Teachers' TPACK Levels and Students' Self-efficacy as Predictors of Students' Academic Achievement

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Article Info	Abstract
	The aim of the current study is to analyze the relationship among teachers' TPACK levels, students' self-efficacy and the academic achievement. Another purpose of this study is to determine whether there is significant difference in teachers' TPACK levels according to their gender and professional experience. In this study, singular survey model and relational survey model were used. This study was conducted in 3 secondary schools in Konya and Ankara in the first semester of 2014-2015 academic year. A total of 78 teachers working in Science and Technology, Mathematics, Turkish, Social Studies and English branches and 1597 (792 female and 805 male) students attending to the courses of these teachers participated in the current study. This study indicates that the students' academic, social, and emotional self-efficacy with teachers' TPACK levels explain 12% of the academic achievement of students. Academic self-efficacy is the most important variable that influences students' general academic achievement. In addition, the impact of teachers' TPACK levels on academic achievement is higher than students' social and emotional self-efficacy.

Introduction

Today, education and technology cannot be considered separately and technology integration in education has become a necessity (Dumpit & Fernandez, 2017; Liao, 2007). Spazak (2013) defines technology integration as the use of technology as a tool for enhancing student learning, better understanding of course content, and the development of high-level thinking skills. According to Wachira and Keengwe (2011), technology integration in education; can be defined as the integration of the learning and teaching process with appropriate technology for the objectives, including the evaluation of lessons and learning outcomes. Research shows that the integration of technology in education has benefited students and teachers in many ways. Some of these are rapid information transfer for students and creating individual learning environments, providing communication among all stakeholders in the teaching process, supporting collaborative learning environments (İşman, 2002). Technology integration is a multi-directional and slow process involving many stakeholders, and it is stated that teachers have one of the most important tasks in this process (Wachira & Keengwe, 2011). Keeping the teachers out of the integration process and ignoring the pedagogical use of technology and equipping learning environments with technological tools do not provide an effective technology integration (Ellis, Dare, & Roehrig, 2016; Dong, Chai, Guo-Yuan, Koh, & Chin-Chung; Sahin, Celik, Akturk, & Aydin, 2013). In such situations, teachers do not know what purpose and how to use the technology in their classroom and it is stated that this can be an obstacle in the integration of technology (Graham, Borup, & Smith, 2012; Sahin, Akturk, & Schmidt, 2009; Niess, 2011). Teachers should be able to actively participate in the integration process and have some competencies in order to use the technology available in learning environments for the purposes of the course appropriately and effectively.

Ilgaz and Usluel (2011) list general teacher competencies in technology integration, using appropriate digital tools in lessons, using technology in student projects, directing students to access the correct information on the Internet, turning to multimedia use in lessons, being open to innovations to learn, and, how to use effective technology. In 2008, International Society for Technology in Education (ISTE) identified some of the teacher qualifications as follows: providing students with the help of technological tools to identify social life problems and seek solutions, use diverse technologies in the evaluation dimension of instruction, being a role model for the students for the legal and ethical uses of digital tools. In the relevant literature, there are a number of theoretical models explaining the process of technology integration, what stakeholders are involved, what these stakeholders should do, and the stages of the integration process (Celik, Sahin, & Akturk, 2014; Mazman, & Usluel, 2011). Five-Stage Model for Computer Technology Integration (Toledo, 2005), Systemic Planning Model for ICT Integration (Wang & Woo, 2007), Concentric Circles Model (Tondeur, Valcke & van Braak,

2008), Activity System Model (Yamagata-Lynch, 2003), Technology Integration Planning Model (Roblyer, 2006) are the most common theoretical frameworks. In recent years, it has been stated that technology integration frameworks tend to shift from technology-focused models to pedagogical-focused models. In other words, while technology-focused models aim to have teachers acquire knowledge and skills for the usage of technology, pedagogy-focused models are models that aim to link teachers' knowledge of technology utilization with pedagogical knowledge throughout their instruction (Kabakçı Yurdakul, 2011; Koh, Chai, Benjamin, & Hong, 2015). Technological Pedagogical Content Knowledge (TPACK) framework is seen as one of the pedagogical-focused models of the integration process.

Theoretical Framework: Technological Pedagogical Content Knowledge (TPACK)

TPACK is a theoretical framework that emerges from the addition of technology knowledge (TK) to the concept of pedagogical content knowledge (PCK), which Shulman put forward in 1986 (Mishra & Koehler, 2006). The TPACK model demonstrates which components constitute teacher knowledge for effective technology integration. TPACK is designed as a seven-component model that reveals the links between technology knowledge (TK), pedagogical knowledge (PK) and content knowledge (CK) (Koehler & Mishra 2008; Mishra & Koehler, 2006). CK expresses the knowledge teachers need to teach about their field. PK is about how to learn or produce knowledge in the process of learning-teaching, and how to apply it to practices. TK is a type of knowledge that includes advanced technologies such as the Internet, digital video and the ability to use them, as well as traditional technologies such as blackboard, chalk, and books. PCK is the pedagogical knowledge that must be possessed for the teaching of a specific subject matter. It aims to integrate PK with subject matter knowledge. While, TCK refers to knowledge of how subject can be represented by technological tools such as using computer animation to represent and study movement of the earth crust, TPK is knowledge of how technology can enable pedagogical methods such as utilizing Web 2.0 tools to support social construction of knowledge (Chai, Koh, Tsai, & Tan, 2011). TPACK is a pedagogical way of knowing how to teach contents using the most appropriate technology for the teaching matter (Mishra & Koehler 2006; So & Kim, 2009).

In the related literature, there are studies to determine which factors affect teachers' TPACK levels. Many studies indicate that gender and professional experience of teachers influence technology integration knowledge. Some studies on this subject state that male teachers have higher TPACK levels compare to women counterparts (Canbolat, 2011; Karataş, 2014; Chai, Koh, & Tsai, 2010). It is stated that this difference in TPACK is due to the fact that male teachers have more TK than women (Bal & Karademir, 2013; Lasen, 2010). Besides, it is observed that TPACK levels of teachers do not change according to gender (Jang & Tsai, 2012; Koh & Chai, 2011). In addition, some studies examining the relationship between teachers' professional experience and TPACK levels indicate that the TPACK level decreases as the professional experience increases (Bal & Karademir, 2013, Kurtoğlu, 2009, Mutluoğlu, 2012).

Self-efficacy and Academic Achievement

Self-efficacy; is the key concept of Social Cognitive Theory, suggests that the behavior of individuals is determined by the social environment and the result of mutual interaction of personal factors. Bandura (1995) defines self-efficacy as the judgments of the individual about arranging the task steps and performing the task successfully in the process of performing any task. Self-efficacy can give an idea of how much effort the individuals will make about the problem situation they encounter (Bıkmaz, 2002). Self-efficacy beliefs determine individuals' thoughts, feelings, behaviors and motivations. It is possible to observe the happiness of success in people with high self-efficacy (Bandura, 1994). Teachers can be considered as an important factor in the development of individual self-efficacy perceptions (Önen & Öztuna, 2006). A teacher who believes that teaching competence is high enables students to increase their motivation and attendance by using appropriate methods and strategies that pupils will best understand the course (Klausmeier & Allen, 1978). This will increase the academic achievement of the students, strengthen their sense of achievement and increase self-efficacy perceptions. The high self-efficacy beliefs of students increase their motivation by influencing their academic life positively. The motivation of the learners towards the lesson has a significant effect on the initiation of behavior, continuity in behavior and consequently academic performance. Academic achievement is defined by Demirel (2012) as the level of competence of the student in relation to the program goals as a result of a curriculum. Academic achievement refers to grades or test scores that measure the knowledge and skills of learners in line with the goals of the given teaching in schools (Erdoğdu, 2006).

Studies based on the TPACK theoretical framework have been mostly carried out with pre service teacher candidates, and research conducted with the teachers is limited (Cetin-Dindar, Boz, Sonmez, & Celep, 2018; Mouza, Karchmer-Klein, Nandakumar, Ozden, & Hu, 2014; Scherer, Tondeur, Siddiq, & Baran, 2018). Also, in the studies which preservice teachers and teachers participated, self-efficacy and perceptions towards TPACK were measured. In addition to determining which factors affect teachers' TPACK, it may be helpful to investigate the effect of teacher TPACK levels on student achievement. Given that a technology-assisted method of teaching has a positive effect on student achievement (Akçay & Şahin, 2012; Uzun, 2013; Şen & Ağır, 2014), the technology integration knowledge of teachers who are practitioners of this method, may have an important influence on the academic achievement. Moreover, another important factor in the students' academic achievement is student self-efficacy (Altun & Yazıcı, 2013, Güneri, 2013, Pekdemir, 2015). In this context, the aim of the current study is to analyze the relationship between teachers' TPACK levels, students' self-efficacy and the academic achievement. Another purpose of this study is to determine whether there is significant difference in teachers' TPACK levels according to their gender and professional experience.

Method

In this study, singular survey model and relational survey model were used. The aim of the singular survey models is to examine the research variables as type and amount separately (Karasar, 2012). In the current study, singular survey model was applied to investigate teachers' TPACK levels. Relational survey models are the research models that aim at defining the degree or existence of change between two or more variables (Karasar, 2012). In the study, it was aimed to investigate the relationship between teachers' TPACK levels, students' self-efficacy and academic achievement with relational survey model. Dependent and independent variables in the study are shown in Figure 1.
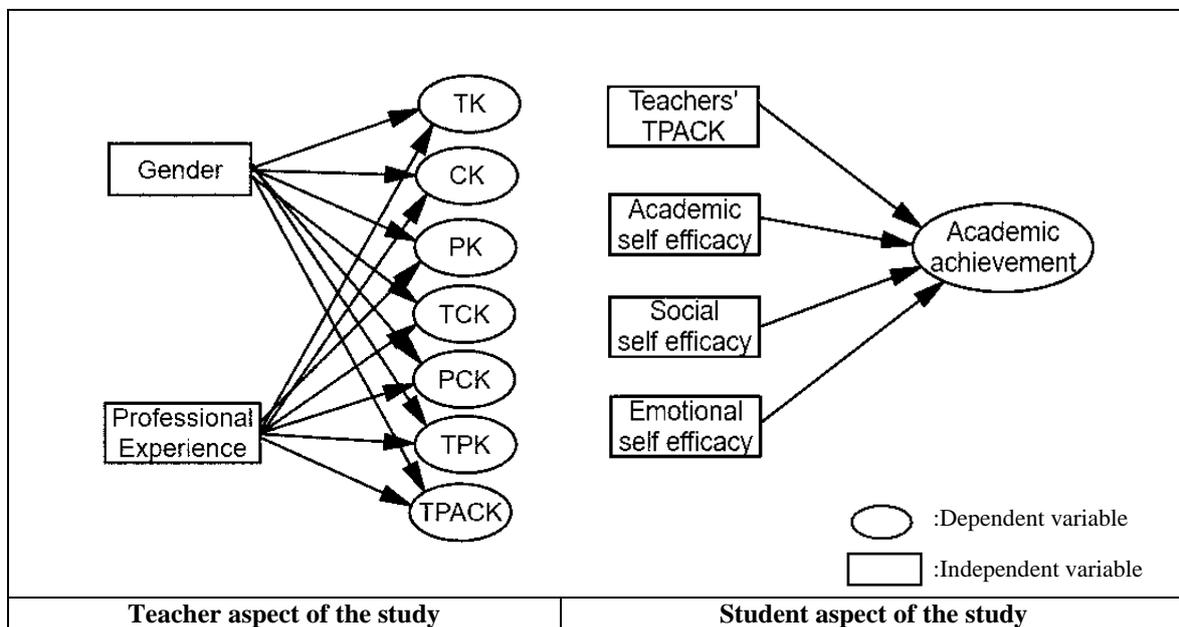

Figure 1. Research variables of the study

Participants

This study was conducted in 3 secondary schools in Konya and Ankara in the first semester of 2014-2015 academic year. A total of 78 teachers working in Science and Technology, Mathematics, Turkish, Social Studies and English branches and 1597 (792 female and 805 male) students attending to the courses of these teachers participated in the current study. Of the teachers participating in the study were 51 (65.4%) female and 27 (34.6%) were male. The distribution of teachers according to their branches is as follows: 19 Turkish, 11 Social Studies, 17 Elementary Mathematics, 15 Science, and 16 English teachers. 43 teachers have between 0-10 years, 25 teachers have 11-20 years, 10 teachers have 21 years and more professional experience. Of the students, 478 (29.9%) were in 5th grade, 407 (25.5%) in 6th grade, 364 (22.8%) in 7th grade and 348 were studying in the 8th grade.

Data Collection Tools

Self-Efficacy Questionnaire for Children (SEQ-C), Technological Pedagogical and Content Knowledge (TPACK) and Grade Point Average (GPA) of Science, Mathematics, Turkish, English and Social Studies courses of the students were used for data collection.

Technological Pedagogical and Content Knowledge (TPACK) Survey: This survey developed by Şahin (2011), is a 5-Likert type, consisting of 7 sub-dimensions and 47 items. The survey items have five response choices, "1 = no knowledge," "2 = little knowledge," "3 = moderate knowledge," "4 = quite knowledge," and "5 = complete knowledge." There are 15 items in the TK, 6 items in the PK, 6 items in the CK, 4 items in the TPK, 4 items in the TCK, 7 items in the PCK, and finally 5 items in the TPACK subscales (Şahin, 2011). The Cronbach alpha internal consistency coefficients for the subscales of the scale are as follows: TK(0.93), PK(0.90), CK(0.86), TPK(0.88), TCK(0.88), PCK(0.92), and TPACK(0.92). In the present study, the Cronbach's alpha coefficients of TK, PK, CK, TPK, TCK, PCK, and TPACK were calculated, and the internal reliability scores of the scale were found to be 0.96, 0.92, 0.81, 0.90, 0.93, 0.95, and 0.92 respectively.

Self-Efficacy Questionnaire for Children (SEQ-C): The scale developed by Muris (2001) and translated into Turkish by Telef and Karaca (2012) is a 5-point Likert type and consists of 3 sub-factors and 21 items. These factors with the number of items and Cronbach's alpha coefficients are as follows: (1) social self-efficacy (seven items, 0.86) which has to do with the perceived efficacy for peer relationships and confidence; (2) academic self-efficacy (seven items, 0.84) which is related to the perceived competency to manage one's own learning performance, to master academic subjects, and to achieve academic expectations; and (3) emotional self-efficacy (seven items, 0.78) which pertains to the perceived capability of dealing with negative feelings. In the present study, the Cronbach's alpha coefficients were found to be 0.70 for social self-efficacy, 0.80 for academic self-efficacy, and 0.79 for emotional self-efficacy.

Grade Point Average (GPA): In order to determine the academic achievements of the students, the GPA of Science and Technology, Mathematics, Turkish, English and Social Studies courses were used after the first semester of the 2014-2015 academic year. These scores were transmitted to the researchers through the e-school system by the administration of the schools where the study was conducted.

Data Analysis

Descriptive statistics, correlation analysis, independent sample t-test to determine the differences between the two groups, one-way ANOVA test analysis to determine the differences between more than two groups and multiple linear regression analysis were used.

Findings

To determine teachers' TPACK levels, mean and standard deviations of the TPACK survey scores were calculated. The results of the analysis are given in Table 1.

Table 1. Teachers' TPACK levels

Scale	N	Min. Score	Max. Score	Mean	SD
TK	78	1	5	3.19	.906
PK	78	1	5	3.92	.793
CK	78	3	5	4.01	.558
TPK	78	1	5	3.64	.832
TCK	78	1	5	3.51	.886
PCK	78	2	5	4.02	.815
TPACK	78	1	5	3.73	.880

As a result of the analysis, teachers' mean scores on the CK subscale was found to be $\overline{X}$ =4.01 and their scores on the PCK subscale was found to be $\overline{X}$ =4.02. According to this result, it can be stated that the teachers' CK

and PCK levels are at a good level. It is seen in Table 1, teachers are at a moderate level in terms of TK ($\overline{X}$ =3.19), PK ($\overline{X}$ =3.92), TPK ($\overline{X}$ =3.64), TCK ($\overline{X}$ =3.51), and TPACK ($\overline{X}$ =3.73) subscales.

The differences of the teachers' TPACK levels according to gender were examined by independent sample t-test and the results of analysis are given in Table 2.

Table 2. Investigation of teachers' TPACK levels by gender

Factor	Gender	N	$\overline{X}$	SD	t	p
TK	Female	51	3.26	.879	.948	.346
	Male	27	3.06	.959		
PK	Female	51	3.99	.763	1.128	.263
	Male	27	3.78	.844		
CK	Female	51	4.05	.547	.714	.477
	Male	27	3.95	.584		
TPK	Female	51	3.67	.842	.397	.693
	Male	27	3.59	.827		
TCK	Female	51	3.54	.901	.470	.639
	Male	27	3.44	.870		
PCK	Female	51	4.06	.811	.477	.635
	Male	27	3.96	.835		
TPACK	Female	51	3.77	.914	.485	.629
	Male	27	3.67	.823		

It is seen in Table 2, there is no statistically significant difference in any subscale of the TPACK Scale in terms of gender. To determine whether the teachers' TPACK levels differ statistically according to their professional experiences, the mean scores of the groups were analyzed by one-way analysis of variance (F test) and the results are given in Table 3 and Table 4.

Table 3. Descriptive analysis results of TPACK levels according to teachers' professional experiences

Factor	Professional Experiences	N	Mean	SD
TK	0-10 years	43	3.44	.769
	11-20 years	25	3.17	.951
	21 years and more	10	2.16	.610
PK	0-10 years	43	4.06	.604
	11-20 years	25	3.89	.806
	21 years and more	10	3.37	1.227
CK	0-10 years	43	4.05	.569
	11-20 years	25	3.97	.542
	21 years and more	10	3.97	.597
TPK	0-10 years	43	3.81	.740
	11-20 years	25	3.61	.764
	21 years and more	10	3.03	1.121
TCK	0-10 years	43	3.70	.739
	11-20 years	25	3.44	.942
	21 years and more	10	2.85	1.062
PCK	0-10 years	43	4.11	.607
	11-20 years	25	4.07	.908
	21 years and more	10	3.54	1.214
TPACK	0-10 years	43	3.95	.698
	11-20 years	25	3.63	.936
	21 years and more	10	3.04	1.103

It is seen in Table 3 that teachers with professional experiences between 0-10 years have the highest mean score in all subscales of TPACK. The Scheffe test was used to determine which variable was the main effect of the statistically significant difference and the results of the analysis are given in Table 4.

Table 4. Teachers' TPACK levels in terms of professional experiences

Factor	Source of Variance	Sum of Squares	df	Mean Squares	F	p	Significant Difference
TK	Between Groups	13.382	2	1505.521			0-10>21+
	Within Groups	49.886	75	149.659	10.060	.000	11-20>21+
	Total	63.269	77				
PK	Between Groups	3.899	2	70.186			0-10>21+
	Within Groups	44.476	75	21.348	3.288	.043	
	Total	48.375	77				
CK	Between Groups	.135	2	2.434			
	Within Groups	23.852	75	11.449	.213	.809	
	Total	23.987	77				
TPK	Between Groups	5.019	2	40.152			0-10>21+
	Within Groups	48.296	75	10.303	3.897	.025	
	Total	53.315	77				
TCK	Between Groups	6.088	2	48.706			0-10>21+
	Within Groups	54.342	75	11.593	4.201	.019	
	Total	60.430	77				
PCK	Between Groups	2.680	2	65.659			
	Within Groups	48.521	75	31.700	2.071	.133	
	Total	51.201	77				
TPACK	Between Groups	7.148	2	89.349			0-10>21+
	Within Groups	52.425	75	17.475	5.113	.008	
	Total	59.573	77	1505.521			

It is seen in Table 4, while there is no significant differences in CK [$F_{(2.75)}$=.213; *p*>.05] and PCK [$F_{(2.75)}$=2.071; *p*>.05] in terms of professional experiences, teachers' TK [$F_{(2,75)}$=10.060; *p*<.05], PK [$F_{(2,75)}$=3.288; *p*<.05], TPK [$F_{(2,75)}$=3.897; *p*<.05], TCK [$F_{(2,75)}$=4.201; *p*<.05] and TPACK levels [$F_{(2,75)}$=5.113; *p*<.05] differed with respect to their professional experiences. According to Table 4, the difference in the TK subscale is from mean score of teachers with 0-10 years, 11-20 years and 21 years and more professional experiences. Thus, it can be stated that teachers' TK levels with professional experiences between 0-10 years and 11-20 years are higher than those with 21 years and more experience. Furthermore, the difference in PK subscale appears to be due to the mean scores of teachers with professional experiences over 21 years and 0-10 years.

For this reason, it is seen that the teachers who have professional experiences between 0-10 years have higher PK levels than teachers with 21 years or more. Similarly, having 0-10 years and 21 years and more professional experience makes a significant difference in teachers' TPK and TCK levels. Teachers with 0-10 years professional experience have more TPK and TCK levels than those with 21 years and more. Finally, the difference in the TPACK is due to the mean scores of teachers with professional experience of between 1-10 years and 21 years and more. Thus, it can be stated that the TPACK levels of teachers with professional experiences of 1-10 years are higher than the teachers with 21 years and more.

The predictors of the students' academic achievement were investigated by stepwise regression analysis. Thus, the variables that affected in academic achievement significantly and the contribution of each of these variables to the total variance explained in academic achievement were determined. Factors predicting secondary students' academic achievement were investigated through stepwise regression analysis. In this way, the variables which made a significant contribution to the prediction of academic achievement and the contribution of each of these variables to the total variance explained in the prediction of academic achievement were determined. As a result of 4 stages (models) in the application of this method, total variance accounted for in the academic achievement related to Science, Mathematics, Turkish, English and Social Studies courses was identified (See. Table 5).

When the regression equations in Table 5 are examined, the students' academic, social and emotional self-efficacy as well as teachers' TPACK levels explain 12% of the variance explained in students' academic achievement. It is seen that academic self-efficacy *(β =.311)* is the most important variable affecting the GPA of Science and Technology, Mathematics, Turkish, English and Social Studies courses. Teachers' TPACK levels, students' social and emotional self-efficacy are other variables that affect academic achievement. According to the values in the regression equation, the effect of teachers' TPACK level on academic achievement *(β = .117)* is higher than social *(β =.099)* and emotional self-efficacy *(β = -. 091)*.

Table 5. Results of the stepwise regression analysis concerning the predictors students' academic achievement

Model		β	t	Sig.	R	R^2	F
1[a]	academic self-efficacy	.311	13.08	.000	.311	.097	171.19
2[b]	academic self-efficacy	.318	13.46	.000	.334	.112	100.18
	TPACK	.122	5.14	.000			
3[c]	academic self-efficacy	.278	9.87	.000	.340	.115	69.22
	TPACK	.122	5.16	.000			
	social self-efficacy	.072	2.57	.010			
4[d]	academic self-efficacy	.311	10.39	.000	.348	.121	54.71
	TPACK	.117	4.96	.000			
	social self-efficacy	.099	3.38	.001			
	emotional self-efficacy	-.091	-3.16	.002			

Dependent variable: achievement (Science, Mathematics, Turkish, English and Social Studies)
a. Predictors: (constant), academic self-efficacy
b. Predictors: (constant), academic self-efficacy, TPACK
c. Predictors: (constant), academic self-efficacy, TPACK, social self-efficacy
d. Predictors: (constant), academic self-efficacy, TPACK, social self-efficacy, emotional self-efficacy

Results and Discussion

According to the findings obtained in this study, it was found that the CK and PCK of teachers were at a good level and the levels of TK, PK, TPK, TCK and TPACK were moderate. Similar findings are also found in the literature (Babacan, 2016; Bal & Karademir, 2013; Karakaya, 2013). Sancar-Tokmak, Yavuz-Konokman, and Yanpar-Yelken (2013) found that the teachers' self-efficacy perceptions regarding their TPACK were high in the study conducted with 154 pre-service teachers. Bal and Karademir (2013), in their study with in-service teachers, pointed out that teachers found themselves sufficiently satisfied at the "agree" level about TPACK; Aquino (2015) found TPACK of teacher candidates at a high level. In the study conducted by Akman and Güven (2015), the TPACK levels of teacher candidates were low; teachers' TPK levels were low and TK, PK, CK and TCK were moderate.

According to another finding in the current study, there was no statistically significant difference between the scores of the teachers on all subscales of the TPACK Scale in terms of gender. This finding supports the results of many studies in the literature (Babacan, 2016; Jang & Tsai, 2012; Mutluoğlu, 2012). Ay (2015) stated that male and female teachers did not differ in TPACK skills. Similarly, Karakaya (2013) reported that there was no difference between both genders in terms of TPACK levels in the study conducted with chemistry teachers. Contrary to these studies, there are also studies indicating that teachers' TPACK levels differ according to gender. For example, Karataş (2014) stated that male teachers perceive themselves more sufficient in terms of TK, CK, TPK, TCK, TPACK scores than female teachers and that male and female teachers are equal in PK and PCK score types. Canbolat (2011) found TK, TCK, TPK and TPACK levels of male candidates higher than female candidates in a study conducted with elementary school mathematics teacher candidates. This difference in genders is due to the fact that in some studies male teachers perceive themselves more sufficient in TK subscale than female teachers (Bal & Karademir, 2013; Lasen, 2010).

In some studies, it is found that female teachers in PK and CK subscales find themselves more sufficient than male teachers (Hopf & Hatzichristou, 1999; Baylor, Shen, & Huang, 2003). Today, both female and male teachers are able to easily access technological tools. For this reason, no difference is expected in terms of gender when teachers are integrating technological tools into their lessons and using them. In addition, this finding related to gender can be explained by the inclusion of teachers into the same training in the education faculties in terms of General Qualifications for Teaching Profession.

According to another finding in the study, the professional experience of teachers makes a significant difference in their TPACK levels. Participating teachers in the survey who have low teaching experience has higher TK and TPACK levels than teachers who have been working for 21 years or more. Similarly, the PK, TPK and TCK levels of the teachers who are in the first 10 years of the teaching profession are higher than the teachers who have been working for 21 years or more. This finding supports the results of many studies in the literature (Ay, 2015; Bal & Karademir, 2013; Kurtoğlu, 2009; Mutluoğlu, 2012). In a study done by Mutluoğlu (2012), he stated that as the seniority goes from low to high, the TK levels fall. Ay (2015) also found that teachers who have been working for 31 or more years had a lower average of TPACK implementation skills than the other

teacher groups. Similarly, Bal and Karademir (2013), in their study, found that teachers who had less than 20 years of seniority compared to teachers with more than 20 years of seniority perceived themselves more sufficient on TK. Kurtoğlu (2009) stated that branch teachers who are working in the second level of primary education for 15 years or more use the technology as an obligation in their classes.

According to the findings obtained from the current study, teachers who have low occupational seniority have higher TK, PK, TPK, TCK and TPACK levels, which constitute TPACK, than those who have higher seniority. This suggests the concept of digital natives and digital immigrants. The rapidly developing technological world in recent years has created the concept of digital natives and digital immigrants. The 21st century generation who began to life with the technology of the present day and do all the daily works with digital technologies are expressed as digital natives, while the generation that found itself in a new world with the development of technology and try to adapt to these developments are expressed as digital immigrants (Prensky, 2001). In such a case, if we consider teachers who have lower seniority as digital natives and teachers whose seniority years are higher as digital immigrants, we can conclude that teachers with low seniority years are expected to choose appropriate technologies and integrate them in their lessons.

Another finding in this study indicates that the students' academic, social, and emotional self-efficacy with teachers' TPACK levels explain 12% of the academic achievement of students. Academic self-efficacy is the most important variable that influences students' general academic achievement averages of Science and Technology, Mathematics, Turkish, English, Social Studies courses. In addition, the impact of teachers' TPACK levels on academic achievement is higher than students' social and emotional self-efficacy. This finding also indicates the importance of teachers' knowledge of technology integration. Teachers who know how to use the technology related to the taught course positively influence the academic achievement of the students. A teacher with a high self-efficacy for TPACK can effectively use the most appropriate technology for the course. This situation can increase the academic achievement of the students learning the course content through appropriate strategies and technology.

In the related literature, it is seen that the use of appropriate technology by the teachers has positive effects on student achievement. For example, Öztan (2012) found that the use of smart boards increased the achievement of 7th grade students on "work, energy and springs" subject in science and technology. Similarly, in a study conducted by Uzun (2013), it was found that the computer-assisted instruction by the teacher had a positive influence on the academic achievement of the students. In addition, there are studies showing that using a technology in teaching Turkish through appropriate pedagogical methods enhances academic achievement. Akçay and Şahin (2012) reached the conclusion that a teacher's use of Webquest learning method in Turkish class was effective in raising academic achievement levels. In their study, Şen and Ağır (2014) found that the use of smart boards in English teaching positively affected the academic achievement of 4th graders, making a significant difference compared to the traditional board. In the social studies class, the multimedia used by the teachers increased the students' achievement compared to the traditional methods (Altınışık & Orhan, 2002).

Consistent with the findings of this research, many studies in the related literature show that students' self-efficacy positively affects their academic achievement. For example, Güneri (2013) stated that there is a positive relationship between students' academic achievement and self-efficacy beliefs in Science and Technology class. Likewise, Pekdemir (2015) stated that there is a significant relationship between students' academic self-efficacy beliefs and mathematics achievement as a result of his work. In addition, positive relationships between self-efficacy and academic achievement are also observed in studies conducted by Schunk (2003) for Turkish lessons and Doğan (2016) for English lessons. Considering that students' self-efficacy belief is one of the indicators for their high motivation towards the lessons (Kauchak & Eggen, 1998), an increase in the academic achievement of highly motivated learners towards lessons may be expected. Given the findings of this research, it is of the utmost importance that both teachers' skills to integrate technology into courses and students' self-efficacy belief in succeeding in the classroom should be increased.

Recommendations

According to the results of this study, the following suggestions can be made for implementation and future researches. It is seen that the studies that measure the TPACK competencies in the related literature are mostly done with the pre-service teachers and studies conducted with the in-service teachers are limited. For this reason, the studies that measure teachers' TPACK competencies should be increased. In addition, since studies on TPACK have been carried out mostly using quantitative methods, the number of studies in which qualitative and quantitative methods are used jointly should be increased in order to have a deeper knowledge of the

subject. In order for teachers to use TPACK-based practices during teaching following their graduation, the number of courses containing the TPACK sub-dimensions in the curricula of education faculties should be increased and learning environments that give pre-service teachers more opportunity to practice should be provided. Instructors in education faculties who train teacher candidates should also use TPACK-based practices in the curriculum so that they can become role models for teacher candidates.

Note

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