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Examining technopedagogical knowledge competencies of teachers in terms of some variables

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Abstract

This research was carried out for the purpose of investigating teachers' levels of technological pedagogical content knowledge (TPCK) competencies. In line with this aim, teachers' levels of TPCK competencies were studied in terms of gender, branch and to attend in service training programs. The findings of the study reveal that the teachers in the sample group of the study have a high level of awareness regarding their technopedagogical knowledge competencies. According to the findings of the study, based on branch and to attend in service training programs, there are statistically significant differences among teachers' awareness levels on their TPCK competencies.

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Keywords: Teachers' perception, technological pedagogical content knowledge, technology integration, educational technology, contemporary education;

1. Introduction

Technology integration is defined as "Technology integration is the incorporation of technology resources and technology-based practices into the daily routines, work, and management of schools" (National Center for Education Statistics-[NCES], 2002). The process integrating the technology with education is complex and multidirectional. In the process, there are a lot of factors such as teachers, students, background, school administrators, policy determiners, parents. The greatest responsibility of the shareholders is teachers' responsibility.

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But domestic and foreign literature showed that teachers are not willing and adequate for technology usage (Aşkar, Altun, Şimşek &Özdemir, 2012; Becker, 1994; Bingimlas, 2009; Butler & Sellbom, 2002; Christiansen, 2002; Earle, 2002; Çağlar, 2012; Hew & Brush, 2007; Oncu, Delialioglu & Brown, 2008; Yıldırım, 2007). Some studies (Aşkar, Altun, Şimşek & Özdemir, 2012; Çağlar, 2012; Yıldırım, 2007) showed that teachers' technology acceptance levels are not adequate, while some studies (Adıgüzel, 2010; Demir, Özmantar, Bingölbali & Bozkurt, 2011; MEB, 2011,2012; Usluel, Mumcu & Demiraslan, 2007) showed that teachers' technology literacy are not adequate.

Many researcher continue to blame teachers for the lack of technology integration in schools; however, some researcher can't blame them without considering the context for teaching, teacher beliefs about teaching and learning, and professional development (Sandholtz, Ringstaff & Dwyer, 1997; Silverstein, Frechtling & Miyaoka, 2000). Some studies revealed that effective integration is directly associated with educational practices and revised educational curriculum (Lee, 2002; Vrasidas & McIsaac, 2001; White, Ringstaff & Kelley, 2002; Willis, 2001; cited. Hosseini & Kamal, 2012). In other words, the effective integration process is closely related to technology supported pedagogical knowledge and skills (Hew & Brush, 2007). In this regard various technology integration models have been developed. Some of these models (Concentric Circles Model, E-capacity Model, Five Stage Model for Computer Technology Integration) focus on technology, while some of these models (5W 1H Unified Integration Model, Generic Model of Pedagogy, Social Interaction and Technology, Systemic Planning Model for ICT Integration, Activity System Model, Technology Integration Model) focus on appropriate pedagogical knowledge. One of the models focus on pedagogy is Technological Pedagogical Content Knowledge - (TPCK). This model is developed by Mishra and Koller (2006).

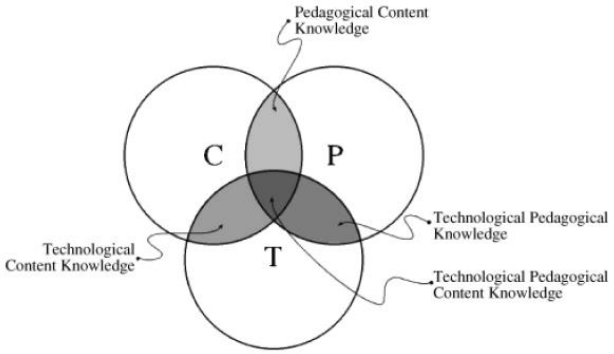

Figure 1. Pedagogical technological content knowledge. The three circles, content, pedagogy, and technology, overlap to lead to four more kinds of interrelated knowledge (Mishra & Koller, 2006).

TPCK (see Figure 1) emphasizes the connections among technologies, curriculum content, and specific pedagogical approaches, demonstrating how teachers' understandings of technology, pedagogy, and content can interact with one another to produce effective discipline-based teaching with educational technologies. According to the research literature, there are very limited studies on the issue. In this context, much more study needs to be done in this area (Archambault & Crippen, 2009; Cox & Graham, 2009; Hosseini & Kamal, 2012). In this context, it is believed that this research will contribute to the literature in Turkey and to the practices in terms of showing what kind of precautions can be taken. In this framework, the overall aim of this research is to measure teachers' level of awareness regarding their TPCK competencies. Answers to the following sub-problems are searched in order to reach this overall objective.

1. What is teachers' awareness level on TPCK competencies?
2. Does teachers' awareness level on TPCK competencies change by gender, branch and HİE status?
3. Does teachers' awareness level on TPCK competencies change by branch?
4. Does teachers' awareness level on TPCK competencies change whether in-service training is received or not?

2. Method

2.1. Research design

Survey method is used in this study. In this context, this research aims to determine teachers' level of awareness regarding their TPCK competencies.

2.2. Participants

Snowball sampling method is used in this study. In snowball sampling, first of all one of the agents of the population is accessed. Via this agent, a second and later a third agent is accessed. Thus, the sample size grows like a snowball (Yazıcıoğlu & Erdoğan, 2004, p.45). In this study, the sample size was enlarged by reaching one teacher from each branch (mathematics, science & technology, Turkish literature and social sciences branch teachers). The teachers in the sample group work at secondary schools. Accordingly, the participants of this research were 216 teachers working at various provinces in Turkey during 2013-2014 academic year. Among these teachers 118 (54,6%) were male, 98 (45,4%) were female. 74 (34,3%) of the teachers in the sample group were social sciences teachers, while 26 (24,0%) were mathematics teachers, 46 (21,3%) were science & technology teachers and 44 (20,4%) were Turkish literature branch teachers.

2.3. Data collection instrument

To determine teachers' awareness regarding their TPCK competencies "Technological pedagogical content knowledge scale (TPCKS)" adapted by Ozturk and Horzum (2011) was used in this study. The original scale was developed by Schmidt at all (2009a). The scale has seven factors, which was found as result of the exploratory and confirmatory factor analyses. In Turkish version of the scale alpha value was calculated as 0.96. Therefore, it can be concluded that Turkish version of the scale was reliable and valid.

2.4. Data collection and analysis

The data of the research were collected online. To this end, a database was form and the participants were given the web address to access the scale. SPSS 13 package program was used in statistical analysis of the data collected for the research. Shapiro-Wilks Normality Test was used in testing the normality hypothesis of the data. The result of Shapiro-Wilks Normality Test revealed that the data did not show a normal distribution. Therefore, Mann Whitney U and Kruskal Wallis test methods, which are nonparametric tests, were used in analyzing the data. In significance tests .05 level was based on.

3. Findings

3.1. Teachers' awareness levels regarding their TPCK competencies

In this section, the findings obtained by analyzing the data collected from the teachers and the comments on these findings are given.

In line with the first sub-problem of the research, high arithmetic average of total points obtained from the scale shows that their awareness level on TPCK competencies is high; and low arithmetic average shows that their awareness level is low. In this framework, descriptive statistics showing teachers' awareness levels on TPCK competencies are given in Table 1.

Table1. The breakdown of the scores of teachers' awareness levels on TPCK competencies

Elements	**N**	$\overline{X}$	**Sd**
Technology knowledge (TK)	216	3,93	3,03
Content knowledge (CK)	216	4,43	0,98
Pedagogical knowledge (PK)	216	4,28	2,33
pedagogical content knowledge (PCK)	216	4,28	0,68
Technological content knowledge (TCK)	216	4,40	0,56
Technological pedagogical knowledge (TPK)	216	3,98	2,16
Technological pedagogical content knowledge (TPCK)	216	4,04	2,11
Total	**216**	**4,19**	**1,69**

According to Table 1, the average of the total score teachers got from the scale is 4.19 over 5. In terms of sub-dimensions, in Technology knowledge subdimension the mean score was 3.93, in Content Knowledge sub-dimension the mean score was 4.43, in Pedagogical knowledge subdimension the mean score was 4.28, in pedagogical content knowledge sub-dimension the mean score was 4.28, in Technological content knowledge sub-dimension the mean score was 4.40, in Technological pedagogical knowledge sub-dimension the mean score was 3.98, and in Technological pedagogical content knowledge sub-dimension the mean score was 4.04. So, it can be said that teachers' awareness level on TPCK competencies is high.

3.2. Differentiation of teachers' awareness levels on TPCK competencies by gender

In line with the second sub-problem of the research, descriptive analysis of teachers' awareness levels on TPCK competencies by gender are given in Table 2. In order to determine whether this is a statistically significant difference or not, Mann Whitney U test, one of the nonparametric tests was used. Test results are given in Table 2.

Table2. Mann Whitney U-test results of teachers' awareness levels on TPCK by gender

Elements	**Gender**	**N**	**Mean Rank.**	**Mean Sum.**	**U**	**P**
Technology knowledge (TK)	Female	98	55,59	2724,00	1392,00	,739
	Male	118	53,59	3162,00		
Content knowledge (CK)	Female	98	58,63	2873,00	1243,00	,182
	Male	118	51,07	3013,00		
Pedagogical knowledge (PK)	Female	98	57,63	2824,00	1292,00	,339
	Male	118	51,90	3062,00		
Pedagogical Content knowledge (PCK)	Female	98	55,30	2709,50	1406,50	,792
	Male	118	53,84	3176,50		
Technological Content knowledge (TCK)	Female	98	56,91	2788,50	1327,50	,407
	Male	118	52,50	3097,50		
Technological Pedagogical knowledge (TPK)	Female	98	57,27	2806,00	1310,00	,396
	Male	118	52,20	3080,00		
Technological Pedagogical Content knowledge (TPCK)	Female	98	59,00	2891,00	1225,00	,167
	Male	118	50,76	2995,00		

When Table 2 is analyzed, it is seen that there is no statistically significant difference among teachers of different genders regarding their awareness levels on TPCK competencies (p>.05). As is seen in Table 2, when the averages of groups are examined, it is seen that female teachers have a relatively high level of awareness compared to male teachers.

3.3. Differentiation of teachers' awareness levels on TPCK competencies by branch

In line with the third sub-problem of the study, Kruskal Wallis test results on whether teachers' awareness levels on TPCK competencies differ by branch are given in Table 3.

Table 3. Kruskal Wallis test results of teachers' awareness levels on TPCK competencies by branch

Elements	Branch	N	$\overline{X}$	Sd	x²	P	Variables in which Statistical Significance is observed
Technology knowledge (TK)	Mathematics (A)	52	3,74	3	10,41	**,015**	**A-D**
	Science & Technology(B)	46	3,92				
	Turkish Literature (C)	44	3,91				
	Social Sciences (D)	74	4,08				
Content knowledge (CK)	Mathematics (A)	52	4,44	3	,59	,899	
	Science & Technology(B)	46	4,43				
	Turkish Literature (C)	44	4,34				
	Social Sciences (D)	74	4,48				
Pedagogical knowledge (PK)	Mathematics (A)	52	4,60	3	40,58	**,000**	A-B A-C A-D B-D C-D
	Science & Technology(B)	46	4,09				
	Turkish Literature (C)	44	4,08				
	Social Sciences (D)	74	4,30				
Pedagogical Content knowledge (PCK)	Mathematics (A)	52	4,69	3	30,51	**,000**	A-C A-D B-C B-D C-D
	Science & Technology(B)	46	4,65				
	Turkish Literature (C)	44	4,18				
	Social Sciences (D)	74	4,28				
Technological Content knowledge (TCK)	Mathematics (A)	52	4,53	3	2,79	,425	
	Science & Technology(B)	46	4,34				
	Turkish Literature (C)	44	4,40				
	Social Sciences (D)	74	4,35				
Technological Pedagogical knowledge (TPK)	Mathematics (A)	52	3,90	3	23,32	**,000**	A-B A-C B-C B-D C-D
	Science & Technology(B)	46	4,30				
	Turkish Literature (C)	44	4,08				
	Social Sciences (D)	74	3,78				
Technological Pedagogical Content knowledge (TPCK)	Mathematics (A)	52	4,26	3	29,49	**,000**	A-C A-D B-C B-D C-D
	Science & Technology(B)	46	4,32				
	Turkish Literature (C)	44	3,80				
	Social Sciences (D)	74	3,96				

When Table 3 is analyzed, it is seen that teachers' awareness levels on TPCK competencies is statistically significant in TK, PK, PCK and TPCK sub dimensions by branch (p<.05). In order to determine among which

groups this differentiation exist Mann Whitney-U test was used. Accordingly, in TK sub dimension there are statistically significant differences between "Mathematics" and "Social Sciences" branch teachers; in PK sub dimension there are statistically significant differences between "Mathematics" and "Science & Technology", "Turkish Literature", "Social Sciences"; and between "Science & Technology" and "Social Sciences"; and between "Turkish Literature" and "Social Sciences"; in PCK sub dimension there are statistically significant differences between "Mathematics" and "Turkish Literature", "Social Sciences", and between "Science & Technology" , "Turkish Literature", "Social Sciences" and between "Turkish Literature" and "Social Sciences"; in TPK sub dimension there are statistically significant differences between "Mathematics" and "Science & Technology", "Turkish Literature", "Social Sciences"; and between "Turkish Literature" and "Social Sciences"; in TPCK sub dimension there are statistically significant differences between "Mathematics" and "Turkish Literature", "Social Sciences" and between "Science & Technology" and "Turkish Literature", "Social Sciences" and between "Turkish Literature" and "Social Sciences".

3.4. Differentiation of Teachers' Perception Levels of TPCK Competencies, Depending on Whether In-Service Training is Received or Not

In line with the fourth sub-problem of the research, descriptive analysis of teachers' awareness levels on *TPCK Competencies* depending on whether in-service training is received or not are given in Table 4.

Table 4. Mann Whitney U-Test results of teachers' awareness levels on TPCK competencies depending on whether in-service training is received or not

Elements	Attend in service training programs	N	Mean Rank	Mean Sum	U	P
Technology knowledge (TK)	Yes	104	75,41	3921,50	368,50	**,000**
	No	112	35,08	1964,50		
Content knowledge (CK)	Yes	104	64,42	3350,00	940,00	**,001**
	No	112	45,29	2536,00		
Pedagogical knowledge (PK)	Yes	104	51,70	2688,50	1310,50	,367
	No	112	57,10	3197,50		
Pedagogical Content knowledge (PCK)	Yes	104	60,38	3139,50	1150,50	**,039**
	No	112	49,04	2746,50		
Technological Content knowledge (TCK)	Yes	104	52,92	2752,00	1374,00	,566
	No	112	55,96	3134,00		
Technological Pedagogical knowledge (TPK)	Yes	104	63,97	3326,50	963,50	**,002**
	No	112	45,71	2559,50		
Technological Pedagogical Content knowledge (TPCK)	Yes	104	53,68	2791,50	1413,50	,791
	No	112	55,26	3094,50		

When Table 4 is analyzed, it is seen that there are differences among average score on awareness levels in TPCK competencies depending on whether in-service training is received or not. In order to determine whether this is a statistically significant difference or not, Mann Whitney U test, one of the nonparametric tests was used. Test results are shown that there is a statistically significant difference among teachers of different genders regarding their awareness levels on TPCK competencies in TK, CK, PCK and TPK subdimensions ($p<.05$). As is seen in Table 4, when the averages of groups are examined, it is seen that male teachers have a relatively high level of awareness compared to female teachers.

4. Conclusion

This research was carried out for the purpose of investigating teachers' (Mathematics, Science & Technology, Turkish Literature and Social Sciences) levels of TPCK competencies. In line with this aim, teachers' levels of TPCK competencies were studied in terms of gender, branch and to attend in service training programs. The findings of the study reveal that the teachers in the sample group of the study have a high level of awareness regarding their technopedagogical knowledge competencies, in general. Findings of the study have some differences compared to the findings of other studies carried out on the same issue in literature (Archambault & Crippen, 2009; Bal, 2012; Bal & Karademir, 2013; Kabakçı-Yurdakul 2011; Kaya, Özdemir, Emre & Kaya, 2011; Konokman, Yanpar-Yelken & Sancar-Tokmak, 2013; Öztürk, 2006; Şimşek, Demir, Bağçeci & Kinay, 2013;Yeşil, 2006).

According to the findings of the study, based on branch and to attend in service training programs, there are statistically significant differences among teachers' awareness levels on their TPCK competencies. That participants' awareness levels on their TPCK competencies are not differ by gender is a result that is parallel to many researches (Şimşek, Demir, Bağçeci & Kinay, 2013; Koh & Chai, 2011; Jang & Tsai, 2012; Ünal-Bozcan, 2010).

The result attained by this research study, which is a generally-expected one, inferring that receiving in-service training is effective on techno-pedagogical content knowledge, should be addressed attentively. From this standpoint, arrangement of the contents of 30-hour in-service training, organized for the purpose of supporting effective use of technology within the framework of the FATIH Project in a way to cover pedagogical approaches, will make positive contributions to the integration process. On the other hand, the connection between the beliefs of prospective teachers on integration with technology and to which extent they prefer using technology in their classrooms in the future indicates the importance of the teacher training process in the acquisition of techno-pedagogical competencies. However, the conducted studies show that prospective teachers graduate from faculties of education with insufficient knowledge and skills to use technology effectively in educational environments, thus failing to integrate technology and pedagogy concepts when they begin their duties. In this regard, prospective teachers need to be trained in using the latest technologies and contemporary teaching methods before starting their duties. Such trainings can be accomplished not only by updating the existing course contents, but also through additional courses.

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