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Investigating Teacher Educators' Perceptions on Technology Integration in Teacher Preparation Programs

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Abstract: *The researchers focus on the TPACK framework, which is used to assess teachers' understanding of how to use technology in the classroom. The goal of the model is to define the skills and knowledge teachers need to effectively integrate technology into their lessons. Teacher educators' can better prepare their students for the problems of the modern world by applying the TPACK. In the Pakistani setting, there is still a lack of technological integration in educational settings. The purpose of this research was to determine how well teacher educators in Karachi, Pakistan, use TPACK and associated domains in their classrooms for the preparation of future teachers. Teacher educators from private teacher education institutions of Karachi were conveniently sampled for this quantitative survey research study. Data was analyzed using SPSS, and the study's measurement and structural models were put through their paces using Smart PLS. It is one of the more sophisticated programs for structural equation modeling that uses partial least squares (PLS-SEM). The study found that teachers educators' technology and technological pedagogical knowledge significantly effects on their TPACK in a positive way. Conclusions and suggestions for further research are provided for implementing the TPACK framework in teacher education programs and designing learning strategies for enhancing instructors' pedagogical skills in light of the study's findings.*

Introduction

The general public tends to believe that a school's educational quality is directly tied to the credentials of its teaching staff and the facilities available to them. How to increase teacher education programs' use of effective teaching techniques is a common issue of discussion among teacher educators, policymakers, and scholars of teacher education in Pakistan. If you want to be a good teacher, you need to focus on more than just one area of knowledge and use technology in all of them (Ali, Busch, Qaisrani, & Rehman, 2020). As Mishra and Koehler (2006) point out, due to the vast diversity of contexts in which teachers must use their knowledge, education is best described as an "ill-structured discipline." Lifelong learning is essential for educators because they operate in situations that are both complicated and dynamic (Koehler & Mishra, 2009). Pakistan faces a significant difficulty in its attempt to provide all of its students with access to a decent education. There is a growing need for market-relevant, job-specific skills, particularly in new economic sectors, but supply gaps in Pakistan's higher education and skills sectors. The world we live in is changing at a dizzying rate; emerging technologies necessitate a drastically altered labor force, and countries must adapt to be competitive in the global economy. If it wants to keep up in the global economy, Pakistan must increase the quality of its education while simultaneously tackling the underlying challenge of increasing access to higher education.

Changes in our educational aims, curricular priorities, and our knowledge of how teachers and students learn and think have all contributed to a deeper understanding of the significance of professional development for educators and the most effective methods for honing their skills and knowledge. The expertise of teachers is essential. Benefits of professional development for educators include improved student outcomes and the development of educators' own expertise in content, pedagogy, and technology (Ali, Thomas, Ahmed, Ahmed, & Ahmed, 2020). They also stressed the importance of providing teachers with training that is both thorough and directly applicable to the subjects they will be teaching while incorporating technology. The most successful ways to assist instructors improve their practice are through professional development events that stress high-quality subject-matter knowledge. There should be more chances for teachers and students to talk about what they're doing and how they're learning in class. Because teachers nowadays need to be as proficient in technology as their students, the value of incorporating it into lessons has increased. Günüç and Kuzu (2014) found that incorporating technology into the classroom increased both student motivation and retention. Successful teachers today understand the significance of integrating technological resources into their curriculum. Among the numerous researcher that explored different dimensions of this form of integration of technology are (Wood & Ashfield, 2008; Ali, Ahmad & Sewani, 2022; Ali, Rehmat Shah, & Ahmad, 2023). It does this by shifting the focus of the educational system to global contexts and giving students access to more information in less time. And if used to get students involved in the learning process, it may be a powerful teaching tool. Incorporating digital technologies like computers into the classroom can significantly improve teaching practices and pedagogy, according to proponents of IT (Collins & Halverson, 2010).

Many of today's teachers feel they are not given enough time or resources to learn how to effectively integrate technology into their lessons. The rapid rate of technological development means that many seasoned educators lack the appropriate training in current tools. Many workshops that aim to address this issue, say Saudelli and Ciampa (2016), focus too much on the technical aspects of technology and not enough on its pedagogical application. Despite the opportunities for pedagogical and content integration, many teachers lack expertise in using technology effectively in the classroom. As Hutchison and Woodward (2014) point out, teachers that rush into incorporating technology into the classroom may have to sacrifice student learning for the sake of efficiency. Teachers still need to be trained on how to use technology effectively in the classroom before introducing it to their students (Pasternak et al., 2016), even though it is largely used as a support for language arts material. In addition, they emphasized the importance of teachers receiving training in the technology's application as well as honing in on the tool's instructional potential. Teachers need not be well-versed in technology because many students acquire their knowledge through collaborative projects and individual study (Zoch, Langston-DeMott, & Adams-Budde, 2016). The candidates enrolled in teacher preparation and professional development programs were found to be more concerned with creating a catalog of digital resources that could be used in the classroom than with honing their skills in using those resources effectively. There needs to be more hands-on experience and opportunities for instructors to work together as part of any technological education program, not less. Schools should prioritize the formation of professional learning communities where teachers can collaborate on the study and implementation of new technologies (Saudelli & Ciampa, 2016), rather than focusing on workshops. Instead of replacing existing training programs, this form of professional development focusing on technological advancements should be added to them.

In today's information-rich, technology-driven culture, the teacher's job has changed from knowledge keeper to coach, mentor, enabler, facilitator, or advisor (Settlage, Odom, & Pedersen, 2004). The role of a teacher is to create a positive learning environment for their students and guide their efforts in the proper directions. Rather than relying entirely on antiquated approaches, educators should be aware of how technological developments might enhance the quality of learning and student outcomes. To be a good teacher, you need to be able to draw on and synthesize knowledge from a wide range of disciplines. Mishra and Koehler (2006) argue that education is poorly organized because it requires the usage of sophisticated knowledge structures in a wide range of contexts. Lifelong learning is essential for educators because they operate in situations that are both complicated and dynamic (Koehler & Mishra, 2009). Therefore, expertise in various areas, including how students think and learn, the subject matter at hand, and the strategies employed to promote student retention, is required. Teachers are the most influential factor in the success or failure of educational technology in the classroom since they have the greatest say over what their pupils learn and how it is implemented (Hite, 2005). Because of their major role in their students' education, teachers must be given the technology literacy to meet the demands of a diverse student body (Uerz, Volman, & Kral, 2018). Teacher educators need to understand more about the root causes of the problem and effective strategies for bridging the gap between what teachers are taught and what they actually practice in the classroom.

The Pedagogical Content Knowledge (PCK) paradigm developed by Shulman (1986) combines' pedagogical knowledge with subject matter knowledge. To discuss how educators put theory into practice while incorporating technology, Koehler and Mishra proposed the Technological Pedagogical and Content Knowledge (TPACK) paradigm. The second chapter will provide an in-depth examination of both of these frameworks. In this study, I investigate how teacher educators are first exposed to the TPACK framework, with the goal of prompting participants to question their own preconceptions and kick starting the process of bridging theory and practice. We will investigate how teacher educators develop a personal vision or justification for teaching even while they do not have direct access to reflecting practices. The technological pedagogical content knowledge (TPACK) framework has evolved as an effective, standard instrument for training teachers for the technology-rich classrooms of the twenty-first century (Harris, Phillips, Koehler, & Rosenberg, 2017). Together with learning by design, which impacts teachers' preexisting knowledge as epistemic resources, the TPACK framework helps instructors build a situated, sophisticated, and integrated understanding of how technology might improve teaching and learning (Koh, Chai, Wong, & Hong, 2015). Design interactions have been identified as a priority area for TPACK research (Boschman, McKenney, & Voogt, 2015; Koh & Chai, 2016) due to their potential to enhance teachers' grasp of design processes and principles.

One paradigm of teacher knowledge, referred to as technology pedagogical and content knowledge (TPACK) (Mishra & Koehler, 2006), has received extensive attention from researchers. In this model, the three traditionally separate spheres of expertise—content, pedagogy, and technology—are integrated. Mishra and Koehler (2006) argue that TPACK provides the basis for sound pedagogical judgment when using technology in the classroom. Studying TPACK has been done in a variety of ways, including through interviews (Harris, Grandgenett, & Hofer, 2012), surveys (Schmidt, Baran, Thompson, Mishra, & Koehler, 2009), and mixed-methods research (Sancar-Tokmak, 2015). The theoretical underpinning of this research was the paradigm developed by Mishra and Koehler (2006) for evaluating educators' technological pedagogical content knowledge (TPACK). Finding out if and how future educators in Karachi, Pakistan are using technology was the focus of this study. The TPACK framework for technological pedagogical content knowledge serves as the theoretical basis for this study. The model makes an effort to describe the data needed by educators to effectively implement technological solutions in the classroom. According to Schmidt et al. (2009), TPACK is based on the premise that teachers need to have a solid understanding of both technology and education in order to effectively integrate it into their classes.

Technological pedagogical content knowledge refers to an educator's familiarity with and skill in using technology in the classroom. Shulman argues that teachers may do the most good for their pupils by drawing on their expertise in both their subject area and pedagogy to create interesting and effective classes. An interdisciplinary body of expertise that goes beyond the traditional TPACK categories of "content," "pedagogy," and "technology." What we need is an understanding that emerges from the interaction of different bodies of knowledge, both theoretically and practically, to develop the malleable knowledge that is necessary for successfully integrating technology into the classroom. Teachers need to be knowledgeable about the topics they teach as well as the ways in which students' understanding of those topics may be impacted by the use of technological resources. These three elements work together to let teachers give classes that help students reach new heights in their technological prowess. As the number of devices and uses for technology in classrooms increases, it is important for educators to grasp how technology might alter both curriculum and pedagogy. This is where the TPACK framework comes in. This study lends credence to the TPACK theory's claim that a teacher's theoretical knowledge of technology might influence how they use technology in the classroom. The results of this research could help administrators in schools determine how well teachers integrate technology into their lessons. Once the most important criteria for increasing teachers' TPACK have been identified, stakeholders in education can tailor strategies to the needs of particular educators.

This research aims to illuminate the relationship between teachers' use of technology in the classroom and their own professional growth and pedagogical expertise. The findings of this study are significant because they provide first-hand accounts from Karachi's teaching faculty regarding the efficacy of professional development and technology pedagogical subject understanding in the city's teacher education programs. That in-service training and teacher education programs in Pakistan have not improved students' learning results sufficiently to warrant the money they have been given is the fundamental argument against them. Teachers' educational backgrounds are important, but they can't be the only factor in explaining students' performance. The success of pupils is impacted by teachers' abilities to effectively incorporate technology into their teachings (Ali, Rehman, & Ullah, 2022). A shortage of teachers with the necessary skills and knowledge to effectively educate today's students is having a negative effect on teacher preparation, professional growth, and, ultimately, student success. Despite having great potential, teachers struggle to innovate their teaching methods and incorporate technology (Ali, Thomas, & Hamid, 2020; Ali, Azam, & Saba, 2023) despite having extensive experience, advanced degrees, and training.

Literature Review

This study is grounded in the theoretical frameworks of Shulman's (1986) and Koehler and Mishra's (2005) PCK extended framework of teacher knowledge (TPACK). There has been a shift in the expectations placed on today's graduating class in terms of their technological and pedagogical content knowledge (TPACK). Historically, pedagogy and content were two separate entities, as Shulman (1986) argues. The absence of pedagogy persisted throughout the late 19th and early 20th centuries, and by the 1980s, content had become secondary. Instead, Shulman put up the idea of "pedagogical content knowledge" (PCK) in 1986. According to Shulman's model, there should be a bridge between instructors' pedagogical and subject knowledge. He argues that the two are inextricably linked, and that the combination of the two is what constitutes a teacher's pedagogical content knowledge. His study includes discussions of both subject-specific and pedagogical/curriculum-specific knowledge.

Theoretical Structure

Koehler and Mishra's (2005) TPACK framework is conceptually similar to Pierson's (2001) approach. They have a holistic perspective on the intersection of technology, learning, and content. To put it another way, Koehler and Mishra's (2005) expansion of Shulman's PCK theory into the technological sphere is a significant step forward. Therefore, one of the modified forms of PCK is the emergence of technological pedagogical content knowledge (TPCK). In order to make the term more easily pronounceable, it was reduced from its original form (Thompson & Mishra, 2007) to TPACK. Koehler and Mishra (2005) look at how instructors can incorporate their technological competence rather than what teachers need to know about technology. Mishra and Koehler (2006) found that the TPACK framework was useful in illuminating the whole cycle of technology integration and identifying key components of teachers' skill in implementing technology in the classroom.

TPACK Underpins this Study

Mishra and Koehler (2006) introduced TPACK as a theoretical framework for studying teachers' knowledge of what's necessary to successfully integrate technology into the classroom. The goal of this method is to highlight the interplay between CK, PK, and TK. Each of these three areas of study informs and enriches the others. This idea consists of seven parts. "Technology knowledge" (TK) encompasses familiarity with a wide range of technological systems, from the analogue (radio and television) to the digital (the internet, digital video, interactive whiteboards, and computer programs)."Content Knowledge" (CK) refers to familiarity with the subject matter being taught or studied (Mishra & Koehler, 2006). Teachers must be well-versed in the topics they intend to cover and have an appreciation for the differences between the methods appropriate for teaching various fields of expertise. Knowing how to teach: Having pedagogical competence is being able to effectively manage a classroom, evaluate students' progress, design engaging lessons, and help their students learn. Knowledge of a subject that is useful for teaching is known as pedagogical content knowledge (PCK) (Shulman, 1986). Pedagogical content knowledge is domain-specific and serves to improve subject-area teaching techniques. We refer to this as "technological content knowledge" (TCK), which is the understanding of how technology can be utilized to create new forms of content representation. It indicates that teachers are cognizant of how a specific technological resource can influence their pupils' methods of learning in a specific subject area. TCK is the result of the convergence of PCK, TPK, and TCK. This paradigm is based on the nexus of three types of expertise: technological, pedagogical, and content. The ideas presented by Shulman (1986) are developed further in this model. Teachers' familiarity with and ease with the ways in which technology could affect their own teaching practices is referred to as "technological pedagogical knowledge" (TPK). Educators in any field require TPACK to successfully integrate technology into their lessons. This research is limited to the TPACK's technological components. Teachers have an intuitive understanding of the interconnected nature of TK, TPK, and TPACK, and it is their responsibility to instill this knowledge in their students through the use of appropriate pedagogical tactics and technology resources in the classroom.

Relationships of variables and theoretical background followed by the hypothesis.

Variable: 1 Technological Knowledge and TPACK

Because of this ongoing change, technological knowledge (TK) is notoriously elusive (Harris, et al., 2009). However, Koehler and Mishra (2005) argue that the term "technology" includes not only modern developments like computers and the internet, but also more traditional resources like books and the blackboard. When we say that someone has "technological knowledge," we imply that they are well-versed in the use of anything from pencils and paper to 3D printers and interactive whiteboards (Schmidt, et al., 2009a). This also includes the knowledge and skills required to install, configure, and decommission hardware and software (Mishra & Koehler, 2006). Technical competence in using and altering computer programs and hardware to achieve a purpose is what "technical knowledge" (TK) refers to, as defined by Cox (2008). Technology can be altered or eliminated outright, according to Mishra and Koehler (2006). Educators should prioritize skill development in areas like learning new technology and adapting them to the classroom. Knowledge of current learning resources like computers and the Internet is what is meant by "technological knowledge" here.

H⊠: There is a statistically significant relationship between teacher educator's technological knowledge and TPACK.

Variable: 2 Technological Pedagogical Knowledge and TPACK

Knowledge of how technology influences classroom learning and teaching practices is what is meant by "Technological Pedagogical Content Knowledge" (Koehler & Mishra, 2009). Teachers with a Proficient Knowledge of Technology (TPK) are those who understand how to best incorporate technological tools into the classroom. (Koehler & Mishra, 2009) TPK is the area where TK and PK intersect. It may also entail gaining an understanding of how to optimize the use of technical tools for pedagogical ends. The definition of TPK offered by McCormick and Thomann (2007) is "the teaching of technology and its application." Simply expressed, technology proficiency in the classroom (TPK) refers to a teacher's ease and experience with implementing various forms of technological training. To be an effective educator, one must be familiar with teaching methods and know when to limit one's usage of technology so as to concentrate on instructional tactics and design (Harris, et al., 2009). In addition, TPK combines instructors' knowledge of the benefits and drawbacks of the many instructional technologies at their disposal, as noted by Cox (2008). TPK is crucial for teachers because mainstream applications like Microsoft Office, blogs, and podcasts are not created with teaching in mind. Therefore, teachers should investigate how to effectively leverage technology in the classroom. TPK among educators is a critical factor in the effectiveness of this adaptation (Koehler & Mishra, 2009). Koehler and Mishra (2008) claim that TPK can help build creative flexibility with accessible resources, allowing for the re-design of these programs for specific instructional aims.

Since TK is always developing, keeping up with it is challenging.

H⊠: There is a statistically significant relationship between teacher educator's technological pedagogical knowledge and TPACK.

Variable: 3 Technological Pedagogical and Content Knowledge

"Technological Pedagogical and Content Knowledge" is how Mishra and Kohler (2006) described the interplay of these three fields of knowledge. Information about how to use technology in a content area, including suitable pedagogical approaches and technologies, stands apart from the three core knowledge categories (Schmidt, et al., 2009). To reiterate, teachers with TPACK know how to employ digital resources to improve student performance (Koehler & Mishra, 2008). TPACK, as defined by Mishra and Koehler (2006), is the foundation of effective technology-based teaching because it includes knowledge of what makes concepts easy or hard to learn, how technology can help students solve some of their problems, and students' prior knowledge and epistemology. Cox (2008) defines TPACK as "a way of thinking about the dynamic relationships between technology, pedagogy, and subject matter" to improve students' knowledge of a topic using technology.

Methodology

We used a questionnaire-based survey study design with convenient sampling, and our research was quantitative in nature (Creswell, 2014). The adapted scale (Schmidt, et al., 2009) was used to three areas of expertise: TK, TPK and TPACK. The targeted population was teacher educators' from private teacher education institutes of Karachi. We employed a 5-point Likert scale, with 1 representing strongly disagreed and 5 representing strongly agreed, with each scale generated by its own set of statements. The researchers briefed the subjects on ethical considerations and informed consent laws, privacy and confidentiality. It was also made clear that participants might stop participating in the study at any time if they wished. Additionally, the respondents were reassured that no one would be able to identify them or find them using the information they provided.

Data Analysis and Results

Structure Equation Modeling

Researchers used SEM for data analysis with its various benefits, SEM has become a popular data analysis tool in a variety of academic disciplines. In the first place, it is possible to limit the impact of any errant measurements. Furthermore, it is simple to implement mediating variables. To conclude, the theoretical model can be statistically evaluated (Hong, 2000).

Measurement Model

The measurement model evaluation justifies latent variable identification. Kim et al. (2015) suggested more detailed reporting on measurement model validity. Factor loadings, standardized estimates, p-values, and squared multiple correlations (SMC) are shown for the measurement model. Any evidence of a link between measurement error sources should also be supplied. While assessing the constructs and measurement model, reliability and validity were emphasized. Reliability is determined by build internal consistency. A measurement must produce consistent results in same situations to be reliable. SMART-PLS dependability is measured using Cronbach's Alpha and Composite dependability. The reporting measurement model's Factor Loading was analyzed first. An item's factor loading shows its concept representation. While Vinzi, Chin, Henseler, & Wang (2010) recommend a factor loading of at least 0.70, social science researchers generally discover lower outer loadings (0.70). Don't get rid of the item if the loading is under.70. Instead, they examined the model and deleted data points to see whether they could significantly improve Composite Reliability and AVE. Cronbach's Alpha, Composite Reliability, Validity, and Factor Loading were reported by the measurement model. Examine a scale's construct measurement to establish validity. Convergent and Discriminant Validity are needed to evaluate concept validity. Convergent validity occurs when a measure's items represent the underlying construct. Statistically, convergent validity is shown when the average variance extracted (AVE) is larger than 0.50. Factor loadings also examine the measurement model's convergent validity, which requires that observed variables describing the same latent variable be highly correlated. Empirical perspectives on standard-estimated factor loadings abound. Any score above 0.5 is good, and anything above 0.7 is great. A large modification index should also be examined and reported on in the measurement model section. Observable variables used to create latent variables must be distinct to support the measurement model's discriminant validity. Therefore, a high modification index for the measurement model indicates discriminant validity issues. We can determine the study's constructs' uniqueness by establishing discriminant validity. It shows that the study's constructs are not associated. The Fornell and Larcker Criterion, Cross Loadings, and Heterotrait-Monotrait (HTMT) Ratio establish discriminant validity in SMART-PLS. According to measurement model analysis, Table 1–5 reveals that all quality constructs met or surpassed their thresholds. Cronbach's alpha, composite reliability, and AVE coefficients showed that all latent constructs in this study were reliable. The study's construct reliability and validity tests showed convergent validity, discriminant validity according to the Fornell and Larcker (1981) criterion, and VIF outer values less than 3, indicating no collinearity among construct items.

Table 1

Construct reliability and validity

Constructs	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
TK	0.719	0.752	0.823	0.541
TPACK	0.765	0.766	0.851	0.590
TPK	0.864	0.876	0.893	0.512

Table 2

Outer loadings

Items of the Constructs	TK	TPACK	TPK
TK_2	0.806		
TK_3	0.815		
TK_5	0.685		
TK_6	0.617		
TPACK_1		0.731	
TPACK_2		0.837	
TPACK_3		0.687	
TPACK_4		0.807	
TPK_1			0.782
TPK_2			0.769
TPK_3			0.719
TPK_4			0.732
TPK_5			0.715
TPK_6			0.619
TPK_8			0.611
TPK_9			0.756

Table 3

Discriminant Validity

Fornell-Larcker Criterion

Constructs	TK	TPACK	TPK
TK	0.735		
TPACK	0.570	0.768	
TPK	0.480	0.620	0.715

Table 4

Heterotrait-Monotrait Ratio (HTMT)

Constructs	TK	TPACK	TPK
TK			
TPACK	0.748		
TPK	0.597	0.732	

Table 5

Collinearity Statistics (VIF)

Outer VIF values

Items of the Constructs	VIF
TK_2	1.511
TK_3	1.581
TK_5	1.358
TK_6	1.276
TPACK_1	1.412
TPACK_2	1.906
TPACK_3	1.288
TPACK_4	1.803
TPK_1	2.018
TPK_2	2.142
TPK_3	1.769
TPK_4	1.799
TPK_5	1.847
TPK_6	1.616
TPK_8	1.339
TPK_9	1.725

Estimates of Structural Model

Structural models are used to analyze the connections between different factors. Only two indirect relationships (TK and TPK) and one direct relationship (TPACK) were found in this analysis. Both hypotheses were supported by the data, and as can be shown in (table 7), (H_1) TK and (H_2) TPK have a positive and substantial effect on TPACK. Using R Square statistics, one can learn how much of an endogenous variable's variance can be attributed to an exogenous one. According to Falk and Miller (1992), an endogenous construct's R^2 value must be more than or equal to 0.10 for the amount of variance it explains to be considered satisfactory. The following criteria are used to evaluate R^2 values for endogenous latent variables, as proposed by Cohen (1988). Strength scale: 0.26 (very strong), 0.13 (moderate), 0.02 (weak). R^2 values of 0.67 (substantial), 0.33 (moderate), and 0.19 (poor) were proposed by Chin (1998) for endogenous latent variables. According to academic studies examining marketing-related topics, R^2 values of 0.75, 0.50, or 0.25 for endogenous latent variables can, roughly speaking, be regarded as large, moderate, or weak. In this study R^2= 0.480, which is moderate according to chin (1998). Multiple other factors may have an impact on or influence one particular variable in a structural model. The elimination of an external factor can have an impact on the dependent variable. The F-Square statistic measures how much the R-Square value shifts when an exogenous variable is taken out of the equation. Effect size is measured by the F-squared statistic, which ranges from small (>=0.02) to medium (0.15–0.35) to large (0.35–1.0). The F-Square results are medium to moderate which are mentioned in (table 6). Predictive relevance, quantified by the Q-square statistic (> 0 is good), indicates how well a model can forecast the future. The usefulness of the endogenous constructs for prediction is also established in Q^2. If your Q-square is greater than zero, it means that your values have been successfully reconstructed and that the model has predictive value. Predictive value is indicated when Q^2 is greater than 0. Researchers examined the results of the Q-square=0.269, which means Predictive value is good and achieved, as shown in (table 7) after running the Blindfolding method in SMART-PLS.

Table 6

Path Coefficients

Mean, STDEV, T-Values, P-Values

Hypothesis	Original Sample	Sample Mean	Standard Deviation	T Statistics	F^2	P Values	Decision
TK -> TPACK	0.354	0.356	0.062	5.743	0.185	0.000	Supported
TPK-> TPACK	0.450	0.452	0.060	7.497	0.300	0.000	Supported

Table 7

R square and Q Square

	R Square	R Square Adjusted	Q Square
TPACK	0.480	0.476	0.269

Figure 1

Algorithm

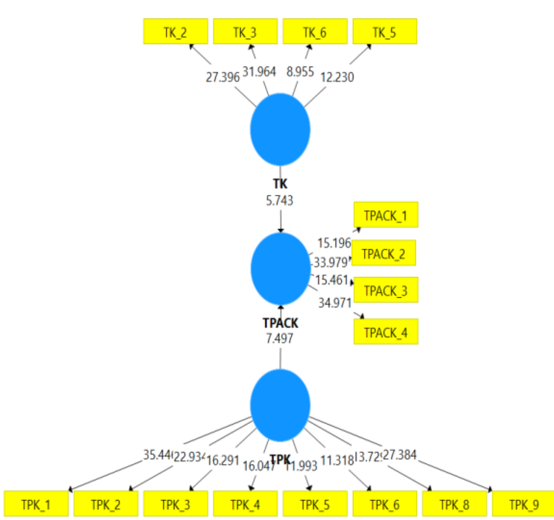


Figure 2

Bootstrapping

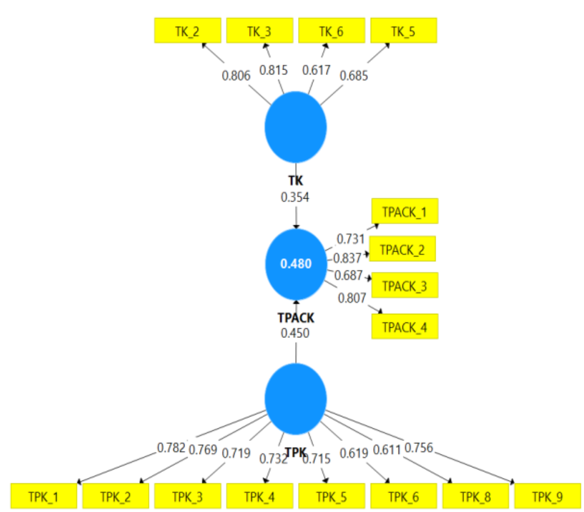
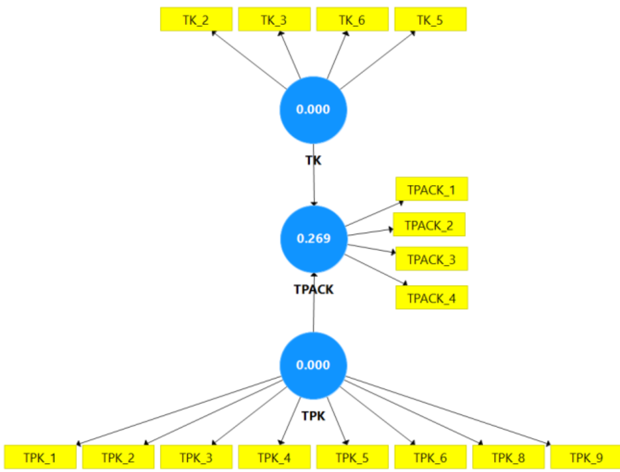


Figure 3
Blind Folding



Discussion

The goal of the research was to find out how teacher educators feel their use of technology in the classrooms where they train future teachers helps generate better teachers who are prepared to handle the challenges of the twenty-first century. According to the findings of this study, the incorporation of technology by teachers into their classroom instruction has a significant and favorable effect on student learning in teacher-training programs. The measurement model analysis shows that all of the quality constructs are at or above their targets. Cronbach's alpha and composite reliability both suggest that all of the latent constructs in this study are highly reliable, and the AVE coefficients for all of these constructs are higher than the minimums specified. Convergent validity has been established based on the results of the study's reliability and validity tests; discriminant validity has been established based on the Fornell and Larcker (1981) criterion; and VIF outer values are less than 3, indicating that there is no collinearity problem between the items of the constructs. Relationships between variables can be examined with the help of structural models. This analysis uncovered just one direct relationship (TPACK) and two indirect relationships (TK, TPK). The data also showed that (H_1) TK and (H_2) TPK have a positive and substantial effect on TPACK (table 6). In addition, values for R-squared, F-squared, and Q-squared are determined; these statistics have a moderate effect size. The study's findings were aimed to aid teacher educators in developing pedagogical strategies, lesson plans, and technological inclusion by illuminating potential sources of support. This was done to generate and grow better instructors with optimal classroom practices, which is the ultimate purpose of quality education in Pakistan. Those in charge of policymaking and curriculum creation were among those intended recipients of the data. The results of this research are meant to provide Pakistani policymakers and administrators with some foundational knowledge as they deliberate how best to incorporate technological learning into preexisting teacher training and education programs.

Future teachers in Pakistan will be impacted by these decisions about the integration of technology into teacher education. The findings may, for instance, help policymakers as they formulate an initial strategy for introducing technology into Pakistan's educational system, with the ultimate aim of enhancing both student learning and educators' familiarity and comfort with technological resources. In addition, the data showed whether the time and effort necessary for training and implementation were comparable for technical and nontechnical academic disciplines. At the end of this study, we hoped that students would have a better understanding of the importance of judicious use of technology in the classroom. Participants in this course will have the opportunity to reflect on their own TPACK knowledge and skills, as well as contribute to the revision of national standards for teacher education. Given the dearth of studies examining either the education system in Pakistan or the incorporation of technology into teacher preparation, the present study is an important first step. Research findings are more easily compared when studies use the same measurement criteria. Educators gain from research-based practice enhancements because they are exposed to novel, well-tested methods. Teachers can then judge the viability of these strategies and how best to apply them in their own classrooms. Scientists are included in policymaking processes. Research is beneficial not just for educators, whose work is informed by it, but also for policymakers and administrators, who get access to evidence on which to base crucial decisions.

Conclusion

The study examined teacher educators' views on using technology in their classrooms to prepare 21st-century teachers. In teacher preparation programs, technological integration has a favorable impact. According to measurement model analysis, all quality constructs met or surpassed their thresholds. This study's latent constructs had strong Cronbach's alpha and composite reliability, and their AVE coefficients exceeded the standards. The construct reliability and validity tests showed convergent validity, discriminant validity according to the Fornell and Larcker (1981) criterion, and VIF outer values less than 3, indicating no collinearity among construct items. Structural models analyze factor relationships. This study discovered two direct correlations (TK and TPK) on (TPACK). As demonstrated in table 6, TK and TPK positively and significantly affect TPACK. R-square, F-square, and Q-square values also had moderate impact. The study's findings were intended to help teacher educators with their pedagogical practices, lesson plans, and technological integration by identifying resources and support. To boost student learning in Pakistan, better teachers with optimal classroom practices were trained. Data was to be shared with policymakers and curriculum developers. This study could help Pakistani politicians and administrators decide how to integrate technological learning into teacher training and education programs. These decisions determine how Pakistani teacher training programs incorporate technology and how they build their curricula. The results could help authorities develop an initial plan to integrate technology into Pakistan's educational system to improve classroom instruction and instructors' digital literacy. The data showed if training and implementation for technical and nontechnical academic courses were equivalent in difficulty and time commitment or if they required different amounts of work and concentration. After the study, participants should have a greater appreciation for smart classroom technology utilization. This course allows teachers to assess their TPACK abilities and knowledge and revise their country's teacher preparation standards. The present study provides a foundation for future research on Pakistan's education system and technology in teacher education due to the lack of prior research. Studies that use the same measurement standard add more knowledge to this field. Research-based practice improvements expose educators to cutting-edge concepts that have been tested elsewhere. These concepts can then be evaluated by educators to establish their applicability. Scientists influence policy. Research informs educators' practice and gives policymakers and administrators data to make important decisions.

Recommendations

TPACK must be integrated into the rudimentary components of teacher education programs. Students need to be taught in a constructive manner utilizing the appropriate technology, which is why this topic needs to be introduced into the curriculum. The ultimate purpose of teaching is to promote student learning, hence it is important that TPACK be processed in a way that facilitates this. Additional study in both urban and rural settings, as well as the public and commercial sectors, is required to analyze various contextual difficulties that may develop during the process of putting TPACK into practice.

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