ICT Integration of Turkish Teachers: An Analysis within TPACK-Practical Model[i]

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Abstract
The aim of the study is to analyze Information and Communication Technologies (ICT) integration of Turkish teachers using various variables within the context of Technological Pedagogical Content Knowledge (TPACK). These variables were indicated as the gender of teachers, the implementation status of FATIH project at their schools, school types that the teachers were commissioned at, and their years of seniority. The study was conducted using causal-comparative design, one of the non-empirical quantitative research methods. TPACK-Practical Scale was utilized as data collection tool in the study. The data were collected from 296 teachers serving at Ministry of Education state schools. The analysis of the data was conducted using descriptive statistics, independent samples t-test, and Analysis of Variance (ANOVA). Findings of the study demonstrated that teachers scored the highest mean points in Curriculum Design, while the mean scores for Infusing ICT to assess students was the lowest. Furthermore, while there was no significant difference between the total mean scores of females and males, a significant difference was observed between the teachers that serve at schools where FATIH project was implemented and the teachers that serve at schools where FATIH project was not implemented, and between the teachers that serve in different types of schools.

Key words: Technology integration, ICT, Technological Pedagogical Content Knowledge, teacher efficiencies, FATIH Project

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Introduction

Nowadays, the developments in the Information Communication Technologies (ICT) are accelerated and its usage areas in education are increasing. The role of the teachers, who are actively involved in the teaching process, on the process of technology integration in education is very important. The topics mainly investigated by educational researchers are; the capabilities that teachers should own and the effects of the developments in ICT on the capabilities of the teachers. Teacher evaluation is much more difficult than student evaluation because teachers' instructional knowledge is dynamic, contextualized, and personal (Jen, Yeh, Hsu, Wu and Chen, 2016). These researches are focused on various models. In this context, the models are grouped under two fundamental approaches, technology focused or pedagogy focused; technology focused models concentrates on teachers' knowledge and skills acquisition for the use of technology, whereas pedagogy focused models addresses the integration of teachers' technology usage with pedagogic knowledge in the education process. Koehler and Mishra (2005) pointed that the recent researches featuring this issue tend to move from technology focused models to pedagogy focused models. The foremost pedagogy focused model about the integration of technology in education is Technological Pedagogical Content Knowledge (TPACK) model (Koehler and Mishra, 2009).

Technological Pedagogical Content Knowledge (TPACK)

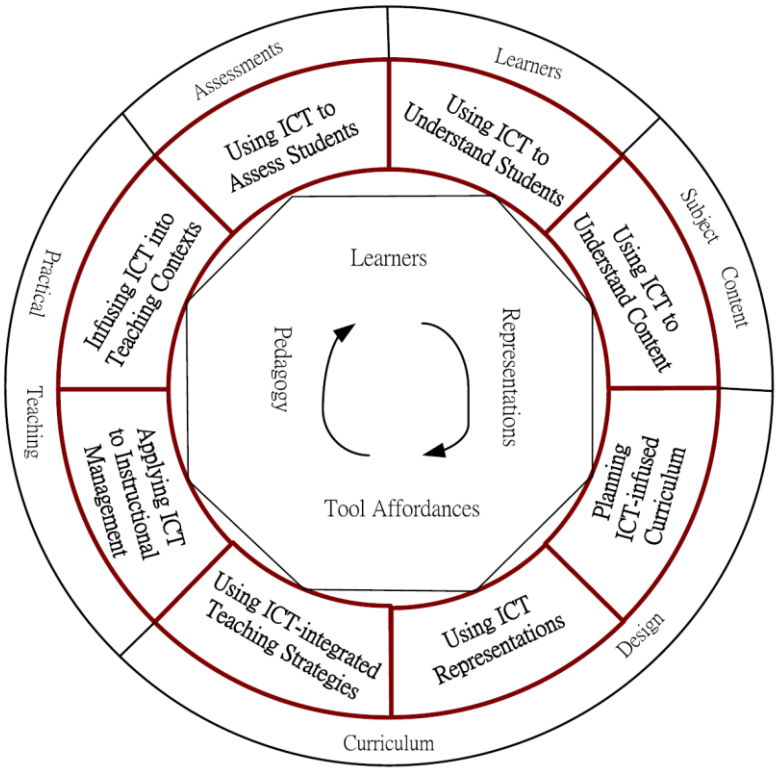
The TPACK model has taken its final shape by integrating the 'Technology' dimension with Pedagogical Content Knowledge [PCK], which is a model that features the necessary characteristics that teachers should have (Koehler & Mishra 2005). The following are components of TPACK; (*i*) technology, which comprises technical knowledge about equipment about technological tools, including tools such as computers, the internet, video, measuring devices, and e-books; (*ii*) pedagogy, which considers teaching methods, strategies, and models and consists of subdomains that include how students learn, how to use classroom management skills, course planning and effective student assessment; and (*iii*) content knowledge, including subject area knowledge, which varies according to grade level and discipline, and all of the theories and ideas of the concepts belonging to this discipline. Pedagogical Content Knowledge [PCK] is the combination of knowledge and pedagogy and involves the presentation of the content area via interactions with pedagogical issues; i.e., the selection of appropriate teaching approaches, methods and techniques. Technological Content Knowledge [TCK] is the combination of technology and content and refers to the use of technology that is more appropriate for representing the subject and content of a particular discipline. Technological Pedagogical Knowledge [TPK] is the combination of technology and pedagogy and considers the effects of technology usage on learning in the teaching process. TPACK addresses the three different skills of technology, pedagogy and content together rather than considering them independently. TPACK involves the presentation of the subject area for effective teaching within the framework of pedagogical approaches in environments that involve the use of technology (Angeli & Valanides, 2009; Koehler & Mishra, 2009; Ay, Karadağ & Acat, 2015)

TPACK-Practical Model

The TPACK models have evolved from different perspectives in the literature and tackle knowledge and skill dimensions independent of teaching experience and performance. From this perspective, the TPACK- Practical model is a model that considers the teaching process as the basis upon which Practical knowledge (teaching experience) and TPACK skills work together. The consideration of TPACK and the teaching process together is important in terms of the skills used through the process and the consideration of the interaction between these two processes in addition to providing immediate feedback. Specifically, it should not be ignored that the processes requiring different technologies, such as the recognition of students, planning, design, and evaluation, require different TPACK skills. According to Yeh, Hsu, Wu, Hwang and Lin (2013), the TPACK skills of teacher candidates are not the same as those of experienced teachers. Thus, teaching processes and outcomes are affected by the interaction of possessed knowledge and skills with teaching experience. The TPACK-Practical model (see Fig. 1) consists of eight knowledge dimensions from five pedagogical areas. These pedagogical areas include the following: (*i*) learners, (*ii*) subject content, (*iii*) curriculum design, (*iv*) practical teaching, and (*v*) assessments. The knowledge dimensions

belonging to these areas are the following: (*i*) using ICT to understand students, (*ii*) using ICT to understand subject content, (*iii*) planning ICT-infused curricula, (*iv*) using ICT representations, (*v*) using ICT-integrated teaching strategies, (*vi*) applying ICT to instructional management, (*vii*) infusing ICT into teaching contexts, and (*viii*) using ICT to assess students (Yeh et al., 2013, Ay, Karadağ & Acat, 2015).

Figure 1: *The framework of the TPACK-Practical model.*



The acceptance and implementation of a new technology is very similar to the process of accepting an innovation. According to Rogers (2003), based on the research conducted on individuals and communities, investigations of adaptation to an innovation and the process of acceptance for different persons are of great importance. Today, where the pace of technological developments is increasing, many studies are conducted on teachers' technology adaptation and their effective usage of technological devices (Doering Veletsianos Scharber and Miller 2009; Abbit 2011; Graham 2011; Lee and Kim 2014).

In Turkey, the most important project implemented within the context of technology integration in education is "Movement of Enhancing Opportunities and Improving Technology", known as FATIH project. FATIH project is one of the most important steps, targeting the effective use of technology by the teachers and students by allowing the technology integration in education. The project, which aims the realization of Information Communication Technologies (ICT) supported instruction by providing the required substructure to the classrooms, consists of five main components, namely; (*i*) providing equipment and software substructure, (*ii*) providing educational e-content and management of e-content, (*iii*) effective usage of ICT in education programs, (*iv*) in-service training of the teachers, and (*v*) conscious, reliable, manageable and measurable ICT Usage.

FATIH project has serious goals such as: (*i*) providing LCD Interactive Boards and internet substructure to 570.000 classrooms in elementary and middle education enabling efficient use of ICT tools in the learning-teaching processes by appealing to more sensory organs, in order to enable equal opportunities in education and to improve technology in the schools; (*ii*) providing a tablet PC to each teacher and student; (*iii*) providing in-service training to the teachers in order to ensure effective usage of ICT equipment in the classrooms in the learning- teaching process; and (*iv*) the adaptation of

education programs to ICT supported instruction and the formation of educational e-contents within this transformation process Ministry of Education (2013).

Today, a need is apparent for tangible Practicals that describe the existing conditions in the process of technological integration and the identification of the factors that affect the integration process. Because, description and framing of the current situation and implementation of an effective integration process, would be the foundation stones in the design of the related roadmap. Thus, this study aimed to contribute in description of the current situation with respect to the integration of the teacher dimension of Information Technologies (IT) with the learning and instruction process, and to scrutinize this situation within the framework of variables that could affect the integration process.

This study aims to provide answers to the following research questions:

- What are the skill levels of the teachers in TPACK-Practical model?
- Is there a statistically significant difference between the scores of female and male teachers on TPACK-Practical scale?
- Is there a statistically significant difference between the scores of teachers, who serve at schools where FATIH project is implemented, and teachers, who serve at schools where it is not implemented, on TPACK-Practical scale?
- Is there a statistically significant difference between the scores of teachers that serve in different school grades on TPACK-Practical scale?
- Is there a statistically significant difference between the scores of teachers with different seniority levels on TPACK-Practical scale?

Methodology

Research Design

The study was conducted using causal-comparative design, one of the non-empirical quantitative research methods. Causal-comparative research aims to determine the reasons for a situation or an event, and the variables that affect these factors. In causal-comparative research, there are at least two groups that were affected in different ways from the same situation, or there are two groups that were affected or not affected by the assumed situation, and these groups are scrutinized based on certain variables (Cohen and Manion, 1994).

Participants

Data was collected from 318 teachers identified using intentional sampling. The data for 22 participants who scored all items with the same points and could negatively affect the data reliability were excluded before the analysis. Thus, data obtained from 22 participants were included in the analysis. Demographical characteristics of the participants are presented in Table 1.

Table 1. Demographic data of the participants

Gender		Male	Female			Total
	n	123	173			296
	%	41.6	58.4			100
School Type		Elementary school	Middle school	High school		
	n	6	4	3		13
	%	46,1	30,7	23,2		100
Age Range	Year	21-30	31-40	41-50	51 or above	Total
	n	104	80	82	30	296
	%	35.1	27.1	27.7	10.1	100
Career year	Year	1-10	11-20	21-30	31 or above	Total
	n	120	92	69	15	296
	%	42.6	31.4	23.3	3.7	100

Data Collection Tools

TPACK-Practical Scale

The TPACK-Practical Scale items were obtained from the Delphi study conducted by (Yeh et al., 2013) which was performed in two stages with the participation of 6 researchers and 54 specialists. Scale was adapted to Turkish by Ay, Karadağ & Acat (2015) and its validity in the context of Turkish culture checked via structural equation modeling. Regarding Turkish version of the scale, as a result of item-total (r= .44 - .65, p<.01) and item-rest (r= .41 - .63, p<.01) correlation analysis, it has been found that there is a significant relationship for each item in the scale, the differentiating power was found to be 27% and the relationship between lower and upper groups' averages was found to be significant for all tested items at p<.05 level. According to the conducted confirmatory factor analysis, the original structure of the scale has been confirmed and as in the original form, eight knowledge dimensions from five pedagogic domains were revealed. In addition, for internal consistency, Cronbach's Alpha reliability coefficient of the scale was found to be 0.89.

Table 2. The content of the scale factors and sample items

The content of the scale factors	*Sample items*
Learners: High scores for this factor indicate that the teacher has gained skills such as recognizing the students using ICT, identifying and resolving the students' difficulties in the learning process (e.g., misconceptions), identifying the students' learning styles and following up on their improvement levels.	I know how to use ICT to identify students' learning difficulties
	I am able to use different technology-infused instruction to assist the students with different learning characteristics
Subject Content: High scores for this factor indicate that the teacher has gained skills such as using ICT to learn the content.	I am able to use ICT to better understand the subject content
	I am able to identify the subject topics that can be better presented with ICT
Curriculum Design: High scores for this factor indicate that the teacher has gained skills such as planning a curriculum integrated with ICT, using ICT designs and teaching strategies integrated with ICT.	I am able to evaluate the factors that influence the planning of an ICT-infused curriculum
	I use appropriate ICT representations to present instructional content
Practical Teaching: High scores for this factor indicate that the teacher has skills such as using ICT in instructional management and facilitating the achievement of the students.	I am able to indicate the advantages and disadvantages of ICT for instructional management
	I am able to use ICT to facilitate the achievement of teaching objectives
Assessment: High scores for this factor indicate that the teacher has gained skills such as using ICT technologies to assess student learning.	I know the types of technology-infused assessment approaches
	I am able to use ICT to assess students' learning progress

Procedure

The data was collected by the Practical of the scales to the participants. Participants initially filled out the first part of the scale containing questions on demographic information, and then filled out the questions on their level of approval for the scale items. Responding to the scale was on voluntary basis and further approvals of the teachers themselves and the school management were obtained.

TPACK-Practical scale descriptive data [($\bar{x}$) arithmetic mean, (*SD*) standard deviation] collected for the first sub-objective of the study for the teachers, are presented in a table 3. The effect

of the independent variables on dependent variables was tested using independent groups t-test to achieve the second and third sub-objectives of the study. The differences between the scores the teachers serving in different types of schools received in the TPACK-Practical skills scale were tested using ANOVA to achieve the fourth sub-objective of the study. Finally, ANOVA was used to determine the difference between the scores of teachers with different seniority levels in TPACK-Practical skills scale, to achieve the fifth sub-objective of the study. Post-hoc test (Scheffe) was used to determine the source of the significant real factors that affect the differences.

Findings

The data concerning the question, which was the first sub-objective of the study; "What are the skill levels of the teachers in TPACK-Practical model?" were obtained by the TPACK-Practical scale developed within the context of TPACK-Practical model to the participants.

Table 3 demonstrates that the general average score for the teachers on the scale was 2.91 and the standard deviation was .45. Furthermore, sub-factor points averages for the scale based on factors varied between 3.59 (SD = .79) and 4.07 (SD = .59). It was observed that the lowest mean was obtained *in "Infusing ICT into teaching contexts"* sub-factor of applied instruction factor ($\bar{X}$ = 3.59, SD = .79); and the highest mean was observed in *"Using ICT-integrated teaching strategies"* sub-factor in program design factor ($\bar{X}$= 4.07, SD = .59). Teacher score distribution identified that the highest point averages were obtained in *Curriculum Design* factor. It was also observed that *Practical Teaching* factor had lower averages than the other factors. Thus, it could be argued that teachers had higher efficiencies in design; however, their efficiency was lower in the implementation process.

Table 3. *Descriptive statistics for the teachers' TPACK-Practical scores.*

Factors		*n*	$\bar{X}$	*SD*
Learners	Using ICT to understand students	296	3.72	.81
Subject Content	Using ICT to understand subject content	296	3.87	.71
Curriculum Design	Planning ICT-infused curriculum	296	4.06	.57
	Using ICT representations	296	4.03	.57
	Using ICT-integrated teaching strategies	296	4.07	.59
Practical Teaching	Applying ICT to instructional management	296	3.85	.68
	Infusing ICT into teaching contexts	296	3.59	.79
Assessment	Using ICT to assess students	296	4.02	.82
TPACK-Practical		296	3.91	.45

The data concerning the question, which was the second sub-objective of the study; "Is there a statistically significant difference between the scores of female and male teachers on TPACK-Practical skills scale?" were obtained by the TPACK-Practical scale developed within the context of TPACK-Practical model to the participants. Based on the findings obtained by independent groups t-test and displayed in Table 4, there was no significant difference between female and male teachers on total mean scores [t (294)=1.69, $p > .05$] received for the scale developed with TPACK-Practical model. However, there was a significant difference on the basis of *Subject Content* [t (294) = 2.33, $p < .05$] and *Curriculum Design* [t (294) = 2.02, $p < .05$], benefiting the female teachers. There was no significant difference in the factors of *Learners* [t (294) = 1.41, $p > .05$], *Practical Teaching* [t (282, 77) = -.20, $p > .05$], and *Assessment* [t (294) = .82, $p > .05$]. Thus, it could be deducted that TPACK-Practical skills of female teachers were at a higher level than males in the *Subject Content* and *Curriculum Design*; however the skills were at the same levels for female and male teachers in other factors.

Table 4. *Independent Samples t-test Results for Female and Male Teacher Scores on TPACK-Practical Scale*

Factors	Gender	*n*	$\bar{X}$	*SS*	df	t	p
Learners	Female	173	3.78	.86	294	1.41	.15
	Male	123	3.64	.74			
Subject Content	Female	173	3.95	.71	294	2.33	.02*
	Male	123	3.76	.69			
Curriculum Design	Female	173	4.10	.52	294	2.02	.04*
	Male	123	3.98	.47			
Practical Teaching	Female	173	3.67	.72	282.77	-.20	.83
	Male	123	3.69	.68			
Assessment	Female	173	4.05	.83	294	.82	.40
	Male	123	3.97	.82			
Total	Female	173	3.94	.45	294	1.69	.09
	Male	123	3.85	.43			

*p< .05

The data for the question formed for FATIH Project variable in the third sub-objective of the study, "Is there a statistically significant difference between the scores of teachers, who serve at schools where FATIH project is implemented, and teachers, who serve at schools where it is not implemented, on TPACK-Practical skills scale?" were obtained by the Practical of the scale developed within the context of TPACK-Practical model to the participants. The findings presented in Table 4 shows that there was a significant difference between the total points the teachers that work in schools that implement the FATIH project and those that work in schools that do not implement FATIH project received in the scale based on *independent samples t-test* results [t (294) = -2.84, p < .01]. Based on the factors, there was a significant difference between the teachers that work in schools that the project was implemented and the teachers that work in schools that the project was not implemented in *Subject Content* [t (294) = -3.63, p < .01] and *Practical Teaching* [t (294) = -3.93, p < .01] factors. It was also observed that there was no significant difference in *Learners* [t (294) = .52, p > .05], *Curriculum Design* [t (294) = -2.77, p > .05], and *Assessment* [t (294) = .79, p > .01] factors.

Table 5 demonstrates that point averages of the teachers that serve in schools that the FATIH project was implemented are higher than the point averages of the teachers that serve in schools that the FATIH project was not implemented on TPACK-Practical skills scale.

Table 5. *Independent Samples t-test Results for the Scores of Teachers in the Context of FATIH Project*

Factors	FATIH Project	*n*	$\bar{X}$	*SS*	Sd	t	p
Learners	Not Applying	153	3.75	.77	294	.52	.60
	Applying	143	3.70	.86			
Subject Content	Not Applying	153	3.73	.38	294	-3.63	.00*
	Applying	143	4.03	.92			
Curriculum Design	Not Applying	153	3.97	.38	294	-2.77	.93
	Applying	143	4.13	.60			
Practical Teaching	Not Applying	153	3.53	.65	294	-3.93	.00*
	Applying	143	3.84	.72			
Assessment	Not Applying	153	4.02	.77	294	.79	.93
	Applying	143	4.01	.88			
Total	Not Applying	153	3.83	.36	294	-2.88	.00*
	Applying	143	3.98	.52			

*p< .05

The data concerning the question, which was the fourth sub-objective of the study; "Is there a statistically significant difference between the scores of teachers that serve in different school grades on TPACK-Practical skills scale?" were obtained by the TPACK-Practical scale developed within the context of TPACK-Practical model to the participants. The findings presented in Table 6 shows that there was a significant difference between the total scores the teachers that serve in different school grades received in the TPACK-Practical skills scale [F (2. 293) = 9.52, p < .01]. Based on the factors, there was a significant difference in *Learners* [F (2. 293) = 10,17, p < .01], *Subject Content* [F (2, 293) = 17.51, p < .01], *Curriculum Design* [F (2, 293) = 4.18, p < .05] , and *Practical Teaching* [F (2, 293) = 16.39, p < .01] factors. No significant difference was found in the factor of *Assessment* between the school grades [F (2, 293) = 1.22, p > .05].

The difference between school grades (Table 6) indicated that this difference benefited high school teachers between the middle school and high school teachers throughout the scale. There was a significant difference between elementary school teachers and middle school teachers in favor of elementary school teachers in the factor of *Learners.* It was observed that high school teachers had significantly higher average scores when compared to middle school teachers in the factor of *Curriculum Design*. Furthermore, while it was observed that high-school teachers had better average points than elementary and middle school teachers in *Subject Content* and *Practical Teaching* factors, no difference was found between elementary school and middle school teachers. Also no difference was indicated between the groups in the factor of *Assessment.* Thus, it could be concluded that high school teachers had higher technology use proficiency compared to middle school and elementary school teachers. Furthermore, it could be argued that elementary school teachers considered the students more in ICT integration.

Table 6. *ANOVA Test Results of Teachers Serving in Different School Grades in TPACK-Practical Scale*

Factors	School grades	*N*	$\bar{X}$	*SS*	F	p	difference
Learners	Elementary school	99	3.98	.66	10,17	.00*	Elementary S.>Middle S.
	Middle school	94	3.46	.82			
	High school	103	3.71	.87			
	Total	296	3.72	.81			
Subject Content	Elementary school	99	3.83	.59	17,51	.00*	High S.>Middle S. High S.> Elementary S
	Middle school	94	3.60	.62			
	High school	103	4.16	.79			
	Total	296	3.87	.71			
Curriculum Design	Elementary school	99	4.05	.45	4.18	.01*	High S.>Middle S.
	Middle school	94	3.94	.43			
	High school	103	4.15	.59			
	Total	296	4.05	.50			
Practical Teaching	Elementary school	99	3.48	.62	16.39	.00*	High S.>Middle S. High S.> Elementary S
	Middle school	94	3.56	.69			
	High school	103	3.99	.69			
	Total	296	3.68	.70			
Assessment	Elementary school	99	4.11	.77	1.22	.29	No difference
	Middle school	94	3.93	.78			
	High school	103	4.00	.91			
	Total	296	4.02	.82			
Total	Elementary school	99	3.90	.38	9.52	.00*	High S.>Middle S.
	Middle school	94	3.77	.39			
	High school	103	4.04	.51			
	Total	296	3.91	.45			

n=296, *p< .05

The data concerning the question, which was the fifth sub-objective of the study; "Is there a statistically significant difference between the scores of teachers with different seniority levels on TPACK-Practical scale?" were obtained by the TPACK-Practical scale developed within the context of TPACK-Practical model to the participants.

The seniorities of the teachers were analyzed in categories of 0-10, 11-20, 21-30, and over 31 years. The findings presented in Table 7 shows that there was a significant difference between teachers with different seniority levels in *Curriculum Design* [F (3. 292) = 10.82, p< .01], *Practical Teaching* [F (3. 292) = 4.51, p< .01], and the scale total point average [F (3. 292) = 8.27, p< .01] factors. No differences were observed in *Learners* [F (3. 292) = 1.12, p> .05], *Subject Content* [F (3. 292) = 2.01, p> .05], and *Assessment* [F (3. 292) = 1.92, p> .05] factors.

Analysis of the direction of the differences demonstrated that there was a significant difference in *Curriculum Design, Practical Teaching* factors and total point. Findings demonstrated that TPAC-Practical scale points for teachers with 31 years or over seniority were lower than other seniority groups.

Table 7. *ANOVA Test Results on Differences between the Seniority of Teachers and the Points They Received in TPACK-Practical Scale*

Factors	Seniority	*n*	$\bar{X}$	*SS*	F	p	Difference
Learners	0-10	119	3.79	.66	1.12	.34	No difference
	11-20	95	3.70	.82			
	21-30	70	3.70	.87			
	31 and over	12	3.36	.81			
Subject Content	0-10	119	3.94	.59	2.01	.11	No difference
	11-20	95	3.80	.62			
	21-30	70	3.93	.79			
	31 and over	12	3.50	.71			
Curriculum Design	0-10	119	4.16	.45	10.82	.00*	0-10 >11-20 0-10 > 31 and over 11-20 > 31 and over 21-30 > 31 and over
	11-20	95	3.98	.43			
	21-30	70	4.09	.59			
	31 and over	12	3.37	.50			
Practical Teaching	0-10	119	3.80	.62	4.51	.00*	0-10 > 31 and over 11-20 > 31 and over
	11-20	95	3.68	.69			
	21-30	70	3.58	.69			
	31 and over	12	3.09	.70			
Assessment	0-10	119	4.07	.77	1.92	.12	No difference
	11-20	95	3.92	.78			
	21-30	70	4.11	.91			
	31 and over	12	3.61	.82			
Total	0-10	119	4.00	.38	8.27	.00*	0-10 > 31 and over 11-20 > 31 and over 21-30 > 31 and over
	11-20	95	3.88	.39			
	21-30	70	3.89	.51			
	31 and over	12	3.36	.45			

*p< .05

Results and Discussion

Results and discussion on TPACK-Practical skills of teachers

Based on the scores the participating teachers received in TPACK-Practical Scale, adapted to Turkish and validated for language, it could be concluded that, this area was the first integration stage

that the teachers encountered in the technological integration process since the highest TPACK-Practical skill proficiency level was observed in the factor of *Curriculum Design.* According to (Yeh et al., 2013), for teachers to be able to use the technology efficiently in accordance with the current innovations in the training process, and for them to be trained to guide the students in teaching-learning processes, are only possible through the development of program design factor. In this factor, which is explained as utilization of IT based instruction strategies, the teachers would gain skills to (i) *Planning ICT-infused curriculum*; and (ii) *Using ICT-integrated teaching strategies.*

The fact that, while the teachers had high averages in the factor of *Curriculum Design,* but fail to succeed in the factor of *Practical Teaching*, could not be explained within the context of *Integrative TPACK models*. Because, according to Angeli and Valanides (2009), *Integrative TPACK model* fails to assert the components of technological integration and the interactions between these components; it also fails to define technological tool utilization in the factor and restricts the pedagogical factor knowledge and does not explain the transformation of these components. Mishra and Koehler (2006) was able to explain the contributions of the structures that form TPACK theoretically, however was not able to explain the factor-based integration process with a transformational and applied approach (Angeli and Valanides, 2009). According to Archambault and Barnett (2010), holistic theoretical model failed to prove that the seven dimensions asserted theoretically worked together in the practice. Thus, the results of the study should be discussed within the context of the transformational model.

Based on the findings of the study, the fact that teachers had different levels of achievement in *Curriculum Design* and *Practical Teaching* skills demonstrated that these skills were transformed during the practical process. This result could provide clear information on the technology integration processes of the teachers when considered within the framework of transformational TPACK models. This fact demonstrates that technology use of teachers was pedagogically based and they are in the first stages of the integration process, and at the same time, they could not display sufficient integration in the transformation process. Assessment of the study findings within the context of TPACK-ICT model, one of the transformational TPACK models proposed by Angeli and Valanides (2009) demonstrates that the teachers are in the stage where they could develop their integration by achieving technology based design skills and in-class implementation experiences, and following that stage, they would be open to skills such as identifying the students using alternative methods, to determine their learning difficulties, to use technology within their areas of instruction, and to utilize instruction strategies.

The fact that the teachers had lower mean scores in the factor of *Practical Teaching* showed that they were at the development stage in the technology integration process structured by Niess (2006). Assessment of the study findings within the framework of *Techno-pedagogical Education (TPACK-deep)* model proposed by Kabakçı, Yurdakul, et al, (2012) would demonstrate that the teachers had the highest average in the *design factor*. This factor reflects the proficiency of the educators in designing the instruction before the instruction process to enrich the instruction process with the aid of suitable technologies for the content and pedagogical knowledge. In other words, efficiencies such as analyzing the existing situation prior to the instruction process using the technology, selecting the suitable method, techniques and technologies that would be utilized in instruction, preparing the environment, material, and measurement tools that would be used in the instruction process, organizing the environment and materials that would be used in instruction, and planning the instruction cases, are included in this factor.

Results and discussion on the differences in TPACK-Practical skills between female and male teachers

The results on the differences between the point averages of female and male teachers on TPACK-Practical scale demonstrated that there were no significant differences between the TPACK-Practical skills of female and male teachers with the exception of certain factors. There were no studies available on the effects of gender on TPACK in the factor literature. However, the fact that TPACK model was based on TK, PK, and CK could reveal the effect of gender on TPACK. Attitude

towards technology, self-efficacy and cognitive processes could be the identified as the factors causing this fact (Harris and Hofer, 2009). Certain studies stated that males claimed they had a superior knowledge when compared to females in technology use, in other words in Technological Information (TI) Koppi et al., 2010; Lasen, 2010). It was considered that these results would influence the TPACK efficiencies of teachers. On the other hand, there were findings that females found themselves more efficient when compared to males in other dimensions of TPACK, namely in PK and TK (Baylor, Shen and Huang, 2003; Einarsson and Granström, 2002; Hopf and Hatzichristou, 1999). The effects of gender on TK, PK, and CK have the capacity to effect TPACK and certain sub-dimensions of TPACK. The fact that TPACK-Practical skills weren't affected by the gender variable could be explained by the fact that they could have arisen within the context of transformational TPACK model. This result was generally similar to several other study results found in the literature. Karakaya (2013) indicated that gender of the teachers did not significantly affect their TPACK skills and Kocaoğlu (2013), in the study conducted on FATIH project, stated that TPACK skills of male and female teachers were similar based on proficiency and Practical skills.

One of the most important factors that could influence TPACK skills of teachers based on their gender is their computer use self-efficacies (Lasen, 2010). International and national research on the differences between computer self-efficacies, which has a significant role in teachers' technology use, demonstrated that gender was not a factor in significant differences (Çuhadar, Bülbül and Ilgaz, 2013; Jamieson, Finger and Albion, 2010; Mudasiru, 2005; Torkzadeh and Dyke, 2002; Chao, 2001). However, findings of certain studies in Turkish literature indicated that males had higher computer self-efficacy when compared to females (Morgil, Seçken and Yücel, 2004; Işıksal and Aşkar, 2003). Under these circumstances, another factor that could affect technology use, namely the attitude towards technology could be considered. However, according to the findings by Yörük (2013) gender was not a determining variable on the attitudes of teachers towards technology. It could also be considered that the education of teachers could affect their technology integration. Assessment of teacher training policies in Turkey would reveal that pre-service education of teachers were similar for females and males (Çoklar, Kılıçer and Odabaşı, 2007).

Results and discussion on the differentiation of TPACK-Practical skills of teachers based on the implementation status of the FATIH project in schools

Assessment of the results on the differences between the point averages that the teachers received based on the implementation status of the FATIH project at their schools showed that the reason for the higher TPACK-Practical skills of the teachers that serve in schools where the FATIH project was implemented than the skills of the teachers that serve in schools where the FATIH project was not implemented could be related to the training they received within the framework of the project, or the technological hardware they possess. Studies showed that the vast majority of teachers believe that the pre-service training they received was far from being efficient in preparing the teachers for the use of educational technologies (Çoklar, Kılıçer and Odabaşı, 2007). Thus, it could be argued that the teachers, who went through a pre-service training process, were able to improve these skills when compared to other teachers. According to the Ministry of Education (2013), one of the components of FATIH project was training of the teachers. Thus, it was reported that 753 educators were trained as a result of educator training within the framework of the project to implement the training of teachers, and 63,760 teachers were trained in interactive blackboard seminars within the FATIH project and 35,902 teachers were trained directly for the FATIH project. By the end of 2013, it was also reported that FATIH project preparatory training, technology use training, interactive blackboard seminar, and technology and leadership forum for the administrators programs are being held with teachers active in 3,657 pilot schools (Ministry of Education, 2013)

The findings of the study demonstrated that the differences in *Subject Content* and *Practical Teaching* factors were far more high in technology integration process for teachers in schools where the project was implemented compared to schools where it was not implemented. This shows that the teachers in schools where the project was implemented and not implemented were in different technology integration processes. An analysis of the differences in integration processes based on *TPACK Instructional Development Model*, a transformational TPACK model developed by Niess

(2007) indicated that while the teachers serving in schools where the project was not implemented had *incentive acceptance* level integration, the teachers that work in schools where the project was implemented had *technological expertise and pedagogical modeling* level integration. It could be stated that this was due to the differences in technological integration and efficient technology implementation skills of the teachers. According to Niess (2007), the difference between these two integration levels was the pedagogical organization of technological expertise and implementation based on the factor and within the dimension of requirements. Teo (2009) stressed that efficient technology use in learning and instruction was based on factors that were affected by technology acceptances. Thus, it could be concluded that the skills and training acquired during the FATIH project process positively affected the technology acceptances of the teachers. Usluel and Mazman (2010) stressed the relationship between the concepts of acceptance of technology and technological innovation, and expressed that the existence of facilitating factors in the innovative environment would increase the perception of the ease of use and benefit of the innovation, and would make the innovation to be accepted more easily.

Kurt et al. (2013), in a study they conducted in Turkey, determined that teachers in schools where FATIH project was implemented utilized the interactive blackboard the most, and thanks to the project, teachers saved time, were able to conduct different course activities, enrich the course using different material during the learning process, and made learning more permanent. Angeli and Valanides (2005) determined that teachers could implement student oriented designs during design and planning stages, which is a common occurrence in the technological integration process of teachers, however, that could not occur during the Practical process due to several reasons, and technology was utilized to support conventional instructional strategies. On the other hand, Timur (2011) reported that although teachers stated that they could implement student centered instructional strategies, in practice they could not fulfill this task. In a study, Adıgüzel (2011) determined that, for effective use of technology in the educational process, the teachers should be informed about how to use this technology, students and educational administrators should be informed, educational administrators should realize that, instead of an economic burden, technology is to improve the quality of education in the long run, and hence they should provide technical support required. Thus, it could be argued that the requirements could be fulfilled by the training, which could be provided within the context of the project.

As a result of the study, the lack of significant difference between the teachers that serve in schools that the project was implemented and in schools that the project was not implemented in the factors of *Learners, Curriculum Design*, and *Assessment* factors was similar to other findings of the study. The high average points that the teachers in both groups received demonstrated that the initial obstacle was resolved in the technology integration process. However, existence of no difference in *Learners* and *Assessment* factors could be explained by the insufficiency of the training provided in FATIH project in the development of these skills. Ministry of Education Teaching Profession General Proficiency criteria stipulate that teachers should be able to use the technology, at the same time, could arrange the classroom environment so that the students could use technology, and could act as role models for the students in technology use. For teachers to achieve proficiency in information and communication technology use, they need a framework that enables them to use technology in integration with professional and factor knowledge in their learning-instruction processes (Shantz, 1995). Timur (2011) compared the in-service training activities for technology use in Finland, where technology integration process was implemented for many years, and in-service training activities towards the technology use of the teachers in the courses implemented in FATIH project, and reported that while in Finland different training processes were implemented for each factor, grade, process and technological equipment, in Turkey all teachers were subjected to an in-service training with the same content on the effective use of information technologies and e-content, without any differentiation based on educational factors and instruction process. TPACK-Practical Scale results demonstrated that in-service training implementations based on transformative model and with regard to factor differences should contribute to the integration process.

Thus, it could be stated that, training that the teachers received prior to the implementation of the project, experiences they gained, and the technological infrastructure the schools obtained due to the projects increase the TPACK-Practical skills of the teachers.

Results and discussion on the differences in TPACK-Practical skills based on school grade and seniority years variables for the teachers

Assessment of the results for the differences between the points that the elementary school, middle school and high school teachers received in TPACK-Practical skills scale showed that the reason why the high school teachers had higher TPACK-Practical skills compared to middle school teachers could be attributed to the fact that FATIH project was implemented in high schools more widely. According to Ministry of Education (2013), expanded pilot Practical concentrated on the infrastructure of high schools and infrastructure work in 3,362 of 3,567 high schools was completed. Thus, it was expected that high school teachers would receive higher average points in program design, subject and applied instruction factors.

The fact that elementary school teachers had higher TPACK-Practical skills compared to middle school teachers in the factor of learner shows that elementary school teachers utilized learner oriented technology in the instruction process. National studies show that, according to Gürol, Donmuş and Arslan (2012), elementary school teachers could activate students with the help of technology more than other school grades, they could recognize students with different types of intelligence better, and could communicate with them more efficiently. In addition, it was also observed that elementary school teachers conducted more student centered implementations.

Study findings demonstrated that teachers with 31 years or more seniority scored the lowest points in TPACK-Practical scale when compared to other seniority groups. This finding was similar to the findings of other studies in the literature. It was reported that TPACK skills were lower in teachers 41 or older compared to other age groups and teachers 30 or younger were more proficient when compared to other age groups (Koh, Chai and Tsai, 2010). On the other hand, Jang (2010) reported that teachers with seniority had higher factor knowledge, pedagogical factor knowledge and technological pedagogical factor knowledge than teachers with less seniority. According to (Yeh et al., 2013), this situation could be explained with the fact that factor knowledge could increase TPACK skills. However, Lee and Tsai (2010) stated that, while TPACK skills in factor centered technology use increase with the increase in the seniority of teachers, seniority deems teachers disadvantaged in technology-oriented Practicals.

Literature review would show that the leading factors that affect the TPACK skills of teachers were computer use or technological proficiencies görülmektedir (Cox and Graham, 2009; Graham, 2011; Harris and Hofer, 2011; Niess, 2005). Studies conducted in Turkey indicated that 20-25 years old teachers had the highest computer use proficiency (Karakaya, 2013). Kocaoğlu (2013) found that the technology use proficiencies of teachers with 26 years or more seniority were lower than other teachers with less seniority. The findings of this study that teachers with 31 years or higher seniority had lower TPACK-Practical averages when compared to other groups demonstrated that they were limited by factor knowledge, pedagogical knowledge or pedagogical factor knowledge in the implementation dimension of experience. The shaping of technological integration of teachers on the basis of factor knowledge and according to seniority within the framework of TPACK-Practical Model could not be explained by transformational TPACK model as well. This situation could also be explained by the differences in the technological integration processes between Singapore, where TPACK-Practical Model was developed, and Turkey. Thus, it could be concluded that teachers with a seniority of 31 years and longer were delayed in the process of technology integration compared to other teachers, but years of seniority contributed to the technologic pedagogical contend knowledge based on factor and pedagogic factor knowledge.

Directions for Future Research and Limitations

- Further studies could be conducted to scrutinize other factors that could affect TPACK skills other than gender, school grade, seniority and attitudes toward technology to fill the gap in the literature.
- The efficiency of the technologies used in FATIH project could be determined, and this information could be used to indicate the efficiency of information technologies in the Practical process based on various criteria within context of the TPACK-Practical Model.
- Further qualitative studies could determine TPACK Practical skills to indicate the reflections of the existing technological infrastructure and hardware on the performance.
- Factor knowledge experiences of teachers with higher seniority could be deemed advantageous in the technological integration process. Integration process should be supported by using software that contain technology Practicals for subject content for these teachers.
- TPACK training based on *Subject Content* and *Learners* level could be provided for high school teachers, similar to Singaporean example.
- FATIH project training should be extended for elementary school and middle school level teachers. Infrastructure for the technology use in *Subject Content* and *Practical Teaching* dimensions for elementary and middle school teachers should be provided and training should be supplied.
- Trainings within FATIH project should be specialized for the factors of teachers and factor training based technological integration process should be developed for teachers.
- Technological infrastructure, software and practical training should be provided to develop IT based evaluation skills of teachers. By inclusion of elementary and middle schools in FATIH project expanded pilot Practicals opportunities should be expanded through the use of technology.
- The place and significance of the technology in education should be explained to the teachers and the reality that technological integration process should not be limited to school should be adopted.
- The courses should be designed to realize the transformation of three main components of TK, FK, and PK skills of the teachers into PFK, TPK, and TFK skills and they should include the process of Practical of TPACK skills in real classroom environment via technology laboratories.
- The following elements could be added to *Instructional Technologies and Material Design* courses in teacher training programs to increase TPACK skills of pre-service teachers and to enable them to conduct technology based educational Practicals in the schools they would serve:
    - Determination of the ITs that FATIH project and other technology oriented projects utilize, and development of the skills of recognition, design, and development of the material that could be used for Practicals, which could be conducted by the utilization of these technologies.
    - Achievements to develop technological software that could be used in factor training, and towards skills to utilize these based on the student level.
- The following elements could be added to *Teaching Practical I-II* courses in teacher training programs to increase TPACK skills of pre-service teachers and for them to easily adapt to technological projects that would be implemented in the schools they would serve when they start their professional lives:
    - The objectives of school Practicals courses could be expanded to make possible for pre-service teachers to have information about the ITs used in projects, etc. utilized in the current system, to use these ITs, and to resolve the problems they face with the help of guidance counselor.
    - It could be made possible to conduct technical details such as communication, classroom administration and data sharing in technology enabled classrooms under the surveillance of specialist teachers.
    - Faculty members could add to performance evaluation criteria the products or documents on factor instruction that pre-service teachers prepared by using ITs.

The most important limitation of this study is the *common method bias*. The main reason of this limitation is the collection of the data from a single source (teachers). This might have caused an artificial increase of the observed correlations. Although the aforementioned limitation cannot be fully eliminated from the study, the errors can be reduced to the minimum level. Therefore, the necessary precautions were taken during the data collection phase via the applications suggested at the beginning of the paper. First of all, the validity and reliability of the scales used in data collection stage were checked. Second, the participants were clearly informed that the responses would be kept confidential and they would not be revealed in any way. In addition the questionnaire is designed in a way that the scale items related to independent variables are listed before the ones related to dependent variables.

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