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An Investigation of Teachers' Self Efficacy Beliefs Concerning Educational Technology Standards and Technological Pedagogical Content Knowledge

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ABSTRACT

This study aims to investigate the technological pedagogical content knowledge levels of teachers and their self-efficacy in educational technology standards. Also, the difference between the mean scores of the teachers in different branches from the Scale of Technological Pedagogical Content Knowledge (TPACK) and its sub factors and Scale for Educational Technology Standards (ETS) and its sub factors were analyzed. The distribution and correlation of teachers' TPACK scores and their self-efficacy in educational technology standards in terms of sub-factors and general averages were analyzed. The sample was composed of 54 teachers at various schools located in Ankara. The descriptive statistics showed that the teachers' scores were above the average for all TPACK and ETS scales, including the scale sub-factors. Also a significant difference between the mean scores of the teachers in different branches from TPACK and ETS scales and their sub factors was not determined. Further, moderate positive and significant correlations were found between ETS and TPACK total scores.

Keywords: teachers, self-efficacy in educational technology standards, technological pedagogical content knowledge

INTRODUCTION

Technology has gained an expected place in education as in other fields in the age of information, and thus, many benefits of technology such as the internet, videos, e-mails, smart boards, online broadcasts, computer laboratories and tablet computers can be beneficial assets to today's classrooms. However, classroom-adoption of these technological devices leads to the question of how to use them effectively. Using technology only in a classroom setting is not sufficient; when teachers combine their technological, content and pedagogical knowledge, that is, when they integrate technology into their classes, more effective learning occurs (Pierson, 2001). Research has shown that students process knowledge by setting up active internal cognitive ties in constructivist learning environments where learning through technology occurs, allowing them to configure knowledge in their mind more easily (Koç, 2005). In classrooms where technology is properly integrated into the learning environment, learning, not technology, is at the core. Conversely, in classrooms where the only purpose is to use technology, these devices are mostly employed only by the teacher, and most of the time is spent by focusing on how to use technology. In these cases, technology is mostly used for transferring knowledge and in attaining low-level learning objectives. However, in classrooms where technology is integrated into teaching, its use is planned and purposeful, the technology is employed mostly by the students, and it encourages their participation in the lesson.

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State of the literature

- To integrate technology into the teaching process, knowledge of what technology to use and of where, how and for what purpose to use it is necessary in addition to a deep technological knowledge. A model that properly represents this process is the Technological Pedagogical Content Knowledge Model.
- In the NETS-T standards developed by ISTE, domains of efficacy in teachers' active use of technology in all processes from the design of teaching-learning environments to measurement and evaluation are described.
- In addition to analyzing the international guidelines that have been set for developing national standards, judgements about teachers' TPACK efficacy capacities should also be evaluated.

Contribution of this paper to the literature

- According to the findings of this research, when teachers use TPACK in their classes to contribute to students' learning, more effective and efficient learning will occur.
- This study will contribute to the development of educational technology standards in Turkey and will improve teachers' TPACK levels.
- After examining the descriptive statistics of the scores teachers received from the overall TPACK and ETS scales and all sub-factors of those scales, it was found that the scores were above average. A significant difference between the mean scores of teachers' in different branches from TPACK and ETS scales and their sub-factors was not determined. Moderately positively significant correlations were also found between total ETS and TPACK scores.

The focus is on technology so that it develops new processes of thinking in students. In particular, it is used to encourage higher-order thinking skills and to configure knowledge (Rao, 2013).

It is evident that knowledge such as what technology to use and how and for what purpose to use it should exist in addition to deep technological knowledge in order to integrate technology into the teaching process.

A model that adopts this process of integration is the Technological Pedagogical Content Knowledge (TPACK) Model. "Technological Pedagogical Content Knowledge (TPACK) attempts to identify the nature of knowledge required by teachers for technology integration in their teaching, while addressing the complex, multifaceted and situated nature of teacher knowledge. The TPACK framework extends Shulman's idea of Pedagogical Content Knowledge" (http://www.matt-koehler.com/tpack/tpack-explained). Accordingly, teachers and pre-service teachers today should have a good understanding of three types of knowledge and their interactions (see **Figure 1**) (Yanpar Yelken et al., 2013). These knowledge types include the following: **Content knowledge (CK)** represents knowledge about the teaching subject; **Pedagogical knowledge (PK)**, which is usually referred to as the knowledge about the teaching profession, involves knowledge and skills in planning, conducting and evaluating the teaching process; **Technological knowledge (TK)** involves knowledge about the use of current information and communication technologies, including digital and standard technologies; **Pedagogical Content knowledge (PCK),** which is at the intersection of pedagogical knowledge and content knowledge , involves teachers' and prospective teachers' knowledge and skills in relation to teaching a domain subject effectively; **Technological content knowledge (TCK)** is the knowledge of selecting, using and evaluating the technology suitable for the subject, as well as understanding how that knowledge is changing parallel to technological applications in addition to the subject of teaching; **Technological pedagogical knowledge (TPK) has been described as follows:** "An understanding of how teaching and learning can change when particular technologies are used in particular ways. This includes knowing the pedagogical affordances and constraints of a range of technological tools as they relate to disciplinarily and developmentally appropriate pedagogical designs and strategies" (Koehler & Mishra, 2009); and **Technological pedagogical content knowledge (TPACK) is** a combination of all knowledge types. TPACK includes understanding technology and curriculum content as well as the interaction between special pedagogical approaches. It represents the mentality that teachers should adopt to interact with technology, pedagogy and content in order to teach effectively (Koehler and Mishra, 2009).

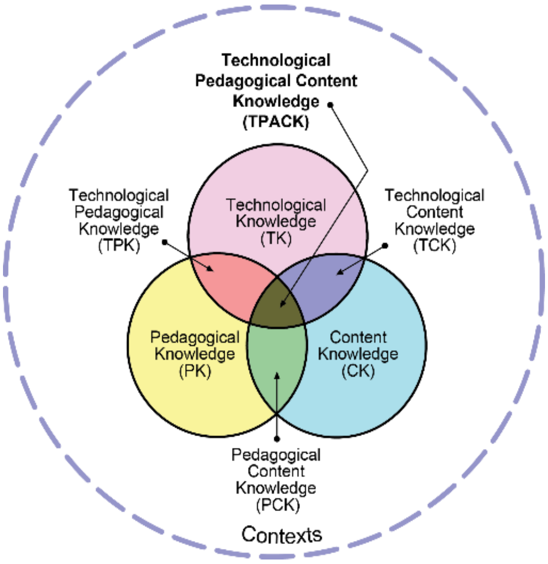

Figure 1. (http://tpack.org)

A pattern of efficacy more detailed than basic knowledge is necessary for the effective use of technology in education (Seferoğlu, 2009). Several efficacy standards (such as National Council for Accreditation of Teacher Education-NCATE) were established after seeking out the views of important stakeholders and evaluating the current applications by national and international organizations. Of those standards, the National Educational Technology Standards (NETS) developed by the International Society for Technology in Education (ISTE) were used as a guide for the use of educational technologies in Turkey and other countries. Despite being developed in the USA, the NETS have a wide influence. They are either directly applied or are regarded as a basis for the implementation of local standards in many countries (Çoklar, 2008). With the adoption of learner-centered approaches in ISTE-developed efficacy, it is clear that there are efforts to integrate new pedagogical approaches into technology (Ilgaz and Usluel, 2011).

NETS-T stresses the "digital age" in current standards and describes the fields of efficacy for teachers' active use of technology in all processes from designing teaching-learning environments to measurement and evaluation.

"According to the ISTE Standards-T, proposed in 2008, teachers should be able to do the following:

- Facilitate and inspire student learning and creativity: Teachers use their knowledge of subject matter, teaching and learning, and technology to facilitate experiences that advance student learning, creativity, and innovation in both face-to-face and virtual environments.
- Design and develop digital age learning experiences and assessments: Teachers design, develop, and evaluate authentic learning experiences and assessments incorporating contemporary tools and resources to maximize content learning in context and to develop the knowledge, skills, and attitudes identified in the ISTE standards for students.
- Model digital age work and learning: Teachers exhibit knowledge, skills, and work processes representative of an innovative professional in a global and digital society.
- Promote and model digital citizenship and responsibility: Teachers understand local and global societal issues and responsibilities in an evolving digital culture and exhibit legal and ethical behavior in their professional practices.

- Engage in professional growth and leadership: Teachers continuously improve their professional practice, model lifelong learning, and exhibit leadership in their school and professional community by promoting and demonstrating the effective use of digital tools and resources.

These standards can be taken as 21st-century teacher competencies" (ISTE, 2017).

The doctoral thesis written by Çoklar (2008) analyzed technologies that were offered in educational faculties in terms of relevant standards based on prospective teachers' views and found that there were high levels of self-efficacy in educational technology standards. Accordingly, the prospective teachers considered themselves adequate in using known technologies in education. Ulucan and Karabulut (2012) analyzed prospective physical education teachers' self-efficacy in educational technology standards based on their gender and university of attendance. Consequently, they found that prospective physical education teachers generally had high levels of self-efficacy in educational technology standards. They also found that the variable of gender did not differ significantly. However, their self-efficacy was found to differ significantly on the sub-dimension of "social, ethical, legal and humanistic issues" based on the university that they attended.

Şimşek (2016), analyzed technological pedagogical content knowledge (TPACK) self-efficacy of prospective teachers in the context of International Society for Technology in Education's educational technology standards that were defined for teachers in 2008 (ISTE-T 2008). The findings of this research indicated that the prospective teachers had high TPACK-ISTE self-efficacy. A significant difference in favor of males in Technological Knowledge (TK) scores observed. Also, the prospective teachers who took computer courses based on a certificate had significantly higher TK and TPACK-ISTE self-efficacy scores than the others. No significant difference in all dimensions and general scores of TPACK-ISTE self-efficacy in point of the type of program that prospective teachers attended was observed. Significantly statistical differences among the teaching branches of the prospective teachers in TPACK-ISTE self-efficacy scores was determined. The prospective teachers at department of Foreign Languages and at department of Computer Education and Instructional Technologies had highest TPACK-ISTE self-efficacy scores, while the prospective teachers at departments of Mathematics and Turkish & Turkish Language and Literature had lowest score.

Several qualitative and quantitative studies have been conducted regarding teachers' and prospective teachers' TPACK self-efficacy and their integration of technology into curricula (Angeli and Valanides, 2005; Beşoluk & Horzum, 2011; Bilgin, Tatar and Ay, 2012; Bozkurt & Cilavdaroglu, 2011; Chai, Koh, Tsai, and Tan, 2011; Gömleksiz & Fidan, 2011; Graham, Borup and Smith, 2011; Harris & Hofer, 2011; Jang & Tsai, 2012).

According to Bandura (1997), teachers' self-efficacy affects the configuration of academic activities in their classrooms. Further, it is commonly known that teachers' self-confidence and self-efficacy influence their use of technology and that individuals who are intentional about allocating time for technology use have positive self-confidence and self-efficacy (Oral, 2008; Rugayah, Hashim & Wan, 2004).

It is necessary to study teachers' and prospective teachers' judgements about their efficacy capacities in addition to analyzing international standards for developing teachers' and prospective teachers' TPACK efficacy.

Purpose

The purpose of this study was to investigate the technological pedagogical content knowledge (TPACK) levels of teachers working in various schools in Ankara, as well as their self-efficacy in educational technology standards set by the International Society for Technology in Education in 2008. In line with this purpose, this study analyzes the distribution of teachers' TPACK levels and their self-efficacy in educational technology standards in terms of sub-factors and general averages. Also, it analyses whether there is a significant difference between the mean scores of the teachers in different branches from the Scale of Technological Pedagogical Content Knowledge and its sub factors and Scale for Educational Technology Standards and its sub factors. It also determines the correlations between teachers' TPACK scores and their self-efficacy in educational technology standards.

In accordance with this basic aim, answers were sought to the following questions:

1. What is the distribution of teacher scores for the overall Scale of Technological Pedagogical Content Knowledge and for the sub-factors of technological knowledge, content knowledge, pedagogical knowledge, pedagogical content knowledge, technological content knowledge, technological pedagogical knowledge and technological pedagogical content?
2. What is the distribution of teacher self-efficacy scores in the overall Scale for Educational Technology Standards and in the sub-factors of technological operations and concepts knowledge, planning and designing learning experiences through learning environments, measurement and evaluation, efficiency and occupational applications, social, ethical, legal and humanistic issues, and planning teaching according to individual differences and special needs?
3. Is there a significant difference between, the mean scores of the teachers in different branches from the Scale of Technological Pedagogical Content Knowledge and its sub factors and Scale for Educational Technology Standards and its sub factors?
4. What is the correlation between teachers' TPACK and self-efficacy scores in educational technology standards?

METHOD

Research Model

This study employs both a descriptive and an explanatory correlational research model. The descriptive research model enables researchers to collect data in order to test the hypotheses on a past or present situation, to answer questions, or to enable them to create descriptions (Karasar, 1999). Correlational research analyzes the correlations between two or more variables without influencing the variables in the model. In correlational research, the changes in the variables are analyzed together without trying to determine cause and effect relationships. In explanatory research, however, correlations between complex variables that are thought to be related to each other are uncovered. In this case, the levels of the correlation are determined, and efforts are made to understand important actions and situations (Fraenkel & Wallen, 2006).

Sample

The research sample was composed of 54 teachers working in various schools located in Ankara. Fifty-seven percent of the participating teachers were female, whereas 43% were male. Of the participants, 33% were at least 30 years old, 26% were in the 31-40 age range, 30% were in the 41-50 age range, and 11% were 51 years old or above. According to branches of teaching, 22% of the teachers were mathematics and physical sciences teachers, while 78% were social science teachers.

Data Collection Tools

The Scale for Determining Prospective Teachers' Self-efficacy in Educational Technology Standards

The scale developed by Çoklar (2008) according to National Educational Technology Standards for Teachers (NETS-T Standards) to determine prospective teachers' self-efficacy in educational technology is a 5-point Likert scale consisting of 41 items within the sub-factors of technological operations and concepts knowledge; learning through learning environments; planning and designing experiences; measurement and evaluation; efficiency and occupational applications; social, ethical, legal and humanistic issues; and planning teaching according to individual differences and special needs.

A description of each efficacy sub-factor is as follows:

Technological concepts and operations: Teachers need to understand many types of technology (primarily computers) and have the ability to actively use them. Teachers are not only expected to use technology, but they should also be able to adapt to rapidly changing technology.

Planning and designing experiences with learning environments: Teachers are expected to arrange learning environments with the benefit of technology according to the level of student development and to enable individual teaching. Teachers need to follow new strategies and up-to-date studies about designing technology-assisted rich learning environments and planning experiences. They also must check the accuracy of the strategies and studies and applying them in their classrooms.

Teaching, learning and curriculum: This sub-factor refers to the qualities that teachers need to have to create appropriate curricula using technology, and the teaching methods and techniques that are used to enrich students' learning experiences. Teachers need to know and apply appropriate methods and techniques to raise student learning levels by helping students acquire knowledge using technology. Teachers must help students uncover their higher-level thinking and creativity skills by considering individual differences and by giving students opportunities to have experiences.

Measurement and evaluation: Teachers are expected to be able to apply different measurement and evaluation techniques with the help of technology, conduct analyses and make interpretations to make the learning process more effective by using technology in accordance with the data they obtain. This helps their students make versatile progress by evaluating various dimensions.

Efficiency and occupational applications: Teachers are expected to pursue professional development in all subjects of general knowledge, professional knowledge and content knowledge. This includes technological operations and concept comprehension through technology. They must be lifelong learners so that they can provide more efficient education. Teachers must also use technology to answer the question, "How can I teach better?"

Social, ethical, legal and humanistic issues: Using technology leads to certain legal responsibilities as well as concerns about human rights. Teachers are expected to train their students so that they have this consciousness. Additionally, teachers must teach their students how to use technology in a safe and healthy way while providing their students with equal opportunities to benefit from technology.

Technological Pedagogical Content Knowledge Scale

The scale developed by Schmidt et al (2009) and translated into Turkish by Öztürk and Horzum (2011) is a 5-point Likert scale and contains 47 items. The scale is composed of sub-factors such as Technological Knowledge, Content Knowledge, Pedagogical Knowledge, Pedagogical Content Knowledge, Technological Content Knowledge, Technological Pedagogical Knowledge and Technological Pedagogical Content Knowledge. Cronbach's alpha internal consistency coefficients for the sub-factors of the scale were found as 0.82, 0.75, 0.84, 0.85, 0.80, 0.86 and 0.92, respectively. The Cronbach Alpha coefficient for the overall scale was found to be .96.

Technological Pedagogical Content Knowledge Scale is developed for teachers and prospective teachers from different branches. Items of the sub-factors such as Content Knowledge, Pedagogical Content Knowledge, Technological Content Knowledge, and Technological Pedagogical Content Knowledge are prepared for different disciplines. Example of the items are given in **Table 1**.

DATA ANALYSIS

The SPSS package program was used for data analysis. Descriptive statistics were used to determine teachers' self-efficacy on the overall scale of educational technology standards, as well as the distribution of TPACK and related scale sub-factor scores. Kruskal-Wallis H Test was used to determine if there is a statistically significant difference between mathematics, physical sciences and social sciences teachers' mean scores of TPACK scale and ETS scale and their sub factors. Additionally, correlation analysis was used to determine the correlations between total scores received from the scales and from the scale sub-factors.

Findings

Table 2 shows the results of descriptive statistical analysis in the sub-factors of the TPACK scale for teachers.

Table 1. Examples of the items of the sub-scales Content Knowledge, Pedagogical Content Knowledge, Technological Content Knowledge, and Technological Pedagogical Content Knowledge prepared for the teachers in different branches

Name of the subscale	Example Item
Content Knowledge	I have adequate knowledge about Mathematics
	I have adequate knowledge about Social Sciences
	I have adequate knowledge about Science
	I have adequate knowledge about Literacy.
	I can think mathematical.
	I can think scientific.
	I can think literary.
Pedagogical Content Knowledge	I know how to choose efficient teaching approaches to guide my students for learning mathematics.
	I know how to choose efficient teaching approaches to guide my students for learning literacy.
	I know how to choose efficient teaching approaches to guide my students for learning science.
	I know how to choose efficient teaching approaches to guide my students for learning social sciences.
Technological Content Knowledge	I have enough knowledge about technologies for learning mathematics
	I have enough knowledge about technologies for learning literacy.
	I have enough knowledge about technologies for learning science.
	I have enough knowledge about technologies for learning social sciences.
Technological Pedagogical Content Knowledge	I can teach mathematics combining related technologies and teaching approaches.
	I can teach literacy combining related technologies and teaching approaches.
	I can teach science combining related technologies and teaching approaches.
	I can teach social sciences combining related technologies and teaching approaches.

Table 2. Descriptive statistical results of TPACK scale sub-dimensions

TPACK Scale subdimensions	N	Mean	Std. Deviation
TCK	54	3.84	.77
TPK	54	3.82	1.10
TK	54	3.71	1.63
CK	54	3.72	.67
PK	54	4.41	.53
TPACK	54	3.82	1.59
Total TPACK Scale	54	3.87	.65

A close examination of the descriptive statistics makes it clear that teachers' overall TPACK and TPACK subdimension scores are above average. Accordingly, they have the highest scores in the sub-factor of Pedagogical Knowledge (X= 4.41).

Table 3 shows the results of the descriptive statistical analysis in the sub-factors of the educational technology standards scale for teachers.

According to **Table 3**, the scores from the overall ETS scale are above average (X= 3.92), which shows that teachers have high self-efficacy in educational technology standards. Teachers also have high self-efficacy in all sub-factors. The sub-factors in which teachers have the highest self-efficacy are Technological Operations and

Table 3. Descriptive statistical results of ETS scale sub-dimensions

ETS Scale subdimensions	N	Mean	Std. Deviation
Technological concepts and operations	54	4.38	1.43
Planning and Designing Learning Experiences with Learning Environments	54	4.13	.62
Measurement and evaluation	54	4.03	.73
Efficiency and occupational applications	54	3.60	.85
Social, ethical, legal and humanistic issues	54	3.59	
Planning Education according to Individual Differences and Special Needs	54	3.60	1.06
Total ETS scale	54	3.92	.74

Concepts Knowledge (X= 4.38), Planning and Designing Learning Experiences with Learning Environments (X= 4.13) and Measurement and Evaluation (X= 4.03).

Table 4 shows Kruskal Wallis H test results of TPACK scale and ETS scale scores and sub-dimensions.

Examination of **Table 4** shows that, there is not a statistically significant difference between mathematics, physical sciences and social sciences teachers' mean scores of TPACK scale and ETS scale and their sub factors. For the sub-factors of ETS Scale: Technological concepts and operations ($x^2=0,72$, $p>0,05$) , Planning and Designing Learning Experiences with Learning Environments ($x^2=0,61$, $p>0,05$), Measurement and evaluation ($x^2=0,99$, $p>0,05$), Efficiency and occupational applications ($x^2=0,11$, $p>0,05$), Social, ethical, legal and humanistic issues($x^2=0,06$, $p>0,05$), Planning Education according to Individual Differences and Special Needs($x^2=0,17$, $p>0,05$), Total ETS scale ($x^2=0,53$, $p>0,05$).

For the sub-factors of TPACK scale: TCK ($x^2=1,53$, $p>0,05$), TPK ($x^2=1,01$, $p>0,05$), TK ($x^2=1,12$, $p>0,05$), CK ($x^2=0,56$, $p>0,05$), PK ($x^2=0,66$, $p>0,05$), TPACK ($x^2=1,69$, $p>0,05$), Total TPACK Scale ($x^2=1,31$, $p>0,05$).

Table 5 shows the correlation results between teachers' TPACK and self-efficacy scores in educational technology standards.

- An examination of **Table 5** shows that, there are significant, but weak, positive correlations between the sub-factor scores of Technological Operations and Concepts Knowledge and TPK, TPACK, TK and CK ($0.49<r<0.30$, $p<.01$).
- There are moderate correlations between the sub-factor scores of Planning and Designing Learning Experiences with Learning Environments and TPK ($0.69<r<0.50$, $p<.01$), and significant, but weak, positive correlations between TPACK, TK and CK scores ($0.49<r<0.30$, $p<.01$). However, there are no significant correlations between PK, PCK and TCK scores ($p>.05$).
- There are significant, moderate positive correlations between scores for the sub-factor of Measurement and Evaluation and TPK and TPACK scores ($0.69<r<0.50$, $p<.01$), and significant, but weak, negative correlations with TK, CK and PK ($0.49<r<0.30$, $p<.01$).
- There are significant moderate positively correlations between the scores for the sub-factor of Efficiency and Occupational Applications and TPK, TPACK, TK and CK scores ($0.69< r <0.50$, $p<.01$).
- There are significant, but weak, positive correlations between scores for the sub-factor of Social, Ethical, Legal and Humanistic Issues and TPK, TPACK, TK and CK scores ($0.49< r <0.30$, $p<.01$).
- There are significant, moderate positive correlations between scores for the sub-factor of Planning Education according to Individual Differences and Special Needs and TPK and TPACK scores ($0.69<r<0.50$, $p<.01$). There are significant, but weak, positive correlations between TK, CK and TPACK scores ($0.49<r<0.30$, $p<.01$).

Table 4. Kruskal Wallis H test results of TPACK scale and ETS scale scores and sub-dimensions

ETS Scale sub dimensions	Branch of the Teacher	n	Mean rank	df	x^2	p	Difference
Technological concepts and operations	Math.		30,14	2	0,72	0,70	-
	Phys. Sci.	5	27,67				
	Soc. Sci.	42	25,17				
Planning and Designing Learning Experiences with Learning Environments	Math.	7	30,50	2	0,61	0,74	-
	Phys. Sci.	5	27,25				
	Soc. Sci.	42	25,74				
Measurement and evaluation	Math.	7	28,57	2	0,99	0,61	-
	Phys. Sci.	5	19,63				
	Soc. Sci.	42	26,82				
Efficiency and occupational applications	Math.	7	26,57	2	0,11	0,95	-
	Phys. Sci.	5	24,13				
	Soc. Sci.	42	26,72				
Social, ethical, legal and humanistic issues	Math.	7	26,93	2	0,06	0,97	-
	Phys. Sci.	5	24,75				
	Soc. Sci.	42	26,60				
Planning Education according to Individual Differences and Special Needs	Math.	7	28,50	2	0,17	0,92	-
	Phys. Sci.	5	27,25				
	Soc. Sci.	42	26,09				
Total ETS scale	Math.	7	28,14	2	0,53	0,77	-
	Phys. Sci.	5	30,67				
	Soc. Sci.	42	25,29				
TCK	Math.	7	33,14	2	1,53	0,46	-
	Phys. Sci.	5	22,50				
	Soc. Sci.	42	26,40				
TPK	Math.	7	33,00	2	1,01	0,60	-
	Phys. Sci.	5	26,10				
	Soc. Sci.	42	26,75				
TK	Math.	7	25,43	2	1,12	0,57	-
	Phys. Sci.	5	34,40				
	Soc. Sci.	42	27,02				
CK	Math.	7	31,00	2	0,56	0,75	-
	Phys. Sci.	5	25,38				
	Soc. Sci.	42	26,49				
PK	Math.	7	24,29	2	0,66	0,72	-
	Phys. Sci.	5	24,30				
	Soc. Sci.	42	28,42				
TPACK	Math.	7	33,93	2	1,69	0,43	-
	Phys. Sci.	5	30,40				
	Soc. Sci.	42	26,08				
Total TPACK Scale	Math.	7	29,93	2	1,31	0,52	-
	Phys. Sci.	5	34,00				
	Soc. Sci.	42	25,85				

- There are moderate positive correlations between total ETS scores and TPK, TK, CK and TPACK scores ($0.69<r<0.50$, $p<.01$). However, there are no significant correlations between PCK and TCK scores ($p>.05$).

Table 5. Results for correlations between teachers' TPACK and self-efficacy scores in educational technology standards

ETS Scale sub dimensions		TPK	TPACK	TK	CK	PK	PCK	TCK	TPACK Scale Total
Technological concepts and operations	Pearson Correlation	.440**	.324*	.348*	.355*	.270	.170	.142	.462**
	Sig. (2-tailed)	.001	.020	.012	.011	.055	.232	.319	.000
	N	54	54	54	54	54	54	54	54
Planning and Designing Learning Experiences with Learning Environments	Pearson Correlation	.587**	.481**	.448**	.379**	.263	.245	.033	.593**
	Sig. (2-tailed)	.000	.000	.001	.006	.060	.083	.818	.000
	N	54	54	54	54	54	54	54	54
Measurement and evaluation	Pearson Correlation	.672**	.524**	.338**	.385**	.297*	.197	.116	.625**
	Sig. (2-tailed)	.000	.000	.014	.005	.033	.166	.418	.000
	N	54	54	54	54	54	54	54	
Efficiency and occupational applications	Pearson Correlation	.509**	.465**	.403**	.488**	.243	.242	-.041	.577**
	Sig. (2-tailed)	.000	.001	.003	.000	.082	.087	.773	.000
	N	54	54	54	54	54	54	54	54
Social. ethical, legal and humanistic issues	Pearson Correlation	.445**	.441**	.312*	.462**	.210	.265	.023	.528**
	Sig. (2-tailed)	.001	.001	.025	.001	.135	.060	.874	.000
	N	54	54	54	54	54	54	54	54
Planning Education according to Individual Differences and Special Needs	Pearson Correlation	.567**	.558**	.310*	.492**	.232	.344*	.186	.639**
	Sig. (2-tailed)	.000	.000	.025	.000	.098	.013	.192	.000
	N	54	54	54	54	54	54	54	54
Total ETS scale	Pearson Correlation	.583**	.486*	.579*	.505*	.349*	.273	.76	.661
	Sig. (2-tailed)	.000	.000	.000	.000	.12	.53	.596	.000
	N	54	54	54	54	54	54	54	54

CONCLUSIONS AND DISCUSSION

The results from analyzing the distribution and correlation of teachers' Technological Pedagogical Content Knowledge (TPACK) scores and teacher self-efficacy in educational technology standards set by the International Society for Technology in Education in 2008, are explained below.

After examining teacher scores from the overall TPACK scale and from all its sub-factors, it was found that the scores were above average. This finding was compatible with those obtained in a previous study (Sancar Tokmak, Yavuz Konokman, & Yanpar Yelken , 2013; Kaya et al. 2011; Gündoğmuş ,2013; Graham et al., 2009) determining prospective primary school teachers' perceptions of their technological pedagogical content knowledge (TPACK). Accordingly, the sub-factor in which they had the highest score was the sub-factor of pedagogical knowledge (X=4.41). Similarly, Archambault & Crippen measured the knowledge levels of 596 online teachers within the framework of TPACK in terms of technology, pedagogy, content and a combination of all three. They found that teachers' levels of pedagogical knowledge, content knowledge and pedagogical content knowledge were higher than levels from the other components of TPACK. These finding indicate that pedagogical knowledge is the oldest competency that a teacher should have. Within the years of the teaching profession most of the teachers gain this competency.

The score teachers received from the overall ETS scale was above average (X= 3.92), which showed that teachers had high levels of self-efficacy in educational technology standards. Teachers also had high self-efficacy in all sub-factors. The sub-factors in which they had the highest self-efficacy were Technological Operations and Concepts Knowledge (X=4.38), Planning and Designing Learning Experiences with Learning Environments (X=4.13), and Measurement and Evaluation (X=4.03). Teachers had high levels of self-efficacy in using technology in a technical sense and in matters of pedagogical knowledge such as preparation, application, evaluation, supporting content learning, effective teaching strategies and performance assessment applications. The sub-factors in which teachers felt they had the lowest efficacy - although their levels of self-efficacy were high - were Social, Ethical, Legal and Humanistic Issues and Efficiency and Occupational Applications. Similar results were found in a study conducted by Özçiftçi and Çakır (2015) in which primary school teachers that were registered in a non-thesis master's degree program, found that teachers had high life-long learning tendencies and high self-efficacy in educational technology standards. Ulucan and Karabulut (2012) also analyzed prospective physical education teachers' self-efficacy in educational technology standards and obtained similar results. Further, these results paralleled those obtained in Oh and French (2005) and in Song et al (2005). These results show that Technological Operations and Concepts Knowledge, Planning and Designing Learning Experiences with Learning Environments, Measurement and Evaluation are also the main concepts of the teaching process. For this reason most of the teachers have highest self-efficacy in these sub-factors. But, Social, Ethical, Legal and Humanistic Issues and Efficiency and Occupational Applications concepts are new concepts for most of the teachers.

It was found that there is not a statistically significant difference between mathematics, physical sciences and social sciences teachers' mean scores of TPACK scale and ETS scale and their sub factors. These results are compatible with the results of the study which examined Technopedagogical Knowledge Competencies of Teacher Trainers (Şimşek., Demir., Bağçeci and Kınay, 2013). One of the reason of this result may be the distribution of the branch of the teachers attending to the study. Most of the teachers were from the social sciences department. While, there is not any teacher from Computer Education and Instructional Technologies branch which contains teachers that have highest technology knowledge. Chukwuemaka ve İşcioğlu (2016), investigated the TPACK levels of the lecturers from Computer Education and Instructional Technologies Department, Elementary Education Department, English Language Teaching Department, Educational Sciences Department (ES), Turkish Language Teaching Department. As a result, they found that lecturers from Computer Education and Instructional Technologies Department had the highest TPACK level. Also, all of the teachers attending to the study are working in the central part of Ankara and working in the similar schools.

The results from the correlation analysis demonstrated that there were significant, moderate positive correlations between teacher ETS scores and total TPACK scores. Forty-four percent of the overall TPACK score total variance stemmed from general ETS scores. These results were compatible with those obtained by Abbit (2011), who analyzed the correlations between Technological Pedagogical Content Knowledge (TPACK) and the technological integration self-efficacy beliefs of pre-service teachers. In a similar way, we also found significant positive correlations between TPACK and self-efficacy in technology integration. Sahin, Akturk and Schmidt (2009) found significant positive correlations between prospective teacher TPACK scores and their self-efficacy in teaching in the classroom. These findings indicate that teachers' self-efficacy in educational technology standards have important effects on their technological pedagogical content knowledge.

RECOMMENDATIONS

The findings obtained in this study show that teachers' self-efficacy in educational technology standards have substantial effects on their technological pedagogical content knowledge. Therefore, future studies in Turkey should be extended and continued in this area so that standards are set in the field of educational technology. Research shows that one of the reasons that pre-service teachers worry about integrating technology into teaching is that they think technology is not adequately used in their training process. It is commonly known that individuals who are intentional about allocating time for technology use have positive self-confidence and self-efficacy (Rugayah, Hashim & Wan, 2004). Education faculties should arrange their program in such a way that prospective teachers can adapt technology into their classes, explore different technology options and understand the importance of the TPACK concept.

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