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A Contrastive Analysis of Pre-Service and In-Service EFL Teachers' Levels of Technological, Pedagogical, and Content Knowledge

Sulaiman Alnujaidi[a],*

[a] Assistant Professor at the Department of English, College of Languages and Translation, Imam Muhammad Ibn Saud University (IMISU), Riyadh, Saudi Arabia.
* Corresponding author.

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Abstract

This study attempted to investigate pre-service and in-service EFL teachers' levels of knowledge in content, pedagogy, and technology in relation to their gender, Internet access at school, and technology training in Saudi Arabia. The Technological, Pedagogical, and Content Knowledge (TPACK) framework was utilized to (1) examine pre-service and in-service EFL teachers' levels of TPACK; (2) investigate the differences between pre-service and in-service EFL teachers' levels of TPACK; (3) scrutinize whether gender, Internet access at school, and technology training had any significant effect on pre-service EFL teachers' levels of TPACK; and (4) analyze whether gender, Internet access at school, and technology training had any significant effect on in-service EFL teachers' levels of TPACK. The participants in this study were (111) EFL pre-service teachers and (106) EFL in-service teachers. The descriptive statistical analysis (mean and standard deviation) revealed that the pre-service teachers' overall level of TPACK was moderate scoring highest in TK, TPK, and TCK and lowest in CK and PK respectively. On the other hand, the in-service teachers' overall level of TPACK was moderate scoring highest in CK, PK, and PCK and lowest in TK, TPK, and TCK respectively. The inferential statistical analysis (t-test) indicated a statistically significant difference between pre-service and in-service teachers' levels of TPACK. All the seven sub-domains of TPACK were significant, with pre-service teachers scoring higher in TK, TCK, and TPK while in-service teachers scoring higher in CK, PK, PCK, and TPACK. The inferential analysis also showed that gender, Internet access at school, and technology training had a significant effect on both pre-service and in-service EFL teachers' levels of TPACK. The study concluded that both pre-service teacher education programs and in-service teacher training courses need to focus on the connections and interactions between content, pedagogy, and technology in order to help EFL teachers integrate technology effectively into their teaching process. The study recommended investigating other factors that might be predictive of teachers' levels of TPACK.

Key words: English as a Foreign Language (EFL); Technological; Pedagogical; Content knowledge (TPACK)

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1. INTRODUCTION

Teaching in the 21st century not only requires teachers who have knowledge of subject matter (*content knowledge*) and knowledge of teaching methods (*pedagogical knowledge*) but also knowledge of integrating technology into teaching (*technological knowledge*) to facilitate learning the subject matter as well as to assess the teaching methods in different subject contexts (Shulman, 1986; Mishra and Koehler, 2006). Pre-service education programs and in-service professional training programs should incorporate all three domains of knowledge: content, pedagogy, and technology. EFL teachers need to be very well-prepared to cope up with the changing dynamics of the learning environment in which technology plays a pivotal role.

1.1 Statement of the Problem

Despite the depth and breadth of research on the technological pedagogical and content knowledge

(TPACK) of teachers in various areas and subjects, little research has compared TPACK levels of pre-service and in-service EFL teachers in Saudi Arabia. This study attempts to fill this research gap and contributes to existing research by examining pre-service and in-service EFL teachers' levels of TPACK, investigating whether there is a significant difference between EFL pre-service and in-service levels of TPACK, and scrutinizing whether gender, Internet access at school, and technology training have any significant effect on the participants' levels of TPACK.

1.2 Purpose of the Study

This study is a response to a recommendation proposed by a previous study stating that "more studies are needed to compare pre-service and in-service teachers' TPACK confidence and gain more insight of the quality of today's teacher education to help shape the quality of education for Saudi future generations" (Al-Abdullatif, 2019, p.3411).

Drawing on the above-mentioned research gap, this study aims to answer the following research questions:

A) What are *pre-service* and *in-service* EFL teachers' levels of TPACK?

B) Is there a statistically significant difference between EFL *pre-service* and *in-service* levels of TPACK?

C) Do gender, Internet access at school, and technology training have any statistically significant effect on *pre-service* EFL teachers' levels of TPACK? This question is divided into three sub-questions:

a) Is there a statistically significant difference among pre-service EFL teachers in terms of their levels of TPACK based on their gender?

b) Is there a statistically significant difference among pre-service EFL teachers in terms of their levels of TPACK based on their Internet access at school?

c) Is there a statistically significant difference among pre-service EFL teachers in terms of their levels of TPACK based on their technology training?

D) Do gender, Internet access at school, and technology training have any statistically significant effect on *in-service* EFL teachers' levels of TPACK? This question is divided into three sub-questions:

Is there a statistically significant difference among in-service EFL teachers in terms of their levels of TPACK based on their gender?

Is there a statistically significant difference among in-service EFL teachers in terms of their levels of TPACK based on their Internet access at school?

Is there a statistically significant difference among in-service EFL teachers in terms of their levels of TPACK based on their technology training?

1.3 Significance of the Study

The implementation and integration of technology into EFL teaching requires teachers who have a solid background in the three domains of knowledge: content, pedagogy, and technology. Investigating the status quo of prospective and practicing EFL teachers' TPACK is of paramount significance to ensure effective technology implementation into EFL teaching. It is anticipated that the findings of this study contribute to the EFL literature in the Saudi context as well as inspire EFL policy makers, curriculum developers, researchers, and professionals in Saudi Arabia to incorporate all TPACK domains into pre-service education programs as well as in-service professional training programs.

2. LITERATURE REVIEW

2.1 Technological Pedagogical Content Knowledge (TPACK)

TPACK is a conceptual framework of the essential qualities of teacher knowledge required for technology integration in teaching (Mishra & Koehler, 2006). TPACK was built on Shulman's (1986) model of pedagogical content knowledge (PCK). The PCK model proposed content knowledge (CK), pedagogical knowledge (PK), and pedagogical content knowledge (PCK) as primary domains of teacher knowledge. By extending Shulman's (1986) PCK model, Mishra & Koehler (2006) added technological knowledge (TK) as a major domain of knowledge. Therefore, TPACK was defined as "an emergent form of knowledge that goes beyond all three components: content, pedagogy, and technology" (Mishra and Koehler, 2006, p. 1028). TPACK included three additional interactions among these knowledge domains: technological content knowledge (TCK), technological pedagogical knowledge (TPK), and technological pedagogical content knowledge (TPCK). In order to integrate technology into the classroom, teachers should know what to teach (CK), how to teach (PK), and what technology is available (TK) (Bugueño, 2013). Accordingly, "teaching successfully with technology requires continually creating, maintaining, and reestablishing a dynamic equilibrium among all components." (Mishra & Koehler, 2006, p. 1030). The seven domains of knowledge (Figure 1) which make up the TPACK framework include the following:

Technological Knowledge (TK): is teachers' knowledge about technology tools and resources for information, communications, and problem solving (Mishra and Koehler, 2006). In the context of EFL teaching, TK is defined as "language teachers' knowledge of current technologies that are available today and how that technology may be used to promote effective teaching and learning inside and outside the classroom" (Bugueño, 2013, p. 44).

Content Knowledge (CK): is teachers' knowledge about the subject matter to be learned or taught. It includes knowledge of facts, concepts, theories, procedures, ideas,

frameworks, evidence and proof, as well as established practices and approaches toward developing such knowledge (Shulman, 1986; Mishra and Koehler, 2006). In the context of EFL teaching, CK is defined as "language teacher's knowledge about grammar, vocabulary, and pronunciation features" (Bugueño, 2013, p. 44).

Pedagogical Knowledge (PK): is teachers' knowledge about the processes, practices, and methods of teaching and learning. It includes recognizing educational aims, values, and purposes, understanding students' learning, planning course lessons, evaluating students' understanding, and managing classroom (Shulman, 1986; Mishra and Koehler, 2006). In the context of EFL teaching, PK is defined as "language teachers' knowledge regarding pedagogical practices that promotes communicative competence among learners" (Bugueño, 2013, p. 44).

Pedagogical Content Knowledge (PCK): is teachers' knowledge about the pedagogies, teaching practices, and planning processes that are appropriate to teaching a given subject matter. It includes knowledge of teaching methods and instructional strategies in different subject contexts (Shulman, 1986; Mishra and Koehler, 2006). In the context of EFL teaching, PCK is defined as "language teachers ' knowledge that permits them to design and deliver language lessons, and assess language students' performance" (Bugueño, 2013, p. 44).

Technological Content Knowledge (TCK): is teachers' knowledge about technologies that can be used to address and learn specific content. In includes not only knowledge about the subject matter but also the manner in which the subject matter can be changed by the application of technology (Mishra and Koehler, 2006). In the context of EFL teaching, TCK is defined as "language teachers' knowledge of how to provide leaners the opportunity of learning vocabulary, practicing grammar and pronunciation features with the help of technology" (Bugueño, 2013, p. 44).

Technological Pedagogical Knowledge (TPK): is teachers' knowledge about how particular technologies can change teaching and learning when used in particular ways. It includes knowing the pedagogical affordances and constraints of technology with regard to pedagogical designs and strategies (Mishra and Koehler, 2006). In the context of EFL teaching, TPK is defined as "language teachers' knowledge of how to adapt technology in language activities that promotes communicative competence" (Bugueño, 2013, p. 44).

Technological Pedagogical Content Knowledge (TPACK): is teachers' knowledge of the interactions between the three domains of knowledge (content, pedagogy, and technology). It includes knowledge of using technology to implement teaching methods in different subject contexts (Mishra and Koehler, 2006). In the context of EFL teaching, TPACK is defined as "language teachers ' knowledge that permits them to integrate technology in the language class to promote and achieve communicative competence among students" (Bugueño, 2013, p. 44).

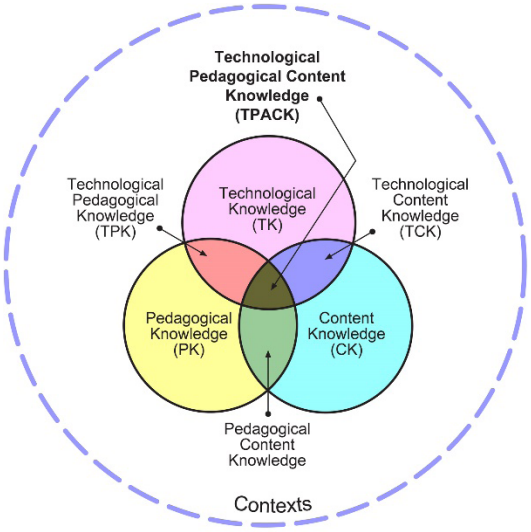

Figure 1
The TPACK Framework (Mishra and Koehler, 2006)

2.2 Pre-service and In-service Teachers' TPACK

An abundance TPACK research has been conducted on pre-service teachers alone or in-service teachers alone; however, few studies have investigated and compared prospective and practicing teachers or novice and experienced teachers. Dong, Chai, Sang, Koh, and Tsai (2015) compared pre-service teachers and in-service teachers based on the seven TPACK constructs in China and reported statistically significant differences in their levels of knowledge and confidence in the subject matter. Saltan and Arslan (2017) found significant differences between pre-service and in-service teachers' self-confidence on TPACK. They indicated that pre-service teachers had the lowest score in TPACK and recommended that teacher education programs need to equip prospective teachers with more understanding, practicing, and modeling. Turgut (2017) compared TPACK between in-service and pre-service EFL teachers in Turkey, reported significant differences among them, and suggested that teacher education and teacher training programs should go beyond simply teaching the basic computer skills and the operational use of computer programs, and should instead focus on how to deliver specific content with a proper pedagogical and technological knowledge. Another study conducted in Estonia by Luik, Taimalu, and Laane (2019) compared pre-service and in-service teachers' perceptions of their content, pedagogical, and technological knowledge according to the TPACK framework. Significant differences were found and suggestions indicated that teacher educators should develop teacher education curricula and courses through providing professional

development for in-service teachers. Alqurashi, Gokbel, and Carbonara (2017) investigated and compared the TPACK of teachers in Saudi Arabia and USA and found that teachers in both Saudi Arabia and USA had higher rating of their knowledge in CK and PK than TK.

2.3 TPACK in EFL Settings

A review of literature on TPACK revealed that extensive research has been carried out to investigate TPACK in science and math; whereas TPACK research in EFL has not been extensively undertaken. Tai (2013) argued that despite the fact that the TPACK framework was not proposed primarily for EFL teachers, the connections and interactions of its three main knowledge domains (content, pedagogy, and technology) have been well-articulated in the technology standards for language teachers stated by the Teachers of English to Speakers of Other Languages (TESOL) Association. The four goals are (1) language teachers acquire and maintain foundational knowledge and skills in technology for professional purposes; (2) language teachers integrate pedagogical knowledge and skills with technology to enhance language teaching and learning; (3) language teachers apply technology in record-keeping, feedback, and assessment; and (4) language teachers use technology to improve communication, collaboration, and efficiency.

Wu and Wang (2015) assessed in-service EFL teachers' performance on the seven TPACK domains, revealed that the EFL teachers needed more TK to develop their TPACK, and recommended that teacher education and professional development programs should not only provide teachers with opportunities to learn about instructional technologies but also allow them to practice how to effectively implement and integrate technology into EFL teaching. Hsu (2016) examined EFL in-service teachers' TPACK as it relates to their adoption of mobile-assisted language learning (MALL), reported that EFL teachers lacked PK and TK, and suggested that EFL teacher education curricula should be tailored to the proper application of technology. Similarily, Cheng (2017) examined in-service EFL teachers' TPACK and reported a low degree of confidence among participants in CK, TK, and TPK. Nazari, Nafissi, Estaji, and Marandi (2019) evaluated novice and experienced EFL teachers' TPACK and indicated significant differences. Experienced teachers were more competent in CK and PK whereas novice teachers were more competent in TK. The study recommended designing and providing different professional development courses based on the needs of both novice and experienced teachers.

In Saudi Arabian EFL classroom settings, Alahmari (2013) investigated EFL in-service teachers' use of technology to support learning and their perceptions of the usefulness of TPACK in their teaching. The study reported that EFL teachers' use of technology was positively associated with their perceptions of TPACK in terms of developing a relevant understanding of the fundamental role of technology in the teaching process and suggested that EFL teachers in Saudi Arabia should understand the complex relationships between technology, teaching, and content. Exploring the effectiveness of TPACK on EFL teachers and students in Saudi Arabia, Alhabibi (2017) indicated that teachers' TPACK had a very strong positive correlation with the students' positive achievements. Although some secondary EFL teachers in Saudi Arabia were reported to be still in need of professional training in technology, Alghamdi (2017) found that they had a high confidence in using ICT in an EFL context and maintained a high level of perception toward TPACK in general. Alharbi (2020) investigated the degree of EFL teachers' TPACK and indicated a significant difference among EFL teachers in the degree of teaching knowledge based on their gender in favor of female teachers, and based on their teaching stage in favor of secondary stage.

The review of literature revealed an apparent lack of comparative research between pre-service and in-service EFL teachers' levels of TPACK in Saudi classroom settings. This study attempted to fill this research gap by investigating the proposed research questions and providing some recommendations for EFL policy makers, educators, and researchers in Saudi Arabia.

3. METHOD

3.1 Research Design

This study employed a quantitative research design to examine the TPACK levels (CK, PK, TK, TCK, PCK, TPK, and TPACK) of pre-service and in-service EFL teachers in Saudi Arabia, investigate the differences between pre-service and in-service teachers in terms of their TPACK levels, and explore whether gender, Internet access at school, and technology training had any significant effect on the participants' levels of TPACK.

3.2 Instrument

Several instruments have been developed by researchers to examine teachers' TPACK (Archambault & Barnett, 2010; Chai, et al., 2010; Jang & Tsai, 2012; Lee & Tsai, 2010; Lin et al., 2013; Mishra and Koehler, 2006; Koh et al., 2010; Sahin, 2011; Schmidt et al., 2009). However, most of these instruments have been tailored to either general content area or specific content area such as science and math. Baser, Kopcha, and Ozden (2016) has developed a TPACK instrument for assessing EFL teachers' knowledge, called TPACK-EFL. It is argued that TPACK-EFL would provide stakeholders a valid and reliable content-specific instrument for assessing EFL teachers' knowledge in content, pedagogy, and technology as well as the interactions of these domains (Baser, et al., 2016).

The TPACK-EFL instrument is a self-report, 39-item questionnaire designed to measure EFL teachers' TPACK based on seven domains: Technological Knowledge

(9 items), Content Knowledge (5 items), Pedagogical Knowledge (6 items), Pedagogical Content Knowledge (5 items), Technological Content Knowledge (3 items), Technological Pedagogical Knowledge (7 items), and Technological Pedagogical Content Knowledge (4 items). For the scope of this study, three items were added to solicit demographic information about gender, Internet access, and technology training.

The TPACK-EFL instrument was employed for this study to (1) examine pre-service and in-service EFL teachers' levels of TPACK; (2) investigate the differences between pre-service and in-service EFL teachers' levels of TPACK; (3) scrutinize whether gender, Internet access at school, and technology training had any significant effect on pre-service EFL teachers' levels of TPACK; and (4) analyze whether gender, Internet access at school, and technology training had any significant effect on in-service EFL teachers' levels of TPACK.

3.3 Validity & Reliability

Braser et al. (2016) asserted that the TPACK-EFL instrument was validated through two rounds of exploratory factor analysis (EFA) and yielded a seven-factor structure that was consistent with the TPACK framework. Baser et al. (2016) also reported high reliability scores of TPACK-EFL with alpha coefficients ranging from .81 to .92. For the scope of this study, the reliability of the instrument was measured again and yielded stable and consistent results (Table 1) which proved the instrument to be valid and reliable for measuring the TPACK of the participants in this study.

Table 1
Cronbach's Alpha Reliability Coefficients for TPACK-EFL

Domain	Number of Items	Alpha
TK	9	.92
CK	5	.90
PK	6	.91
PCK	5	.89
TCK	3	.83
TPK	7	.88
TPACK	4	.85

3.4 Data Collection and Analysis

Data was collected from a sample of (111) pre-service EFL teachers and (106) in-service EFL teachers. The pre-service teachers were in their last semester at college. The in-service teachers were full-time teachers at Saudi public schools. The TPACK-EFL survey was distributed and collected electronically (web-based) and results obtained in this study were analyzed using SPSS Statistics.

For the scope of this study, three independent variables and seven dependent variables were investigated. The independent variables were gender, Internet access at school, and technology training. Gender included two groups: male and female. Internet access at school included two groups: teachers who had Internet access and teachers who did not have Internet access. Technology training included two groups: teachers who had technology training and teachers who had no technology training. The dependent variables were TK, CK, PK, PCK, TCK, TPK, and TPACK.

Descriptive statistics (mean and standard deviation) were used to examine *pre-service* and *in-service* EFL teachers' levels of TPACK (the first research question). A series of two-sample (independent) t-test was employed to investigate whether there were significant differences between *pre-service* and *in-service* teachers' levels of TPACK (the second research question), scrutinize whether gender, Internet access at school, and technology training had any significant effect on pre-service EFL teachers' levels of TPACK (the third research question), and analyze whether gender, Internet access at school, and technology training had any significant effect on in-service EFL teachers' levels of TPACK (the fourth research question). The significance level was set at $p < .05$.

4. RESULTS

4.1 Descriptive Statistical Analysis of Pre-service and In-service Teachers' Demographics

Descriptive statistics of pre-service teachers (Table 2) revealed that (N = 53, 48%) of participants were male and (N= 58, 52%) were female. The pre-service participants were also divided into two groups depending on their Internet access at school: respondents with Internet access (N= 42, 38%) and respondents without Internet access (N= 69, 62%). Furthermore, the pre-service participants were also divided into two groups depending on their technology training: respondents with previous technology training (N= 40, 36%) and respondents without any technology training (N= 71, 64%).

Table 2
Frequency Distributions of Pre-service & In-service Demographics

Variable	Pre-service Teachers (N= 111)			In-service Teachers (N= 106)		
	Category	f	%	Category	f	%
Gender	Male	53	48%	Male	49	46%
	Female	58	52%	Female	57	54%
	Total	111	100%	Total	106	100%
Internet Access at school	Yes	42	38%	Yes	40	38%
	No	69	62%	No	66	62%
	Total	111	100%	Total	106	100%
Technology Training	Yes	40	36%	Yes	45	42%
	No	71	64%	No	61	58%
	Total	111	100%	Total	106	100%

On the other hand, descriptive statistics of in-service teachers (Table 2) yielded that (N= 49, 46%) of

participants were male and (*N*= 57, 54%) were female. The in-service participants who had Internet access at school were (*N*= 40, 38%) while those without Internet access were (*N*= 66, 62%). In terms of technology training, the in-service participants who had technology training were (*N*= 45, 42%) as compared to (*N*= 61, 58%) of respondents who had no previous technology training.

4.2 Differences Between Pre-service and In-service Teachers' Levels of TPACK

In order to examine the participants' levels of TPACK, descriptive statistics (mean and standard deviation) were computed (Table 3) and the mean scores were ranked according to three levels: *low* (1:00-2:50), *moderate* (2:51-4:00), and *high* (4:01-5:00).

In terms of the *pre-service* teachers' TPACK profile, the results showed that the participants had the highest mean scores in TK (M= 4.47, SD= 0.64), TPK (M= 4.41, SD= 0.58), and TCK (M= 4.30, SD= 0.81); whereas they had the lowest mean scores in CK (M= 2.40, SD= 0.67) and PK (M= 2.46, SD= 0.72). The overall level of pre-service teachers' TPACK was moderate (M= 3.62, SD= 0.69).

In terms of the *in-service* teachers' TPACK profile, the results revealed that the participants scored highest in CK (M= 4.73, SD= 0.62), PK (M= 4.69, SD= 0.40), and PCK (M= 4.61, SD= 0.37) but scored lowest in TK (M= 2.42, SD= 0.79), TPK (M= 2.44, SD= 0.53), and TCK (M= 2.49, SD= 0.39). The overall level of in-service teachers' TPACK was moderate (M= 3.55, SD= 0.53).

Table 3
Pre-Service vs In-service EFL Teachers' Levels of TPACK

Domain	Pre-service Teachers (N= 111)			In-service Teachers (N= 106)		
	M	SD	Level	M	SD	Level
TK	4.47	0.64	high	2.42	0.79	low
CK	2.40	0.67	low	4.73	0.62	high
PK	2.46	0.72	low	4.69	0.40	high
PCK	3.62	0.69	moderate	4.61	0.37	high
TCK	4.30	0.81	high	2.49	0.39	low
TPK	4.41	0.58	high	2.44	0.53	low
TPACK	3.90	0.78	moderate	3.48	0.67	moderate
TOTAL	3.65	0.69	moderate	3.55	0.53	moderate

A two-sample t-test was conducted to evaluate whether there were any significant differences between pre-service and in-service teachers' levels of TPACK. The results (Table 4) showed a statistically significant difference in the scores of the participants' TK; $t(215)$= -10.781, $p < .001$, TCK; $t(215)$= -9.315, $p < .001$, and TPK; $t(215)$= -12.843, $p < .001$, with pre-service teachers scoring significantly higher than in-service teachers. On the other hand, the t-test results (Table 4) also indicated a statistically significant difference in the scores of the participants' CK; $t(215)$= 15.159, $p < .001$, PK; $t(215)$= 15.456, $p < .001$, PCK; $t(215)$= 13.084, $p < .001$, and TPACK; $t(215)$= 4.246, $p < .001$, with in-service teachers scoring significantly higher than pre-service teachers.

Table 4
A Two-sample t-Test for Pre-service and In-service EFL Teachers' Levels of TPACK

Domain	Group	N	M	SD	t	df	p
TK	Pre-service	111	4.47	0.64	-10.781	215	< .001***
	In-service	106	3.42	0.79			
CK	Pre-service	111	3.40	0.67	15.159	215	< .001***
	In-service	106	4.73	0.62			
PK	Pre-service	111	3.46	0.72	15.456	215	< .001***
	In-service	106	4.69	0.40			
PCK	Pre-service	111	3.62	0.69	13.084	215	< .001***
	In-service	106	4.61	0.37			
TCK	Pre-service	111	4.30	0.81	-9.315	215	< .001***
	In-service	106	3.49	0.39			
TPK	Pre-service	111	4.41	0.58	-12.843	215	< .001***
	In-service	106	3.44	0.53			
TPACK	Pre-service	111	3.48	0.78	4.246	215	< .001***
	In-service	106	3.90	0.67			

*p < .05. **p < .01. ***p < .001.

4.3 The Effect of Gender on Pre-service and In-service EFL Teachers' Levels of TPACK

In terms of the *pre-service* teachers' TPACK profile, a two-sample t-test was calculated to examine whether *gender* had any significant effect on the pre-service teachers' levels of TPACK. The results (Table 5) showed a statistically significant difference among pre-service teachers in terms of their TK; $t(109)$= -7.007, $p < .001$, CK; $t(109)$= -6.286, $p < .001$, PK; $t(109)$= 6.000, $p < .001$, and PCK; $t(109)$= 5.191, $p < .001$, with male teachers scoring significantly higher in TK and CK while female teachers scoring significantly higher in PK and PCK. Interestingly, no significant difference was found between male and female teachers regarding their TCK, TPK, and TPACK.

In terms of the *in-service* teachers' TPACK profile, a two-sample t-test was also used to analyze whether *gender* had any significant effect on the in-service teachers' levels of TPACK. The results (Table 5) revealed a statistically significant difference among in-service teachers in terms of their TK; $t(104)$= -2.287, $p = .024$, and PK; $t(104)$= 2.551, $p = .012$, with male teachers scoring significantly higher in TK while female teachers scoring significantly higher in PK. However, no significant difference was observed in the scores of male and female teachers regarding their CK, PCK, TCK, TPK, and TPACK.

Table 5
A Two-sample (independent) t-Test for Pre-service and In-service EFL Teachers' Levels of TPACK Based on Gender

Domain	Pre-service teachers						In-service teachers					
	Gender	N	M	SD	t	p	Gender	N	M	SD	t	p
TK	Male	53	4.92	0.45	-7.007	< .001***	Male	49	4.68	0.75	-2.287	.024*
	Female	58	4.02	0.83			Female	57	4.36	0.69		
CK	Male	53	2.80	0.61	-6.286	< .001***	Male	49	4.77	0.67	-0.544	.587
	Female	58	2.00	0.72			Female	57	4.69	0.82		
PK	Male	53	2.05	0.75	6.000	< .001***	Male	49	4.61	0.63	2.551	.012*
	Female	58	2.87	0.69			Female	57	4.91	0.58		
PCKw	Male	53	3.28	0.71	5.191	< .001***	Male	49	4.50	0.83	1.415	.160
	Female	58	3.96	0.67			Female	57	4.72	0.77		
TCK	Male	53	4.36	0.83	-0.780	.439	Male	49	3.57	0.66	-1.214	.227
	Female	58	4.24	0.79			Female	57	3.41	0.69		
TPK	Male	53	4.37	0.57	-0.725	.469	Male	49	3.46	0.59	-0.312	.755
	Female	58	4.54	0.59			Female	57	3.42	0.71		
TPACK	Male	53	3.94	0.79	-0.540	.590	Male	49	3.54	0.49	-1.190	.236
	Female	58	3.86	0.77			Female	57	3.42	0.54		

*p < .05. **p < .01. ***p < .001.

4.4 The Effect of Internet Access at School on Pre-service and In-service EFL Teachers' Levels of TPACK

In terms of the *pre-service* teachers' TPACK profile, a two-sample t-test was employed to investigate whether *Internet access at school* had any significant effect on the pre-service teachers' levels of TPACK. The results (Table 6) showed a statistically significant difference among pre-service teachers in terms of their TK; $t(109)= -9.870$, $p < .001$, TCK; $t(109)= -9.457$, $p < .001$, TPK; $t(109)= -8.295$, $p < .001$, and TPACK; $t(109)= -6.145$, $p < .001$, with teachers who had Internet access at school scoring significantly higher in TK, TCK, TPK, and TPACK. It is worth noting that no significant difference was obtained between teachers who had Internet access and their counterparts who did not have Internet access regarding their CK, PK, and PCK.

In terms of the in-service teachers' TPACK profile, a two-sample t-test was utilized to evaluate whether Internet access at school had any significant effect on the in-service teachers' levels of TPACK. The results (Table 6) indicated a statistically significant difference among in-service teachers in terms of their TK; $t(109)= -3.775$, $p < .001$, TCK; $t(109)= -3.059$, $p < .001$, TPK; $t(109)= -2.757$, $p < .001$, and TPACK; $t(109)= -3.588$, $p < .001$, with teachers who had Internet access at school scoring significantly higher in TK, TCK, TPK, and TPACK. Regarding their CK, PK, and PCK, no significant difference was detected between teachers who had Internet access at school compared to their counterparts without Internet access.

Table 6
A two-sample t-Test for Pre-service and In-service EFL Teachers' Levels of TPACK Based on Internet Access at School

Domain	Pre-Service Teachers						In-Service Teachers					
	Internet Access	N	M	SD	t	p	Internet Access	N	M	SD	t	p
TK	Yes	42	4.66	0.52	-9.870	< .001***	Yes	40	4.73	0.61	-3.775	< .001***
	No	69	3.32	0.87			No	66	4.22	0.71		
CK	Yes	42	3.41	0.56	0.887	.377	Yes	40	4.52	0.81	0.614	.540
	No	69	3.53	0.76			No	66	4.61	0.68		
PK	Yes	42	4.05	0.72	0.538	.591	Yes	40	4.49	0.66	0.943	.347
	No	69	4.12	0.63			No	66	4.60	0.53		
PCK	Yes	42	3.28	0.71	0.596	.552	Yes	40	3.90	0.63	0.366	.714
	No	69	3.36	0.67			No	66	3.95	0.71		
TCK	Yes	42	4.69	0.56	-9.457	< .001***	Yes	40	3.75	0.49	-3.059	< .001***
	No	69	3.41	0.76			No	66	3.41	0.59		
TPK	Yes	42	4.47	0.72	-8.295	< .001***	Yes	40	4.89	0.90	-2.757	< .001***
	No	69	3.39	0.63			No	66	4.42	0.82		
TPACK	Yes	42	3.92	0.97	-6.145	< .001***	Yes	40	3.93	0.79	-3.588	< .001***
	No	69	2.89	0.78			No	66	3.41	0.68		

*p < .05. **p < .01. ***p < .001.

4.5 The Effect of Technology Training on Pre-service and In-service EFL Teachers' Levels of TPACK

In terms of the *pre-service* teachers' TPACK profile, a two-sample t-test was calculated to explore whether *technology training* had any significant effect on pre-service teachers' levels of TPACK. The results (Table 7) indicated a statistically significant difference among pre-service teachers regarding their TK; $t(109)= -5.542$, $p < .001$, TCK; $t(109)= 8.102$, $p < .001$, TPK; $t(109)= -10.861$, $p < .001$, and TPACK; $t(109)= -5.239$, $p < .001$, with teachers who had previous technology training scoring significantly higher in TK, TCK, TPK, and TPACK. Nevertheless, no significant difference was noted between teachers who had previous technology training and their counterparts who did not have any technology training regarding their CK, PK, and PCK.

In terms of the *in-service* teachers' TPACK, a two-sample t-test was conducted to scrutinize whether *technology training* had any significant effect on in-service teachers' levels of TPACK. The results (Table 7) yielded a statistically significant difference among in-service teachers regarding their TK; $t(109)= -3.154$, $p < .001$, TCK; $t(109)= -12.149$, $p < .001$, TPK; $t(109)= -3.498$, $p < .001$, and TPACK; $t(109)= -6.217$, $p < .001$, with teachers who had previous technology training scoring significantly higher in TK, TCK, TPK, and TPACK. As for the subdomains: CK, PK, and PCK, no significant difference was shown between teachers who had previous technology training and their counterparts who did not have any technology training.

Table 7
A two-sample t-Test for Pre-service and In-service EFL Teachers' Levels of TPACK Based on Technology Training

Domain	Pre-Service Teachers						In-Service Teachers					
	Technology Training	N	M	SD	t	p	Technology Training	N	M	SD	t	p
TK	Yes	40	4.52	0.66	-5.542	< .001***	Yes	45	4.76	0.55	-3.154	< .001***
	No	71	3.71	0.78			No	61	4.44	0.49		
CK	Yes	40	3.52	0.62	-0.223	.823	Yes	45	4.89	0.41	-1.334	.185
	No	71	3.49	0.71			No	61	4.77	0.49		
PK	Yes	40	3.11	0.80	-1.205	.230	Yes	45	4.90	0.54	-1.107	.270
	No	71	2.93	0.73			No	61	4.78	0.56		
PCK	Yes	40	3.12	0.69	-0.270	.787	Yes	45	4.20	0.59	-1.776	.078
	No	71	3.08	0.78			No	61	3.99	0.61		
TCK	Yes	40	4.19	0.54	8.102	< .001***	Yes	45	4.79	0.50	-12.149	< .001***
	No	71	3.23	0.63			No	61	3.61	0.49		
TPK	Yes	40	4.21	0.60	-10.861	< .001***	Yes	45	4.76	0.66	-3.498	< .001***
	No	71	2.88	0.63			No	61	4.24	0.82		
TPACK	Yes	40	3.79	0.79	-5.239	< .001***	Yes	45	4.73	0.39	-6.217	< .001***
	No	71	2.89	0.91			No	61	4.21	0.45		

*p < .05. **p < .01. ***p < .001.

5. DISCUSSION

This study sought to (1) examine pre-service and in-service EFL teachers' levels of TPACK; (2) investigate the differences between pre-service and in-service EFL teachers' levels of TPACK; (3) scrutinize whether gender, Internet access at school, and technology training had any significant effect on pre-service EFL teachers' levels of TPACK; and (4) analyze whether gender, Internet access at school, and technology training had any significant effect on in-service EFL teachers' levels of TPACK.

5.1 Discussion of the First Research Question' Results

The descriptive statistical analysis (mean and standard deviation) of the first research question *(What are pre-service and in-service EFL teachers' levels of TPACK?)* revealed that the *pre-service* teachers' overall level of TPACK was moderate scoring highest in TK, TPK, and TCK respectively and lowest in CK and PK respectively. On the other hand, the *in-service* teachers' overall level of TPACK was moderate scoring highest in CK, PK, and PCK respectively and lowest in TK, TPK, and TCK respectively.

The results of the first research question indicate that both pre-service and in-service Saudi EFL teachers are not quite confident about their overall knowledge in content, pedagogy, and technology as well as the interactions among these three domains. These findings are consistent with previous studies which reported an overall low to moderate level of TPACK among Saudi pre-service and in-service teachers. The low to moderate level of TPACK among Saudi teachers as reported by

previous studies were attributed to several factors such as lack of technology and Internet access, lack of training and professional development, lack of technical support, and lack of institutional support (Al-Abdullatif, 2019; Al-Asmari, 2005; Alghamdi, 2017; Alhababi, 2017; Alharbi, 2013; Alharbi, 2014; Alqurashi & Samarin, 2015; Al-Wehaibi et al., 2008; Bingimlas, 2018; Gamlo, 2014).

5.2 Discussion of the Second Research Question' Results

The inferential statistical analysis (t-test) of the second research question *(Are there significant differences between EFL pre-service and in-service levels of TPACK?)* yielded a statistically significant difference between pre-service and in-service teachers' levels of TPACK. All the seven sub-domains of TPACK were significant, with pre-service teachers scoring significantly higher in TK, TCK, and TPK while in-service teachers scoring significantly higher in CK, PK, PCK, and TPACK.

The results of the second research question imply that *pre-service* teachers seem to have sufficient knowledge about using computer peripherals, troubleshooting common computer problems, establishing an Internet connection, taking advantage of multimedia to express ideas about various topics in English, and meeting students' individualized needs by using technology. However, the results entail that pre-service teachers lack knowledge about following-up new sources and recent development in the field of EFL, are not aware of how EFL can be applied beyond the classroom in the real world, and are not sure about designing a learning experience appropriate for the level of their students. On the other hand, *in-service* teachers seem to have sufficient knowledge of the subject matter, have sound familiarity with the culture of target language, are able to use teaching methods and techniques appropriate for EFL learning environment, and are ready to provide tailored support for students' learning in accordance with their physical, mental, emotional, social, and cultural differences. Nonetheless, the results suggest that in-service teachers lack knowledge about using social media, such as (Twitter, Facebook, YouTube, and Wiki), are unable to take advantage of multimedia to express ideas about various topics in English, and show low competence in using new technologies to develop their teaching approaches and increase their students' engagement. The findings of the second research question agree with Luik, Taimalu, and Laane' study (2019) which found that in-service teachers' PK, CK, PCK, and TPACK were significantly higher than pre-service teachers. The same results are echoed by Nazari et al. (2019) who indicated that experienced EFL teachers were more competent in PK and PCK whereas novice EFL teachers were more competent in TK, TCK, and TPK. These results are also in line with Alqurashi and Samarin's study (2015) which investigated the TPACK of 52 English language teachers in five countries: the USA, the UK, Saudi Arabia, Turkey, and Peru and revealed that teachers' knowledge in TK, TCK, and TPK was not as strong as their knowledge in CK, PK, and PCK.

5.3 Discussion of the Third Research Question' Results

The inferential statistical analysis (t-test) of the third research question (Do gender, Internet access at school, and technology training have any significant effect on *pre-service* EFL teachers' levels of TPACK?) indicated a significant effect. The t-test analysis of the variable (gender) showed a statistically significant difference in the scores of the pre-service teachers' TK, CK, PK, and PCK, with male teachers scoring significantly higher in TK and CK while female teachers scoring significantly higher in PK and PCK. However, no significant difference was found in the scores of male and female teachers regarding their TCK, TPK, and TPACK. The t-test analysis of the variable (Internet access at school) also revealed a statistically significant difference in the scores of the pre-service teachers' TK, TCK, TPK, and TPACK, with teachers who had Internet access at school scoring significantly higher in TK, TCK, TPK, and TPACK than their counterparts. As for CK, PK, and PCK, no significant difference was found in the scores of teachers who had Internet access and their counterparts who did not have Internet access. In addition, the t-test analysis of the variable (technology training) yielded a statistically significant difference in the scores of the pre-service teachers' TK, TCK, TPK, and TPACK, with teachers who had previous technology training scoring significantly higher in TK, TCK, TPK, and TPACK than their counterparts. It is worth mentioning that no significant difference was found in the scores of teachers who had technology training and their colleagues who did not have technology training regarding their CK, PK, and PCK.

5.4 Discussion of the Fourth Research Question' Results

The inferential statistical analysis (t-test) of the fourth research question (Do gender, Internet access at school, and technology training have any significant effect on EFL *in-service* levels of TPACK?) showed a significant effect. The t-test analysis of the variable (gender) showed a statistically significant difference in the scores of the in-service teachers' TK and PK, with male teachers scoring significantly higher in TK while female teachers scoring significantly higher in PK. Interestingly enough, no significant difference was found in the scores of male and female teachers regarding their CK, PCK, TCK, TPK, and TPACK. The t-test analysis of the variable (Internet access at school) also indicated a statistically significant difference in the scores of the in-service teachers' TK, TCK, TPK, and TPACK, with teachers who had Internet access at school scoring significantly higher in TK, TCK, TPK, and TPACK than their counterparts. Nevertheless,

no significant difference was found in the scores of teachers who had Internet access and their colleagues who did not have Internet access regarding their CK, PK, and PCK. In addition, the t-test analysis of the variable (technology training) revealed a statistically significant difference in the scores of the in-service teachers' TK, TCK, TPK, and TPACK, with teachers who had previous technology training scoring significantly higher in TK, TCK, TPK, and TPACK than their counterparts. However, no significant difference was found in the scores of teachers who had technology training and their colleagues who did not have technology training regarding their CK, PK, and PCK.

The results of the third and fourth research questions suggest that male teachers have a high level of English proficiency and sufficient knowledge of lexical and grammatical resources and seem more confident in using Office programs (i.e. Word, PowerPoint, etc.), multimedia (e.g. video, web pages, etc.), collaboration tools (wiki, virtual environments, etc.), and digital classroom equipment (projectors and smartboards) with a high level of proficiency. Female teachers, in contrast, appear to have sufficient knowledge about adapting their teaching styles to different learners, managing classroom learning environments, and selecting teaching materials appropriate to the needs of their students. These findings also postulate that teachers with Internet access at school and previous technology training are more competent in using software that helps them complete a variety of tasks more efficiently, utilizing virtual discussion platforms to develop student's higher order thinking abilities, and supporting their own professional development by using technological tools and resources to continuously improve the language teaching process.

These findings are analogues with previous studies which confirmed that male teachers were more competent in CK and TK than female teachers but female teachers were more competent in PK and PCK than male teachers (Cheng, 2017; Ekrem & Recep, 2014; Erdogan & Sahin 2010; Hsu et al., 2017; Jang and Tsai 2012; Jordan, 2013; Koh & Chai, 2014; Koh et al., 2014; Lin et al., 2013; Oz, 2015). The results of this study also agree with previous studies which asserted that Internet use and access at school had a significant effect on teachers' TPACK. Positive and significant correlations between the use of technology and TPACK were confirmed and an increase in the use and availability of technological resources was significantly associated with an increase in TPACK levels (Alahmari, 2013). Al-Asmari (2005) showed similar findings as he examined the integration of the Internet by Saudi EFL teachers, noted that teachers had limited levels of access to and expertise with the Internet as a pedagogical tool, and proposed that more money should be spent on improving the Internet access and services. When examining the current availability of ICT facilities to Saudi EFL teachers, Alshumaimeri and Alhassan (2013) indicated that teachers who had a computer lab in their school used ICT significantly more than teachers who did not have access to a computer lab and recommended increasing availability of new teaching technologies and training programs in order to better integrate technological resources into EFL teaching. Al-Wehaibi et al. (2008) examined problems that teachers experience in their adoption and use of Internet technologies in teaching and revealed that limited Internet access was a major barrier to Internet integration in teaching. Lack of access, lack of confidence, and lack of competence were the most cited barriers to technology integration among Saudi teachers (Bingimlas, 2009; Gamlo, 2014). Another study with similar findings by Alrwaished, Alkandari, & Alhashem (2017) examined in-service and pre-service teachers' TPACK and concluded that availability and accessibility of technology in higher education institutions as compared to the shortage of technological resources and Internet access at schools caused a significant difference between pre-service and in-service teachers as well as created a technological gap between higher education institutions and workplace.

The findings of this study are also in accordance with previous studies which reported that previous technology training had a significant impact on teachers' TPACK. Alharbi (2014) investigated the relationship between teachers' level of technology implementation and their level of TPACK in Saudi Arabia, reported that Saudi teachers demonstrated low level of technology implementation and low level of TPACK knowledge, and concluded that lack of proper training programs was found to be one of the most influential factors with respect to their lack of knowledge and their low level of technology implementation. Through comparing teachers' attitudes towards integrating technology in Saudi Arabia and the United States, Alharbi (2013) identified several factors that hinder teachers from adopting and integrating technology in classrooms, found that teachers' lack of technology training in Saudi Arabia existed in pre-service teaching programs as well as in-service professional development, and recommended that a great amount of training is needed in order to better integrate technology into teaching. Alshumaimeri (2008) analyzed the perceptions and attitudes of EFL teachers in Saudi Arabia regarding the use of computer assisted language learning (CALL) in English classrooms, indicated a positive correlation between teachers' training and positive attitudes toward the use of technology in the Saudi classroom, and suggested specialized training for EFL teachers who are required to integrate CALL into regular classroom instruction. Additional training opportunities, as concluded by Alahmari (2013), should be offered to EFL teachers in order to refine and increase their level of TPACK.

CONCLUSION

Several studies have investigated the TPACK framework in EFL settings. Nevertheless, limited research has investigated the TPACK profiles of both pre-service and in-service EFL teachers and examined whether gender, Internet access at school, and technology training had any significant effect on their levels of TPACK. This research has shown that these three variables have a significant impact on some sub-domains of TPACK as reported by the participating teachers from both groups.

This study has indicated a gap between EFL pre-service and in-service teachers in terms of TPACK. It is, therefore, apparent that both pre-service teacher education programs and in-service teacher training courses need to focus on the connections between *content*, *pedagogy*, and *technology* in order to integrate technology into the teaching process, create real-time interactions, and promote cooperation among students (Targut, 2017). Today's students are digital natives (Prensky, 2001) and their teachers should not only have technical competence, but should also be very-well prepared and informed on how to effectively use technology in context so that it reflects the connections and interactions between content, pedagogy, and technology, maximizes the learning experience, and ensures an interactive learning environment (Mishra & Koehler, 2006). The gap between male and female teachers in terms of TPACK should also be taken into account. Male teachers should have more opportunities to enhance their pedagogical knowledge as much as female teachers need more exposure to technological knowledge. Although availability of technology resources is crucial, it does not ensure accessibility. EFL classrooms should have full access to technology resources (e.g. hardware, software, Internet access) as well as proper technical support in order to ensure that teachers can effectively incorporate technology into their teaching practices. Lack of technology training and professional development have been associated with lack of technology adoption and low technology integration in EFL classroom settings (Alahmari, 2013; Alharbi 2013; Alshumaimeri, 2008). Therefore, technology training (on-site and online) should also be provided for teachers at all levels and should go beyond the technical training aspects to tackle the content and pedagogical aspects so that teachers are able to effectively choose and use technological applications which meet their students' needs. The TPACK framework could be effectively implemented in designing pre-service teacher education programs and in-service teacher training courses to provide teachers with technical and pedagogical skills about using technology in the learning and teaching processes.

This study identified and emphasized the types of knowledge needed by EFL teachers in terms of content, pedagogy, and technology as well as the variables which influence teachers' TPACK. The results of this study could guide future research into investigating the TPACK profiles of prospective and practicing EFL teachers. The findings of this study would also suggest a need for investigating other factors that might be predictive of teachers' levels of TPACK such as teachers' education degree (undergraduate vs graduate), education level (primary, intermediate, secondary), school location (urban vs rural), and school type (public vs private).

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