

Examining the Self-Efficacy of Prospective Teachers in Technology Integration According to their Subject Areas: The Case of Turkey*

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Abstract

The purpose of this study is to examine prospective teachers' TPACK self-efficacy and variables affecting their training to integrate technology in education according to their subject areas. The survey research, a quantitative research method, was used in the study. The sample of the study is composed of senior prospective teachers (n=3553) from 19 different departments of 18 state universities in Turkey. The departments were gathered into nine subject areas by taking into consideration the criteria of prospective teachers' subject areas. Mann-Whitney U and Kruskal-Wallis H tests were used for the comparisons of the groups. The results of the study show that TPACK is perceived differently according to the subject areas. Prospective teachers think that teacher educators do not sufficiently exhibit technology integration behaviors in their lessons and participants think that they somewhat have authentic experiences in using technology in education. While both scores of TPACK self-efficacy and variables affecting prospective teachers' training to integrate technology in education are higher in favor of Foreign Languages subject area; prospective teachers in Mathematics and Turkish language have lower scores than other subject areas in the study. As a result, the self-efficacy of prospective teachers' technology integration significantly differentiates.

Keywords: *Technology integration; TPACK; Prospective teachers; Self-efficacy*

Introduction

The more the role of technology increases in daily life, the more its varieties of usage increases in school environments. The possibilities of accessing technological infrastructure are improved in this context. However, equipping classes with hardware and software does not mean that these are used effectively (Zhao & Frank, 2003). The people who make learning meaningful are the teachers who integrate these tools and resources with pedagogic methods (Ertmer, 2005; Goktas, Yildirim, & Yildirim, 2009; Tondeur, van Braak, Siddiq, & Scherer, 2016).

* This study was part of the first author's doctoral dissertation, which was completed under the supervision of the second author.

On the other hand, it is a complicated process for teachers to meet this criterion (Mumtaz, 2000) and improper or insufficient use of technology in education can cause learning to get worse (Borko, Whitcomb, & Liston, 2009). In this context, it is the responsibility of Faculties of Education to train prospective teachers to acquire technological, pedagogical and content knowledge (TPACK) (Tondeur, Scherer, Siddiq, & Baran, 2017).

Technological Pedagogical Content Knowledge (TPACK), which stresses the integration of teachers' technological abilities into education, has revealed a new perspective on teachers' skills in recent years, and various studies have been conducted on this topic in international context (Jamieson-Proctor et al., 2012). While the number of studies based on TPACK providing guidance to educators and researchers about the effective integration of technology, including teacher training programs (Mishra & Koehler, 2006) has gradually increased; the number of studies examining teachers' Information and Communication Technology (ICT) usage according to their subject areas are insufficient (Tay, Lim, & Lim, 2015) and these kinds of technology integration frameworks are still in their first phase (Angeli & Valanides, 2015; Cavanagh & Koehler, 2013). Especially definition of these frameworks can be detailed by the studies focusing on different curriculum and different subject areas because the content knowledge of each subject area, the learning-teaching process, the quality of the material used and the processes of assessment and evaluation differ from each other. Therefore, the qualifications required for TPACK may not be perceived in the same way. Indeed, while Darby (2009) states that the integration of ICT in education is related to the culture of the subject area, including its structure and functioning, Karaseva Siibak and Pruulmann-Vengerfeldt (2015) explain that the use of digital technologies is related both to the subject area and to dominant pedagogical beliefs. For this reason, it has been stressed that studies should be conducted to show how TPACK differs according to subject areas (discipline, teaching field etc.) or how it is related to these (Voogt & McKenney, 2017).

It is important that prospective teachers acquire effective technology integration qualifications before entering the teaching profession full-time. Besides the opinions of prospective teachers about technology usage (Tondeur, van Braak, Sang, Voogt, Fisser, & Ottenbreit-Leftwich, 2012) and pedagogical beliefs (Bandura, 1986) in education have an important influence on their future experiences of technology. Prospective teachers' beliefs in their capabilities to organize and execute the TPACK can produce self-efficacy (Bandura, 1997) in technology integration. Moreover, Abbit (2011) states that prospective teachers' self-efficacy belief is correlated with the TPACK model. For this reason, curriculum should be examined so that prospective teachers can gain experience about technology in various ways while they are in training (Krueger, Hansen, & Smaldino, 2003). It will be easier to formulate a plan to integrate technology in education by considering the TPACK self-efficacy of prospective teachers and their views on the variables about preparing them to integrate technology in their educational practice. The variables about preparing prospective teachers to integrate technology in this study are; (a) Capacity of using computers, (b) Capacity of using the internet, (c) Attitude towards using technology in education, (d) Access to technology resources, (e) Teacher educators as role models, (f) Authentic technology integration experiences, (g) Using ICT when developing educational materials, and (h) Collaborating with peers in using technology. Examining them separately may limit the development of teachers' ability to integrate technology during their training. However, comparing these variables, in particular according to subject areas, may provide an insight to structure relevant curriculum. Also prospective teachers' self-evaluations about themselves and their institutions will make a contribution to educational technology field in terms of preparation of an effective technology integration map in education.

Theoretical Framework

Disciplinary Differences in Integration of Technology in Education

Technology integration in education is a research interest which is commonly studied and about which various methods have been put forward. According to Hsu (2010), teachers should be able to access multiple sets of information and benefit from content, technological and pedagogical information so that technology can be integrated into education. However technology integration in education may not be a norm or a significant part of the culture of some teaching areas, or it may not conform to certain disciplines. A discipline is a major factor in shaping the several aspects of course planning and teaching (Waggoner, 1994). Therefore, the structure and content of subject matter shapes the ways of technology integration (Yeh, Hsu, Wu, Hwang, & Lin, 2014). For this reason, teachers may think differently about integrating their own subject areas with technology (Tay, Lim, & Lim, 2015). For example, science and mathematics teachers found their topics to be more related to technology in the study of John and Baggot la Velle (2004), while history teachers stated that they use technology in a limited way because the topics studied are based on a humanist perspective. Again, while all Science and English language teachers believed that their subject was suitable for integration with ICT, Literature and Mathematics teachers did not, according to the study of Kula and Deryakulu (2017).

Zelkowski, Gleason, Cox, and Bismarck (2013) stated that mathematics' prospective teachers had difficulties in expressing Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK) and Pedagogical Content Knowledge (PCK). In Niess' (2005) study, which is about how science and mathematics prospective teachers prepared courses with technology, it is stated that the integration of technology accords with the nature of the teaching is an important element affecting the development of TPACK. Accordingly, it is possible to find studies stressing that the nature of mathematics makes it difficult to integrate ICT into the courses (Kula & Deryakulu, 2017). Again Niess et al. (2009) assert that as TPACK standards, TPACK development methods and new technologies emerge and as the number of studies about teaching-learning increases, the usage of these technologies changes. Considering the explanations in the literature, it has been seen that technology integration in education is evaluated differently in various disciplines. Of course, the depth, intensity, culture or functioning of the curriculum of each subject area may vary from country to country. In this study, technology integration self-efficacy of a large sample of teachers in different disciplines in Turkey was examined. This study, conducted with a large sample, may contribute to the literature in making comparisons at both local and international levels.

Technological Pedagogical Content Knowledge Model

The TPACK model that Mishra and Koehler presented as a framework for technology integration in 2006 and which has been examined by many international and domestic researchers (i.e. Turkish) has offered a clear and beneficial structure for those researching about the integration of technology in learning and teaching (Baran, Chuang, & Thompson, 2011) and has critically affected education technology studies and applications (Koehler, Shin, & Mishra, 2012). This structure covers the three basic knowledge components of teachers. These are Content Knowledge, Pedagogical Knowledge and Technological Knowledge. Content

Knowledge includes the subject area to be taught or learned, Pedagogical Knowledge includes applications, processes, strategies, activities and teaching-learning methods, and Technological Knowledge includes the overhead projector, black/whiteboards and the books which are commonly used, as well as modern technologies such as computers, the internet and video (Koehler & Mishra, 2008). Technological Content Knowledge, Pedagogical Content Knowledge and Technological Pedagogical Knowledge emerged as the interaction of these principal three structures have emerged. TPACK is the joint interaction of these three fundamental bodies of knowledge (Koehler & Mishra, 2008). Pedagogical content knowledge (PCK) requires the application of specific subject areas of teaching knowledge. TCK is an understanding of the manner in which technology and content influence and constrain each other. Teachers must figure out which technology is appropriate for the subject area and how to use it in education. TPK is an understanding of how teaching and learning can change when particular technologies are used in particular ways (Harris, Mishra & Koehler, 2009). Voogt et al. (2012) acknowledged that this framework has resulted from technology integration with a specific educational content and that teachers should integrate content, pedagogy and technology carefully and should also be qualified in these three fields. The knowledge structure that emerged as TPACK can be seen as the 21st century skill required for the classes which adopt cooperative learning environments using ICT. According to the TPACK literature, there are different models which take this framework interdependently or separately. For instance, Angeli and Valanides (2009) address TPACK as a unique body of knowledge in the transformative model. Kabakci Yurdakul et al (2012) distinguished different competencies for TPACK as designing instruction, implementing instruction, ethical awareness and proficiency in the TPACK-deep model. Lee and Tsai (2010) bring forward TPACK-Web as another model while integrating Web technology into their pedagogical practice.

Numerous scales have been developed to measure TPACK self-efficacy of prospective teachers (Aydin-Gunbatar, Boz, & Yerdelen-Damar, 2017; Chai, Koh, Tsai, & Tan, 2011; Kabakci Yurdakul, Odabasi, Kilicer, Coklar, Birinci, & Kurt, 2012). Prospective teachers' TPACK self-efficacy measurement tools are about their availability to integrate technology in education. Also these tools either measure TPACK self-efficacy for only one specific subject area group or various groups. In order to better prepare prospective teachers to integrate technology in education, these tools can help understand the pedagogical issues they encounter in their education period. In the current study, TPACK-ISTE self-efficacy belief is the TPACK self-efficacy based on ISTE standards for teachers (Simsek & Yazar, 2016), and is considered as indicating prospective teachers' beliefs on the capacity to effectively use technology (Wang, Ertmer, & Newby, 2004). TPACK-ISTE self-efficacy, which is closely related to teachers' beliefs concerning their capability to appreciate technology integration in education, plays a crucial role in knowing and implementing TPACK (Lai & Lin, 2018).

Preparing Prospective Teachers to Integrate Technology in Education

In literature, there are many studies about the integration of technology in education structured within the framework of the models for teachers (Kopcha, 2010; Roblyer, 2006; Toledo, 2005; Wang, 2008). However, Tondeur et al. (2012) tried to establish a model of technology integration for a more specific group in terms of educating prospective teachers. Unlike the integration of technology developed at the level of the individual teacher or school, Tondeur et al. (2012) developed a model to prepare prospective teachers to use technology by synthesizing qualitative studies. This model, focusing on what strategies are important when

prospective teachers use technology, presents key themes consisting of three parts which have been created by synthesizing qualitative studies about this topic in the literature. In this model, the researchers reviewed qualitative studies that focused on strategies to prepare pre-service teachers to integrate technology into their lessons in order to identify effective strategies. That is why they call this model as SQD (Synthesize Qualitative Data) model. This model includes two principal themes (training teachers for technology integration in education and institutional context) that has emerged from this model based on qualitative studies in the literature (see Figure 1). Key themes related to the institutional level comprise of training staff, technology planning and leadership, cooperation between institutions and access to resources. These themes are important to define efficient technology integration process but prospective teachers may have limited or incorrect observation about them.

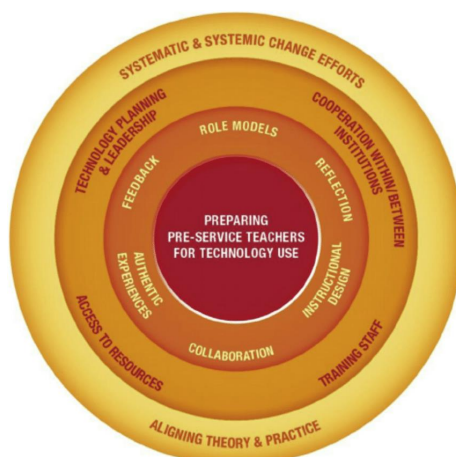


Figure 1. SQD Model to Prepare Pre-service Teachers for Technology use

Therefore, the second principal theme is focused in the study. The key themes related to the preparation of prospective teachers examined in this study are; views about teacher educators as role models, attitudes about the role of technology in education, learning technology by design, collaborating with peers, scaffolding authentic technology experiences and access to resources. These key themes are translated into Likert-type items as; capacity of using computers, capacity of using the internet, attitude towards using technology in education, access to technology resources, teacher educators as role models, authentic technology integration experiences, using ICT when developing educational materials, collaborating with peers in using technology. The variables in this model emphasize the need for prospective teachers to provide effective technology integration. In the framework of these opportunities and competencies, prospective teachers in different subject areas can develop ICT skills. However, it is not known exactly what these opportunities are for each teaching branch. It should also be determined whether these facilities and competences differ statistically. Taking into consideration both TPACK-ISTE self-efficacy and the variables in the SQD model could offer a new perspective specifically in preparing/educating prospective teachers for integrating technology in education.

Apart from TPACK self-efficacy, the key themes of the model are “variables in training prospective teachers to integrate technology in education” in this study. The variables about technology integration in education proposed in this model are investigated by comparing the scores of different subject areas of prospective teachers. And the variables do not directly resemble their behaviours; they resemble prospective teachers’ views.

Purpose of the Study and Research Questions

The main purpose of this study is to compare TPACK-ISTE self-efficacy scores of prospective teachers and the scores of variables affecting their training to integrate technology in education according to their subject areas. In addition the correlation of the numbers of significant differences in TPACK-ISTE self-efficacy and the numbers of significant differences in variables affecting prospective teachers' training to integrate technology in education is investigated. For this purpose, answers were sought to the following research questions.

1. Do the TPACK-ISTE self-efficacy scores of prospective teachers show statistically significant differences according to their subject areas?
2. Do the scores of variables about training prospective teachers to integrate technology in education show statistically significant differences according to their subject areas?
3. Is there a statistically significant relationship between the differences in TPACK-ISTE self-efficacy scores according to subject areas and the differences in variable scores about training prospective teachers to integrate technology in education?

Method

Research Model

The survey research, a quantitative research method, was used in the current study which aims to determine TPACK-ISTE self-efficacy and views of prospective teachers about the variables affecting their training to integrate technology in education. This model is a quantitative research type conducted in order to describe the tendencies, attitudes or opinions of individuals in a sample from a population selected with a data collection tool (Creswell, 2012).

Population and Sample

The population of study was composed of prospective teachers who were senior university students in Faculties of Education in state universities during the spring semester of the 2014-2015 academic year in Turkey and prospective teachers who were attending the pedagogical formation certification program. The sample of the study was composed of senior prospective teachers of 18 state universities selected randomly with the cluster sampling method in various geographical regions ($n=7$) of Turkey. According to the sample calculations, the sample of this study ($n=3553$) represented the population ($N=93725$) according to the margin of error (5%) and confidence interval (99%) for the sample limit ($n=659$). Gender and demographic information about subject areas of the participants in the study is presented in Table 1.

Table 1. Demographic Characteristics of Participants

Variable	Property	n	%
Gender	Male	1328	37.6
	Female	2202	62.4
	<i>Total</i>	3530	100.0

Departments	Physical education	94	2.6
	CEIT*	306	8.6
	Science	562	15.8
	Fine Arts	65	1.8
	Mathematics	482	13.6
	Basic Education	454	12.8
	Social Science	684	19.3
	Turkish Language	599	16.9
	Foreign Languages	307	8.6
	<i>Total</i>	3553	100.0

* Computer Education and Instructional Technologies

When Table 1 is examined, it is seen that a rich variety of departments (n=19) is included in the study. Majority of the prospective teachers were female (62%). While the largest number of participants was from department of Social Science (19%), the lowest number was from Fine Arts (2%). In the study, 19 different departments were gathered into nine subject areas by taking into consideration the criteria of specific teaching fields. For instance; science, physics, chemistry and biology have been considered as "science fields", preschool and primary education departments have been considered as "basic education" and social studies, history and geography have been considered as "social fields". Turkish language education and Turkish Language and Literature departments have been considered as Turkish language. Department of foreign languages consists of English, German and French languages.

Data Collection

The survey form used for data collection was composed of three sections. The first section covers personal information, the second section covers eight questions prepared by Tondeur et al. (2012), involving variables about integrating technology in education, and the third section covers 27 items covered by the TPACK-ISTE self-efficacy scale developed by Simsek and Yazar (2016). An example of the items related to the variables in training prospective teachers to integrate technology in education, is: "How do you rate the way in which the teaching staff (lecturer, instructors, professors etc.) guide you in the use of technology in education during your university course?"

The items in the TPACK-ISTE self-efficacy scale are based on performance indicators representing both TPACK and ISTE standards developed in 2008 for teachers (ISTE, 2014). In the scale, items such as "I can design learning environments to develop students' learning skills based on their co-operation" and "I can arrange learning environments to develop students' creative thinking skills" comply with ISTE's principles such as facilitating students' learning, encouraging creativity and its other dimensions. The scale used for data collection in the present study is composed of six dimensions, which are: TK (Technological Knowledge), PK (Pedagogical Knowledge), CK (Content Knowledge), PCK (Pedagogical Content Knowledge), TPK (Technological Pedagogical Knowledge) and TPACK (Technological Pedagogical Content Knowledge).

Data Analysis

In this study, the TPACK-ISTE self-efficacy scores of prospective teachers and variables scores about training them for technology integration in education were not normally distributed. Accordingly, analyses were conducted using the Mann-Whitney U and Kruskal-Wallis H tests for the comparisons.

The significance of differences between mean scores was statistically tested at (.05/9=.0055) .0055 level with Bonferroni correction (Field, 2009) due to the possibility of significant difference emerging by coincidence and with the aim of not making a Type I error. Also significant difference was determined by taking the effect size of significant difference in consideration (Cohen, 1988). In the third sub-problem, the Spearman Brown test was used to determine whether the numbers of significant differences in TPACK-ISTE self-efficacy and variables scores about training them for technology integration in education are correlated in point of subject areas.

Kruskal Wallis test is utilized to determine significant differences, and Mann Whitney U test is used as a post hoc test to determine which groups differ (Field, 2009). However, the results of the comparisons made in this way cannot reveal detailed tabulation, how often the subject area scores are significantly higher or lower according to the other subject areas. For example, for each variable (e.g. technology knowledge) in the TPAB, 36 comparisons are required with the calculation in the $\binom{n}{2} = \frac{n.(n-1)}{2}$ formula for the subject areas (n = 9). In this study, a total of $36 \times 7 = 252$ comparisons were made for 7 variables in determining the significant differences between TPAB-ISTE scores. Similarly, $36 \times 8 = 288$ comparisons were made in variables of training prospective teachers to integrate technology in education. For a study involving such an intensive comparison table, an examination of groups that differ only significantly (both $p < .0055$ and at least $r > .10$ effect size) could better serve sub-problems of this study. As a result, a new table was created to show significant difference counts of the subject areas in favor and not in favor of according to the scores. The number of significant differences in favor of subject area is indicated as "Favorable" and the number of significant difference not in favor of (against) subject area is indicated as "Unfavorable".

The mean scores in the 5-point Likert scale have been divided into various levels. Accordingly, a calculation ((the number of options - 1) / options (0.80)), in which the self-efficacy level corresponds with each range, was made. Levels have been converted into the following options: .00–1.80: "I completely disagree"; 1.81–2.60: "I disagree"; 2.61–3.40: "I somewhat agree"; 3.41–4.20: "I agree", and 4.20–5.00: "I completely agree" to determine the TPACK-ISTE self-efficacy of prospective teachers. The Cronbach Alpha internal consistency coefficient of the TPACK-ISTE self-efficacy scale was .94 for the general scale.

Findings

Examining TPACK-ISTE Self-Efficacy of Prospective Teachers

The results of the Kruskal-Wallis H test conducted to determine difference between mean scores are presented in Table 3.

Table 3. Kruskal Wallis - H test Results of TPACK-ISTE Self –Efficacy Scores by Subject Areas

	TK	PK	CK	PCK	TPK	TPACK	TPACK-ISTE
n	3553	3553	3553	3553	3553	3553	3553
χ^2	105.74	68.33	85.49	38.77	108.13	76.59	70.77
df	8	8	8	8	8	8	8
p	.001	.001	.001	.001	.001	.001	.001

Table 3 indicates that there are statistically significant differences in all sub-dimensions of the TPACK-ISTE self-efficacy in Kruskal-Wallis H test ($p < .05$). The Mann-Whitney U test was used to determine between which subject areas these differences emerged. The distribution of these differences in the sub-dimensions of the scale and the total numbers are presented in Table 4.

Table 4. Number of Favorable and Unfavorable Significant Differences in TPACK-ISTE Self-Efficacy Scores by Subject Areas

	Number of favorable differences								Number of unfavorable differences							
	TK	PK	CK	PCK	TPK	TPACK	TPACK-ISTE	Total	TK	PK	CK	PCK	TPK	TPACK	TPACK-ISTE	Total
Physical Education	0	0	6	0	3	2	2	13	1	0	0	0	0	0	0	1
CEIT	6	1	0	0	5	2	3	17	0	0	2	1	0	0	0	3
Science	0	2	0	2	2	2	2	10	1	1	4	0	2	0	1	9
Fine Arts	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mathematics	0	0	3	0	0	0	0	3	1	4	1	3	5	6	5	25
Basic Education	0	3	0	1	2	2	2	10	1	0	3	0	2	0	0	6
Social Science	0	0	0	0	0	1	0	1	1	2	3	1	3	1	2	13
Turkish Language	0	0	1	0	0	0	0	1	1	3	1	2	5	5	5	22
Foreign Languages	0	4	4	4	5	3	4	24	0	0	0	0	0	0	0	0
General Scores	6	10	14	7	17	12	13	79	6	10	14	7	17	12	13	79

* CEIT: Computer Education and Instructional Technologies

According to Table 4 in which all sub-dimensions and TPACK-ISTE self-efficacy scores differences are shown in a comparative way, it is seen that 79 significant differences emerged. While prospective teachers in the CEIT field have generally higher scores in the TK and TPK dimensions, those in Physical Education have higher scores in the CK dimension. Those in Foreign Language department have similarly high scores except for TK. In contrast, unfavorable differences for Mathematics, Turkish language participants are seen especially in TPK, TPACK and TPACK-ISTE except for the TK and CK dimensions. These differences show that the subject area affects the self-efficacy beliefs of prospective teachers regarding technology integration in education.

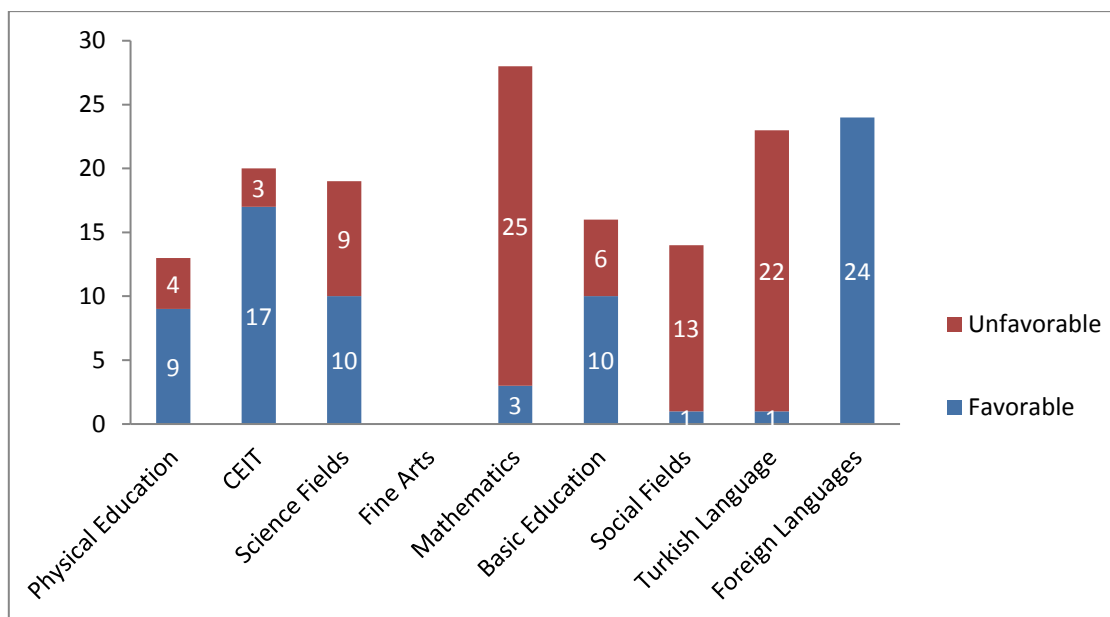


Figure 2 . The Total Number of Favorable and Unfavorable Differences in Scores for TPACK-ISTE Self- Efficacy by Subject Area

As seen in Figure 2, in comparisons made by subject area in the Mann Whitney U test, the numbers of favorable significant differences are, respectively, Foreign Languages (n= 24), CEIT (n= 17), Physical education (n= 13), Basic Education (n= 10) and Science Fields (n= 10). When the situations, in which differences are unfavorable are examined, it is seen that the highest are Mathematics (n= 25), Turkish language (n= 22) and Social Fields (n=13).

Examining Variables in Training Prospective Teachers to Integrate Technology in Education

The number of participants answering the questions about the distributions of variables in training prospective teachers to integrate technology in education, the mean scores regarding the answers, standard deviation values and results regarding the levels are presented in the Table 5.

Table 5. Distribution of Variables in Training Prospective Teachers to Integrate Technology in Education

Variables	n	\bar{X}	Sd	Levels
Capacity of using computers	3529	3.55	0.83	Agree
Capacity of using the internet	3515	3.85	0.80	Agree
Attitude towards using technology in education	3523	3.82	0.85	Agree
Access to technology resources	3527	2.80	1.01	Somewhat Agree
Teacher educators as role models	3527	2.72	1.01	Somewhat Agree
Authentic technology integration experiences	3514	3.05	0.94	Somewhat Agree
Using ICT when developing educational materials	3530	3.06	0.95	Somewhat Agree
Collaborating with peers	3531	3.01	0.98	Somewhat Agree

When Table 5 is examined, the variables of "teacher educators as role models" and "access to technology resources" are the two which have the lowest means, at the level of "I somewhat agree" in regard to training prospective teachers to integrate technology in education. In

addition, the capacity to use the internet and attitudes towards using the technology in education are the highest variables, at the level of "I agree". The other variables have been evaluated at the level of "I somewhat agree".

Table 6. Kruskal Wallis - H test Results of the Variables about Training Prospective Teachers to Integrate Technology in Education by Subject Areas

Variables	n	χ^2	df	p
Capacity of using computers	3529	227.978	8	.001
Capacity of using the internet	3515	165.882	8	.001
Attitude towards using technology in education	3527	132.571	8	.001
Access to technology resources	3527	98.255	8	.001
Teacher educators as role models	3523	81.876	8	.001
Authentic technology experiences	3514	151.310	8	.001
Using ICT when developing educational materials	3530	180.009	8	.001
Collaborating with peers	3531	190.044	8	.001

As seen in the Table 6, there are statistically significant differences between all variables with regard to training prospective teachers to integrate technology in education according to subject areas ($p < .05$). The Mann-Whitney U test has been used to determine between which subject areas these differences emerged. The differences in variables in regard to training prospective teachers to integrate technology in education in terms of these subject areas have been accordingly transformed into numeric expressions of favorable and unfavorable significant differences. The distribution and total numbers of these differences in the sub-dimensions are presented in the Table 7.

Table 7. Comparing the Numbers of Favorable and Unfavorable Significant Differences in the Variables about Training Prospective Teachers to Integrate Technology in Education Scores by Subject Areas

	Number of favorable differences								Number of unfavorable differences									
	Computer use	Internet use	Access to resources	TE role models	Attitudes	Experiences	Material develop	Collaborating	Total	Computer use	Internet use	Access to resources	TE role models	Attitudes	Experiences	Material develop	Collaborating	Total
Physical Education	0	0	0	0	0	0	1	3	4	2	2	1	1	0	1	1	1	9
CEIT	7	7	8	8	6	8	6	8	58	0	0	0	0	0	0	0	0	0
Science	1	0	0	4	0	1	1	1	8	2	2	2	1	3	1	3	3	17
Fine Arts	2	0	0	0	0	0	0	0	2	0	1	2	4	2	1	3	4	17
Mathematics	0	0	0	0	0	0	0	0	0	3	2	1	3	3	4	5	5	26
Basic Education	0	0	1	2	1	1	3	3	11	1	1	1	1	1	1	0	1	7
Social Science	0	0	0	0	0	0	0	0	0	2	2	1	2	2	2	2	2	15
Turkish Language	0	0	0	0	0	0	0	0	0	4	2	1	2	2	2	2	3	18
Foreign Languages	5	5	0	1	5	3	5	5	29	1	0	1	1	0	1	0	1	5
General Scores	15	12	10	15	13	13	16	20	114	15	12	10	15	13	13	16	20	114

In Table 7, it is seen that prospective teachers in CEIT received high scores in all the variables. Participants in the Foreign Language subject area also received higher scores in using computers and using the internet, using ICT in developing materials about their subject area

and conducting collaborative activities in using technology, having authentic experiences in using technology in education, having positive attitudes towards technology integration than those in other subject areas.

The significant differences in the variables of conducting collaborative activities (n=5), developing materials about the subject area (n=5) and having authentic experiences of using technology in education (n=5) of Mathematics prospective teachers were notably lower than those of other groups. Similarly, prospective teachers in Turkish language field has significantly lower scores than in other subject areas in using the internet (n=4) and conducting collaborative activities (n=3).

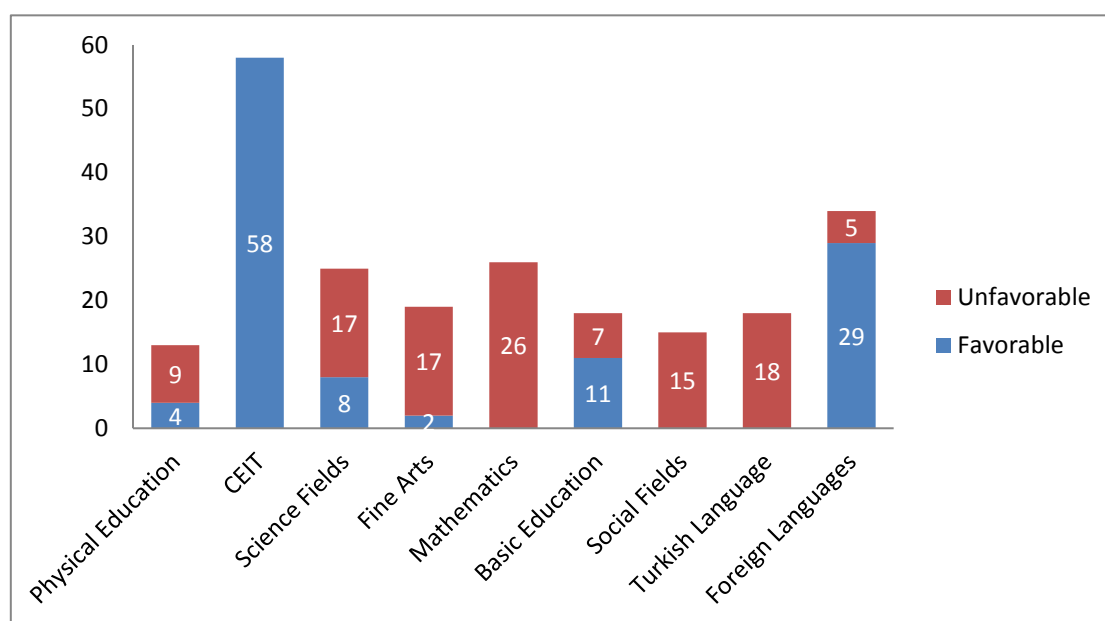


Figure 3. The Total Number of Favorable and Unfavorable Differences by Subject Area in Scores for Variables in Training Prospective Teachers to Integrate Technology in Education

Figure 3 shows that CEIT prospective teachers frequently (n=58) have statistically higher scores in answers about variables than those in other subject areas. Furthermore, those in the Foreign Language field received higher scores (n=29) than those in other subject areas. Those in the Basic Education area (n=11) followed.

When the groups, in which unfavorable significant differences were found are examined in Figure 2, Mathematics (n=26) and Turkish language (n=18) are the areas which frequently showed unfavorable differences. The Science Fields (n=17), Fine Arts (n=17) and Social Fields (n=15) followed these groups.

Relationship between Numbers of Differentiation in TPACK-ISTE Self-Efficacy Scores According to Subject Area and Numbers of Differentiation in Variable Scores in Training Prospective Teachers to Integrate Technology in Education

The relationship between numbers of differentiation in TPACK-ISTE self-efficacy scores according to subject area and numbers of differentiation in variable scores in regard to training

prospective teachers to integrate technology in education was examined with the Spearman Brown test. A strong, significant relationship was found between situations in favor of differentiation numbers in TPACK-ISTE self-efficacy scores according to subject areas and situations in favor of variables scores in terms of training prospective teachers to integrate technology in education ($r = .81$; $p < .01$).

A strong, significant relationship was found between unfavorable situations for significant difference numbers in TPACK-ISTE self-efficacy scores according to subject area and unfavorable situations for scores for variables in training prospective teachers to integrate technology in education ($r = .74$; $p < .02$).

Discussion and Conclusion

In this study, a large prospective teachers sample from several subject areas is examined in point of TPACK self-efficacy and some variables affecting their training to integrate technology in education. The variables stated here reveal the capacity perceptions of prospective teachers as well as technology integration status of teacher training institutions in Turkey. Although these institutions are responsible for preparing prospective teachers to the extent of TPACK competencies, they are less focused in the educational technology studies or they have primarily focused on ICT knowledge and skills in the introductory ICT courses (Tondeur, Aesaert, Pynoo, van Braak, Fraeyman, & Erstad, 2017). Also, investigating TPACK self-efficacy and preparing prospective teachers to integrate technology in education in terms of prospective teachers' subject area may contribute to realize the nature of a subject area to structure the curriculum and make up shortages for educational technology.

In this study, TPACK self-efficacy of prospective teachers in different subject areas differed significantly. In addition, prospective teachers had significantly different views on the process of training for technology integration in education. In particular, some branches differed predominantly in this regard, while others reported less positive opinions on the same issue. Especially scores of TPACK-ISTE self-efficacy of prospective teachers in Foreign Language are considerably high in the study. On the other hand, the fact that TPACK-ISTE self-efficacy scores of Mathematics and Turkish language prospective teachers are lower than the other subject areas in the study are striking. This study has shown that those having higher scores feel better at using computers and the internet, developing materials about their subject area and conducting collaborative activities in using technology than other groups.

Accordingly, some subject areas are exposed to technology integration in education at different levels in terms of the nature of the discipline, the qualifications of the teachers or the curricula, while being educated as a teacher. In fact, it is thought that prospective teachers' integration of technology in education process is mostly related to the teaching staff who train them. In this context, instructors should develop course activities with current pedagogical approaches and technologies in teacher training institutions. As a result of the study teacher educators are not seen as role models in using technology in education. If educators in teacher training institutions have little or lack the knowledge and experience about technology integration in education (Tondeur et al., 2012), it does not make sense to expect prospective teachers to use technology effectively in their future teaching processes (Baylor & Ritchie, 2002; Voogt & McKenney, 2017). The fact that prospective teachers observe their own

teachers using technology in education is a factor which encourages them to use technology in the future.

The results of the present study show that TPACK is perceived differently in each discipline and that technological opportunities in institutions training teachers, the qualifications of teaching staff and curriculum in education differ in terms of technological integration. Those in Mathematics and Turkish language fields received low scores in terms of variables affecting training prospective teachers in integrating technology with TPACK-ISTE self-efficacy. Mathematics and Turkish subject areas have the highest weekly course hours from primary school to university level in Turkey; that is why, effective curriculum and teacher training are crucial for every aspect of education including technology integration for these groups. In terms of language teaching, although generally Turkish or a foreign language has similar disciplinary understanding, the results about technology integration and TPACK self-efficacy significantly differed. In a sense, training Turkish language prospective teachers may still be trained based on conventional manner. Studies in the literature conducted about TPACK or technology integration have concluded that the TPACK perceptions of mathematics teachers or mathematics prospective teachers are at the moderate or lower level (Ozgen, Narli, & Alkan, 2013; Kula, 2015). According to some studies conducted in Turkey, Turkish Language and Literature and Turkish prospective teachers think that the use of Information Technologies (IT) has a negative impact on Turkish (Gezgin & Silahsizoglu, 2016), corrupts the structure of Turkish and causes degeneration of the language (Yaman & Erdogan, 2007). Dargut and Celik (2014) stressed in another study that although Turkish prospective teachers have positive attitudes and thoughts about using technology in education, teacher educators mostly do not have enough information about technology and support for technology in particularly public schools is inadequate.

According to the results, prospective teachers think that the possibilities in accessing to technology resources, teacher educators as role models in using technology in education, authentic technology integration experiences and using ICT when developing educational materials have lacks in their undergraduate education processes. Hereunder, it can be said that prospective teachers' positive beliefs about their TPACK self-efficacy can play an important role in organizing and carrying out the teaching profession in the future (Bandura, 1995); however, they also think the curriculum did not include experience-based technology integration activities and their teachers were not well qualified in integrating technology in education. They are in need of experiences and environment about how to integrate pedagogy and technology knowledge (Hirca & Simsek, 2013).

Another important result of the study is that there was a significant positive relationship between training for technological integration according to subject areas and TPACK-ISTE self-efficacy. Therefore, experiences of integrating technology and access to technology in teacher training institutions, and teacher educators as role models in using technology in education are all related to the TPACK-ISTE self-efficacy of prospective teachers (Tondeur, Scherer, Siddiq, & Baran, 2017). In the context of the results of the current study, it is thought that curriculum should be structured to support prospective teachers in developing their TPACK self-efficacy through experiences, access to technological resources should be provided as required, and a "technology guidance system", supporting continuous integration of technology in institutions training teachers, should be created.

It is thought that determining effective technology integration characteristics of instructors is an important indicator for future research. Most technology integration research is designed to investigate prospective teachers competencies; however, solving the issue in the teacher training institution level is another critical factor.

Because TPACK self-efficacy perceptions of prospective teachers in different subject areas differentiate significantly, content-based activities should be increased particularly in the Turkish Language and Mathematics subject groups in Turkey. In other words, content-based resource support and activities should be increased for disadvantaged teaching areas. In this context, it is the responsibility of the faculties of education to prepare prospective teachers to the extent of TPACK competencies. In the context of the use of technology in education, general competence areas for prospective teachers and specific competence areas specific to subject areas should be determined. This process should not be left to the random initiatives of the instructors.

As limitation of the present study, the variables taken for the training of prospective teachers are limited and are based on a single model. Accordingly, the use of measurement tools that take these variables as a dimension can produce more meaningful results.

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