ATU PRESS

ISSUES IN LANGUAGE TEACHING (ILT)
VOL. 12, NO. 2, 1-30, December 2023
https://doi.org/10.22054/ilt.2023.72069.754
Document Type: Research Paper

Factors Determining the Technological Pedagogical Content Knowledge (TPACK) of the Iranian Pre-Service English Teachers

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Received: March 23, 2023**; Accepted:** August 30, 2023

Abstract

This study aimed at describing the variables influencing pre-service EFL teachers´ technological pedagogical content knowledge (TPACK). A descriptive correlational design was used to meet the objective of the study, therefore, 203 (82 male and 120 female) fourth-year student teachers at Teacher Education University were selected through convenience sampling method. A questionnaire including seven sections and 39 items, each of which measuring an aspect of TPACK, was utilized. The sections of instrument were borrowed from those validated by Sahin (2011) for evaluating content knowledge (CK), pedagogical knowledge (PK), pedagogical content knowledge (PCK), and technological knowledge (TK), and by Chai, et al. (2011) for measuring TK, technological pedagogical knowledge and TPACK. Path analysis and Pearson correlation were used for inferential statistical analysis. Results showed that there existed significant positive correlations between the TPACK constructs. Additionally, CK and PK, unlike TK, were found to have a direct impact on TPACK. Moreover, it was found that, among the measured variables, CK had the greatest total effect on TPACK whereas that of PCK was the minimum. Therefore, the results of this study have implications for curriculum design, policy decisions and teacher education planning.

Keywords: Farhangian University, Pre-service English Teachers, TPACK

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INTRODUCTION

The great growth of information and communication technology (ICT) and the widespread use of global information networks that have increased the speed and quality of service delivery are the hallmarks of the 21st century. Advances in ICT not only affect many aspects of human life but also have a significant impact on education. Therefore, experts believe that integrating technology into educational content and methods is necessary to prepare would-be teachers for future classes. However, studies show that classrooms equipped with technology do not always use technology effectively (Kim et al., 2013). For example, while many teachers use smart boards to present course content without interacting with students, others use smart boards for student-based research processes (Hall, 2010).

Preparing teacher candidates for classroom ICT integration has been the focus of teacher education programs, especially for the last two decades. For example, Chai et al. (2010) examined prospective teachers' perceptual development in terms of a combination of different aspects of teacher knowledge, known as technological knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK). After reviewing the questionnaire, they measured prospective teachers' perceptions of the TPACK before and after the ICT course and reported a statistically significant increase with good effect sizes. They also found that TK, PK, and CK were significant predictors of technological pedagogical and content knowledge (TPACK) for prospective teachers, with PK having the greatest impact. Regarding the TPACK framework, Pamuk (2012) discussed the barriers to pre-service teachers' success in technology integration and identified the difficulties encountered in making new knowledge. The deficiency of educational experience limits the growth of the right technology combination methods. He believes the PCK development is a vital element of general technology integration. Teachers should prioritize acquiring a PCK before integrating technology. In short, PCK development in pre-service teacher education needs to be supported by applied teaching experience.

The limited use of technology as an instrument for presenting content only through classroom management tools, rather than research-based learning facilitators, take flipped instruction as an example (Jong, Chen, Tam, Hue, & Chen, 2022), is assumed to be due to the absence of belief in teacher education and a lack of motivation (Kim et al., 2013; Kim & Keller, 2011). Many researchers have concentrated on teacher knowledge and on how to develop teacher knowledge, how to utilize technology in the classroom, and how to successfully integrate technology into national education, as well (Koehler & Mishra, 2009).

Recent studies have shown that neglecting teachers' PK, PCK, and technology integration knowledge can result in technology misuse in education (Maghsoudi, 2021). In addition, it is known that teacher training programs should provide general teachers and professional teacher candidates with the opportunity to acquire comprehensive CK, PK and TK (Lee & Kim, 2014). To this end, the TPACK framework aims to provide a theoretical basis for demonstrating the requirement for teachers to improve full technical knowledge.

The TPACK framework is designed to increase teacher awareness of the use of technology to improve student learning. The framework emphasizes a combination of the CK, PK, and TK. The model emphasizes that teachers need CK and educational knowledge of teaching methods and strategies, as well as knowledge of computer technology, the Internet, and video footage. They also need to keep up with technological developments. This framework helps teachers design and evaluate education so that they can combine educational CK with technical knowledge (Kaya & Dağ, 2013). The framework also emphasizes the use of technology to support learning difficulties and use students' current and current knowledge to improve new knowledge (Koehler et al., 2014).

TPACK, as a new form of knowledge, moves beyond the three components (PCK, TPK, and TCK) (Mishra & Koehler, 2006). This type of knowledge shows how technology tools affect content and pedagogy, how technology can be used to enhance existing knowledge, and how new

epistemology can be created or developed (Mishra & Koehler, 2006).TPACK demonstrates that there is no single solution that can be applied to any teacher, curriculum or perspective. It provides the basis for establishing a specific educational strategy (Mishra & Koehler, 2006). TPAK is considered the foundation of excellent education using technology.

Many studies have been done on the contribution of various variables to teacher TPACK, but it has been found that CK, PK and TK, and their overlap determine pre-service English language teachers' TPACK. More research is needed to explore the dynamics of TPACK framework and determine how different variables may contribute to pre-service teachers' TPACK development. For example, Yurdakul (2018) admits that pre-service teachers are highly competent in both digitally native and TPACK skills and shows that digital native skills are an important predictor of TPACK. Scherer et al. (2018) found that attitudes towards technology were positively related to TPACK's self-confidence, but there was a difference between attitude and TPACK dimensions. Joe et al. (2018) also showed that TPACK has a significant effect on self-efficacy perceptions and ease of technology use for teachers and prospective teachers. The teacher's TPACK also positively affected the ease of technology use. However, enough research has not been done in Iran to discover the existing relationships between TPACK components and how to create TPACK for pre-service teacher. This study may be considered an attempt to fill the existing gap in the related literature on the variables influencing Iranian pre-service teachers' TPACK.

In the present study, a model has been developed to examine the role of effective factors on Iranian pre-service EFL teachers' TPACK and to examine the effects of CK, PK, TK and the interactions resulting from these bodies of knowledge on TPACK of pre-service teachers who are going to be recruited in high schools in Iran. This research is significant since its results can be a clear guide to increasing teachers' TPACK need, which in turn will ultimately improve their learners' learning outcomes. Many qualitative studies have been conducted on various topics related to TPACK but, little, if any, research has been done on the effect of these components on EFL pre-service teachers'

success in Iran. This is of special significance, especially for the pre-service teachers covering the curricular requirements specific to Farhangian University which is unique to Iranian context. That is, it was hoped that this research would present an image of the dynamics of the current status of TPACK development which results from the current curricular requirements at Farhangian University. Therefore, the present study focuses on presenting a causal model of the role of effective factors on pre-service EFL teachers' TPACK in the context of Farhangian University. Accordingly, the following research question guided this study:

> To what extent do the six components of the TPACK model proposed by Mishra and Koehler (2006), determine the current TPACK of the pre-service English teachers at Farhangian Teacher Education University?

LITERATURE REVIEW

The TPACK framework is an extension of Shulman's idea of PCK. Schulman introduced the concept of PCK to the education community at the 1986 annual meeting of the American Education and Research Association. Shulman (1986) defines PCK as the most useful form of content expression and the strongest metaphor for teacher education. According to him, this knowledge includes understanding what facilitates learning a particular subject, such as the perceptions and attitudes faced by students of different ages and backgrounds when learning a particular subject.

The PCK Framework is a valuable and effective model for examining teacher education and learning. The basis of this knowledge is that general PK and CK are independent, but common parts of the two knowledge systems form their own new knowledge. This theory is very controversial and difficult to study for researchers as it contains conceptual and behavioral knowledge and is difficult to observe and measure. As Atai, Babaii and Taherkhani (2017) mentioned, PCK is among the most crucial categories of knowledge a

teacher must possess, since “it represents the blending of content and pedagogy into an understanding of how particular topics, problems, or issues are organized, represented, and adapted to the diverse interests and abilities of learners, and presented for instruction”. Schulman's basic model includes specific areas of knowledge such as understanding what is being taught and understanding how it is being taught (Cox, 2008).

The following year, Schulman saw PCK as one of the seven knowledge bases of teacher education and raised its position in the field of CK (Gess-Newsome, 1999). The seven knowledge bases it highlights are CK, general educational knowledge, curriculum knowledge, student knowledge, contextual and educational contextual knowledge, philosophy of education, and knowledge of historical goals (Gess-Newsome, 1999). Grossman (1990) reduced seven knowledge bases to four, including general educational knowledge, CK, PCK, and familiarity with educational context. It is believed that teaching CK from the four knowledge bases has the greatest influence on teachers' classroom behavior (Gess-Newsome, 1999).

TPACK is drawn from Schulman's PCK framework (Schmidt et al., 2009a). Mishra and Koehler (2006) argue that TPACK is the basis of a good education using technology and this knowledge requires an understanding of using technology to express concepts. TPACK includes knowing what facilitates learning the concept and how technology can help students correct their mistakes. TPACK includes background knowledge, student prior knowledge and epistemology, and how technology can build new epistemology based on existing knowledge or enhance previous epistemological knowledge. TPACK framework includes three components: TC, AB and PK, and the interaction between these three components gives PCK, TPK and TCK as well as TPACK (Schmidt et al., 2009b) (Figure 1).

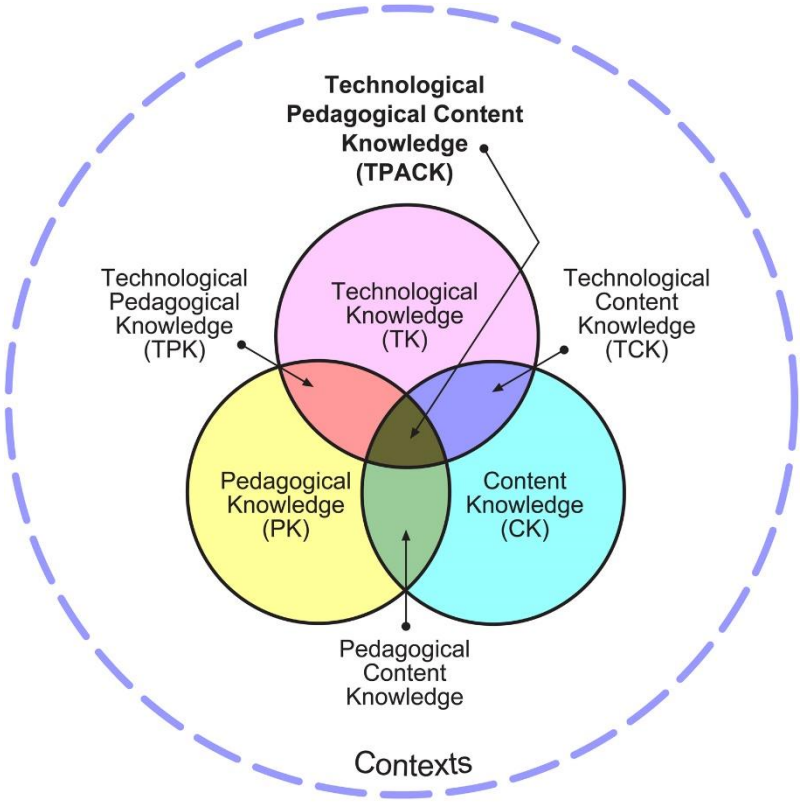

Figure 1: TPACK model proposed by Mishra and Koehler (2006)

CK is associated with all subjects that teachers are responsible for teaching (Koehler et al., 2014). This includes the concepts, ideas and theories of an organization's framework, knowledge of evidence and proof, and knowledge of how to develop knowledge. PC is the teacher's knowledge of teaching methods, strategies and methods that facilitate students' learning (Koehler et al., 2014). This general form of knowledge is concerned with classroom management skills, lesson planning, and student evaluation (Schmidt et al., 2009b). TK is the knowledge of acquiring and using technology (Forbes & Davis, 2007). In general, TK includes knowing about using aids such as books, chalk, and blackboards, as well as more advanced skills such as hiring

the Internet, video images, and various methods of providing information (Polly et al., 2010).

PCK is beyond the knowledge of a particular subject and is composed of knowledge of content and educational knowledge (Wardani et al., 2020). PCK is the knowledge that is determined by the specific field and subject being taught. It covers the educational content, teaching, learning, curriculum, evaluation and reporting of a specific subject of teaching. The importance of PCK is based on ideas, previous knowledge of students, replacement of teaching strategies and flexibility in the classroom (Hosseini& Kamal, 2012). For example, in language education, in addition to CK, special teaching methods for problem-solving, provoking creativity and developing learners' new ideas are complementary to good teaching.

TPK is an extended form of TK and PK and is knowledge of using technology in order to effectively implement different teaching methods. As Valtonen et al. (2020) believe, this knowledge is related to the general understanding of the application of technology in education, without the use of specific content. TPK is the knowledge of how to use different technologies in teaching, knowledge of how to change teaching as a result of using technology and knowledge of the effectiveness of technological strategies to achieve an educational goal (Shin et al., 2009). TCK is an extension of content and technical knowledge. TCK is the knowledge of presenting content using technology (Chai et al., 2011). For example, computer animation can be used to help students tell a story. This knowledge is about understanding technology that applies to all situations, whether in the classroom or at work.

Chai et al. (2011) investigated the structural validity of the TPACK study, contextualizing the teaching methods adopted in the 12-week ICT course designed by the TPACK framework for teacher candidates in Singapore. Using this framework, the researchers were able to discover five of the seven TPACK structures that fit the model better than some existing TPACK research studies. Using these results, they constructed pre- and post-class structural equation models and explained the relationships between the

various constructs recognized by TPACK teachers. They found that at the beginning of the course, PK had a direct effect on TPACK. When the teacher connects TB and PK in the lesson to create a TPK, the direct relationship between PC and TPACK is simplified and the relationship between PC and TPK and TPK and TPACK is strengthened. Comparison of the pre-lesson and post-lesson models also showed that the prospective teachers' perceived relationship between PE and TPACK changed from unnecessary to important. Joe et al. (2018) examined the structural relationship between TPACK, teacher self-efficacy, awareness of the ease of use and awareness of the usefulness of teacher candidates who plan to use technology on the basis of the Technology Acceptance Model (TAM). The results show that pre-service teacher TPACK has a significant effect on teacher self-efficacy and technology usability. The teacher's TPACK also had a positive impact on the ease of use and usefulness of technology in the classroom. Finally, teachers' self-efficacy, awareness of the ease of use, and awareness of the benefits of using the technology affect teachers' willingness to use technology. However, TPACK did not directly affect the intention to use the technology.

Schmid, Brianza and Petko (2021) investigated if variation in using digital technologies is correlated with TPACK as reported by 173 pre-service teachers. The results of Logistic and multinomial regression analysis displayed gender, age, and subject group do not influence the TPACK components; however, subject group emerged as the only significant predictor. Moreover, the results indicated significant correlations between the TPACK components and the technology use. Tondeur, Scherer, Siddiq and Baran (2020) in their two-step mixed-method study explored if the strategies used to improve pre-service teachers for technological pedagogical content knowledge (TPACK) are effective. The results indicated direct correlations between the use of synthesis of qualitative evidence model and the TPACK development. Kulaksız and Karaca, (2023), conducting a mixed-method study, revealed that administrative support, professional development, teachers’ attitudes and beliefs influence can significantly affect TPACK.

METHODOLOGY

Based on the nature and purpose of this research, it can be argued that this study was a descriptive correlational research because the relationships of six variables, namely, CK, PK, TK, PCK, TCK, and TPK were tested in the form of a causal model via path analysis.

Participants and Sampling

The statistical population studied in this research was all the Iranian EFL pre-service teachers at Farhangian University who were studying fourth-year courses (N = 203). The number of participants was considered adequate for the purpose of this study, according to the Tabachnick and Fidell (2001), and Tomarken and Waller (2005) who considered the minimum of 100-150 participants enough for running equation modeling. Among these students, 138 student teachers were selected via convenience sampling method from different provinces of Iran as Markazi, Tehran, Khozestan and Kerman. The students came from different social and economic backgrounds. In addition, they included both male (n= 82) and female (n= 121) student teachers. They were all informed about the purpose of the study.

Instruments

To collect data from the participants, Sahin's (2011) questionnaire was used to measure the variables of CK (n = 8), PK (n = 7), PCK (n = 5) and TCK (n = 5), and Chai et al.'s (2011) questionnaire was used for assessing the variables of TK (n = 4), TPK (n = 6), and TPACK (n = 4) (see Appendix). The reason behind using different parts from two questionnaires for measuring TPACK was that the results from the pilot study conducted on 34 participants showed that the reliability indices of the data collected via some parts of these two questionnaires were not above the desired level. Cronbach's alpha was used to measure the reliability of the data and the indices below .70 were considered to be undesirable (Tinsley & Weiss, 2000). The participants

were asked to answer each item on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Cronbach's alpha coefficient was used to evaluate the reliability. The observed coefficients revealed that CK (α = .84), PK (α = .89), TK (α = .88), TPK (α = .89), PCK (α = .75), TCK (α = .90) and TPACK (α = .91) were all reliable. These values indicate the internal reliability of the parts of the questionnaire used in this study and also indicate that they were suitable tools for measuring research variables. Confirmatory factor analysis was used to assess the construct validity of the questionnaire. Accordingly, the factor loading indices of these variables as showed that the observed values CK (.74), PK (.81), TK (.71), TPK (.88), PCK (.78), TCK (.80) and TPACK (.77) indicated the desirable construct validity of the questions related to these variables.

Procedure

The study began by confirming the reliability and validity of the instrument for data collection. To this end, a body of research on teachers' TPACK conducted in the field of education was reviewed. Having found reliable and well-referred instruments, i.e. the TPACK questionnaires developed by Sahin (2011) and Chai et al. (2011), the researcher piloted them among the group of 34 participants in order to testify the reliability of the instrument in the context of the study. Having piloted these two instruments, the researcher selected the sections with desirable levels of reliability. Then four experts in language teaching were requested to study the final merged questionnaire for further clarification and understandability. Having revised some small parts such as wording and merging some items, the researcher approached the participants of the current study who were passing their fourth-year courses at Teacher Education University from different provinces.

Having informed the participants about the aims of this study and the procedure of data collection, they were requested to fill out the online questionnaire which was accessible in Google Forms format. The participants

were asked to express their status and condition regarding each item of the questionnaire. After the data had been collected, they were transferred into SPSS version 21 and correlational analysis was conducted. Moreover, AMOS version 18 was used to conduct path analysis.

RESULTS

Descriptive and inferential statistics were used for further data analysis. The results of descriptive statistics confirmed the normality of distribution (Table 1). Accordingly, correlation analysis and path analysis were used to analyze the research data. The results of descriptive analysis are shown below.

Table 1: Descriptive Statistics of the Variables of the Study

	Descriptive Statistics				Kolmogorov-Smirnov Test		
Variables	Min	Max	Mean	*SD*	*Z*	*N*	*p*
CK	11	31	15.27	4.09	.10	203	.20
PK	12	28	17.45	5.59	.08	203	.20
TK	14	19	16.09	3.54	.10	203	.20
TPK	14	23	19.27	4.31	.11	203	.07
PCK	9	16	12.59	3.81	.16	203	.20
TCK	15	23	18.36	3.77	.09	203	.20
TPACK	11	18	16.40	2.59	.15	203	.09

Since the basis of path analysis studies is correlation analysis between variables, the correlation matrix of the research variables is given below in Table 2.

Table 2: Correlation Matrix between the Variables of the Study

Variables	CK	PK	TK	TPK	PCK	TCK	TPACK
CK	1						
PK	.71**	1					
TK	.44**	.30**	1				
TPK	.47**	.40**	.70**	1			
PCK	.60**	.64**	.30**	.40**	1		
TCK	.49**	.39**	.73**	.76**	.42**	1	
TPACK	.46**	.43**	.63**	.78**	.42**	.79**	1

**p = .00 <.01

According to Table2, among the exogenous variables of the model shown in Figure 1, namely, TK (r = 0.63, p = .00 < .05), is strongly correlated with TPACK; however, CK (.46, p = .00 < .05) and PK (.43, p = .00 < .05) have a weak correlation with the TPACK. All these three coefficients were statistically significant at p<0.01.Among the endogenous variables, TCK (.79, p = .00 < .05) and TPK (.78, p = .00 < .05) were strongly correlated with TPACK; by contrast, PCK (.42, p = .00 < .05) had a weak correlation with TPACK. These coefficients were statistically significant at p < 0.01, too. Table 3 shows the results of path analysis in terms of the direct effect of the variables.

Table 3: Direct and Indirect Effects of the Variables on TPAC

Variables	Direct Effect		Indirect Effect		Total Effect	
	Standardized Coefficient	t	Standard ized Coefficient	T	Standardized Coefficient	t
TK → TCK	.83**	23.38			.83**	23.38
TK → TPK	.51**	6.96			.51**	6.96
TK → TPACK			.17**	5.81	.17**	5.81
PK → TPK	.22**	3.42			.22**	3.42
PK →PCK	.46**	8.83			.46**	8.83
PK → TPACK	.23**	5.85	.07**	.30	.30**	8.13
CK → PCK	.51**	9.71			.51**	9.71
CK → TPACK	.45**	9.32	.02**	1.97	.47**	10.91
TCK → TPACK	.15**	3.18			.15**	3.18
TPK → TPACK	.20**	6.61			.20**	6.61
PCK→ TPACK	.09**	2.38			.09**	2.38

According to Table 3, it is observed that CK has the strongest direct effect (.45) and PCK has the weakest direct effect (.09) on the participants'TPACK. In addition, the results shown in Table 3 revealed that TK (.17) had the strongest indirect effect, and CK (.02) has the weakest indirect effect. However, considering the total effects of the variables of the study, it can be concluded that CK has the strongest role (.47) in determining the participants' TPACK and PCK has the weakest role. Regarding the observed total effects

in Table 3, it can be argued that CK (.47), TPK (.20), TK (.17), TCK (.15), TCK (.15) and PCK (.09) have the strongest to the lowest roles in determining the participants' TPACK.

Table 4 shows the observed statistics of goodness of fit for the data collected in this study.

Table 4: Indices of Goodness of Fit for the Predictive Variables

X^2/df	2.61
P	.15
Comparative Fitness Index (CFI)	.99
Goodness of Fit Index (GFI)	.96
Adjusted Goodness of Fit Index (AGFI)	.92
Root Mean Square Error of Approximation	.02

According to the results shown in Table 4, it can be concluded that the observed model reported so far enjoys a high level of fitness with special regard to the values reported for CFI (.99), GFI (.96) and AGFI (.92) which are all very close to one, the maximum possible observable number.

Considering the details of the results obtained in this study, the observed contribution of the six components of the TPACK model proposed by Mishra and Koehler (2006) to the current TPACK of the pre-service EFL teachers at Farhangian University can be illustrated in Figure 2. The results indicated that, unlike CK and PK, TK does not have a direct determining role in the TPACK of the participants and indirectly affects the pre-service teachers' TPACK via the TCK and TPK. Furthermore, CK strongly contributes to their TPACK both directly and indirectly, through PCK. Although the determining role of their PK is not comparable to CK, it also contributes to the pre-service teachers TPACK both directly and indirectly, through PCK and TPK.

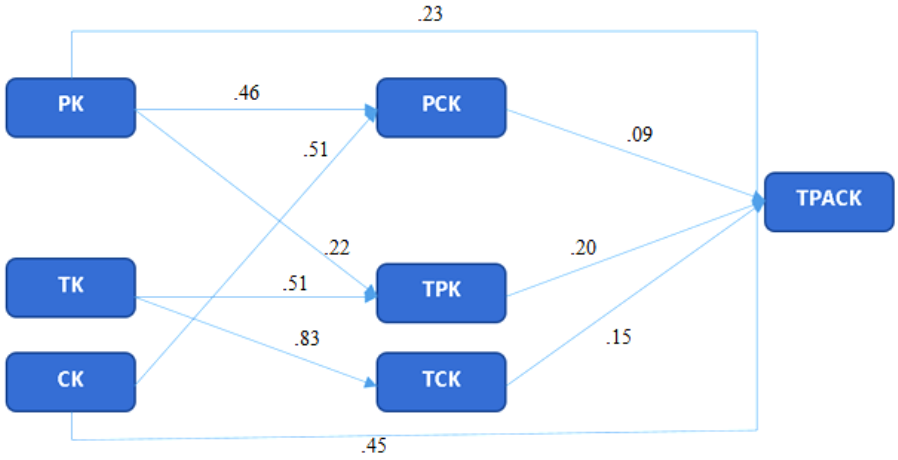

Figure 2: The Emerged Model Tested in this Study

DISCUSSION

According to the results of this study, a comparison of the direct effects of variables shows that TK has the strongest indirect effect on TPACK. This result is in line with the results of Agyei and Keengwe (2014), Joo et al. (2018), Karadeniz and Vatanartıran (2013), Koh et al. (2013), Koh et al. (2014), Pamuk et al. (2015), Sahin et al. (2013), Scherer et al. (2018), Valtonen et al. (2020), Nami (2022), and Yurdakul (2018). As a result, it can be argued that teachers who have the knowledge of technology, i.e. the knowledge of operating systems, and the ability to use standard software, such as word processors, browsers, e-mail, etc. can progress in various fields neck to neck with technological developments and efficiently use new methods in EFL classrooms.

The results on the direct effect of PK on TPACK are in line with those of Agyei and Keengwe (2014), Chai et al. (2011), Chai et al. (2013), Joo et al. (2018), Karadeniz and Vatanartıran (2013), Koh et al. (2014), Pamuk et al. (2015), Sahin et al. (2013), Scherer et al. (2018), and Yurdakul (2018). It can be concluded that a teacher with deep PK understands how students build knowledge, acquire skills and improve their learning skills, and knows what

methods to use. To make it easier for students to understand, s/he knows how to manage a class, formulate and implement a lesson plan, organize a class during teaching, and evaluate student learning. As a result, such knowledge affects the use of technology, effective implementation of different teaching methods and the teachers' understanding of educational needs and limitations of educational technology use. As a result, teachers' skills in selecting and delivering content (essential to meaningful learning activities, maintaining mastery in group discussions, and identifying and highlighting content applications to their students' lives) play a crucial role in their practice. This also confirms Taopan et al.'s (2020) findings in that teachers' confidence in teaching and learning processes or methods, including teaching objectives, classroom management skills, curriculum planning and development, has a positive effect on TPACK.

The direct effect of CK on PCK is confirmed by Chai & Koh (2017), Agyei and Keengwe (2014), Chai et al. (2012), Doukakis et al. (2011), Joo et al. (2018), Koh et al. (2013), Pamuk et al. (2015), Karadeniz and Vatanartıran (2013), and Sahin et al. (2013).This shows that a teacher with strong CK has a broader knowledge of the content and its relevance to other topics, and can, therefore, rely on this knowledge in teaching and problem-solving in different situations. This confirms that teachers need to know what concepts are difficult or easy for students to learn, and know about students' previous background. This also emphasizes the fact that teachers must be prepared to provide a clear presentation of the content, understand the concepts and theories, and possess practical skills related to the subject being taught.

Direct and significant effect of TCK on TPACK aligns with the results of Chien (2016), Valtonen et al. (2020), Petko (2018), Chai et al. (2013), Doukakis et al. (2011), Giannakos et al. (2015), Joo et al. (2018). It implies that teachers' knowledge of the subject they are teaching and appropriate technology for teaching a subject as well as being aware of how the content is affected by technology, or vice versa, is essential to their successful teaching and, as a result, better students' learning.

TPK had the strongest direct effect on TPACK which approves what was previously reported by Agyei and Keengwe (2014), Joo et al. (2018), Karadeniz and Vatanartıran (2013), Koh et al. (2013), Koh et al. (2014), Pamuk et al. (2015), Sahin et al. (2013), Scherer et al. (2018), and Yurdakul (2018). Therefore, if an EFL teacher can establish a good relationship between knowledge of hardware and software, and with teaching and learning methods including educational objectives and values, classroom management skills, lesson planning and student assessment, they would have a higher level of TPACK so that they can creatively use available technological tools in an educational field to improve their teaching performance.

According to the statistics provided for the goodness of fit, the research model has a suitable fit with the data collected from the community of pre-service EFL teachers in Farhangian University. Based on the results obtained in this study, TPACK development in this teacher training center can be illustrated as Figure 3. Therefore, it can be a good model for presenting the current level of pre-service teachers' TPACK in teacher training centers in terms of the integration of technology into the content and course syllabi of the training courses offered to pre-service EFL teachers. It is worth mentioning that a minor change was made in Figure 1, based on the results of this study; that is, considering the contribution of TK to other components of the model and TPACK, in general, its role as a direct contributor to TPACK was found to be insignificant according the analysis of the data collected from the participants of the study. Therefore, the TK circle in the model was presented colorless in Figure 3, in accordance with its role in the sample of the present study. However, considering its indirect role, as observed in the analysis reported above, the TK circle in the model overlaps PK and CK circles, indicating its contribution to TCK and TPK in the observed model and confirming the overlaps in the original model (Figure 1) by Mishra and Kohler (2009).

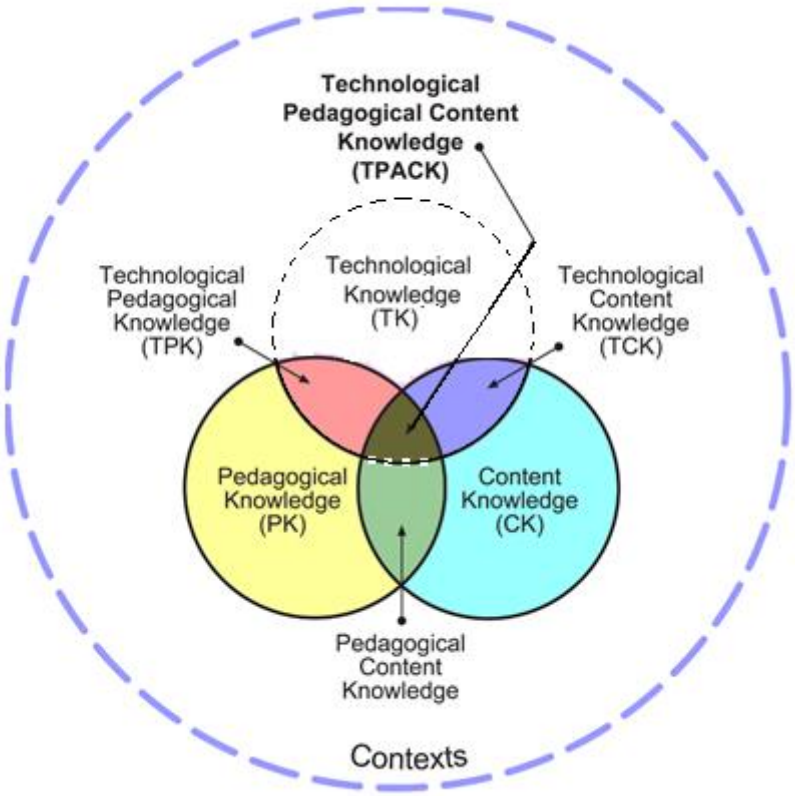

Figure 3: The current status of the pre-service EFL teachers' TPACK in Farhangian University

Regarding the emerged model, Iranian EFL teacher education centers and departments should provide programs to improve pre-service teachers' TK so that they can indirectly integrate (educational) technology into their classroom practice. In addition, it is necessary for these centers to provide the necessary tools and equipment for the would-be teachers' effective and efficient use of technology in schools.

Interestingly the result of this study is in contradiction with a few studies conducted on pre-service teachers in the past two decades. For example, unlike Chai et al. (2010), it was found that although PK and CK are significant predictors

of pre-service teachers' TPACK, TK is a poor predictor which does not directly contribute to the pre-service EFL teachers at Farhangian University. In comparison to Chai, et al.'s (2010) study which depicted a direct contribution of TK to TPACK, the present study revealed that the TK component was not as influential as it was in Chai et al.'s (2010) study. Additionally, unlike their study which identified PK as the strongest predictor, this study found CK to have the largest impact.

CONCLUSION AND IMPLICATIONS

This study was inspired by the existing gap in the research done on Iranian EFL pre-service teachers' TPACK. The ultimate purpose of this study was to explore the extent to which each of the variables included in the TPACK model, introduced by Mishra and Koehler (2006), was contributing the current TPACK of the pre-service EFL teachers who would be English teachers within a year in Iran. Accordingly, a quantitative design was adopted in order to survey the current level of TPACK components of the pre-service EFL teachers at Farhangian University, the core center for training EFL teachers in Iran. A reliable questionnaire was devised based on previously developed questionnaires and its reliability and content validity were testified. Having collected the data, correlation and path analysis were conducted. It was discovered that, CK was the strongest determinant of the participants' TPACK (.47) whereas PCK was the weakest (.09). To sum up, CK, PK, TPK, TK, TCK, and PCK have the strongest to lowest determining roles in predicting the Iranian pre-service EFL teachers' TPACK.

These findings have a number of implications for teacher training programs in Iran, especially those implemented at Farhangian Teacher Training University. First and foremost, the results implied that there is an imbalanced model in terms of the shares of the variables determining pre-service teachers' TPACK. For example, the contribution of CK to the current status of TPACK among pre-service teachers is far beyond that of TK which means the current student teachers are leaning toward empowering

themselves in terms of the subjects they are going to offer rather than investing in how they can employ the current technologies and upcoming hardware or software to deliver the contents more efficiently to their prospect EFL learners. This is especially significant when we consider the indirect and marginal contribution of the TK to TPACK; as it was shown in this research, unlike other components of TPACK, TK of the pre-service EFL teachers do not contribute to TPACK directly. In the same vein, PK is not as strongly determining as CK. This also implies that what the pre-service teachers are equipped with are the knowledge of the subject and content they are covering sooner or later; however, their knowledge of available and possible educational technology does not practically contribute to their TPACK. This implies that teacher development programs, especially those offered at Farhangian Teacher Training University have to be revised so that future high school teachers gain stronger supplies of PK and TK.

Moreover, the results of the study implied that in comparison with CK, the blended components of the TPACK model, i.e. PCK, TCK and TPK do not have strong roles in determining the pre-service EFL teachers' TPACK. The situation is even terribly worse if the marginal role of PCK is kept in mind. This implies that even if the pre-service teachers were knowledgeable in terms of the content they will deliver and the pedagogy they will implement, they would not be unable to blend these bodies of knowledge. This is particularly of great significance when pedagogical and content are going to be merged into an operational whole. This implies that major revisions have to be made in the current teacher training curriculum, especially, the one presented in Farhangian Teacher Training University. Moreover, current teacher trainers at English departments need to be aware of the current status of their students' TPACK status and set the scene in a way that even within the frame of the current curriculum the student teachers could flourish their PCK, TCK and TPK.

Blending what was gained in this study with the contributions of previous studies such as Joo et al. (2018), we need to be cautious when interpreting the pre-service teachers' TPACK level in the light of teacher training program content. It

has to be noted that raising the TPACK level would not suffice and special attention has to be paid to the interrelationship between TPACK and other variables such as teacher self-efficacy and perceived ease of using technology among the pre-service teachers. In line with Chai et al. (2011), it is proposed that parallel small-scale revised courses aiming at technology integration be piloted in different teacher training centers, the changes in the relationships amongst the different constructs of the pre-service teachers' TPACK are monitored so that the revisions which best fit the context of Farhangian Teacher University is identified and extensively implemented.

This study was not without its limitations. For example, a larger body of participants might have participated in this study. Moreover, qualitative data on the current status of the teacher students' TPACK and the possible sources of the imbalanced contributions of the variables could have been collected. It can be concluded that further research is needed to explore to what extent the current curriculum is responsible for the current status of the Iranian EFL student teachers' TPACK and what are the other possible sources of their current poor level of the measured variables in the current study. Additionally, further action research has to be conducted in order to explore the possible ways of improving their PK, TK, PCK, TCK and TPK.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Appendix

پرسشنامه سنجش سطح دانش محتوایی تربیتی فناوری دانشجو-معلمان

خرده مقیاس دانش فناوری (TK)

1- از دانش فنی کافی برای استفاده از رایانه برخوردارم.

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد

2- می‌توام مسائل مربوط به فناوری رابه‌آسانی فراگیرم.

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد

3- هنگام استفاده ازفناوری می‌توانم مشکلات خود را به‌تنهایی حل کنم.

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد

4- ازنظراستفاده ازفناوری به‌روزم.

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد

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خرده‌مقیاس دانش تربیتی(PK)

5- می‌توانم با ارائه تمریات چالش‌برانگیز قدرت تفکر شاگردان خود را ارتقا بخشم.

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد

6- من قادرم به شاگردان خود کمک کنم تا از راهبرد یادگیری مناسب استفاده کنند.

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد

7- من قادرم به شاگردان خود کمک کنم تا بر یادگیری خود نظارت کنند.

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد

8- من قادرم به شاگردان خود کمک کنم تا بر یادگیری خود بازاندیشی کنند (تا دوباره به یادگیری خود بیاندیشند).

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد

9- میتوانم فعالیت‌های گروهی برای شاگردانم طراحی و اجرا کنم.

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد

10- می‌توانم به شاگردانم کمک کنم تا درحین کار گروهی به‌درستی باهم گفتگو و همکاری کنند.

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد

11- می‌توانم عملکرد شاگردان خود را ارزشیابی کنم.

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد

دانش محتوایی (CK)

12- بر مطالب آموزشی که باید در کلاس ارائه بدهم مسلطم.

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد

13- در مطالب آموزشی که باید در کلاس ارائه بدهم تخصص دارم.

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد

14- می‌توانم مطالب آموزشی که باید در کلاس ارائه بدهم را به‌طور عمیق درک کنم.

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد

15- می‌توانم تمرین‌ها و پروژه‌های مرتبط با مطالب آموزشی را طراحی و تولید کنم.

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد

16- از آخرین تغییرات و نوآوری‌ها در رشته‌آموزشی خود آگاهم.

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد

17- افراد سرشناس رشته‌آموزشی خود را می‌شناسم.

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد

18- منابع روزآمد رشته‌آموزشی (مثل کتاب و ژورنال) را مطالعه می‌کنم.

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد

19- در همایش‌ها و گردهمایی‌های تخصصی مرتبط با رشته‌ی خود شرکت می‌کنم.

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد

دانش فناوری تربیتی (TPK)

20- می‌توانم از رایانه برای معرفی چگونگی کاربرد مطالب آموزشی در دنیای واقعی استفاده کنم.

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد

21- می‌توانم به شاگردان خود کمک کنم تا با استفاده از رایانه مطالب جدید و بیشتری را به تنهایی بیابند.

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد

22- می‌توانم به شاگردان خود کمک کنم تا با استفاده از رایانه بر یادگیری خود نظارت داشته‌باشند و برای آن برنامه‌ریزی کنند.

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد

23- می‌توانم به شاگردان خود کمک کنم تا با استفاده از رایانه دانش خود را به روش‌های مختلف ارائه دهند.

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد

24- می‌توانم از گوشی‌همراه برای معرفی چگونگی کاربرد مطالب آموزشی در دنیای واقعی استفاده کنم.

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد

25- می‌توانم به شاگردان خود کمک کنم تا با استفاده از گوشی‌همراه مطالب جدید و بیشتری را به تنهایی بیابند.

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد

دانش تربیتی محتوایی(PCK)

26- بدون استفاده از فناوری، می‌توانم شیوه‌های موثری را برگزینم تابه شاگردان خود کمک کنم تا به رشته‌آموزشی من فکرکنند و آن را فراگیرند.

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد

27- بدون استفاده از فناوری، می‌توانم شیوه‌های موثری را برگزینم تا به شاگردان خود کمک کنم تا محتوای‌آموزشی را درک‌کنند.

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد

28- بدون استفاده از فناوری، می‌توانم شیوه‌های موثری را آزمودن شاگردان خود استفاده‌کنم.

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد

29- بدون استفاده از فناوری، می‌توانم طرح درس و تمرینات آموزشی را برای شاگردان خود آماده‌کنم.

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد

30- بدون استفاده از فناوری، می‌توانم به اهداف آموزشی تعیین شده در برنامه درسی دست‌یابم.

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد

دانش فناوری محتوایی(TCK)

31- از فناوری لازم برای تحقیق درباره رشته‌آموشی خود آگاهم.

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد

32- می‌توانم از فناوری مناسب (مثل چندرسانه‌ای یا شبیه‌سازی)برای ارائه مطالب‌آموزشی استفاده‌کنم.

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد

33- می‌توانم با استفاده از فناوری به اهداف آموزشی تعیین شده در برنامه درسی دست‌یابم.

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد

34- می‌توانم با استفاده از فناوری طرح درس و تمرینات آموزشی را برای شاگردان خود آماده‌کنم.

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد

35- می‌توانم با استفاده از فناوری آموزشی تمرین‌ها و پروژه‌های مرتبط با مطالب آموزشی را طراحی و تولید کنم.

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد

دانش محتوایی تربیتیفناوری(TPACK)

36- می‌توانم با تلفیق متناسب محتوای آموزشی، روش‌های تدریس مختلف و فناوری کلاس درس را به‌پایان برسانم.

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد

37- می‌توانم فناوری را برای استفاده در کلاس درس خود انتخاب کنم که محتوای آموزشی، روش تدریس و یادگیری شاگردانم را بهبود بخشد.

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد

38- می‌توانم از راهبردهای موجود برای تلفیق محتوای آموزشی، روش‌های تدریس مختلف و فناوری در کلاس درس خود استفاده کنم.

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد

39- می‌توانم به معلمان دیگر در مدرسه یا در سطح ناحیه کمک کنم تا محتوای آموزشی، روش‌های تدریس مختلف و فناوری را به‌طور متناسب در کلاس درس خود تلفیق کنند.

هیچ	ناچیز	کم	متوسط	زیاد	بسیارزیاد