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Measuring University Teacher Educators' Knowledge and Skills Using TPACK in Teachers Education Programs

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Abstract

This study focuses on the perceptions that teacher educators have of their own effectiveness and capabilities with regard to the integration of technological pedagogical and content knowledge into their courses. To successfully incorporate knowledge, skills and technology into the classroom, educators' need to have a broad base of knowledge and TPACK alludes to this breadth of knowledge. This article examines the various different types of expertise that an educator has to possess in order to successfully incorporate knowledge, skills, and technology into their lessons. In order to accomplish the objective of the research, quantitative research design was employed and teacher educators from public and private universities in Karachi, Pakistan were solicited to take part in a quantitative survey. The data were gathered with the assistance of a modified survey instrument that possesses a high level of reliability and validity. The data were then analyzed with the assistance of Statistical Software for the Social Sciences. The results of the study indicated that teachers' TPACK has a significant impact on the instructional strategies they choose to implement in their classrooms. On the basis of the findings, it is suggested that the TPACK framework be used to improve the curriculum for teacher education, to design learning strategies, to develop the teaching abilities of teachers and in order to effectively implement these strategies in their teaching practices in teacher education programs in Pakistan. This suggestion is based on the fact that the findings indicate that the framework is expedient.

Keywords: University teacher Educators, *Knowledge and Skills*, TPACK, Teacher Education Programs

Introduction

Pakistan's efforts in teacher education over the past two decades have had a major impact on the country's ability to create well-prepared, well-groomed educators who can improve the standard of education for students at all levels. Efforts have also been undertaken to create a high-quality teaching and learning environment for students in the twenty-first century's digital arena, which has its own unique set of issues (Ali, Thomas, & Hamid, 2020). With the support of national and international funding organizations, many new teacher education institutes have been established, and curriculum has been revised to incorporate cutting-edge ideas and methods. However, current systems for training educators are not sufficient to produce the kind of instructors needed to implement these kinds of reforms and upgrades in the classroom (Ali, Ahmad, & Sewani, 2022).

Ali, Thomas and Hamid (2020) expressed that Teachers nowadays are not equipped to deal with the complexities of the modern digital environment. As a result, they are unable to effect meaningful change in their classrooms. These days, students have access to a wide variety of digital tools, but few teachers have a working knowledge of the same tools. This is a missed opportunity, as a teacher is uniquely positioned to effect positive change in the classroom by virtue of his or her extensive knowledge of how to effectively integrate technology into the educational process. Mostly educators well versed with the current trends in technology and effective teaching methods. As a result, they are unable to improve their teaching practices. Therefore, they fall short of the mark of constitutes outstanding instruction and fail to foster the development of the students.

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Researchers have found that our educators, particularly those tasked with using technology in the classroom, are not well-versed in the latest tools and pedagogies. Therefore, it is crucial to learn how they see the role of technology in education (Ali, Busch, Qaisrani, & Rehman, 2020). In Pakistan, there is still a lack of a unified approach to promoting educational innovation (Ali, Thomas, Ahmed, Ahmed, & Ahmed, 2020). It has been observed that teacher education in Pakistan places insufficient emphasis on implementing teaching in actual classrooms, which reduces the number of opportunities that are available to teachers to successfully implement learner-centered pedagogy in their own classrooms. This is a problem because teacher education in Pakistan is intended to prepare teachers to teach in Pakistan. It has been decided to implement a change in the educational system for teachers in Pakistan, and one of the proposed changes is to add practicum. This was done in order to solve the problem.

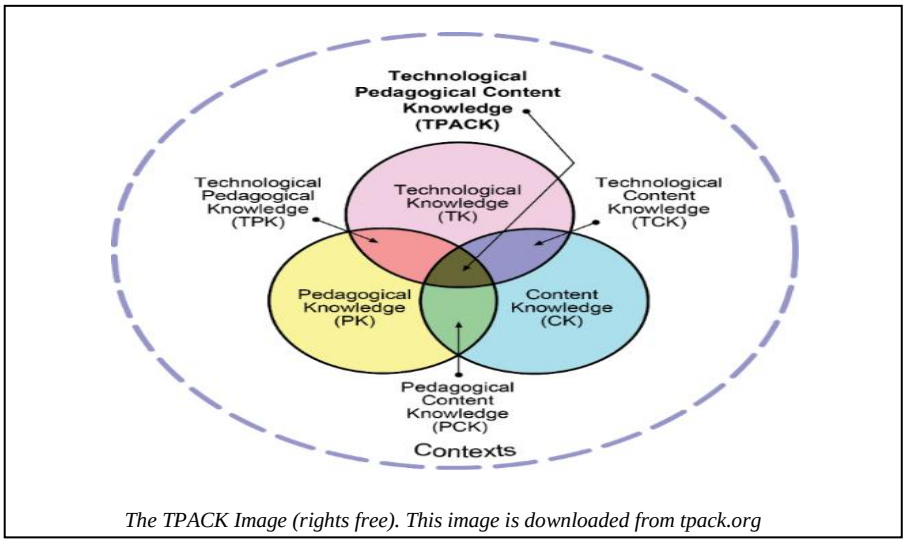
However, authorities have failed to recognize the critical function that teacher educator's play, and as a result, very little action has been taken to improve the effective practices and skills of teacher educators. (Ali, Ahmad & Sewani, 2022). Teacher preparation is at the heart of the issue of incorporating technology into classrooms, which is becoming increasingly urgent in today's schools. To have an impact on teachers' use of technology, teacher educators must consider both the learners' needs and the teachers' existing body of knowledge as practitioners. This will allow the educators to better meet the teachers' informational and practical needs while also encouraging innovative uses of the technology, (Mishra, Koehler, Zellner, & Kereluik, 2012). Effective lesson delivery that makes use of technology is known as "Technological Pedagogical Content Knowledge" (TPACK). It's a great tool for facilitating education in all its many forms, Santos, & Castro, (2021). On the basis of their findings, they advocated for the development of more organized alternative techniques to aid instructors in public schools in implementing 21st-century learning through the incorporation of technology.

Literature Review

Theoretical background and empirical studies

Education is not immune to the pervasive and perilous effects of technology's rapid evolution in the twenty-first century. To improve education under these circumstances, future educators need access and experience with digital learning tools. However, many aspiring educators lack sufficient expertise with technology, making them feel unprepared to integrate it into their own classroom instruction. It is important for instructors to build instructional techniques and skills that are suited to learners in obtaining learning materials using Pedagogy Content Knowledge (PCK) as a means to overcome the constraints of teachers' abilities to integrate technology in learning (Shulman, 1986). PCK especially excels in its ability to comprehend the factors that contribute to the resistance of children to the idea of utilizing learning resources. In light of the context that was described, Shulman (1986) eventually developed alongside the advancement of technology to assist and enhance learning methods in the classroom. Technology, pedagogical, and content knowledge is a concept coined by Koehler and Mishra (2006) to describe the ever-increasing value of technological literacy in the classroom. A teacher's TPACK should include three main areas of expertise: pedagogy, content, and technology. The remaining parts are denoted by the notation (TCK), (PCK), and (TPK), and they act as mutual constraints.

Figure: Mishra and Koehler's TPACK Model



The TPACK Image (rights free). This image is downloaded from tpack.org

Consequently, in order to integrate technology, pedagogy, and materials into the classroom, teachers require a thorough understanding of each of these subfields Koehler, Shin, & Mishra, 2012; Koehler, & Mishra, 2014). Teachers-to-be who have mastered the art of synthesis between pedagogical content knowledge, technology expertise, and subject matter context are more likely to successfully employ TPACK in the classroom Koehler, Mishra, Cain, (2013). They claimed that employing technology in the classroom is challenging. In theory, future educators should be able to juggle multiple TPACK responsibilities at once. Aspiring educators can learn more about research, professional growth for educators, and classroom use of technology by implementing TPACK. Koehler, Mishra, Kereluik, Shin, & Graham, (2014), argue that the pedagogical content knowledge (PCK) approach to technology pedagogical content knowledge (TPACK) is a natural method because teachers' knowledge of how to effectively provide learning materials to students is already well-established. After educators have gained PCK through non-technological means of teacher preparation, they are taught to utilize technology in the classroom for the purpose of enhancing teaching and learning. In the classroom, this strategy has been implemented through the use of activities and approaches such group discussions, field trips, and role play. Harris and Hofer (2009) argue that in education, the subject matter is paramount and that technology is merely a tool to aid in the teaching and learning process. One type of highly applicable professional educational knowledge is teachers' technology, pedagogy, and content knowledge (TPACK), which includes their knowledge of how to integrate technology into the classroom as well as their expertise in a variety of subject areas. The planning done by educators is situational, context-aware, routine, and activity-based; it is an expression of teachers' knowledge in action.

According to Niess, van Zee, & Gillow-Wiles (2010), however, PCK's approach to TPACK has limits, and it is noted that teachers in training may encounter difficulties applying the new technologies that will be utilized to teach their pupils. Because with this strategy, educators should keep improving their TPACK, or "technology, pedagogy, and content knowledge," rather than stopping with merely learning about technology. Teachers should consider the subjects they are teaching their pupils, for example, how they approach and engage their students in social studies versus mathematics. In order for students to gain from classroom learning, teachers must refocus the lesson's objectives, choose a suitable activity and evaluation model for the students, and last, and choose the proper technology. The problem with this strategy is the mental strain placed on students as they attempt to increase their understanding of pedagogy, material, and technology all at once. According to Akyeampong (2017), teacher educators build their practice and vision of successful teaching around the use of teaching and learning resources and step-by-step, collaborative small-group activities. Learner-centered pedagogy, which has wide applicability in the classroom, is something they are unfamiliar with, though. It is also recommended that teachers make time for and have access to professional development programs.

TPACK is a prospective paradigm for comprehending the knowledge teachers need for integrating technology, as stated by Lavidas, Katsidima, Theodoratou, Komis, and Nikolopoulou (2021). They tested the ICT integration knowledge and abilities of 147 Greek preschool instructors currently working in the field. Results showed that educators working with young children have adequate self-efficacy across all seven TPACK domains to successfully implement ICT integration. ICT self-efficacy appears to be explained by age, experience, and degree of education. Implications for teacher preparation programs are discussed in relation to the goal of integrating ICT into classroom activities. According to Zhang and Tang (2021), the acronym TPACK, which stands for technological pedagogical content knowledge, highlights the numerous forms of information that are required for a teacher to have in order to successfully integrate technology into their lessons. After examining the process by which TPACK is developed and the components that make up TPACK, they further highlighted the study investigates the approaches that teachers have utilized in order to develop TPACK and proposed that more research be conducted on the subject-dependent evolution of TPACK on a relatively large scale.

Researchers (Yilmaz, Turkmen, Pedersen, & Huyuguzel Cavas, 2007) looked into elementary pre-service teachers' perceptions of science instruction, examined gender differences in those perceptions, and the data gathering for this study involved two hundred thirteen pre-service primary teachers from three different western universities. According to the study's findings, 20% of Turkish elementary school pre-service teachers saw science teaching as being student-centered, 41% as being

teacher-centered, and 39% as being somewhere in between. These findings raise some critical questions about the preparation of new elementary teachers and the ongoing improvement of teaching techniques. In light of the substantial influence of teachers' pedagogical modelling on new teachers' capability to use technology to help student learning, Voithofer, & Nelson, (2021) performed a study to reply to two related concerns. (A) How are today's teacher educators and teacher preparation programs aiding in the preparation of teachers for the integration of technology? Integrating technological, pedagogical, and content knowledge, TPACK is a complex model. How exactly are teacher educators implementing this? These statements were supported by analyzing quantitative and qualitative survey responses from 843 teacher educators representing approximately half (n = 541) of the authorized teacher education programs in the United States. The findings revealed that pedagogical content knowledge (TPACK) is widely misunderstood, acceptance rates for pedagogical content knowledge are low, and the ways in which TPACK is seen by different stakeholders are rather diverse. This research provides a better understanding of how teacher educators are teaching teachers to use technology to promote student learning in comparison to previous studies.

Ardiç, (2021 stated that secondary education mathematics instructors' confidence in TPACK's technological components as well as their level of technology integration. He enrolled 57 math teachers using a mixed method's convergent parallel design. The majority of teachers incorporated technology into their lessons at the replacement level and were deemed to have a moderate level of self-confidence. Additionally, it was discovered that instructors' TPACK self-confidence levels did not vary in accordance with their amount of technological integration. However, there was a substantial difference in the participants' TPACK self-confidence scores in favor of those who agreed that students should use technology resources in the classroom. Technological Pedagogical Content Knowledge (TPACK) is a set of concepts that can help teachers incorporate technology into their lessons in a way that is pedagogically sound, as noted by research by Karchmer-Klein and Konishi (2021). They used a mixed-methods explanatory sequential study design to inquire into whether or whether and how newly-minted K-12 educators who had also acquired TPACK in the same teacher-training program actually used it in their classrooms. Fifty people were surveyed about their thoughts on incorporating technology in their daily lives. Twenty individuals were interviewed in order to delve more into the survey's findings. There were three major takeaways from this study: (1) participants believed that incorporating technology into their teaching was crucial; (2) there was a discrepancy between teachers' perceptions of the importance of technology-integrated activities and actual integration; and (3) teachers continued to struggle with overcoming barriers to integrating technology into their lessons.

A study by Baran, Canbazoglu Bilici, Albayrak Sari, and Tondeur (2019) looked at how aspiring educators viewed the support they were receiving from their programs to develop their own technology pedagogical subject expertise (TPACK). There were 215 future educators in Turkey who were enrolled in their last year of teacher training who took part in the research. Use of teacher educators as examples, design-based learning, collaborative learning, scaffolding of authentic technology experiences, and continuous feedback were some of the methods considered. The findings supported a positive association between TPACK and effective pedagogical practices in pre-service teacher education. Teacher educators frequently used reflection and teacher educators as role models, and students were encouraged to draw parallels between the two strategies. A critically review study of previous research was conducted by (Tseng, Chai, Tan, & Park, 2022). Their research showed that 51 studies, largely from Asia and the Middle East, peaked in publishing activity in 2015. We divided the 51 articles into four groups: (a) those that investigate TPACK, (b) those that evaluate it, (c) those that build TPACK, and (d) those that use it. To be more specific, research that explored teachers' perceptions of their own TPACK competency varied widely, although all agreed that traditional teacher-centered classrooms made extensive use of technology. This was the case despite the fact that their confidence levels in their TPACK competence varied. Digital technology integration that has any real impact on student learning and teacher practice is chaotic, difficult, and poorly organized.

The interaction between several spheres of teacher expertise is an integral part of the complexity. Diverse students and advanced tools in today's ever-changing classrooms only add to the complexity of the issue. Many future educators lack confidence in their ability to strategically incorporate technology into their classes. With the theoretical framework given by technological pedagogical content knowledge (TPACK), teachers can better understand the many moving parts

involved in incorporating technology into the classroom, (Redmond & Lock, 2019). According to the findings of the research, (Saritepeci, 2021) there is a noticeable correlation between TPACK and the use of technology in the classroom. Roussinos and Jimoyiannis, (2019) investigated that how Greek teachers perceived their knowledge and expertise in relation to integrating ICT into their teaching methods. The findings revealed that the participants seem to think they are knowledgeable about the three key TPACK domains, namely content, pedagogy, and technology. However, the majority of teachers saw them as distinct and were unable to combine their TPACK knowledge in order to create and implement effective lesson plans

Methodology

The quantitative cross-sectional survey technique (Creswell & Creswell, 2017) was utilized to gather data of university teacher educators' through an adapted survey questionnaire Schmidt et, al. (2009). The respondents of the study were picked through convenience sampling technique. The data were analyzed utilizing the Statistical Package for the Social Sciences (SPSS), version 22.

Data analysis and results

Table 1 Gender Distribution

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	189	53.5	53.5	53.5
	Male	164	46.5	46.5	100.0
	Total	353	100.0	100.0	

Table 1 describes the division of data of respondents by their gender. It represents that male respondents 46.5% (n=164) and female are 53.5% (n=189) of total respondents.

Table 2 Gender * Martial Status Cross tabulation

			Marital Status		
			Married	Unmarried	Total
Gender	Female	Count	117	72	189
		% within Gender	61.9%	38.1%	100.0%
	Male	Count	140	24	164
		% within Gender	85.4%	14.6%	100.0%
Total		Count	257	96	353
		% within Gender	72.8%	27.2%	100.0%

Table 2 describes the division of data of participants by their marital status. It shows that female respondents 61.9% (n=117) were married and 38.1% (n=72) were unmarried. It also represents that 85.4% male respondents (n=140) were married and 14.6% (14.6) were unmarried of total respondents in the study. Majority of the respondents 72.8% (257) were married and 27.2% unmarried.

Table 3 Gender * Age Cross tabulation

			Age				
			25-35years	36-45years	46-55years	Above than 55years	Total
Gender	Female	Count	83	66	31	9	189
		% within Gender	43.9%	34.9%	16.4%	4.8%	100.0%
	Male	Count	35	81	37	11	164
		% within Gender	21.3%	49.4%	22.6%	6.7%	100.0%
Total		Count	118	147	68	20	353
		% within Gender	33.4%	41.6%	19.3%	5.7%	100.0%

Table 3 describes the division of data of participants by their age. It represents that age of female respondents 43.9% (n=83) having the age of 25-35 years, 34.9% (n=66) were between 26-45 years, 16.4% (n=31) were 46-55 years age and 4.8% (n=09) were above 55 years age. Age of male participants 21.3% (n=35) having the age of 25-35 years, 49.4% (n=81) have the age of 36-45 years, 22.6% (n=37) having the age of 46-55 years and 6.7% (n=11) were above than 55 years of age. It shows that 33.4% (n=118) were 25-35 years, 49.4% (n=147) were between 36-45 years, 19.3% (n=68) were from 46-55 years and 5.7% (n=20) were above than 55 years age. It represents that majority of the participants 41.6% have the age of 36-45 years in the study.

Table 4 Gender * Experience Cross tabulation

			Experience					
			1-5years	6-10years	11-15years	16-20years	More than 20years	Total
Gender	Female	Count	46	64	40	21	18	189
		% within Gender	24.3%	33.9%	21.2%	11.1%	9.5%	100.0%
	Male	Count	18	47	42	35	22	164
		% within Gender	11.0%	28.7%	25.6%	21.3%	13.4%	100.0%
Total		Count	64	111	82	56	40	353
		% within Gender	18.1%	31.4%	23.2%	15.9%	11.3%	100.0%

Table 4 describes the division of data of participants by their experience. It represents that experience of female respondents 24.3% (n=46) having the experience of 1-5 years, 33.9% (n=64) have the experience of 6-10 years, 21.2% (n=40) were 11-15 years' experience, 11.1% (n=21) having the experience of 16-20 years and 9.5% (n=18) were above 20 years' experience. Male participants experience 11% (n=18) having the 1-5 years of experience, 28.7% (n=47) have the experience of 06-10 years, 25.6% (n=42) having the experience of 11-15 years, 21.3% (n=56) have the experience of 16-20 years and 13.4% (n=40) were above than 20 years of experience. It shows that 18.1% (n=64) were 1-5 years' experience, 31.4% (n=111) were 6-10 years' experience, 23.2% (n=82) were 11-15 years' experience, 15.9% (n=56) were experience of 16-20 years and 11.3% (n=40) were above than 20 years' experience. It represents that majority of the participants 31.4% have the experience of 06-10 years in this study.

Table 5 Gender * Institution Cross tabulation

			Institution		
			Public	Private	Total
Gender	Female	Count	136	53	189
		% within Gender	72.0%	28.0%	100.0%
	Male	Count	137	27	164
		% within Gender	83.5%	16.5%	100.0%
Total		Count	273	80	353
		% within Gender	77.3%	22.7%	100.0%

Table 5 describes the division of data of participants by their institutes. It shows that female respondents from public sector institutes were 72% (n=136) and from private sector institutes were 28% (n=53). While male participants from public sector institutes were 83.5% (n=137) and from private institutes were 16.5% (27). Majority of participants 77.3% (n=273) were from public sector institutes in current research.

Table 6 Gender * Qualification Cross tabulation

			Qualification				
			Masters	MS/M.Phil.	PhD	Others	Total
Gender	Female	Count	117	58	12	2	189
		% within Gender	61.9%	30.7%	6.3%	1.1%	100.0%
	Male	Count	96	48	18	2	164
		% within Gender	58.5%	29.3%	11.0%	1.2%	100.0%
Total		Count	213	106	30	4	353
		% within Gender	60.3%	30.0%	8.5%	1.1%	100.0%

Table 6 describes the division of data of participants by their qualification. It represents that qualification of female participants were 61.9% (n=117) having the masters qualification, 30.7% (58) have MS/M.Phil. Qualification, 6.3% (n=12) have PhD and 1.1% (n=02) have others qualification. While the qualification of male respondents 58.5% (n=96) have master's degree, 29.3% (n=48) were MS/M.Phil. Qualification, 11% (n=18) have the PhD qualification and 1.2% (n=02) have others qualification in this study. It represents that majority of the participants 60.3% (213) have the masters qualification in the study.

Table 7 Gender * Professional Qualification Cross tabulation

			Professional Qualification			
			B.Ed.	M.Ed.	Others	Total
Gender	Female	Count	55	125	9	189
		% within Gender	29.1%	66.1%	4.8%	100.0%
	Male	Count	36	127	1	164
		% within Gender	22.0%	77.4%	0.6%	100.0%

Total	Count	91	252	10	353
	% within Gender	25.8%	71.4%	2.8%	100.0%

Table 7 describes the division of data of respondents by their professional qualification. It represents that professional qualification of female participants were 29.1% (n=55) having the B.Ed. qualification, 66.1% (125) have M.Ed. qualification and 4.8% (n=09) have others qualification. While the professional qualification of male respondents 22% (n=36) have B.Ed. degree, 77.4% (n=127) were M.Ed. degree and 0.6% (n=01) have others qualification in this study. It represents that majority of the participants 71.4% (252) have the M.Ed. qualification in the study.

Table 8 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.424[a]	.179	.177	.38077	2.152

a. Predictors: (Constant), Technology Pedagogy and Content Knowledge (TPACK)

b. Dependent Variable: Effective Teaching Practices

Table shows that TPACK predicts 18% of DV and no issue of auto correlation.

Table 9 ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	11.126	1	11.126	76.736	.000[b]
	Residual	50.890	351	.145		
	Total	62.016	352			

a. Dependent Variable: Teacher Educators Knowledge and Skills(TEKAS)

b. Predictors: (Constant), Technology Pedagogy and Content Knowledge (TPACK)

Table shows that model is fit as Sig value is .000 which is <0.05. Analysis of Variance was used to examine the technology, pedagogy and content knowledge of teachers on their effective teaching practices. According to the results, the TPACK has a significant impact on the teaching practices of school teachers, F (1, 351) =76.736, p (0.000).

Table 10 Coefficients

		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B		Collinearity Statistics	
Model		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	3.314	.123		26.840	.000	3.072	3.557		
	Technology Pedagogy and Content. Knowledge. TPACK	.264	.030	.424	8.760	.000	.205	.323	1.000	1.000

a. Dependent Variable: Teacher Educators Knowledge and Skills(TEKAS)

Table shows that hypothesis is accepted as p value is .000 which is <0.05 and no issue of multicollinearity as VIF is less than 2.

Discussion and conclusion

The results indicates that the majority of respondents of the current research were female 53.5% (n=189) and male respondents were 46.5% (n=164) of total respondents (n=353). Results showed that female respondents 61.9% (n=117) and 85.4% male respondents (n=140) were married. Majority of the respondents 72.8% were married and 27.2% unmarried. The division of data of participants by their age described that majority of the participants 41.6% were between ages of 36-45 and majority of the participants 31.4% have the experience of between 6-10 years in teaching at as a teacher educator. Majority of participants 77.3% were from public sector institutes in current research. Demographic results also showed that female participants were 6.3% (n=12) and male respondents 11% (n=18) have earned Ph.D. degree. Respondents are more likely to rely on their own experience, as well as their technology pedagogical and subject expertise, because of their demographic features. The findings revealed that the TPACK framework is useful for educating about the subject matter of the course. These findings corroborate the findings of Cubeles and Riu (2018), who found that teachers with more experience using technology in the classroom also reported higher levels of self-efficacy. This indicates that student learning in Sindh will increase and teachers will have more faith in their own ability to teach if they are provided with opportunities for professional development to enhance their TPACK.

The results of this study also reveal that teacher educators' technology pedagogical and content knowledge has a large and promising effect on their knowledge and skills, leading to better teaching practices. Table 8 shows that there is no problem with autocorrelation and that TPACK can predict 18% of DV. Table 9 shows that the model is acceptable because the Sig value is less than 0.05. According to Table 10, the hypothesis is supported as the p value is less than 0.05 and there is no evidence of multicollinearity since the value of the variance inflation factor (VIF) is less than 2. The results of this study agree with those of many others from different parts of the world and with different methodologies. Previous research (Mishra & Koehler, 2006; Koehler & Mishra, 2009; Schmidt et al., 2009; Bruce & Chiu, 2015; Harris & Hofer, 2017; Kirikcilar & Yildiz, 2018; Ali, Thomas, Ahmed, Ahmed, & Ahmed, 2020; Ali, Busch, Qaisrani, & Rehman, 2020; Ali, Ahmad & Sewani, 2022) has also found that educators' technological, pedagogical, and content knowledge greatly affect their knowledge and skills in their teaching practices.

Implications for teacher educators' and teacher candidates

Educators can better their own teaching practices and the learning of their students when they are exposed to and trained in all parts of the knowledge framework that allows them to effectively integrate technological pedagogical and content into learning. To better understand how knowledge, teaching skills, and technology can all work together in the classroom, educators can look to the TPACK model. They can help students achieve a deeper mastery of the ways in which technology can be used to improve the quality of instruction across a range of subject areas. Educators can assess how well their students are using the tool and then offer constructive criticism to boost their performance. By incorporating TPACK, both teacher educators and prospective teachers are able to enhance their own cognitive abilities in the classroom. Teachers can aid their students' efforts to improve their academic performance by utilizing creative activities as part of their effective teaching practices, in addition to making the most of the best opportunities for exploration and improving critical thinking. If we want to see students succeed in school, teacher preparation programs, ongoing professional development, and classroom instruction all need to incorporate TPACK.

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