A systematic review of Technological Pedagogical Content Knowledge (TPACK) of EFL teachers

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ABSTRACT

This systematic review investigates studies on Technological Pedagogical Content Knowledge (TPACK) in the context of teaching English as a foreign language. Employing synthesis research methods, we analyze qualitative data to achieve practical goals. We gathered relevant literature from international databases using specific keywords, resulting in the selection of 18 articles for analysis. Reliability was ensured by assessing data quality using Cohen's kappa coefficient, which yielded a value of 0.76. Our findings indicate that previous TPACK research predominantly focuses on four key areas: review, evaluation, development, and application. Notably, research has primarily explored two dimensions: assessing teachers' TPACK proficiency and innovating methods for its measurement, as well as investigating differences in TPACK levels among various teacher groups to enhance their effectiveness. In conclusion, this study highlights a gap in understanding how English language educators can effectively utilize the seven elements of TPACK to enhance student learning through technology-integrated lessons. Additionally, it aims to provide valuable insights for future researchers to advance the TPACK model within this field.

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1. Introduction

In today's globalized world, the importance of teaching English as a foreign language (EFL) in non-English speaking countries has grown tremendously. To embrace globalization, teachers in these countries employ diverse instructional approaches to educate their students. EFL typically refers to the instruction of English to non-native speakers in an environment where English is not the primary language. These classes are often taught by non-native English teachers who are themselves English learners and may not possess native-like proficiency. Given this context, designing effective EFL courses is crucial to enable learners to attain an adequate level of proficiency and communicate effectively with individuals in various linguistic contexts. However, it is essential to recognize that teaching is a complex process that extends beyond the mere transfer of knowledge from teacher to learner (Dewey, 1902). Effective teaching is based on teachers' comprehensive understanding of the subject matter, teaching methods, and the unique needs of their students. Integrating technology into teaching enhances the effectiveness of the learning experience and enables students to engage in diverse and enriching educational opportunities (Maor & Roberts, 2011). The significance of incorporating technology into education became unmistakable during the COVID-19 pandemic in 2020. With the shift to online instruction, teachers faced fresh hurdles. They had to enhance their digital skills, seamlessly weave technology into their teaching, and adjust their methods to suit virtual classrooms (Eghtesad & Mehrabi, 2023). Numerous studies have shown that teachers' level of technological knowledge is often lower than their expertise in other areas, such as content and pedagogical knowledge. This is because many teachers, despite years of successful teaching experience, lacked the motivation and skills to enhance their understanding and practical application of technology (Eghtesad & Mehrabi, 2021). Therefore, given the importance and role of technology, teaching in the present era has taken on a special significance for teachers, prompting educational researchers to conduct research in this field.

Experienced teachers, under the right approaches, can seamlessly integrate all forms of knowledge to make teaching more understandable and effective for their students (Shulman, 1986). The importance of incorporating technology into English language teaching has never been more evident in our modern world. English learners often struggle to access real-life English-speaking settings and have few chances to converse naturally with native speakers. Consequently, they lean heavily on technology to facilitate authentic language learning, especially in listening and speaking skills. Integrating technology into the design of the English language curriculum presents a tangible solution to aid learners in enhancing their proficiency. Nonetheless, effectively integrating technology into education proves to be a complex and multifaceted task (Herring, Koehler, Mishra, Rosenberg & Teske, 2016). Ultimately, the seamless integration of

technology into the classroom follows a logical process: first, clearly defining the objectives; then, choosing an appropriate example of the concept; and finally, aligning a specific piece of technology with the selected idea or activity (Bugueño, 2013). In recent years, a significant educational approach known as Technological Pedagogical Content Knowledge (TPACK) has gained prominence across diverse educational domains. TPACK, a dynamic framework, integrates teachers' pedagogical expertise with their understanding of the subject matter, empowering them to adeptly craft, execute, and assess curriculum and instruction with the support of technology. Within this framework, technology serves as an augmentative tool, enriching the learning experience, rather than being the primary objective or a substitute for interactive language acquisition. In this context, Jang and Chen (2010) state that TPACK represents a shift and new direction in understanding the complex interaction between content, pedagogy, and technology, which ultimately enhances the integration of technology with education in the classroom for educational outcomes. Several key factors come into play in creating a strong educational framework that effectively integrates technology with instruction. Firstly, a comprehensive understanding of the concepts of using technology is essential. Secondly, this framework encompasses practical instructional techniques that utilize technology to facilitate subject matter learning, address challenges students may face, and provide solutions. Finally, it emphasizes the importance of students'

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background knowledge, epistemological theories, and their ability to harness technology to expand existing knowledge or refine established theories (Mishra & Koehler, 2006). From a higher perspective, why have researchers recently shown an increasing interest in the TPACK framework of teachers? In the present research, the question is to what extent have researchers been able to use this theoretical framework in their research in English language teaching?

Some studies have shown that while teachers are highly motivated to incorporate technology into their teaching methods, they approach this approach with caution due to the complex and challenging nature of technology-based education (Eghtesad & Mehrabi, 2023). Research on Technological Pedagogical Content Knowledge (TPACK) in English language education is crucial for several reasons. Firstly, the integration of technology into teaching methods has become an essential skill for English language teachers today, as it expands learning opportunities. English language teachers who cannot effectively integrate technology into their teaching practices often experience lower teaching effectiveness. Additionally, these teachers may lack the necessary technological skills to fully engage their students (Blackwell, Lauricella & Wartella, 2016; Harris, Phillips, Koehler & Rosenberg, 2017; Jang & Tsai, 2013, Koh, Chai & Tay, 2014; Porras-Hernández & Salinas-Amescua, 2013; Rosenberg & Koehler, 2015; Swallow & Olofson, 2017). Research on TPACK has been relatively less compared to other fields in English language teaching in schools, highlighting a research

gap in this area in Iran. In this context, it is important to examine the extent to which the research conducted in this area has addressed this gap.

2. Theoretical and Practical Framework

The TPACK framework, initially developed by Shulman (1986) and later expanded by Mishra and Koehler (2006) to include technology, has paved the way for a new frontier in English language teaching. The incorporation of technology into education using the Technological Pedagogical Content Knowledge (TPACK) framework has presented teachers and researchers with unfamiliar challenges. The question of whether or not to use technology in English language teaching is no longer a simple choice or option for teachers. Instead, the focus has shifted to examining the extent to which English language teachers can effectively use technology in their teaching practices, and teachers need to be aware of the latest educational technologies to ensure they remain effective in their teaching methods (Mishra, Koehler & Kereluik, 2009). In 1986, Shulman introduced a framework highlighting the importance of integrating both content knowledge and pedagogical knowledge for effective teaching practices (Tallvid, Lundin & Lindström, 2012). While pedagogical knowledge and content were previously considered separately, in the realm of pedagogical content knowledge, Shulman (1986) highlights the importance of identifying the most effective forms of representation for topics typically taught in a subject area (Figure 1). These forms include

ideas, powerful analogies, clear images, convincing examples, clear explanations, and impactful displays. Collectively, these strategies contribute to the development of pedagogical content knowledge (PCK), which encompasses the ability to represent and express a topic in a way that enhances understanding among others.
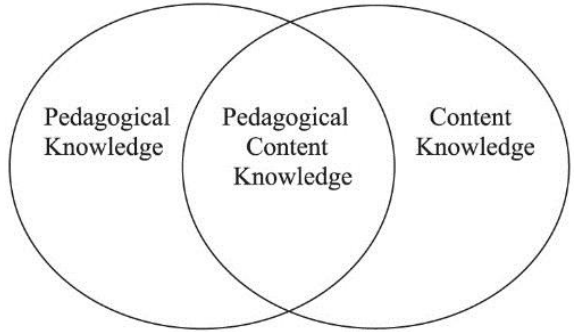

Figure 1. The theoretical framework of integrating content knowledge with teacher's educational knowledge (Shulman, 1986: 9)

With the widespread acceptance of pedagogical content knowledge (PCK), the educational community of teachers has shown a growing interest in the pedagogical content knowledge framework. However, the concept of TPACK has brought about an emerging framework that highlights the complex connections, interactions, capabilities, and limitations between content, pedagogy, and technology. This framework has been well-recognized for its potential to increase the effectiveness and efficiency of teaching methods among teachers (Mishra & Koehler, 2006). Technological Pedagogical Content Knowledge (TPACK) represents the fundamental connections between three key areas of knowledge: Content Knowledge (CK), Pedagogical Knowledge (PK), and Technological Knowledge (TK). However, Mishra and Koehler identified a significant challenge in the absence of a coherent and

globally accepted definition of knowledge in the areas of technology, education, and content (Mupita, Widiaty & Abdullah, 2018). However, due to the pervasive influence of computer technology on education, teachers are increasingly integrating technology tools and resources into their teaching. When teachers use technology in their teaching, they need to have a good understanding of technology in addition to the PCK they already have. This means they need to integrate TK with PCK. The Seven Main Components of Technological Pedagogical and Content Knowledge (TPACK) (Mishra & Koehler, 2006; Koh, Chai & Lee, 2015) are described as follows: Content Knowledge (CK): Knowledge of the subject matter. Pedagogical Knowledge (PK): Knowledge of teaching methods and strategies. Technological Knowledge (TK): Knowledge of how to use technology tools. Pedagogical Content Knowledge (PCK): Knowledge of how to use appropriate teaching strategies to teach subject matter content. Technological Pedagogical Knowledge (TPK): Knowledge of how to use technology to enhance teaching strategies. Technological Content Knowledge (TCK): Knowledge of how to represent subject matter content with technology. TPACK: Knowledge of how to facilitate students' learning of a particular content by properly integrating teaching and technology. Teachers construct their Technological Knowledge (TK), Content Knowledge (TCK), and Pedagogical Knowledge (TPK) to formulate their Technological Pedagogical Content Knowledge (TPACK). Mishra and Koehler (2009) provide the following explanation when defining TPACK:

"TPACK is the basis of good teaching with technology and requires an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face; knowledge of students' prior knowledge and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge and to develop new epistemologies or strengthen old ones" (p. 1029).

Technological Pedagogical Content Knowledge (TPACK) is about what teachers need to know for integrating technology into the classroom. Schmidt et al. (2009) stated that TPACK serves as a valuable framework for conceptualizing the essential knowledge required for teachers to effectively integrate technology into their teaching practices and how to cultivate this knowledge. In addition, using TPACK as a tool for evaluating teachers' teaching skills is likely to shape the nature of educational and professional development opportunities designed for both pre-service and in-service teachers (Lehiste, 2015). Despite this, research in educational technology has frequently faced criticism due to its weak theoretical underpinnings (Mishra & Koehler, 2006). It's unclear how teachers employ particular teaching methods with certain technologies in specific situations to convey subject content. Thus, TPACK theory is reinforced through the development

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of three key areas of knowledge: technological knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK) (Tseng, 2018). Technological knowledge (TK) encompasses teachers' skills in utilizing a wide range of technologies, from traditional tools like chalk and board to modern resources like the internet and mobile devices. Pedagogical knowledge (PK) relates to teachers' understanding of effective procedures and strategies for lesson planning, classroom management, and student assessment. Content knowledge (CK) refers to teachers' expertise in the subject they teach, including components and skills such as vocabulary, grammar, reading, listening, speaking, and writing in the context of English language teaching. Technological pedagogical knowledge (TPK) comprises teachers' understanding of how to employ specific instructional strategies that are aligned with cost-effective technologies. Technological content knowledge (TCK) focuses on teachers' knowledge of how to deliver subject matter using various technologies. Pedagogical content knowledge (PCK) encompasses teachers' ability to implement instructional strategies that effectively convey content, address learner issues, and enhance student understanding. TPACK, ultimately, signifies teachers' awareness of the dynamic and interactive relationships between all three knowledge components (technology, pedagogy, and content).
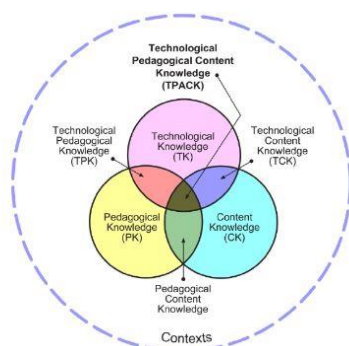

Figure 2. The theoretical framework of the knowledge structure of technological educational content of TPACK (Koheler & Mishra, 2009)

According to Figure 2, the TPACK framework has the potential to improve student learning, support students and their parents, and create a more engaging school environment. Additionally, it can help to create equal opportunities for all students and support the professional development of teachers (Malik, Rohendi, & Widiaty, 2019). This model can be considered as teachers' understanding of the importance of time and place, as well as their ability to increase students' subject-based learning through the effective implementation of technology-supported teaching strategies (Koehler, Mishra & Yahya, 2007; Mishra & Koehler, 2006; Niess, 2011). This theoretical framework has been used to support teachers in developing TPACK and strengthening technology-related teaching practices (Jang, 2010; Tseng, Lien & Chen, 2016). Implementing Technological Pedagogical Content Knowledge (TPACK) requires contextualization within specific educational settings, rather than being executed in isolation (Koheler, Mishra & Cain, 2013; Rosenberg & Koheler, 2015).

In conclusion, the TPACK model highlights the paramount importance of employing this pedagogical approach among English language teachers. Consequently, numerous studies have investigated this area, prompting the researchers of this paper to undertake a systematic review focused on TPACK for English language educators.

3. Methodology

The present research has employed a qualitative approach and a rigorous and comprehensive systematic review process, combining research synthesis approaches, particularly meta-synthesis. Systematic review is an overarching term that aims to collect and synthesize a diverse range of research conducted on a specific topic (Ring et al., 2011: 3). In other words, a systematic review is an observational study of existing research (Moher et al., 2015). In this approach, a wide range of research findings and studies on a specific topic is gathered in a systematic manner. These diverse studies are then brought together, forming cohesive connections. Subsequently, the entire body of research data undergoes thorough evaluation, reconstruction, and interpretation to ensure it aligns with current needs and demands (Kaviani & Nasr, 2016). In this context, the present study strives to provide a comprehensive and strong understanding of the subject matter, namely TPACK, among English teachers. Therefore, the research process began with a search of the international bibliographic database. In review studies, the latest scientific information on a specific topic is reviewed and criticized, and the purpose of this review study, in addition to informing, is to evaluate and interpret.

This study employed a mixed-methods approach, combining qualitative data coding with quantitative frequency counting of codes. The research focused on identifying findings from studies published between 2015 and 2023 in prominent international databases, including ScienceDirect,

SpringerLink, Wiley Online Library, Taylor & Francis Online, and Sage. The search strategy utilized keywords related to two main themes: "TPACK in English as a Foreign Language (EFL)" and " TPACK development in English as a Foreign Language (EFL) classroom". Initially, a total of 124 articles were screened, and subsequently, 18 articles that met the inclusion criteria outlined in the PRISMA checklist were selected. These inclusion criteria encompassed original research articles without restrictions on research type, publication date, or language. Articles were excluded if they were review articles, lacked full-text access, or were not directly relevant to either TPACK in EFL education or TPACK development in EFL classrooms. Articles focusing on TPACK in other educational subjects were not considered. The findings from the selected articles were then systematically categorized and presented, as illustrated in Figure 4. Additionally, detailed information about the reviewed studies, including author information, country of study, research methodology, sample size, scale, and key findings, is provided in Table 3 in the appendix. The current research utilized the Sandelowski, Barroso & Voils (2007) model, which comprises seven stages, as depicted in Figure 3.
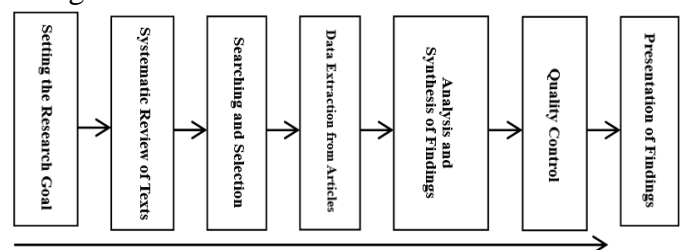

Figure 3. The seven steps of Sandelowski and Barroso's synthesis procedure

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3.1. Step 1: Setting the Research Goal

The purpose of conducting a systematic review in the field of technological pedagogical content knowledge (TPACK) for English language teachers is multifaceted. In the first stage, this review aims to aggregate and synthesize existing research findings to provide a comprehensive understanding of the current state of TPACK among English language teachers. By systematically examining a wide range of studies, researchers can identify patterns, trends, and gaps in the literature, and thus chart and guide future research directions. Secondly, a systematic review makes it possible to identify effective strategies and interventions that enhance teachers' TPACK and provide valuable insights for teacher professional development programs and policy initiatives. Therefore, the main research question of this study is the systematic exploration of TPACK studies of English language teachers, which seeks to answer the research questions raised based on the stated objective (Table 1).

Table 1. Research questions

Parameter	Research Question
What	Today, the widespread adoption of the Technological pedagogical content knowledge (TPACK) framework is transforming teaching methodologies, particularly in the realm of English language education. However, amidst this surge in TPACK utilization, numerous studies have already explored its applications. This saturation of research prompted the researcher to embark on a comprehensive investigation employing a systematic review methodology. Consequently, the current study aims to address the ensuing research problem by posing the following research questions: 1- How is the concept of TPACK described in the conducted research? 2- How has the concept of TPACK been evaluated and developed in learning English? 3- What is the use of TPACK in teaching English?
How	By integrating data from multiple studies, this approach yields a robust understanding of outcomes, and distinct trends, guides future research efforts, and facilitates evidence-based practices across domains. In general, systematic reviews play a central role in providing an in-depth analysis of current research to guide future research processes.
Who	The statistical population of the current research includes 18 related studies in the field of teachers' Technological pedagogical content knowledge (TPACK) in English language education, and they are indexed in the journals available in international scientific databases (Table 2) and can also be found in the Google Scholar search engine.
When	The articles that were analyzed in the present study are related research published in journals between 2014 and 2023.

3.2. Step 2: Systematic Review of Texts

To collect research data, a wide range of reputable scientific information databases were carefully reviewed. Table 2 shows the names of the scientific databases used in this search process. These sources include

English-language scientific research articles published in reputable international journals and case studies from various countries, including Iran. The initial research data was collected through comprehensive searches conducted in foreign databases using relevant keywords.

Table 2. The list of scientific databases used

Scientific databases
ScienceDirect
SpringerLink
Wiley Online Library
Taylor and Francis Online
Sage Journals
Google Scholar

3.3. Step 3: Searching and Selection

In this phase, the Critical Appraisal Skills Programme (CASP) tool, renowned for its efficacy in assessing the quality of primary qualitative research studies, was employed. Utilizing this tool involved a thorough examination of scientific databases, where articles underwent meticulous scrutiny. Key aspects such as research objectives, methodological coherence, research design, sampling techniques, and measures were carefully evaluated. Each article's title, abstract, methodology, discussion, and conclusion sections were rigorously assessed against predetermined criteria. Initially, we identified 124 primary articles. However, after applying our study inclusion criteria - which excluded articles such as conference papers, those lacking thematic focus, review papers, meta-analyses, and those unavailable in full text - 106 articles were deemed ineligible and excluded from

further consideration. Ultimately, 18 articles that aligned with systematic study inclusion criteria were selected for inclusion in our analysis (see Figure 4).
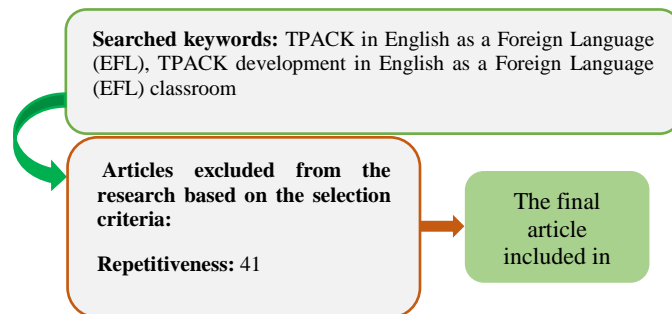
Searched keywords: TPACK in English as a Foreign Language (EFL), TPACK development in English as a Foreign Language (EFL) classroom

Articles excluded from the research based on the selection criteria:

Repetitiveness: 41

The final article included in

Figure 4. Flowchart of the review and selection process of articles

A systematic review of the indexing dates of the included articles revealed an increasing interest in research on TPACK of English language teachers in recent years. Based on Figure 5, the line graph shows an upward trend since 2021, indicating an increase in the number of articles written related to the TPACK of English language teachers and, consequently, an increase in the level of research interest in this area. Additionally, the oldest article included in the systematic review was published in 2014, and the newest in 2023 (Figure 5).
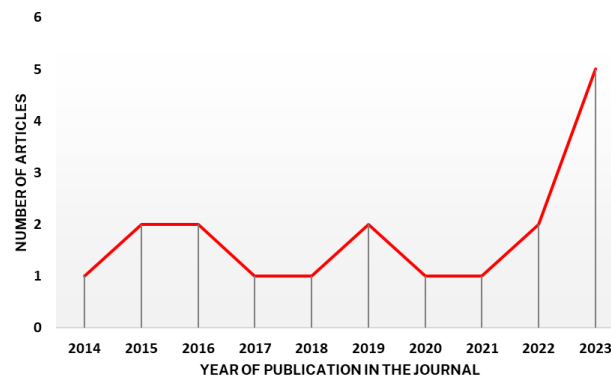
Figure 5. Line chart of the number of published articles per year

Also, by analyzing the geographical distribution of studies and comparing them, it was found that Taiwan had the highest

number of studies compared to other countries. In addition, Iran, with three attributed articles, emerged as one of the prominent participating countries in TPACK research among English teachers (Figure 6).
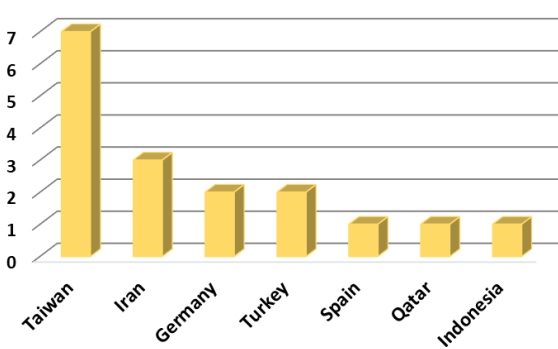

Figure 6. Column chart of geographic distribution of studies

3.4. Step 4: Data Extraction from Articles

In this step, we organized the information from the chosen studies into a table (Table 3). The table presents details such as the author and publication year, the country where the study took place, the research methodology, the sample size, the scale used for data classification, and the research outcomes. You can find these details in Table 3 of the appendix.

3.5. Step 5: Analysis and Synthesis of Findings

Based on the coding of the research findings, four themes with 14 axes and 81 concepts were identified, which are categorized in Table 4.

Table 4. Classification of concepts, axes and themes

Themes	Axes	Concepts	References
Conceptualizing TPACK	Competence of teachers in using TPACK	Conceptualizing confidence in teachers' competence at different levels of TPACK; The participation of language teachers in the design of TPACK jointly; Effective interventions include language teachers' understanding of the TPACK framework; TPACK competency level of teachers; Different perceptions among students, teachers, and trainers about the level of TPACK competence of in-service teachers	Tseng and et al. (2022); Tseng (2014); Baser and et al. (2016)
	Technology use strategy	The dominant concept of using technology in traditional teacher-centered teaching; Determining specific content strategies and technologies in English; effective integration of technology; All-round presence of technology	
	Modeling TPACK for teaching	Determining the boundaries between the seven subdomains of TPACK; Determining the development of TPACK tools by viewing the structure of TPACK; The effectiveness of TPACK-based language training courses and platforms; Enriched training program for pre-service language teachers to increase their knowledge about strategies, students, and curriculum; Modeling from teacher trainers or experienced teachers	

TPACK assessment	TPACK as a thinking skill	Integrating TPACK and Bloom's revised taxonomy with thinking skills; English teachers' confidence in teaching higher order thinking skills with TPACK assessment; Practicing lower order thinking skills and needing more practice in higher order thinking skills	Wang (2022); Tseng (2014); Baser & et al.; (2016) Bostancıoğlu & Handley (2018); Turgut (2017)
	Language learning with computer tools	Assessing the understanding of learning needs with new tools; computer-aided language learning assessment; evaluating the use of technology to innovate new educational practices; Evaluation of productive and meaningful use of computers in language teaching	
	TPACK self-assessment tool and standardization	Stability and consistency of TPACK assessment and survey; Integrating instructional practices and content with TPACK assessment; Developing effective survey items with the TPACK self-assessment tool; A three-step approach to developing the TPACK questionnaire; standardization of curricula with TPACK assessment; Investigating the validity and reliability of the TPACK questionnaire	
	Evaluating teachers' professional development	Continuous professional development programs with TPACK assessment; separating language awareness and approaches/methods; Evaluating language skills with TPACK; facilitating teaching and learning processes; Revising the curriculum in English language education; TPACK assessment and development models in teacher retraining; customized professional development programs to promote TPACK; TPACK needs-based professional development; professional development for teachers with experience in utilizing TPACK; Using test-based tools to assess pre-service teachers' TPACK	
TPACK development	TPACK development in the web space	Implementation of TPACK in online education; creating more opportunities for learning in the correct and effective use of technology in the web-based language class; Creative and effective training with web technology; Support for sustainable web technology; Improved search and selection of OISS online information	Tseng and et al. (2019); Belda-Medina & Calvo-Ferrer (2022); Wu & Wang (2015); Hsu (2016); Nazari and et al. (2019);
	Development of TPACK with thinking method	Contributing to the design thinking of pre-service English teachers in implementing TPACK; Educational content assistance for pre-service teachers; Reflecting on TPACK due to lack of explicit training on TPACK concepts; Creating community and peer collaboration in learning with	

		TPACK; Providing need-based professional development courses to English language teachers in TPACK; PCK development among pre-service English teachers through an enrichment training program	Nazari and et al. (2020); Hsu & Chen (2023); Reza Adel & Azari Noughabi (2023); Budianto and et al. (2023); Lachner & et al. (2021)
	Developing theories of learning through TPACK	Using TPACK in reconstructing the theories of constructivism, situational learning, and communicationism; Assessing the current situation, and identifying the need for further development of TPACK; Integrating technology into the teacher education curriculum; TPACK is a function of both context and teaching experience; integrating technology into the curriculum to enhance teaching and learning; Integrating technology into language teaching practices in different educational environments; Intercultural awareness among language learners; solving the authentic language problem; adaptation to different events and cultural environments; A quasi-experimental method in real-world contexts; Acquiring teachers' professional knowledge through TPACK	
Application of TPACK	Application of TPACK in improving writing competence	Application of TPACK in improving writing competence; Instruction for teaching English writing based on TPACK; The effect of TPACK on writing skills; Technology in teaching writing skills; Peer review and quality of writing skills; Using technology in writing skills classes	Tseng and et al. (2019); Tai and et al. (2015); Wu & Wang (2015); Kulaksız (2023); Hsu (2016); Nazari and et al. (2019); Turgut (2017); Nazari (2020); Budianto and et al. (2023); Lachner & et al. (2021);
	Application of TPACK in improving grammar competence	The role of TPACK in grammar challenges; grammar and syntax challenges; vocabulary competence; and Improving vocabulary level	
	The application of TPACK in the integration of emerging technologies	Impact on emerging technologies in education; Integration of emerging technologies in education; teachers' tendencies on new educational technology; Transforming education through emerging technologies; Major emerging trends in education technology	
	Application of TPACK in knowledge transfer	Application of TPACK on knowledge transfer ability; peer support and collaboration in knowledge transfer through TPACK; TPACK competencies in specific areas; improving TPACK with applied learning; English teachers' knowledge	

		and TPACK; self-regulated learning (SRL); Evaluating the knowledge of English language teachers	Abubakir & Alshaboul (2023)

3.6. Step 6: Quality Control

In systematic research, meticulous attention to upholding the highest standards of quality is indispensable. The current investigation encompasses several pivotal and influential facets aimed at attaining this objective. Firstly, an unwavering dedication to transparency pervades every phase of the research endeavor, from the meticulous curation of articles to the exhaustive scrutiny of findings. Secondly, a thorough examination of Latin sources pertinent to TPACK within the realm of English language education, alongside an exploration of TPACK evolution within English language classrooms, forms a cornerstone of this study. Moreover, a comprehensive survey of literature spanning various epochs has been undertaken, facilitating an extensive juxtaposition of findings. Lastly, rigorous endeavors have been exerted to accurately delineate the principal criteria exerting influence on the TPACK proficiency of English language educators and its subsequent evolution.

In addition, Cohen's kappa coefficient was also used to ensure the reliability and validity of the findings. At this stage, the results obtained were carefully compared by two university experts, and both agreed on the extraction of 14 distinct categories. Consequently, the kappa coefficient for this study was calculated to be 0.76, which confirms its significance at the P < 0.05 level.

3.7. Step 7: Presentation of Findings

According to Table 4, which summarizes the coding and is based on the findings, 14 themes and 4 subthemes were extracted concerning the research. The identified themes were: a) Conceptualization of TPACK (consisting of the themes of teacher competency in using TPACK, technology use strategies, and modeling TPACK for teaching). b) Evaluation of TPACK (consisting of the themes of TPACK as a thinking skill, computer-assisted language learning, TPACK self-assessment tools, and standardization and evaluation of teacher professional development). c) Development of TPACK (consisting of the themes of TPACK development in web-based environments, TPACK development using a reflective approach, and development of learning theories and curricula through TPACK). d) Application of TPACK (consisting of the themes of TPACK application to improve writing skills, TPACK application to improve grammar skills, TPACK application to integrate emerging technologies, and TPACK application to transfer knowledge).
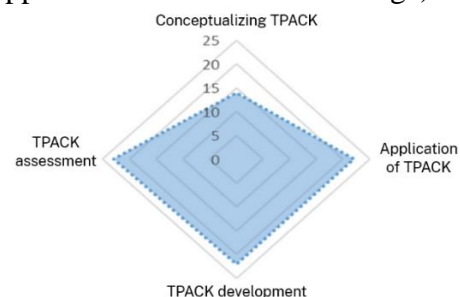

Figure 7. Radar chart of qualitative analysis

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The analysis primarily covered studies conducted both inside and outside Iran, totaling 18. The majority (15) were conducted outside Iran, leaving only 3 within the country. Among the non-Iranian studies, a notable number (7) centered on Taiwan. Geographically, most studies took place in Asia. Findings exhibited some diversity, possibly stemming from variations in samples and research methods. Nevertheless, qualitative data consistently underscored positive outcomes linked with TPACK implementation.

An analysis of the 18 articles revealed four main research areas: a) Exploration and description of TPACK, b) Assessment of TPACK levels among teachers, c) Development and expansion of TPACK through various means, d) Implementation of TPACK to enhance teachers' professional development. The majority of studies (15 studies) involved in-service English language teachers. Researchers primarily employed a mixed quantitative-qualitative approach (17 studies), with some studies utilizing qualitative methods (two studies). The Likert scale (5- or 9-point) was the most common measurement tool (12 studies).

The research focused on two main areas: a) Identifying innovative methods for TPACK evaluation and measurement and b) Investigating and understanding differences in TPACK levels among various teacher groups (beginner vs. experienced, pre-service vs. in-service) to improve their TPACK. Figure 7 summarizes the thematic density of the extracted themes, indicating a focus on establishing a foundation for TPACK assessment, followed by TPACK development and application. Conceptualization received the least attention.

4. Discussion and Conclusion

In recent years, the TPACK framework has gained significant traction as an educational approach, highlighting the crucial link between education and technology. It has captured the interest of researchers and English language teachers alike. However, a persistent challenge remains the lack of a clear and practical understanding of TPACK and the limited incorporation of this approach into the professional development programs for English language teachers. This study aimed to delve into the TPACK (Technological Pedagogical Content Knowledge) of English language teachers through a systematic review. Initially, 18 articles meeting specific criteria were selected for analysis. Through this process, key concepts were identified, leading to the delineation of relevant axes and subsequent thematic analysis. Four overarching themes emerged from this classification: conceptualization, evaluation, development, and application, representing the focal points of the reviewed research.

Accordingly, it is important to emphasize that the emergence of emerging technologies and the growing landscape of the digital age have presented teachers with significant challenges. From this perspective, technology plays a pivotal role as a catalyst for enhancing the effectiveness of education and facilitating optimal learning experiences for students in the classroom. In this context, TPACK has emerged as a notable approach,

specifically designed to address the multifaceted challenges faced by teachers. By examining the history of the TPACK framework, one can acknowledge the significant role that Mishra & Koehler (2006) played in its development based on Shulman's model (1986) (which was based on pedagogical content knowledge). They introduced the concept of technological pedagogical content knowledge (TPACK) to show how different forms of teacher knowledge can be achieved through the integration of technological knowledge, pedagogical knowledge, and content knowledge. The TPACK framework (Mishra & Koehler, 2006) serves as a theoretical foundation, and research following the introduction of this framework has shown that it can be adapted, extended, and strengthened to include additional variables. In other words, it can be personalized to enhance or limit the integration of technology into a teacher's instruction (Chai et al, 2013; Voogt et al. 2013). Despite this, numerous studies have been conducted in various educational fields around the world that examine the use of TPACK to effectively address the challenges of teachers' teaching and learning in their classrooms. Additionally, many studies in various teaching sciences have been conducted on the use of TPACK throughout the educational world to address the challenges of teachers' classroom teaching and learning. Based on reviews of databases, there were 124 indexed studies, which shows the importance and necessity of this educational training approach.

To clarify the findings, it should be acknowledged that the commonalities and differences between the research conducted in the discussion and results, and their comparison and integration with each other, can further open up the perspective of future researchers on the above topic. Based on these findings, it is necessary to discuss TPACK from the perspective of different types of knowledge in the three main components proposed by Koehler and Mishra (2008):

The first component of TPACK is technological knowledge (TK), which is crucial in teachers' professional knowledge systems. Given the wealth of online resources available for learning English, TK holds significant importance in English language teaching. English, being a foreign language, differs from other subjects, as it is acquired as a tool for study or work. Consequently, proficiency in speaking and listening is essential. Mere comprehension of English and a sufficient vocabulary are insufficient to help students develop these skills. Teachers must create a classroom atmosphere that mirrors a natural English environment, allowing students to engage with and practice authentic English. Achieving such an environment necessitates teachers' technical proficiency in utilizing audio and visual resources.

The second component is technological content knowledge (TCK). Content knowledge refers to a basic understanding of a subject that is widely known by teachers (Cochran-Smith & Lytle, 1999: 254). In the context of English language instruction, English itself serves as the subject matter.

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When teachers integrate technology into their teaching methods, such as using TCK, they have a deep understanding of how technology can transform the subject matter or the different representations that can be used (Koehler & Mishra, 2008: 16). This means that English teachers can select, modify, apply, and integrate specific technologies that are aligned with the content they intend to teach. In other words, individuals with strong TCK can determine the appropriate content for instruction based on the available technology.

The third and final component, Technological Pedagogical Knowledge (TPK), highlights a crucial aspect of teaching proficiency. Seasoned educators, equipped with a comprehensive grasp of various teaching methodologies and communication techniques, set themselves apart from novices (Nilsson, 2008). Particularly in the realm of English language instruction, the adept incorporation of technology into pedagogy serves as a key indicator of teaching efficacy. Mishra et al. (2009) elaborate that TPK entails familiarity with a diverse array of tools tailored to specific educational objectives, coupled with the skill to judiciously select and deploy these tools to optimize learning outcomes. Essentially, TPK encapsulates proficiency in pedagogical techniques along with the adept integration of technology into instructional strategies.

To further clarify the findings of this study, it should be noted that the present systematic review reveals that most articles have been conducted to identify the knowledge base of TPACK of language teachers through surveys and understand how TPACK-based interventions have affected the development of TPACK of teachers. This finding has led to several studies that have dealt with the development and validation of survey instruments for assessing the TPACK of teachers.

It is worth noting that TPACK research has provided valuable insights into the varying levels of teachers' confidence in their TPACK competence. These studies also shed light on how teachers' TPACK aligns with the prevalent use of technology in traditional teacher-centered teaching methods. Additionally, research related to TPACK assessment indicates that the boundaries between the seven TPACK subcomponents are blurred by specifying content strategies and technologies in survey items. The development of TPACK instruments can also be guided by examining the structure of TPACK itself. In terms of interventions, research on TPACK development highlights the effectiveness of specific approaches, including increasing English teachers' understanding of the TPACK framework, providing models such as teacher coaches or experienced teachers, and involving English teachers in collaborative lesson design. These interventions are effective in fostering TPACK growth. Finally, the reviewed research emphasizes the value and effectiveness of language education courses and platforms that incorporate TPACK information, as these resources serve as valuable tools for equipping English teachers with the knowledge and skills necessary to

effectively integrate technology into their teaching practices.

Several studies have shown a significant difference in the level of TPACK understanding between novice and experienced English teachers. Novice teachers demonstrate higher levels of skill in technical knowledge, technological content knowledge, pedagogical technological knowledge, and overall TPACK; however, they have lower levels of skill in pedagogical and content knowledge. On the other hand, experienced teachers have a stronger understanding of pedagogical knowledge and pedagogical content knowledge, but they have lower levels of skill in technical knowledge and its various aspects compared to novice teachers. Other research has also shown that novice and experienced English teachers conceptualize TPACK and its subcomponents differently. Novice teachers have a comprehensive understanding of technology, but their limited experience hinders the depth of their pedagogical and content knowledge.

In this interpretation, there appears to be a notable disparity between teachers' comprehension of the seven TPACK elements and their ability to effectively utilize them in crafting technology-integrated lessons for enhanced 21st-century learning. Consequently, insufficient research has been conducted to delve into and expand upon the theoretical underpinnings of TPACK. This lack of exploration extends to its relationship with other theoretical frameworks and the diverse factors impacting successful technology integration in classrooms. This critique suggests the necessity for further

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theoretical exploration into the cognitive nature and processes intrinsic to developing TPACK. While the TPACK framework outlines the requisite knowledge for integrating technology, there remains a gap in understanding how to refine this process, which has not been adequately addressed in some research endeavors. In essence, while the framework delineates the types of teacher knowledge essential for technology integration, it lacks comprehensive guidance on how teachers, trainers, and researchers can cultivate more robust TPACK. This gap warrants deeper investigation. Moreover, additional studies are warranted to scrutinize English language teachers' reflections on their utilization of TPACK.

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A systematic review of Technological Pedagogical Content Knowledge (TPACK) of EFL teachers

This research paper embarks on an extensive and meticulous examination aimed at delving into the realm of Technological Pedagogical Content Knowledge (TPACK) among educators of English as a foreign language. Its primary goal is to augment the existing knowledge reservoir within this domain by subjecting qualitative data to a comprehensive synthesis research methodology. To ensure a thorough analysis, a wide array of relevant sources was amassed from international databases, utilizing appropriate keywords. This rigorous selection process led to the identification of 18 articles deemed suitable for thorough examination. The quality of the gathered data underwent meticulous scrutiny, employing Cohen's kappa coefficient, a widely endorsed metric for assessing inter-rater reliability. The resulting coefficient of 0.76 signifies a substantial consensus among researchers, thus bolstering the credibility of the findings. Through this statistical validation, the research establishes a solid foundation upon which to build its subsequent analyses and conclusions. The findings of this systematic

review divulge that previous research on TPACK has predominantly centered on four key areas: review, evaluation, development, and application. Within these domains, studies have primarily focused on two main facets: assessing educators' TPACK and devising innovative methodologies for measuring

its proficiency, while also exploring variations in TPACK levels among different teacher demographics to enhance their competency in this domain. This nuanced understanding of the landscape sheds light on both the breadth and depth of inquiry into TPACK, providing valuable insights for educators and researchers alike. One significant conclusion drawn from this inquiry is the lack of insight into how English language instructors can effectively leverage the seven dimensions of TPACK to facilitate technology-integrated lessons and enhance student learning outcomes. While existing research underscores the importance of TPACK, there remains a critical need for further exploration and guidance on adeptly integrating technology into language pedagogy. This acknowledgment of gaps in the current literature serves as a call to action for future research endeavors, highlighting areas ripe for investigation and innovation. Furthermore, this research endeavor strives to provide invaluable insights for future scholars in this field by identifying research gaps and limitations in the current literature, thus laying a robust foundation for subsequent inquiries. The overarching aspiration is to enrich the evolution of the TPACK framework and promote effective technology integration in English language instruction. In summary, this systematic scrutiny of TPACK studies among educators of English as a foreign language offers a comprehensive assessment of the current research landscape. By delineating focal points and highlighting knowledge gaps, it provides invaluable guidance for practitioners and scholars alike, advancing efforts to optimize technology utilization in language education and setting the stage for future research endeavors. Given the relentless advancement of technology, staying informed about optimal technology integration practices in language pedagogy is imperative, and this research paper serves as a cornerstone resource, furnishing a robust platform for further exploration and refinement in the TPACK domain. The insights gleaned from this study are poised to shape the trajectory of TPACK research, informing instructional practices and contributing to the ongoing enhancement of language education worldwide.

Appendix

Table 3. Introduction of reviewed articles and summary of their results

Row	Author / year	Country	Method	Simple	Scale	Result
1	Tseng, J. J., Cheng, Y. S., & Yeh, H. N (2019)	Taiwan	Qualitative analysis of interviews	6 English teachers	Coding	Teachers' discussions indicated a bias toward pedagogical content knowledge, as opposed to technology-based knowledge. Notably, their discussions were not particularly related to technological pedagogical knowledge.
2	Tai, H. C., Pan, M. Y., & Lee, B. O.			51 nursing students in the first four semesters of	6-degree	Students' writing proficiency significantly improved in each dimension after instruction with TPACK. Only half of the learners preferred online writing compared to

	(2015)	Taiwan	A single group experimental study	the two-year course	scale	traditional handwritten writing. Participants reported that they preferred to receive feedback from teachers rather than peers, but disliked indirect feedback.
3	Wang, A. Y. (2022)	Taiwan	Two-dimensional scale and report of confidence and thinking skills	525 English teachers	The two-dimensional structure of EFL-TPACK	English language teachers in different cultures reported varying levels of confidence in TPACK and thinking skills. High-achieving English language teachers reported high TPACK self-efficacy.
4	Belda-Medina, J., & Calvo-Ferrer, J. R. (2022)	Spain	Sequential method (quantitative and qualitative) through presentations and project reviews	85 college students who were placed in different teams.	Framework (TPACK) and (ARAAS)	Statistical data and qualitative findings revealed that participants lacked practical knowledge of creating and implementing AR content in education. The main issues revolved around the intersection of TPK (Technological Pedagogical Knowledge), as participants had previously been trained in AR technology as recipients rather than as content creators and instructors.
5	Wu, Y. T., & Wang, A. Y. (2015)	Taiwan	Qualitative method (interviews and classroom observations)	22 English teachers working in primary schools	Modified Bloom's classification	English teachers need more technological knowledge to further develop their TPACK, and TPACK of English teachers focuses more on motivating students rather than using technology to create opportunities for meaningful and authentic use of English language.
6	Kulaksız, T. (2023)	Germany	Mixed method	37 English teachers	Five-point Likert scale	The technological pedagogical content knowledge (TPACK) of teachers showed a significant difference before and after the course, and the strategies of online information search evaluation, selecting main ideas, and trial and error were significantly improved.
7	Tseng, J. J (2014)	Taiwan	Evaluation of exploratory factor analysis	257 Taiwanese students from classes of three English teachers in high school	Multi-point Likert scale	The results showed that the TPACK instrument is a valid and reliable tool for measuring English language learners' understanding of their teachers' TPACK. Finally, suggestions are provided for future studies concerning the use of the TPACK instrument in evaluating teachers' TPACK.

8	Baser, D., Kopcha, T. J., & Ozden, M. Y. (2016)	Turkey	Mixed method (qualitative-quantitative)	378 pre-service English language teachers	9 - point rating scale	In the first round, five factors were identified: technology knowledge, content knowledge, pedagogical knowledge, pedagogical content knowledge, and a combined factor for TCK, TPK, and TPACK. After reviewing the survey, the second round revealed a consistent seven-factor structure aligned with the TPACK framework.
9	Hsu, L. (2016)	Taiwan	Descriptive method-correlation with structural equations	158 serving Taiwanese English teachers	7- point Likert scale	It was found that TPACK significantly impacts perceived ease of use (PEU) and perceived usefulness (PU). PEU significantly impacts PU, which has a significant effect on attitude toward use (ATU) and continued use.
10	Bostancıoğlu, A., & Handley, Z. (2018)	International	Evaluation research in the direction of developing and validating the EFL-TPACK questionnaire	542 English teachers (188 men and 351 women)	Three-point rating scale	The findings support approaches to English language teacher education that seek to integrate TK, PK, and CK, rather than introducing them in isolation, and demonstrate ways in which emerging and established technologies can be used to represent language.
11	Nazari, N., Nafissi, Z., Estaji, M., & Marandi, S. S. (2019)	Iran	A Mixed study (qualitative and quantitative) using the TPACK framework	427 English teachers	A nine-point Likert scale	Limited findings indicated that experienced teachers scored higher in terms of pedagogical knowledge and subscales of content knowledge for education. In contrast, novice teachers scored higher in terms of technological knowledge, technological content knowledge, pedagogical technological knowledge, and TPACK. Qualitative findings revealed that novice and experienced English language teachers welcomed different professional development programs tailored to their needs.
12	Turgut, Y. (2017)	Turkey	Mixed study (TPACK survey with open questions)	174 English language students in a teacher training program	Five-point Likert scale	Based on the open-ended questions survey data from the TPACK survey, the study findings indicated a nonlinear pattern of TPACK development over time. In line with these findings, suggestions were made for teacher educators, policymakers, and future research.

13	Nazari, N., Nafissi, Z., & Estaji, M. (2020)	Iran	Mixed method (quantitative and qualitative) - Sequential Descriptive	30 English language teachers (15 beginners and 15 experienced) in English teaching academies located in Tehran	TPACK-EFL survey with 9-point Likert scale	The online course has had a significant impact on English language teachers' TPACK, except for PCK in both the beginner and CK groups. Qualitatively, the results showed that all interviewees had a positive attitude towards the course. Additionally, themes related to the distinguishing features of the course, the challenges they faced, and the aspects of TPACK that they had improved were present in their responses.
14	Hsu, L., & Chen, Y. J. (2023)	Taiwan	Assessment and survey about TPACK	492 English teachers and 112 principals from 71 schools in Taiwan	Hierarchical linear modeling	The three elements of TPACK significantly influenced teachers' TPACK. The DOI background factor was found to significantly impact English language teachers' TPACK. This impact was negatively related to teachers' technical knowledge; however, it was not significantly related to their pedagogical and content knowledge.
15	Reza Adel, S. M., & Azari Noughabi, M. (2023)	Iran	Interpretive qualitative design (semi-structured interview, field notes, and classroom observation)	4 pre-service English teachers who were preparing to teach intermediate courses.	Coding (open, axial and selective)	Enriched teacher training programs can help pre-service English language teachers reflect on their teaching practices and develop their PCK. Additionally, analysis of observational data revealed that enriched teacher training programs can primarily impact pre-service English language teachers' knowledge of teaching strategies as one of the core subdomains of PCK.
16	Budianto, L., Arifani, Y., Wardhono, A., & Poedjiastutie, D. (2023)	Indonesia	Mixed research (quantitative and qualitative) with an assessment of the comprehensive perspective of TPACK	120 high school English teachers, 360 students and five English teachers with Ph.D	Likert scale - coding and classification	Quantitative findings revealed different perceptions among students, teachers, and trainers about the level of CK, TPK, PCK, and TPACK competencies of teachers. Qualitative results showed that familiarity with basic hardware, research in English, intercultural awareness, authentic language problem-solving, and learner engagement and adaptation to cultural events and environments are needed to strengthen future TPACK practices.

17	Lachner, A. & et al. (2021)	Germany	A quasi-experimental field study	208 pre-service English teachers	A four-point Likert scale	Pre-service teachers in courses with TPACK modules were found to gain more TPACK than teachers in control courses without TPACK modules. Additionally, significant effects were found for pre-service teachers' technology-related self-efficacy and their perceived support for technology integration.
18	Abubakir, H., & Alshaboul, Y. (2023)	Qatar	Descriptive research design and quantitative data collection using a self-report survey	182 English language teachers in service	A two-part web-based survey	Significantly, male teachers demonstrated a higher level of technical knowledge than female teachers. Furthermore, the results indicate that teachers with 1 to 5 years of experience scored the highest in technology knowledge, and teachers who received professional development outperformed their peers in TPACK.