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ASSESSING TPACK COMPETENCE AMONG SECONDARY ENGLISH TEACHERS TRAINED UNDER THE SECONDARY SCHOOLS EDUCATION IMPROVEMENT PROJECT IN SINDH, PAKISTAN

Assan Das [*1], Prof. Dr. Amjad Ali Arain[*2]

[*1]*Ph.D Scholar at Department of Education, Government College University Hyderabad (GCUH)*
[*2]*Professor at Department of Education, Government College University Hyderabad (GCUH)*

[*1]assanumedani@gmail.com [*2]dr.amjad@gcuh.edu.pk

Corresponding Author: *
Assan Das, Prof. Dr. Amjad Ali Arain
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ABSTRACT

Technology usage in learning of English language is an integral part of quality education and teacher training. The aim of this study is to examine the Technological Pedagogical and Content Knowledge (TPACK) of Secondary School Education Improvement Project (SSEIP) trained English language teachers in Sindh, Pakistan. In particular, the study analyzed the teachers' competence in all seven TPACK elements, examined correlations among the TPACK elements. A quantitative cross sectional survey design was used. The target population of this study is trained secondary school English teachers. Among the target population 110 secondary school English teachers who attended SSEIP training were selected through random sampling. A structured questionnaire consisting of seven components of TPACK were administered. In this way, data were collected through google forms. Then, using descriptive and inferential statistics data were analyzed. The results indicate that the teachers possessed moderate to high level of competence in each of the TPACK component with the highest mean score in the domain of Pedagogical Knowledge. All TPACK components showed significant positive correlation with each other. The study concludes that the teachers who participated in the SSEIP have significant level of TPACK competence and suggests that continuous, technology-focused professional development is essential for enhancing the capacity of teachers to utilize technology effectively in teaching the English language. The results also have important implications for training of teachers, educational policy, and future teacher professional development programs in Pakistan.

Key words: *Technological, Pedagogical and Content Knowledge (TPACK), Technology integration, English Language teachers, Secondary Schools Education Improvement Project (SSEIP), Secondary Schools*

Introduction

In the 21st century incorporation of Technology has significantly revolutionized the pedagogical approaches in education. Nowadays, teacher professionalism demands the competency to incorporate the technology in teaching and learning effectively (Sukarni et al., 2025). For secondary English language teachers, the need to adjust to this basic change has become more essential as they must learn both language content and the modern approaches to teaching languages. Furthermore, in today's world, educational systems are increasingly demanding teachers to apply technology in classrooms in a manner that

helps to increase learners' engagement, foster higher order thinking, and boost learning. Nevertheless, usefulness of integration of technology, relies much on the ability of teachers to integrate technological tools, as it does on the availability of technological resources. So, incorporation of the technological tools with the right pedagogical strategies and knowledge is essential. Thus, teachers' professional competence is a significant determinant for successful technology-integrated teaching and learning. On the basis of this, the professional competency of the teachers has become important factor in influencing successful technology-integrated educational process (Voogt et al., 2013; Koehler et al., 2013).

It is consistently proven that technology alone can't enhance the quality of education. Instead, quality education is possible when teachers have the knowledge to make evidence based decisions regarding the usage of technology, how to integrate this, to achieve the goals of curriculum and how to use pedagogical strategies with technology to enhance students learning. This perspective contrasts with a technology-centered model toward teacher-led vision of educational innovation, which emphasizes the role of teachers' for creating effective learning opportunities from technological resources. This has made it a key issue in educational research and teacher training to understand what knowledge is essential to make successful technology integration (Koehler et al.,2013; Voogt et al., 2013).

Especially in language education, with technology innovations that have opened up new ways to communicate, collaborate, and engage in real-world learning experiences, the importance of TPACK has become clearer. As the usage of technology in English as a Foreign Language classroom has become more common, teachers are using multimedia applications, digital storytelling, online discussion forums, language learning applications, virtual classrooms, artificial intelligence writing applications, and learning management systems to assist with language learning. But for effective integration of technology only technical skills aren't sufficient. Most importantly, teachers must have knowledge to use digital resources to achieve specific language learning goals, to complement communicative teaching strategies and to address learners' language needs. Therefore, it is necessary to align English language with TPACK competence so that language learning can be enhanced and improved. There are several studies which indicate the positive correlation between TPACK competencies and practices of integration of technology. It reveals that those teachers who possess higher level of TPACK tend to create student-centered learning environments, using technology to facilitate collaboration and critical thinking, and modifying digital resources for learners as needed. In Pakistan, the integration of ICTs in education has also been identified as one of the important strategies to achieve quality education. Sindh is Pakistan's second largest province with unique problems of education system. The Government of Sindh started the Secondary Schools Education Improvement Project (SSEIP) under the School Education and Literacy Department (SELD) with financial and technical assistance from Asian Development Bank (ADB). In 2020, this project was approved by the Government of Pakistan with several interventions to support the inclusion and quality of secondary education in Sindh, such as upgrading the primary schools to become secondary, improving science laboratory facilities, transforming the examination system, and improving professional capacities of teachers. The key aspect of the project is the training of 2,630 secondary school teachers in five key subjects namely: English, Mathematics, Physics, Chemistry and Biology. This initiative encompasses designing content for training and mentoring of teachers and creating assessment methodologies to improve teaching and learning. Owing to these measures taken, this study, hence attempts to find out the TPACK level among secondary school English teachers trained under Secondary Schools Education Improvement Project in Sindh.

Problem statement

Digital technologies are now a key element in supporting all learning and teaching activities across educational systems around the world.

However, evidences indicate that the successful usage of technologies in education is more about ability of teachers to combine technology with necessary pedagogical practices and subject matter expertise (Mishra & Koehler, 2006; Koehler et al., 2013; Voogt et al., 2013). There are several studies which reflect the level of inconsistencies among teachers regarding their subject knowledge, methods of teaching along with technology. These changing levels are potential barrier in the incorporation of technology in classes by teachers (Schmid et al., 2021; Wang et al., 2018). In Pakistan, integration of technology in education is an emerging policy goal to enhance educational quality. Reforms at national and provincial level are constantly undertaken to improve the professional competencies of teachers, which will consequently improve overall standards of teaching, ultimately enhance learning of students. There are an increasing evidences of global studies on TPACK, however, sufficient gaps exist in the present research in the context of Pakistan. One of the limitations of the existing studies is that most of them have been conducted at pre-service teachers or university faculty. However, little research was carried out regarding examination of reforms related to curriculum in government secondary schools on in service teachers. Second, owing to the growing demands of technology based language teaching, there are limited empirical studies on English language teachers. Thirdly, relationship among the components of TPACK wasn't conducted. Therefore, this study is designed to address these gaps. Furthermore, results will inform the SSEIP's effectiveness of its teacher capacity building initiative, and give concrete suggestions for enhancing teacher professional development initiatives, technology integration plans, and education policy in Pakistan.

Research objectives

Following are the objectives of the research.

1. To determine the existing levels of self-reported TPACK competence among trained secondary English teachers
2. To investigate significant difference in Teachers TPACK levels on the basis of their teaching experience, academic qualification and access to ICT
3. To explore the inter-relations among seven TPACK constructs and determine which of the components is most strongly correlates with the overall score of TPACK

Null Hypotheses (H_0)

H_{01}: There is no statistically significant difference between Teaching experience and overall TPACK score.

H_{02}: There is no statistically significant difference between teachers' overall TPACK score on the basis of academic qualification.

H_{03}: There is no statistically significant difference in teachers overall TPACK score on the basis of access to ICT facilities.

Significance of this study

Digital technologies have been integrated in the field of education across globe and this incorporation of technologies in school education is an important policy priority. However, the educational value of technologies is largely determined by abilities of teachers to use tools related to technology and embed them within subject matter and teaching methods knowledge (Mishra & Koehler, 2006; Koehler et al., 2013; Ertmer & Ottenbreit-Leftwich, 2010). Therefore, the study of teachers' knowledge of subject matter, methods of teaching and appropriate Technology is gaining increasing significance for teachers because teachers can align subject matter with right teaching methodology and technology through TPACK model. In this context present study has theoretical, empirical, practical and policy level significance.

Theoretically, the study adds to the currently available literature in the area of TPACK by investigating its applicability in the perspective of Secondary Schools English Language Teachers who participated in the Secondary Schools Education Improvement Project (SSEIP) in Sindh, Pakistan. The study's analysis of teachers' technological pedagogical competencies in relation to a provincial educational reform initiative offers context-specific evidence that helps to move the global conversation on TPACK

into new educational contexts. The study is also of theoretical importance because it looks at the ways the seven TPACK domains are related to each other, as opposed to technological competence being a stand-alone construct. Integration of technology becomes effective when there is an interaction between subject matter, knowledge of methods of teaching and technology (Mishra and Koehler, 2006). The interrelationships among these constructs offer empirical validation of the TPACK's multidimensional nature and help continue the discourse on the conceptual validity of TPACK. Such evidence is especially significant since researchers are still studying.

Empirically, the study fills some significant gaps in the existing literature in the context of Pakistan. However, previous research in the area of TPACK in Pakistan was mostly conducted on prospective teachers or faculty of Higher Education Institutions, and little research was carried out on practicing secondary English teachers in government schools.

This study represents a piece of evidence that can be used to evaluate teachers from the Secondary Schools Education Improvement Project (SSEIP) to help School Education and Literacy Department as well as development partners to determine the effectiveness of current professional development strategies. The results may help inform evidence-based decisions on future investments in ICT integration, teacher preparation in ICTs, and curriculum changes.

The findings of the study are meaningful for teachers, school leaders, teacher trainers, curriculum developers, and administrators. Moreover, these results will report and identify strengths and weaknesses across the seven TPACK domains for classroom teachers so that they can identify the areas that need additional professional development. The evidence could facilitate reflective practice and lead to better incorporation of digital technologies into learning of English language.

Moreover, the study adds to the international debate about the digital transformation in education. The enhancement of digital skills among teachers' is a priority for achievement of equitable, inclusive and high-quality education in the 21st century, as expressed by UNESCO, OECD and other international organizations (UNESCO, 2019; OECD, 2021).

Finally, this study provides an empirical information from a developing country, and thus contributes to the understanding of how teacher professional development programs can enhance digital teaching competence in resource-limited educational settings. In sum, the meaning of this work transcends the scope of evaluating teachers' technological skills. The study offers theoretically informed, empirical evidence, and policy recommendations relevant to teacher educators, teacher professional development, and educational policy that address the TPACK competencies of secondary English teachers trained under SSEIP. The results of this research are likely to help in the continuous process of enhancing the incorporation of technology and quality of English language teaching in Sindh.

Literature review

Theoretical basis of TPACK Framework

A TPACK model explains an interaction among three domains of knowledge: subject matter, teaching methodology and technology. It adopts the concept of pedagogical content knowledge (PCK) from Lee Shulman (1986, 1987) and incorporates technology knowledge. The development of TPACK is an integral perspective of effective usage of technology in teaching (Koehler et al., 2013). This theoretical underpinning came from the realization that meaningful incorporation of technology in education is far beyond the mere application of technology to existing pedagogies. However, it involves a comprehensive knowledge about domains of technology, teaching methods and subject knowledge.

TPACK framework, is an important theoretical model for the professional development programs regarding the integration of technology. On the basis of this perspective, it is inferred that this framework is useful as a theory reference for how effective the incorporation of technology has been in the educational process and how it has transformed the overall scenario of education. This framework has been practiced in various

educational settings and disciplines, and is now a recommended theory for prospective and practicing teachers' education programs worldwide.

Components of TPACK Framework

There are seven domains of TPACK model. They are interconnected and form a total teacher's competence in technology-integrated teaching. This framework states that effective integration of technology demands that a teacher must have the knowledge and proficiency in all seven elements of this framework (Ngu et al., 2022).

This model has significant relevance in the field of educational technology research. Voogt et al. (2013) carried out a systematic review of 55 empirical studies to come up with a comprehensive conceptual framework for teachers' incorporation of technology in education. However, there were also a number of methodological issues that were identified, such as inconsistencies in the assessment of TPACK, differences in TPACK conceptualization and the lack of evidence for the provision of TPACK through teacher education development programs. The results of this study prompted significant research both nationally and internationally focused on enhancing the tools used to measure TPACK and investigating contextual influences on teachers' technological capabilities.

Recently, Schmid et al. (2021) designed and tested the TPACK.xs instrument and found empirical evidence in support of the multidimensionality of the TPACK framework. Their research revealed that the seven TPACK domains are not separable but are also highly interrelated aspects of teachers' professional knowledge. The study also confirmed that technological knowledge was not the only dimension to be understood when speaking about Technological Integration Competence, but it was rather a complex construct which is influenced by several dimensions.

Research studies highlighted the inter-relationship between TPACK and teacher professional development. Petko (2020) claimed that pedagogical beliefs held by teachers had a great impact on how technological knowledge was put into practice inside the classrooms. Likewise, recent study indicates that increased level of teachers' TPACK knowledge is best achieved through ongoing professional development and learning activities that include collaborative lesson planning, testing in the classroom, reflective practice, and authentic classroom problem solving in learning, as opposed to stand-alone ICT professional development courses.

TPACK for ELT (English language teaching)

With fast-paced evolution of digital technologies, English language teaching (ELT) has been greatly transformed, providing opportunities for new and more interactive, student-centered, and communicative approaches to teaching English. The usage of modern application of technology like learning management systems, collaboration through online platforms, mobile applications, virtual classrooms, AI writing tools, digital storytelling software, and multimedia resources has broadened the scope for the teaching and learning of English language skills. Nevertheless, successful use of these technologies, will not only require teachers' knowledge but also skills to align technologies with the linguistic goals and pedagogical methods. In this way, TPACK model has emerged as highly effective model for developing the competence of English language teachers in equipping them with technology in their teaching (Mishra & Koehler, 2006).

The teaching of English language has different approach because it involves four interrelated skills of language. This demonstrate that language teacher should select specific digital tools to assist and equip the learners in getting desired goals of learning. Moreover, there are several research studies which indicate that teaching English with high TPACK is correlated with the usage of technology, communicative teaching methods, and creation of engaging activities. Bostancioglu and Handley (2018) designed a valid instrument of TPACK for English language teachers in one of the first subject-specific TPACK research studies. The findings obtained indicates a positive relationship between the English teachers' TPK level and their confidence to use technology in effective implementation at the classroom level. It

was also found out that TPACK framework is a reliable conceptual instrument to evaluate incorporation of technology in the educational process of a language.

Recently, some systematic reviews have confirmed the relevance of TPACK with the perspective of developing English language teaching skills. Tseng, et al. (2022) synthesized empirical research on TPACK in language learning and found that teachers' integrated knowledge has significant effects on instructional design, technology use in the classroom, learner engagement and language learning outcomes. The review also revealed that teachers' Professional Development programs that included components related to authentic lesson design and reflective teaching approach had more impact on teachers' TPACK than those that target the digital literacy or technical ICT skills.

Although the technology is becoming more prevalent, but there are still some barriers in the proper incorporation of technology in the English language classroom. Likewise, lack of ICT infrastructure, poor supportive mechanism at school, limited availability of digital equipment, lack of time to plan instructions and lack of professional development are persistent obstacles identified in research, especially in the developing world (Tondeur et al., 2020). Thus, it is considered as a substantial challenge for teacher education institutions (TEIs) and educational policy makers to build up English language teachers' TPACK to promote the level of language teaching in technology-rich learning environments.

Teachers Professional Development and TPACK

The rapid development of digital technologies demands constant opportunities for teachers to keep their technological skills up to date, develop pedagogical skills and build innovative approaches for teaching. Past ICT training initiatives have tended to emphasize technical skills, expecting that once teachers develop technical skills in ICTs, they will use them in their classrooms. But, studies have shown that meaningful and effective technology integration goes beyond the technical skills (Mishra & Koehler, 2006).

TPACK framework is an important reference point for the design of teacher professional development programs. In contrast, focus of TPACK approach to Professional Development is on developing the ability of technology usage with subject matter and appropriate methods of teaching. These programs usually include co-planning, lesson implementation, peer feedback, mentoring input, and classroom reflection and re-planning in order for teachers to build up an integrated approach to professional knowledge rather than simply building up ICT skills (Koehler et al.,2013).

Research from the contemporary period emphasizes the significance of teachers' belief and attitudes on the effectiveness of professional development. Petko (2020) claimed that teachers' pedagogical beliefs influence the transformation of technological knowledge into practice in the classroom. Teachers who tend to be more open to using novel technologies redesign the learning activities of students according to learners' interest and collaborate them meaningfully. Therefore, quality professional development needs to focus on teachers' technological skills as well as their beliefs about technology-supported learning.

While professional development plays a significant role in helping to build TPACK, there are some contextual factors that remain. The lack of ICT infrastructure, administrative support, access to technological resources and high workloads have been repeatedly found as factors that hinder the incorporation of new knowledge in the classroom. The results are significant for developing countries, in which the uneven distribution of technological access and institutional resources can limit teachers' potential to experiment with new curricular and pedagogical methods, even after attending professional development programs.

Therefore, it is necessary to realize that teachers' professional development is an ongoing process that takes place continuously, and should be geared to the specific context. Based on this, evidence shows it is better to consider teacher professional development as a continuous process rather than short time development program. In the long-term, teachers' TPACK requires sustained

commitment from their institution, ongoing mentoring and learning communities, and opportunities to reflect on their classroom experiences. Therefore, assessing teachers' TPACK after teacher development programs is a meaningful technique to document the usefulness of this program and to guide future teacher education policies.

A number of studies in the literature indicate that use of TPACK model improves teachers' self-confidence, teaching skills and technological practices. Nevertheless, how these improvements are achieved will depend on the context, as well as institutional capacity and opportunities to implement the enhancements in the classroom. Such results underscore the need to assess the government sponsored professional development program like, Secondary Schools Education Improvement Project (SSEIP) for their effectiveness in developing secondary teachers' integrated technological, pedagogical and content knowledge in the context of education in Sindh, Pakistan.

TPACK in the international context

TPACK research has also occurred internationally, and on different demographic and contextual characteristics that relate to teacher TPACK. For teachers professional learning experiences had an impact on the scores for TPACK, particularly if it included collaborative lesson design and the real usage of techniques inside the classroom as encouraged (Koh, J.H.L et al., 2017). Similarly, Valtonen et al. (2017) discovered that professional development and field experiences had a greater impact on TPACK development than did single ICT training sessions.

Based on the empirical evidence from international research, there are four important findings. TPACK begins by providing a solid theoretical foundation to understand teachers' competency in using technology in the classroom. Secondly, overall, the technical knowledge is the least developed area of teachers' professional knowledge. Third, professional development has an important impact in the emergence of TPACK. Finally, teachers' educational policy, institutional support, and infrastructure related to technology should be given due consideration to assess how context effects the opportunities the teacher has to develop and implement TPACK in the classroom.

TPACK in the context of Pakistan

Compared to the extensive literature from other countries, limited empirical studies have been conducted in Pakistan on TPACK. Existing studies were carried out the prospective teachers and higher education teachers, however little research was conducted on the currently practicing secondary school teachers. Furthermore, there are hardly studies were conducted on the language teachers who are teaching English and implementing TPACK framework. One of the previously conducted researches in Pakistan that aimed at investigating the opinions of prospective teachers on TPACK in Karachi was carried out by Ali et al. (2020). The results indicate the average level of TPACK across elements of this model measured through self-reported competence. Conversely, content knowledge, teaching methods knowledge and integrated domains (Technological Pedagogical Knowledge (TPK) and Technological Pedagogical Content Knowledge (TPACK)) were relatively underdeveloped. The authors concluded that there is a need to increase teacher support and their awareness of authentic classroom based incorporation of technology in the programs of teacher education, not only related to theoretical aspects of ICT.

Similarly, Ghayyur and Mirza (2021) explored prospective teachers' beliefs about incorporation of Information and Communication Technology (ICT) and identified primary challenges to effective integration of technology as lack of ICT infrastructure, poor availability of technology related resources, weak institutional support and less personnel having practical experience in using technology in real setting. However, respondents indicated acceptable behavior to adopt educational technology, but their confidence in using the information and knowledge of technology in real school environment was reported as being low. The results indicate that positive attitudes aren't enough for the

development of meaningful TPACK competencies.

These observations have been confirmed by more recent studies. Ali, et al., (2023) examined the relationships among the seven components of TPACK with pre-service elementary teachers, and the results revealed positive correlation among all the constructs of TPACK. This study confirmed that all the elements of TPACK are dependent as well as interrelated.

Therefore, it is clear that there is a definite lack of empirical and context specific studies on the in-service secondary English teachers who were involved in their professional development program in the government system as is evident from literature available in Pakistan. This studies can offer evidence of the teacher's technology integration skills, feedback for teacher education policies and can add to the international literature on TPACK in developing educational settings.

Research methodology

Research Design

The present study used quantitative cross sectional survey research design to measure the competencies of Secondary School English teachers trained under Secondary Schools Education Improvement Project (SSEIP) in Sindh, Pakistan in terms of Technological Pedagogical Content Knowledge (TPACK). A quantitative approach is suitable as the study goals involved measuring teachers' TPACK competencies, comparing TPACK levels among teachers on the basis of their experience in teaching and using statistical techniques to analyze relationships among the TPACK components.

Research Population

The target population were all secondary school English teachers who have successfully completed the professional development training under Secondary Schools Education Improvement Project (SSEIP) in Sindh, Pakistan. The School Education and Literacy Department (SELD) official records revealed that around 530 Secondary School English teachers from various districts of Sindh completed a standardized professional development program aimed at improving their instructional capacity, pedagogy and skills to incorporate technology. All the participants were trained equally through TPACK competencies.

The sampling technique and sample

Simple random sampling technique was used for selecting the participants in this study. All the Secondary English teachers trained under SSEIP were identified and then a sampling frame was constructed and the participants were selected using random sampling technique. Finally, 110 secondary English teachers participated in this study.

Research Instrument

Structured questionnaire was used to collect data on the basis of TPACK framework developed by Mishra and Koehler (2006). The questionnaire assessed the teachers' self-reported competencies in all the domains of TPACK. The instrument had been adopted from the previously validated TPACK survey created and validated by Schmidt et al (2009). A slight modification was made in the questionnaire, keeping the conceptual structure of the original questionnaire with consideration to the context of secondary English teachers of Sindh. Each item in the questionnaire had a five-point Likert scale for measurement. In addition, instrument used has been validated and reliable.

The questionnaire was checked by experts. Their feedback on language clarity, content relevance and appropriateness to the context were taken into account prior to the final administration of the instrument. In addition, each construct was further tested for reliability by the Cronbach's alpha coefficient. Table 1 indicates the Cronbach's alpha values of the items of the TPACK elements. All Cronbach's alpha coefficients are greater than 0.80, exceeding the commonly accepted threshold of 0.70.

Table 1
Cronbach's Alpha Reliability coefficients for the TPACK Instrument

Variable	No. of items	Cronbach's Alpha	Interpretation
TK	3	0.895	Good to Excellent
PK	3	0.929	Excellent
CK	4	0.822	Good
TPK	3	0.856	Good
TCK	3	0.915	Excellent
PCK	3	0.886	Good
TPACK	4	0.892	Good to Excellent

Data Collection Procedure

Data was collected from trained secondary school teachers of subject English through Google form questionnaires. Participants filled those forms voluntarily and they were informed that provided data would not be used for any other purpose other than academic research.

Data Analysis

The data collected were coded and cleaned in the Microsoft Excel spreadsheet and then exported to IBM SPSS Statistics (Version 32) for analysis. The descriptive statistics were used, to find the level of teachers' TPACK competencies.

In order to meet the second research objective, inferential statistical tests were conducted. Moreover, Pearson Product-Moment Correlation analysis was conducted to look into the relationships among the seven TPACK domains. The criterion for statistical significance of all inferential analyses was $\alpha = .05$, which is standard in the educational and social sciences.

Results

Objective 1: To determine the existing levels of self-reported TPACK competence trained secondary English teachers

The TPACK competence of teachers was measured using descriptive statistics. The Table 2, indicates that participants' competency in the seven elements of TPACK were relatively high. Pedagogical Knowledge (PK) has the highest mean score (M = 4.18, SD = 1.65), followed by overall TPACK (M = 4.14, SD = 1.36) and Content Knowledge (CK) (M = 4.13, SD = 1.81). However, the mean score of Technology Knowledge (TK) was the lowest (M = 3.66, SD = 1.96). Likewise, Pedagogical Content Knowledge (PCK) has a mean score of 4.01 (SD = 1.91) and Technological Content Knowledge (TCK) has a mean score of 3.99 (SD = 1.62). The mean value of Technological Pedagogical Knowledge (TPK) was 3.97 with the standard deviation of 1.91, indicating that the teachers were generally self-confident in using technology with pedagogical practice. The results indicate teachers' perception of higher levels of pedagogical and content knowledge than technological knowledge.

Table 2
Levels of self-reported TPACK competence

Variable	No of items	N	Mean	Standard Dev.
TK	3	110	3.66	1.96
PK	3	110	4.18	1.65
CK	4	110	4.13	1.81
TPK	3	110	3.97	1.91
TCK	3	110	3.99	1.62
PCK	3	110	4.01	1.91
TPACK	3	110	4.14	1.36

Objective 2: To investigate significant difference in Teachers TPACK levels on the basis of their teaching experience, academic qualification and access to ICT

Based on the teaching experience, the scores for TPACK were compared with four groups: 1-5 years, 6-10 years, 11-15 years, and greater than 16 years, using a one-way ANOVA. Table 3, shows the between group sum of squares (SS) is 7.11, the within group sum of squares (SS) is 193.81 and the total sum of squares (SS) is 200.92. The mean square between groups (MS = 2.37) and the mean square within groups (MS = 1.83) yields an F value of 1.30 with degrees of freedom (3, 106). However, it is concluded that there is no difference in TPACK scores between the groups, F (3, 106) = 1.30, p = .28. So, the null hypothesis is not rejected, indicating that teaching experience is not significantly associated with differences in teachers' TPACK scores.

Table 3

One-Way ANOVA OF TPACK Scores across Teaching Experience Groups

Teaching Experience	n	Sum	Mean (M)	SD	Variance
1-5 Years	47.00	769.00	16.36	1.29	1.67
6-10 Years	32.00	528.00	16.50	1.24	1.55
11-15 Years	23.00	390.00	16.96	1.64	2.68
16+ Years	8.00	136.00	17.00	1.20	1.43

ANOVA

Source of Variation	*SS*	*Df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	7.11	3.00	2.37	1.30	0.28	2.69
Within Groups	193.81	106.00	1.83			
Total	200.92	109.00				

To compare the scores on the TPACK between teachers with Bachelor's and Master's degree, an independent samples t-test was used. Table 4 indicates there was no statistically significant difference between the scores of teachers with a Bachelor's (M = 16.65, SD = 1.28) and Master's (M = 16.43, SD = 1.54) degrees, t(57) = 0.75, p = .46. So, the null hypothesis is not rejected and it indicates that teachers' academic qualification has no significant impact on their TPACK scores.

Table 4

Comparison of TPACK Score between Bachelors' and Masters' Degree Trained Teachers

Statistic	Bachelors' Degree	Masters' Degree
Mean	16.65	16.43
SD	1.28	1.54
Variance	1.63	2.37
Observations	75.00	35.00
Df	57.00	
t Stat	0.75	
P(T<=t) two-tail	0.46	

To compare the scores of the teachers with/without access to ICT facilities, an independent samples t-test was used. Table 5 reveals that the difference in the scores of teachers with ICT facilities (M = 17.05, SD = 1.46) and teachers without ICT facilities (M = 15.52, SD = 1.30) was statistically significant, t(85) = 5.62, p < .001.Thus, it can be concluded that there is significant difference between the availability of ICT facilities and the TPACK scores of teachers, so the null hypothesis is rejected.

Table 5
Independent samples T-test Comparing TPACK Scores by availability of ICT Facilities in Classroom/School

Statistic	ICT Available	ICT Not Available
Mean	17.05	15.52
SD	1.46	1.30
Variance	2.13	1.70
Observations	44.00	66.00
Df	85.00	
t Stat	5.62	
P(T<=t) two-tail	0.00000022	

Objective 3: To explore the inter-relations among seven TPACK constructs and determine which of the components is most strongly correlates with the overall score of TPACK

Pearson product-moment correlation analysis was used to analyze the relationships between the seven TPACK constructs. The findings as indicated in the table 6 reveals that most of the components are significantly and positively correlated. Technological Pedagogical Knowledge (TPK) was the most significantly associated with Pedagogical Content Knowledge (PCK) with r = .678, p < .001. Pedagogical Knowledge (PK) and Content Knowledge (CK) also had significant positive relationships, r = .634, p < .001, and Technological Content Knowledge (TCK) and Pedagogical Content Knowledge (PCK) has significant positive relationships, r = .566, p < .001. Correlations between the overall TPACK score and its components were generally weak but statistically significant for PK (r = .235, p < .05), CK (r = .268, p < .01), TPK (r = .299, p < .01), TCK (r = .277, p < .01), and PCK (r = .302, p < .01). There was no significant relationship between the scores on Technology Knowledge (TK) and Content Knowledge (CK) or the overall TPACK score.

Table 6
Pearson Correlations Among TPACK Components

Variable	1	2	3	4	5	6	
TK	1.00						
PK	.276**						
CK	0.14	.634***					
TPK	.292**	.484***	.452***				
TCK	.476***	.348***	.313***	.506***			
PCK	.363***	.514***	.504***	.678***	.566***		
TPACK	0.10	.235*	.268**	.299**	.277**	.302**	-
N	110.00	110.00	110.00	110.00	110.00	110.00	-

Findings

The findings demonstrate that teachers exhibited a moderate to high overall TPACK competence. This implies a positive impact of the professional development under the Secondary Schools Education Improvement Project (SSEIP) on teachers' perceived capacity to utilize the technology in the teaching of English language. There are evidences which support the claim that sustained and practice-oriented professional development can improve TPACK level of teachers. The scores in most of the TPACK domains were relatively high in this study, indicating that teachers demonstrated the technological, pedagogical and content knowledge needed to facilitate technology enhanced learning.

According to inferential analysis, there were no significant differences between teaching experience and academic qualification in terms of overall TPACK competence of the teachers. In addition, the study results also indicate that years of teaching experience and higher academic attainment may not necessarily yield competent integration of technology into curriculum. However, there was statistically significant relationship between access to ICT facilities and teachers' competence of TPACK. The mean scores for the teachers who have better access to the technological resources were significantly higher than for those who have limited access to ICTs. This finding highlights the significance of school infrastructure, technology resources and institutional support for helping teachers to successfully incorporate technology into their classrooms. Finally, the correlation analysis also reveals that all seven TPACK constructs are significantly and positively correlated with others, which confirmed the interconnections among components of TPACK. The components that showed the highest positive correlation with the overall TPACK score were Pedagogical Content Knowledge (PCK) indicating that teachers' content knowledge and methodology is a strong. This is in line with studies that have indicated that pedagogical and content knowledge are frequently used as basis for meaningful use of knowledge of technology in the classroom practice.

Conclusion

This study is a practical contribution in the context of a developing country and the findings of the study provide empirical evidence from trained teachers of the TPACK framework under Secondary School Education Improvement Project. The findings highlight the need for the continued advancement of technology infrastructure, ongoing technology-related professional development and mentoring programs in school to improve teachers' technology integration skills, and enhance English language teaching quality. These findings are useful for teacher educators, school administrators and policy makers.

Moreover, findings also suggest TPACK competence among secondary English teachers is moderate to high, and therefore the teachers have benefited from the implementation of teacher professional development program under Secondary Schools Education Improvement Project. Teachers' builds their technological, pedagogical and content knowledge. This result aligns with the idea that TPACK evolves over a long period of time, as opposed to being learned in a single training session (Tondeur et al., 2020). Finally, results also demonstrate that there is more to strengthen teachers' TPACK than simply having access to technological resources. Pedagogical knowledge, content knowledge, ongoing professional development, and enabling institutional contexts are all essential to effective technology integration as proposed by the TPACK model. Rethinking these interrelated aspects will help to prepare English language teachers to offer meaningful and engaging pedagogical assistance to address the 21st century's challenges in education through technology.

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