technology to support their instructional practices, they may struggle with using it in more interactive and collaborative contexts, which are increasingly important in school environments where grade-level teams plan and teach together. Therefore, teacher preparation programs should focus on developing strategies that prioritize using technology to enhance collaboration and active engagement among PSTs (Sabah, 2022). This can be achieved through inquiry learning methods such as project-based learning and digital collaboration platforms (Scherer et al., 2019).

In terms of recommendations, teacher preparation programs should emphasize providing authentic learning experiences and opportunities for reflection, as these were identified as areas for improvement in the SQD results. The relatively low score in 'feedback' further indicates that PSTs may not receive sufficient feedback on their use of technology, which is vital for developing technological content knowledge and improving instructional practices (Tondeur et al., 2021). To address this deficit, teacher preparation programs should incorporate more hands-on and reflective activities, such as lesson study, peer modelling, and mentoring, where PSTs can observe one another's use of technology, offer constructive feedback, and engage in ongoing professional development around technology integration. Additionally, teacher educators can address PSTs' concerns about the impact of technology and encourage more willingness to adopt innovative practices by modelling best practices (Phan et al., 2021), providing experiential learning opportunities and vicarious experiences (Bandura, 1986; Kolb, 2014; Martin et al., 2020), and addressing ethical and pedagogical concerns through discussion (Celik, 2023). Incorporating discussions around ethical and responsible technology use may help alleviate these concerns while promoting more thoughtful and effective technology integration in the classroom.

The study has several limitations that should be considered in future research. The data suggested that while PSTs may express interest in technology and acknowledge its usefulness for instruction, their self-reported confidence does not translate into advanced or innovative instructional design practices (as seen in the SQD instructional design M 3.21). This gap suggests that further research should explore how teacher preparation programs can better translate theoretical knowledge into practical, classroom-ready skills. Additionally, future studies could investigate the contextual factors influencing PSTs' confidence and proficiency with technology, such as access to resources, administrative support, and opportunities for ongoing professional development. Further research is also needed to track the long-term impact of teacher preparation programs on technology integration and PST outcomes, particularly in light of the evolving nature of information, communication, digital and robotics technologies. Lastly, although there was a large response rate (n=791), many universities had difficulty gaining ethics approval and collecting data promptly. It is recommended that university ethics committees consider the challenges of collaborative research and work toward offering minimal review when a host university has received full ethics approval for the same survey data collection on the same type of adult subjects. Future research within this larger research program and research team will explore differences in gender, program type, country and the experiences of teacher educators participating in an unfunded global research program.

Conclusion

This quantitative study explored PSTs' technology proficiency, their stage of technology adoption, qualitative evidence, attitudes toward technology, and TPACK core from a global perspective. If teacher preparation programs are going to be successful in preparing teacher candidates to be effective in the use of technologies in their future classrooms, teacher education programs must gain insights into all potential factors that influence a PST's ability to enter future classrooms prepared to integrate technology effectively in ways that support teaching and learning. Program-level initiatives that provide teacher candidates opportunities and experiences to develop technology proficiency, resulting in improved self-efficacy, will positively impact stages of adoption. It can be seen that the participants consider it more important to integrate technology into the classroom when they are in a real working context with students and other teachers. Therefore, their perceptions are very positive when supported by interest and usefulness in the classroom. They recognize that combining different types of knowledge is essential: pedagogical, technological and content (Koehler & Mishra, 2009). They also emphasize the importance of the course they are studying through the opportunities they are given that will contribute to their own training.

Using adaptable and transferable classroom technology to establish collaborative learning environments, provide experiential learning opportunities, and pursue professional growth will provide teacher candidates with models for their future classrooms. This international data provides a unique and powerful perspective of the ongoing wicked problem of technology integration in teacher education.

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