iojes
www.iojes.net

International Online Journal of Educational Sciences

ISSN: 1309-2707

The Relationship between Technological Pedagogical Content Knowledge and Web 2.0 Self-Efficacy Beliefs

Research Article

Umit KUL[1], Zeki AKSU[2], Salih BIRISCI[3]

[1]*Artvin Coruh University, Faculty of Education, Turkey,* ORCID: 0000-0002-3651-4519
[2]*Artvin Coruh University, Faculty of Education, Turkey,* ORCID: 0000-0001-6839-6847
[3] *Uludag University, Faculty of Education, Turkey,* ORCID: 0000-0001-7131-5112

To cite this article: Kul, U., Aksu, Z., & Birisci, S. (2019). The Relationship between Technological Pedagogical Content Knowledge and Web 2.0 Self-Efficacy Beliefs, *International Online Journal of Educational Sciences*, 11(1), ??.

ARTICLE INFO

Article History:
Received 29.06.2018

Available online
10.01.2019

ABSTRACT

The aim of the present study was to investigate the development of technological pedagogical content knowledge (TPACK) and Web 2.0 self-efficacy beliefs (W2SEB) and to determine the relationship between them for middle school pre-service mathematics teachers through their involvement in a course designed using a Web 2.0 tools. To achieve this aim, thirty pre-service teachers participated in forty two hours of the course in which they could interact with Web-based applications. In the course, pre-service mathematics teachers were requested to develop and present e-content related to the use of these applications for learning outcomes determined in 5-8th grade mathematics curriculum. In order to collect the required data, the TPACK and W2SEB scale were applied to pre-service teachers at the beginning and end of the course. The data obtained from these scales were quantitatively analyzed. Within this scope, while there were positive developments in terms of the technological pedagogical knowledge levels and self-efficacy beliefs, there was a significant relationship identified between them. Additionally, when the regression results related to the post-test are investigated, the TPACK sub-factors of technological and mathematical knowledge were shown to be significant predictors of Web 2.0 rapid content development self-efficacy beliefs.

Keywords:
Web 2.0, TPACK, Self-efficacy beliefs, Pre-service mathematics teachers

Introduction

Today, the rapid development of information technology in all areas of life has become an expected situation. Naturally, it is necessary for educational activities to include technological materials and its applications. In schools, administrators, teachers, students and families are significant stakeholders in the

[1] Corresponding author's address: Artvin Coruh University, Faculty of Education, Department of Mathematics and Science Education, Artvin/Turkey
Telephone: 04662151043
Fax: 04662151042
e-mail: umitkul@artvin.edu.tr
DOI: https://doi.org/10.15345/iojes.2019.01.014

incorporation of technology, and they have to be conscious of the reasons why technology integration is necessary. Amongst these stakeholders, teachers have been given more responsibility in using technology in their teaching so as to improve students' learning and high-level thinking skills (Kumar, Rose & D'Silva, 2008). In other words, teacher's role has always been a fundamental factor in the technology integration process; it is proposed that teachers should have hands-on experience of the new technological tools which they are expected to integrate into the classroom. Certificates, proficiencies and experiences of teachers are significant in organizing and maintaining teaching activities in classroom. Previously, expertise in the content knowledge was used as a criteria for the qualified teacher. However, there is a need for a conceptual framework to allow teachers to include these technological developments in teaching activities in an effective manner. Mishra and Koehler described the Technological Pedagogical Content Knowledge (TPACK) concept based on Lee Shulman's Pedagogical Content Knowledge (PCK) concept. TPACK presents a conceptual framework ensuring knowledge required is integrated with efficient technology related to a certain topic (Voogt, Fisser, Pareja Roblin, Tondeur & van Braak, 2012). This framework includes technological knowledge, pedagogical knowledge, content knowledge, the pedagogical content knowledge, technological pedagogical knowledge and technological content knowledge formed by the overlap of these fields (Figure 1).

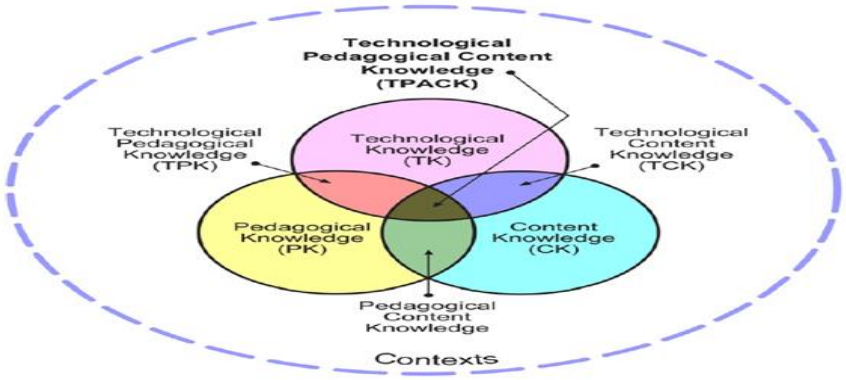

Figure 1: TPACK framework and its knowledge components (Mishra & Koehler, 2006).

For teachers to have good TPACK, it is necessary for successful technology integration of the above knowledge types to be ensured. In other words, teachers should apply digital technologies appropriately within their teaching process. Preparation of teaching material supported by necessary and sufficient technology related to the content and the ability to use technology are important qualities that teachers should have (Kabakçı-Yurdakul, Odabaşı, Kılıçer, Çoklar, Birinci & Kurt, 2014). State organizations desiring that teachers and students effectively benefit from technology have completed studies with this aim. Projects such as "*Preparing Tomorrow's Teachers to Use Technology*" (PT3) in the United States of America and "*Movement of Enhancing Opportunities and Improving Technology*" (FATIH) in Turkey may be listed as examples. However, as mentioned above, though the FATIH project allowed the possibility for teachers to use different types of electronic content in lessons, the revision and differentiation of these were left to teachers (Ministry of National Education [MEB], 2017). In other words, the job of developing the true integration between technology and teaching activities was left to the teacher. Many technological developments have occurred especially in recent years that may be used in teaching. The use of the internet is increasing daily in terms of both user numbers and use rates. In this way, many opportunities for teachers were provided to create effective learning environments and prepare teaching materials in the digital environment are Web 2.0 tools. The use of Web 2.0 applications in educational activities makes it possible to carry all types of information and teaching content onto an easy and rapidly accessible platform. Web 2.0 applications, presenting users with a variety of web-based applications (D'Souza, 2006; O'Reilley, 2007), allow the production of user-based knowledge, presenting a variety of opportunities for communication between individuals within this framework (Thompson, 2007).

Opportunities to make access to information, working in groups, social interaction and feedback easier make the use of Web 2.0 opportunities unavoidable in the field of education (Alexander, 2006; Elmas & Geban, 2012; Eren, Yurtseven Avci, & Seckin-Kapucu 2014; Horzum, 2010; Hung & Yuen, 2010; Thompson, 2007). When considered in this way, it will be possible to bring all types of knowledge and learning content to an easily and rapidly accessible platform with the use of Web 2.0 applications. Together with this concept, researchers emphasizing the usefulness of Web 2.0 technologies in creating and structuring knowledge have proposed that these technologies will provide significant contributions to social constructivist learning environments (Rosen & Nelson, 2008; Vaughan, 2010). Thus, the inclusion of Web 2.0 applications in teaching activities of teachers and pre-service teachers with the characteristics of forming a significant share of current technologies appears to be an effective factor in determining performance. In benefitting from this situation effectively, it will be possible for teachers to direct students by including this new generation of applications in teaching and learning. Firstly in spite of the consideration that the use of technology in education will be reform, an attempt has been made to mount technology on top of traditional learning in many environments. This has prevented the expected change from occurring.

There are many factors underlying this lack of change. These factors have been dealt with in two groups by different researchers as an individual (belief, knowledge, and attitude, etc.) and organisational (equipment, software, technical support, etc.) (Ertmer, 2005; Keengwe, Onchwari & Wachira, 2008). When there is a desire to integrate technology into teaching and learning, external factors may be easily taken under control; however internal factors directly related to the teacher are a significant obstacle to technology integration process (Ertmer, 2005). Internal factors like knowledge and self-efficacy of the teacher, especially, may be effective determinants in the decision about how to integrate technology with teaching. Understanding the knowledge, attitude, and beliefs of pre-service teachers about information technologies will provide an idea about the use of technology in the future classrooms (Anderson & Maninger, 2007).

Due to the increasing use of digital technologies in educational activities, the importance of self-efficacy beliefs of teachers become an important. Bandura (1982) stated the self-efficacy concept was personal judgments related to what the person would do in possible situations they may encounter. In other words, self-efficacy may be stated to be a person's organisation of the necessary skills to bring about the aimed and desired results and the beliefs about applying these (Bandura, 1997). Self-efficacy beliefs is unique to the job and situation at hand. The self-efficacy of teachers was revealed to be linked to their feelings of sufficiency in terms of occupation (Kanadlı, 2017; Pajares, 1996). Teachers with high self-efficacy beliefs have a tendency to use different teaching methods, and are inclined to use student-centred teaching strategies and to use different teaching material in applications (Tschannen-Moran & Woolfolk-Hoy, 2002). Contrary to this, teachers with low self-efficacy beliefs preferred teacher-centred teaching activities (Martin, 2006; Plourde, 2002). Related to the integration process of technology with learning and teaching, the self-efficacy beliefs of teachers may affect in-class behaviour and decisions related to technology use in classroom (Abbitt, 2011; Littrell, Zagumny & Zagumny, 2005; Teo, 2009; Wang, Ertmer & Newby, 2004). Within the framework of planning a lesson, it is believed that teachers' self-efficacy related to the degree of use of Web 2.0 tools and the necessity of directing the training in line with identifying requirements are important.

With this aim, the study by Birişçi, Kul, Aksu, Akaslan & Çelik, (2018) developed a W2SEB scale to determine self-efficacy levels of pre-service teachers related to how Web 2.0 applications are included in the process of planning a lesson (preparation, presentation and evaluation). Considering the effectiveness of new generation digital technology in the teaching process, the ability of teachers to effectively use technology is linked to their knowledge of technology and their self-efficacy levels about ability to use these technologies (Sahin, Akturk & Schmidt, 2009; Şahin, Çelik, Aktürk & Aydın, 2013). In this way having knowledge about factors affecting the self-efficacy of teachers is important in terms of enhancing self-efficacy. Similarly, it is

known that no innovative move can be successful if it is not well understood, accepted or effectively used by teachers (Baki, 2008). For this reason, the necessity of application and research studies to ensure development of effective technology integration knowledge and of self-efficacy beliefs of pre-service teachers in teacher education programs and of teachers in the field is obvious.

In the relevant literature, there are studies about increasing TPACK (Chai, Koh, Tsai & Tan, 2011; Guzey & Roehrig, 2009; Jang & Chen, 2010; Niess, Van-Zee & Gillow-Wiles, 2011) and self-efficacy beliefs (Bilici & Baran, 2015; Pratt, 2002) of teachers and pre-service teachers. For example, Tatlı, Akbulut and Altınışık (2016) completed a study about applications given under the auspices of efficient use of Web 2.0 tools for educating of pre-service teachers to ensure the development of material related to their own field and the effect of this education on their TPACK self-confidence levels. According to the researchers, it was important that pre-service teachers were aware of Web 2.0 tools that could be used in their field and adopted these applications for use them in professional life. Related to this topic, Akgün (2013) completed a study to investigate the web pedagogical content knowledge and the related teaching self-efficacy perception of pre-service teachers. Data for the research were collected with a web pedagogical content knowledge scale and teacher self-efficacy scale tool. In the study, the researcher determined that pre-service teachers had high levels of web pedagogical content knowledge. Additionally, according to the research findings, they identified a positive and significant correlation between the web pedagogical content knowledge and teacher self-efficacy perceptions of pre-service teachers. Similarly, a study by Abbitt (2011) provided 16 hours of training in the use of technology in education to 45 preschool teacher candidates during one semester. According to the post-test results of the study, there was a significant relationship between the self-efficacy beliefs related to technology integration and TPACK knowledge component of pre-service teachers. Additionally, the study stated that the effort pre-service teachers expended to develop TPACK knowledge was beneficial in increasing self-efficacy beliefs. As observed in the relevant literature (Akgün, 2013; Erdemir, Bakırcı & Eyduran, 2009; Gömleksiz & Fidan, 2011; Lim, Yan, & Xiong, 2015; Mishra & Koehler, 2006; Sarı, Bilici, Baran & Özbay, 2015; Tatlı, Akbulut, & Altınışık, 2016; Kabakçı Yurdakul, 2011), for a quality education and teaching approach, the focus has been on the use of learning approaches that ensure the union of technological, pedagogical and content knowledge, in addition to the idea that the use of technology in education and teaching is unavoidable and the necessity to educate pre-service teachers in this field. In other words, for a teacher to integrate technology into lessons, the necessity to firstly have integrated TPACK and self-efficacy beliefs is understood. In this case, it becomes important to increase the TPACK and Web 2.0 self-efficacy beliefs of teachers or pre-service teachers and to identify the relationship between them. As a result, web-based course was prepared for pre-service mathematics teachers. With the name "Web 2.0 applications for mathematics education (WAME)", the 42-hour course aimed to develop the TPACK and Web 2.0 Self-efficacy beliefs of pre-service teachers and to identify the relationship between them.

Purpose of the Study

Developments and new applications in technology have made the use of technology an important part of education. Technology has provided new methods and approaches for education and teaching activities. Many studies have emphasized the necessity of developing teachers' content knowledge by including technology and gaining teaching skills with technology (Mishra & Koehler, 2006; Niess, 2005). Hence, the present study concerns the need for technology-based courses to assist pre-service teachers in promoting a critical standpoint on teaching and learning and the use of technology in education. This study aims to determine the development of technological pedagogical content knowledge and Web 2.0 content development self-efficacy beliefs related to successfully using technology in class of pre-service mathematics teachers and to determine the relationship between them. In line with this basic aim, it is possible to list the sub-problems dealt with in the research as follows:

a. Is there a significant difference between the pre-test and post-test scores obtained for general and sub-dimensions of the TPACK scale of pre-service teachers?

b. Is there a significant difference between the pre-test and post-test scores obtained for general and sub-dimensions of the W2SEB scale of pre-service teachers?

c. How does the relationship between Web 2.0 self-efficacy belief and TPACK content knowledge levels change during the Web-based course?

Method

Design of the Study

The purpose of this study was to investigate the development of technological pedagogical content knowledge and Web 2.0 self-efficacy beliefs of pre-service mathematics teachers through their participation in Web-based course. Therefore, this study used a single group pre and post-test pre-experimental model that is one of the quantitative research design. With pre-experimental designs, the researchers worked on a single group and offers an intervention during the experiment. This does not have a control group to compare with experimental group (Creswell, 2014). This design measures a single group twice, before and after an application (Creswell, 2008; Fraenkel & Wallen, 2006). The design used in the research determined the independent variable was the effect of Web 2.0 education activities, with the dependent variables in the research the technological pedagogical content knowledge and Web 2.0 rapid content development self-efficacy beliefs. Accordingly, variation occurring in the dependent variables was determined by the difference between the measurements before and after the course activities (Cohen, Manion & Morrison, 2007; Creswell, 2014). Within the scope of this study, the variations in the technological pedagogical content knowledge and Web 2.0 rapid content development self-efficacy beliefs of primary level pre-service mathematics teachers receiving education related to Web 2.0 tools were assessed. The symbolic appearance of the model is given in Figure 2.

G_1	$O_{1.1}$	X	$O_{1.2}$

G_1: Research group, $O_{1.1}$: Measurement before application (Pre-test), X: Application, $O_{1.2}$: Measurement after application (Post-test).

Figure 2. Symbolic appearance of the model used within the scope of the research

Participants

The study group for the research was determined with the targeted sampling method. The basic aim of this type of sampling is not to generalize the research results to the population; but contrarily to describe and understand the people or situation in depth (Ekiz, 2009; Miles & Huberman, 1994). The criteria sampling method was chosen from among the targeted sampling determination types In accordance with the aim of the research. The basic approach in the criteria sampling method is to fulfil all situations in which a set of previously determined criteria are encountered. Here, just as a previously prepared set of criteria may be used, the criteria may be determined by the researchers (Yıldırım & Şimşek, 2011). In the research, the basic criterion determined by the researchers in the selection of participants for the application was participants with high technological literacy. At this point, the notes obtained for Computer I-II and Computer-supported Mathematics Teaching lessons taken by the pre-service teachers in the previous semester were taken as criteria. Finally, thirty pre-service mathematics teachers registered, spring semester of 2017-2018, for the elective lesson of WAME within Artvin Coruh University the Faculty of Education comprised the study group of the research. These students were 11 males and 19 females, with ages ranging from 21 to 30 years.

Teaching Process

This study investigating the development levels of technological pedagogical content knowledge and Web 2.0 content development self-efficacy beliefs of mathematics pre-service teachers encompasses one section of a scientific research run by the university. With this aim, education was completed including 30 pre-service mathematics teachers registered for the WAME course opened as an elective course. The activities and content of this education completed over 14 weeks are presented in Table 1.

Table 1. *Content of WAME course*

STAGE	LESSON CONTENT	DURATION
PREPARATION	Introduction to content management system like Wordpress	6 hours
	Use of concept mapping and drawing tools like Cacoo	4 hours
	Preparation of animation with Powtoon	6 hours
	Introduction and use of online file storage and sharing tools like Google Drive and Screencast	2 hours
	Introduction to image, audio and video tools like Eddpuzzle	4 hours
	Learning to code with Scratch	6 hours
PRESENTATION	Introduction to interactive presentation tools like Prezi	4 hours
	Holding online meetings with the Google Hangouts	2 hours
EVALUATION	Survey (Survey Monkey)	2 hours
	Use of digital class applications like Khoot and Plickers	2 hours

The aim of the course was for pre-service teachers to become aware of the potential of Web 2.0 tools in mathematics education, to comprehend the epistemological and pedagogical principles of web-supported mathematics education, to gain sufficiency in the use of Web 2.0 tools for web-supported mathematics teaching, and to prepare web-based mathematics projects and activities for teaching concepts and topics in the mathematics teaching programs. In the first week of the activities, pre-service teachers were informed about the activities planned within the scope of the lesson and the TPACK and W2SEB pre-tests were administered. In the relevant weeks within the scope of the activities run in three stages in line with the interest areas of three researchers, applied training was provided related to the necessity of using various Web 2.0 tools for educational activities in the lesson planning process in the form of preparation, presentation and evaluation. Lesson explanations over three lesson hours per week allowed the possibility for pre-service teachers to use individual computers in the computer laboratory. Activities related to the use of web tools in teaching mathematical concepts and to solve problem-solving activities focused on examples. For project homework for the lesson, students were requested to design teaching material unique to the topic content included in the applications belonging to Web 2.0 tools and the three stages of lesson planning. Additionally, the developed web-supported content was debated in the class environment. In this process, the aim was to positively develop the technological pedagogical content knowledge and Web 2.0 rapid content development self-efficacy beliefs of pre-service teachers. In the last week of the activities, a general evaluation of the activities within the course was completed and the TPACK and W2SEB post-tests were administered.

Data Collection

Technological Pedagogical Content Knowledge Scale (TPACK). Schmidt et al. (2009) developed a 58 item inventory to measure the TPACK self-efficacy levels in content areas like mathematics, social sciences, science and literary knowledge for primary education teachers in a study researching the teaching and technology knowledge of primary school pre-service teachers. The internal consistency of the inventory had a Cronbach Alpha value of .80 calculated. The structural validity of the scale tool was tested with factor analysis. Övez and Akyüz (2013) adapted the TPACK self-efficacy scale for use only in mathematics lessons. This scale

comprises 27 items and four factors. These factors are in the form of 3 items for mathematics knowledge, 6 items for technological knowledge, 8 items for mathematics teaching knowledge and 10 items for integration of technology in mathematics teaching knowledge. The scale items are prepared with a five-point Likert type ranging from 5 "Completely agree", 4 "Agree", 3 "Undecided", 2 "Disagree" and 1 "Definitely disagree". The lowest points that can be obtained from the scale are 27 with highest points of 135. The Cronbach alpha reliability coefficient calculated to determine the reliability of the scale was found to be .91.

Web 2.0 Rapid Content Development Self-Efficacy Beliefs Scale (W2SEB). In this study the Web 2.0 rapid content development self-efficacy beliefs (W2SEB) scale developed by the researchers was used (Birişçi, Kul, Aksu, Akaslan & Çelik, 2018). The scale was administered to 337 pre-service teachers (127 male, 210 female) attending different departments of educational faculties in different universities and the obtained data had exploratory and confirmatory factor analysis applied. The scale comprises 21 items and three factors aiming to determine the self-efficacy beliefs in using Web 2.0 tools in the planning stages of a lesson. These factors are "lesson preparation (13 items)", "lesson presentation (4 items)" and "lesson assessment (4 items)". The scale items were prepared with a five-point Likert type of 1 "I am very inadequate", 2 "I am inadequate", 3 "Undecided", 4 "I am competent" and 5 "I am very competent". The lowest points that can be obtained from the scale are 21, with highest points of 105. The general internal coefficient for the scale in development studies (Cronbach alpha reliability coefficient) was calculated as .95. Additionally the Cronbach alpha reliability coefficient values calculated to determine the reliability of the scale were .93 for the first factor (lesson preparation), .85 for the second factor (lesson presentation) and .84 for the third factor (lesson assessment). The confirmatory factor analysis results showed the scale had acceptable fit indices (=516.18, /df =2.86, RMSEA=0.074, SRMR=0.053, NFI=0.9, CFI=0.94, RFI=0.85 and IFI=0.94). The results of the analysis showed the developed scale may be used to determine sufficiency levels in the use of Web 2.0 tools for educational purposes.

Analysis of Data

The data obtained from pre-test and post-test scale administrations to pre-service teachers within the scope of the research were uploaded to the SPSS 20.0 program. Primarily, it was investigated whether the variables exhibited normal distribution. The coefficient of skewness for TPACK was found to be -1.353 and .235, and the kurtosis coefficient for TPACK was 1.140 and -748. The coefficient of skewness for the Self-Efficacy was found to be .063 and .045 and determined to be -.273 and -.894, respectively. Similarly; the skewness coefficients for the four factors of TPACK were found to range from -971 to -.240 before the program, and the kurtosis coefficient ranged from -828 to .863. After the program, the coefficient of skewness of the four factors for TPACK ranged between -148 and .437, and the kurtosis coefficient ranged from -854 to -529. These values show that all variables exhibit standard normal distribution. Analysis of data obtained in the research completed data analysis procedures on pre-test and post-test applications of TPACK and W2SEB scales and the points obtained from sub-dimensions. In the analysis process, arithmetic means were calculated and these values were calculated in accordance with the 5-point scale structure of both scales and the correlation between the two test groups was analyzed with the Wilcoxon test. Additionally, multiple regression analysis was used to determine the level of prediction of Web 2.0 self-efficacy beliefs of pre-service teachers by TPACK development levels. For the regression analysis, the assumptions were discussed. In this sense, multiple correlation with the VIF value was examined. In the pre and post-test regression model, VIF values were found to be less than 2.067 and 1.562 in this study respectively. According to the recommendation of Tabachnick and Fidell (2012) (VIF <10), it was found that there was no multiple correlation. In addition, the Durbin-Watson value was calculated as to whether the terms were correlated and 1.90 and 1.59 were found in the models,

respectively. It can be revealed that the terms are not correlated based on the recommendation of Field's (2005) between 1 and 3. The results were also tested at levels of p<0.5.

Results

Results from the TPACK scale

The first sub-problem of the study aimed to investigate the variation in TPACK during the training process of pre-service mathematics teachers. With this aim, the Wilcoxon signed ranks test was applied to determine the variation between points obtained by pre-service teachers on the pre-test and post-test administrations of the TPACK scale and the obtained data are given in Table 2.

Table 2. *Wilcoxon Signed Ranks test results related to TPACK scale*

Variable	Measurement			N	Row Mean	Row Total	Z
TK	Pre-test *M* (20.00)	Post-test *M* (23.53)	Negative row	7	6.86	48.00	-3.25**
			Positive row	19	15.95	303.00	
			Equal	4			
MK	Pre-test *M* (10.30)	Post-test *M* (11.77)	Negative row	8	7.75	62.00	-2.91**
			Positive row	18	16.06	289.00	
			Equal	4			
MTK	Pre-test *M* (27.33)	Post-test *M* (30.53)	Negative row	8	7.50	60.00	-2.94**
			Positive row	18	16.17	291.00	
			Equal	4			
TMTK	Pre-test *M* (33.10)	Post-test *M* (41.07)	Negative row	2	2.50	5.00	-4.68**
			Positive row	28	16.43	460.00	
			Equal	0			
TPACK	Pre-test *M* (90.73)	Post-test *M* (106.9)	Negative row	0	.00	.00	-4.71**
			Positive row	29	15.00	435.00	
			Equal	1			

Note: ** p < .001; TK Technological knowledge, MB Mathematical knowledge, MTK Mathematical Teaching Knowledge, TMTK Technological Mathematical Teaching Knowledge.

When Table 2 is investigated, it appeared the total points levels for technological pedagogical content knowledge of pre-service teachers before and after the application differed by a statistically significant degree (z = 4.71, p < .001). When the direction of this difference is investigated, it is understood the positive rows, in other words post-test points, were higher. As a result, it may be said that the completed course was effective in increasing the technological pedagogical content knowledge levels of pre-service teachers. When sub-dimensions are investigated, it appeared the TK (z = -3.25, p < .001), MK (z = -2.91, p < .001), MTK (z = -2.94, p < .001) and TMTK (z = -4.68, p < .001) levels of pre-service teachers appeared to be statistically significantly different before and after the WAME. The positive rows created this significant difference, in other words it was understood that the post-test points were higher. Stated differently, the completed course may be said to be effective in increasing the knowledge levels of both technological pedagogical content and its sub-dimensions among mathematics pre-service teachers.

Results from W2SEB scale

The second sub-problem of the study aimed to investigate the variation in W2SEB of pre-service mathematics teachers during the educational process. With this aim, the Wilcoxon signed ranks test was applied to determine the variation between points obtained by pre-service teachers on the pre-test and post-test administrations of the W2SEB and the obtained data are given in Table 3.

Table 3. Wilcoxon Signed Ranks test results related to self-efficacy levels

Variable	Measurement			N	Row mean	Row total	*Z*
LPr	Pre-test *M* (42.2)	Post-test *M* (53.73)	Negative row	2	10.50	21	-4.35**
			Positive row	28	15.86	444	
			Equal	0			
LPs	Pre-test *M* (12.3)	Post-test *M* (16.76)	Negative row	0	.00	.00	-4.8**
			Positive row	30	15.50	465	
			Equal	0			
LA	Pre-test *M* (12.27)	Post-test *M* (16.77)	Negative row	1	3	3	-4.56**
			Positive row	27	14.93	403	
			Equal	2			
W2SEB	Pre-test *M* (66.77)	Post-test *M* (87.17)	Negative row	1	5.50	5.50	-4.67**
			Positive row	29	15.84	459.50	
			Equal	0			

Note: ** $p < .001$; LPr Lesson preparation; LPs Lesson presentation; LA lesson assessment

When Table 3 is investigated, it appears there was a statistically significant degree of difference between the total point levels for Web 2.0 rapid content development self-efficacy beliefs of pre-service teachers before and after the course ($z = -4.67$, $p < .001$). When the direction of this difference is investigated, the positive rows, in other words post-test points, were understood to be higher. As a result, the completed course may be said to be effective in increasing the self-efficacy levels of pre-service teachers. When investigated in terms of sub-dimensions, there appeared to be a statistically significant degree of difference in the LPr ($z = -4.35$, $p < .001$), LPs ($z = -4.8$, $p < .001$) and LA ($z = -4.56$, $p < .001$) levels of pre-service teachers before and after the course. In forming this significant difference, positive rows, in other words post-test points, were understood to be higher. Stated differently, the completed course may be said to be effective in increasing both the Web 2.0 self-efficacy perception and its sub-dimensions among mathematics pre-service teachers.

The relationship between TPACK and Web 2.0 self-efficacy beliefs

The third sub-problem of the study aimed to investigate the relationship between the Web 2.0 rapid content development self-efficacy beliefs and technological pedagogical content knowledge levels during the training process. Within this scope, two types of analysis were completed, firstly correlation analysis was completed to determine the relationship between TPACK self-efficacy levels and W2SEB of pre-service mathematics teachers before and after the course activities and the results are given in Table 4.

Table 4. Relationship between pre-test and post-test TPACK and sub-dimensions with W2SEB

	Self-efficacy	
	Pre-test	**Post-test**
	r	***r***
TK	.41*	.61**
MK	.48**	.75**
MTK	.47**	.42*
TMTK	.47**	.39*
TPACK	.57**	.76**

Note. * $p < .01$; ** $p < .001$;

When the pre-test results are examined on Table 4, it appears there was a positive significant correlation between the general points obtained for W2SEB and TPACK scales (r = .57, p < .001). It appeared there was a positive significant correlation between W2SEB and TK (r = .41, p < .01), MK (r = .48, p < .001), MTK (r = .47, p < .001) and TMTK (r = .47, p < .001) sub-dimensions. Additionally, there was a positive significant correlation present between post-test results on W2SEB and TPACK (r = .76, p < .001). When the post-test results are considered, there appeared to be a positive significant correlation between W2SEB and TK (r = .61, p < .001), MK (r = .75, p < .001), MTK (r = .42, p < .01) and TMTK (r = .39, p < .001) sub-dimensions. After determining the correlation between the variables, according to data obtained from pre-tests and post-tests, the aim was to determine whether TPACK predicted W2SEB or not. With this aim, multiple regression analysis was applied with the regression analysis results for pre-tests are presented in Table 5.

Table 5. Prediction of Web 2.0 self-efficacy beliefs by TPACK on the pre-test

	Unstandardized Coefficients		**Standardized Coefficient**				
	B	**SE**	***β***	***t***	**95% CI**	R^2	***F***
TK	.65	.66	.18	.98	[-.71, 2.01]	.34	3.27*
MK	1.33	1.32	.21	1.01	[-1.39, 4.05]		
MTK	.42	.57	.17	.74	[-.76, 1.60]		
TMTK	.38	.48	.18	.79	[-.61, 1.37]		

Note. * $p < .01$; ** $p < .001$.

When the regression results for the pre-tests are investigated, though the correlation analysis revealed significant correlations, it appeared the sub-dimensions of TPACK did not significantly predict self-efficacy beliefs.

Table 6. Prediction of Web 2.0 Self-efficacy beliefs by TPACK on the post-test

	Unstandardized Coefficients		**Standardized Coefficient**				
	B	**SE**	***β***	***t***	**95% CI**	R^2	***F***
TK	1.27	.39	.38	3.24**	[.46, 2.08]	.73	16.57**
MK	3.45	.89	.51	3.89**	[1.62, 5.28]		
MTK	.88	.47	.22	1.87	[-.09, 1.85]		
TMTK	.18	.36	.06	.50	[-.57, .93]		

Note. * $p < .01$; ** $p < .001$;

When the regression results related to the post-test are investigated, it is understood that TK and MK significantly predicted W2SEB (see Table 6). Additionally TPACK explained nearly 73% ($R^2 = .73$) of the total variance in self-efficacy and it was concluded that the regression model was significant ($F_{4\text{-}25} = 16.57$, $p < 001$). However, on the post-test the MTK and TMTK sub-dimensions were not identified to significantly predict self-efficacy.

Discussion

This study aimed to investigate the development of technological pedagogical content knowledge and Web 2.0 rapid content development self-efficacy beliefs of mathematics pre-service teachers and to determine the relationship between them within the scope of WAME course. According to the results of the study, there was a positive relationship between TPACK and W2SEB of pre-service teachers. In other words, according to the analysis as the TPACK of pre-service teachers increased, there was an increase in W2SEB levels.

When the TPACK scale administered to pre-service teachers within the scope of the activities to create an effective learning environment related to Web 2.0 tools for mathematics teaching and develop assisting teaching materials is investigated, there was a significant increase identified in all sub-dimensions of technological pedagogical content knowledge of pre-service mathematics teachers. In parallel with these results, applications used in studies by Atasoy, Uzun and Aygün (2015); Erdoğan (2014), Karataş et al. (2016), Ceylan, Türk, Yaman and Kabakçı-Yurdakul (2014), Koyunkaya (2017) and Uygun (2013) were identified to affect development of technological pedagogical content knowledge (TPACK) of pre-service teachers. Within the conceptual framework forming the basis of all these studies, the target was to regularly and effectively apply the planned teaching application. In this way, effective development was shown in TPACK and sub-dimension knowledge levels of teachers and pre-service teachers. The lessons completed in this study were run in the computer laboratory allowing each pre-service teacher the opportunity to use an individual computer. The focus was on activities and examples related to the use of web tools in teaching mathematical concepts and in solving problem-solving activities. All these applications, the discussion environment and feedback appeared to contribute to the development of TPACK of pre-service teachers.

The second research problem investigated in the scope of the study investigated whether the self-efficacy beliefs related to Web 2.0 of pre-service teachers differed before and after the completed activities. The variation in mean points for the general and sub-dimensions (lesson preparation, lesson presentation and lesson assessment) of the W2SEB scale in the obtained results was shown to be in favour of the post-tests. This increase was found to be statistically significant in the analysis. Within the scope of activities run in this study, training was given related to the use of various types of Web 2.0 tools in educational activities during the planning process of a lesson in the form of preparation, presentation and assessment stages. The completed application affected the development of Web 2.0 self-efficacy perception of pre-service teachers in a positive direction. Similarly, Altıok, Yükseltürk and Üçgül (2017) showed that pre-service teachers had positive opinions about learning outcomes after an "Evaluation of a scientific activity about use of Web 2.0 technologies in education". The study by Durusoy (2011) aimed to investigate the effect of the use of Web 2.0 technologies and digital video in applied teaching lessons on the teaching self-efficacy of pre-service teachers. As a result of the application, the use of Web 2.0 technologies like digital video in educating teachers were identified to be effective tools for development of self-efficacy of pre-service mathematics teachers.

The final research problem investigated in the study examined the relationship between technological pedagogical content knowledge and Web 2.0 rapid content development self-efficacy beliefs of pre-service mathematics teachers after the course activities. According to the results of the analysis, there was a positive moderate-level relationship between the technological pedagogical content knowledge and Web 2.0 rapid content development self-efficacy beliefs of mathematics pre-service teachers. One of the results of the study is that TPACK components were significant predictors of Web 2.0 self-efficacy beliefs and the relationship between them changed in the context of Web 2.0 applied lessons in mathematics education. Thus, due to the similarity of items on the TPACK scale and items on the W2SEB scale in terms of integration of technology in teaching this relationship is an expected result. This result of the study is similar to the studies by Abbitt, (2011), Sahin, Akturk and Schmidt, (2009) and Şahin, Çelik, Aktürk and Aydın (2013). For example, the study by Abbitt (2011) identified a significant and positive relationship between the TPACK of preschool teacher candidates and self-efficacy perception related to technology integration. Similarly, Şahin, Çelik, Aktürk and Aydın (2013) determined statistically significant and strong relationships between all knowledge domains contained in the TPACK model and the self-efficacy beliefs about educational internet use.

Previous research showed that the use of technology in classes for teachers or pre-service teachers affected the self-efficacy levels of these individuals (Abbitt, 2011; Akgün, 2013; Karataş, 2014; Köseoglu et al,. 2007; Kutluca & Ekici, 2010; Nathan, 2009; Wang et al., 2004). In this study, the four independent variables

(TK, MK, MTK and TMTK) from data collected before the training were found not to be significant predictors of self-efficacy beliefs (R^2 = .34). However, two independent variables (TK and MK) predicted self-efficacy after the application, while the other two independent variables (MTK and TMTK) were not significant predictors (R^2 = .73). Pre-service teachers participating in the study received education about the place of Web 2.0 tools in mathematics education during 14 weeks of "Web Applications in Mathematics Education". As a result, it may be said the TPACK sub-dimensions of TK and MK affected Web 2.0 self-efficacy of pre-service teachers due to the completed activities. A noteworthy point in terms of the results about the level of the relationship between TPACK and Web 2.0 self-efficacy is that the technology training given did not reveal any change in the mathematics teaching skills. Thus, the basic aim of the Web 2.0 based educational process is not to gain mathematical teaching skills, but rather about the necessity of including Web 2.0 technologies in mathematics teaching. Accordingly, the lack of prediction of Web 2.0 self-efficacy at significant levels by MTK and TMTK sub-dimensions is an expected situation. It is believed the experiences gained by pre-service teachers included in technology-based educational processes with inclusion during teaching in a real classroom environment will be effective in predicting the effect of teaching skills on Web 2.0 technologies. Thus, in future studies about integration of mathematics teaching activities with courses about Web 2.0 technologies may reveal the relationship between the MTK and TMTK sub-dimensions. These results of the study are in parallel with results from similar TPACK research findings (Abbitt, 2011; Koehler, Mishra & Yahya, 2007).

Limitations

There are some limitations and restrictions to the research. Due to the small sample, it may only be possible to generalise the research results to similar contexts. In other words, the mathematics teaching program was limited to 30 pre-service teachers. Additionally 42 hours of training were given to pre-service teachers during one semester. The results obtained in the study represent this group. To generalise the study results it will be appropriate to provide longer durations of training to different and larger pre-service teacher groups. The study is limited in this regard. An additional restriction of the study is the focus on TPACK self-efficacy perceptions and Web 2.0 self-efficacy beliefs of participants. The ability of the scale tools used in the study to show true information is limited by pre-service teachers' accurate evaluation of their own knowledge and beliefs.

Implications

In line with the results obtained in the research, the recommendations related to the application and future studies are as follows; this study showed that the varying content of technology over time and the relationship with pedagogical principles have a more complex consideration trend. As a result, to develop TPACK and its knowledge types in teacher education programs there is a need for studies to better understand the conceptual structure. Additionally, education and guidance studies related to original integration of different Web 2.0 technologies in the topic content of classroom teaching activities should be increased and successful applications should be supported. Mixed studies investigating the reflection of how certain technologies may be used in teaching certain topic contents in real classroom environments should be completed. In this context, there is need for research using different types of data collection tools in the pre-service teacher training field and investigating TPACK development and different internal structures of pre-service teachers in different disciplines. In this way, the internal factors (like attitude) related to TPACK self-efficacy levels and web technologies of teachers will be determined and it is recommended that researchers complete applied and longitudinal research.

REFERENCES

Abbitt, J. T. (2011). An investigation of the relationship between self-efficacy beliefs about technology integration and technological pedagogical content knowledge (TPACK) among preservice teachers. *Journal of Digital Learning in Teacher Education, 27*(4), 134-143.

Akgün, F. (2013). Pre-service teachers' web pedagogical content knowledge and relationship between teachers' perceptions of self-efficacy. *Trakya University Journal of Education, 3*(1), 48-58.

Alexander, B. (2006). Web 2.0: A new wave of innovation for teaching and learning?. *Educause Review, 41*(2), 32-44.

Anderson, S. E., & Maninger, R. M. (2007). Preservice teachers' abilities, beliefs, and intentions regarding technology integration. *Journal of Educational Computing Research, 37*(2), 151-172.

Atasoy, E., Uzun, N., & Aygün, B. (2015). Dinamik matematik yazılımları ile desteklenmiş öğrenme ortamında öğretmen adaylarının teknolojik pedagojik alan bilgilerinin incelenmesi. *Bartın Üniversitesi Eğitim Fakültesi Dergisi*, *4*(2), 611-633.

Baki, A. (2008). *Kuramdan uygulamaya matematik eğitimi* [Mathematics education from theory to practice]. Ankara: Harf Eğitim Publishing.

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist, 37(*2), 122-147.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: Freeman.

Bilici, S.C., & Baran, E. (2015). The investigation of science teachers' self-efficacy toward technological pedagogical content knowledge: A Longitudinal Study. *GUJGEF*, *35*(2), 285-306.

Birişçi, S., Kul, Ü., Aksu, Z., Akaslan, D., & Çelik, S. (2018). Web 2.0 hızlı içerik geliştirme öz-yeterlik algısını belirlemeye yönelik ölçek (W2ÖYAÖ) geliştirme çalışması. *Eğitim Teknolojisi Kuram ve Uygulama*, *8*(1), 187-208.

Ceylan, B., Türk, M., Yaman, F., & Kabakçı-Yurdakul, I. (2014). Determining the changes of information and communication technology guidance teacher candidates' technological pedagogical content knowledge competency information and communication technology usage stages and levels. *Journal of Theory and Practice in Education, 10*(1), 171-201.

Chai, C. S., Koh, J. H. L., & Tsai, C. C. (2013). A review of technological pedagogical content knowledge. *Educational Technology & Society*, *16*(2), 31-51.

Cohen, L., Manion, L., & Morrison, K. (2007). *Research methods in education* (6th. ed.). Routledge, London.

Creswell, J. W. (2008). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (3rd ed.). Upper Saddle River, NJ: Pearson Education, Inc.

Creswell, J. W. (2014). *Research design: qualitative, quantitative, and mixed methods approaches.* 4th ed. Thousand Oaks, California: SAGE Publications.

D'souza, Q. (2006). Web 2.0 ideas for educators. Retreived 30 September 2017 from http://www.teachinghacks.com/audio/100ideasWeb2educators.pdf.

Ekiz, D. (2009). Bilimsel araştırma yöntemleri[Scientific Research methods]. Ankara: Anı Publishing.

Elmas, R., & Geban, Ö. (2012). Web 2.0 tools for 21st century teachers. *International Online Journal of Educational Sciences, 4*(1), 243-254.

Erdemir, N., Bakırcı, H., & Eyduran, E. (2009). Determining of student teachers' self-confidence using technology in instruction. *Turkish Science Education, 6*(3), 99-108.

Eren, E., Yurtseven Avci, Z., & Seckin-Kapucu, M. (2014). Developing a scale for competencies and perceptions of necessity about using practical tools for content development. *Journal of Theory and Practice in Education. 10*(5), 1177-1189.

Ertmer, P. A. (2005). Teacher pedagogical beliefs: The final frontier in our quest for technology integration? *Educational technology research and development, 53*(4), 25-39.

Field, A. (2005). Reliability analysis. In: Field, A., Ed., Discovering Statistics Using spss. 2nd Edition, Sage, London.

Fraenkel, J. R., & Wallen, N. E. (2006). *How to design and evaluate research in education*. New York: McGraw-Hill.

Göktaş, Y., Yıldırım, S., & Yıldırım, Z. (2009). Main barriers and possible enablers of ICTs integration into pre-service teacher education programs. *Educational Technology & Society, 12*(1), 193–204.

Gömleksiz, M. N. & Fidan, E. K. (2011). Self-efficacy perception levels of prospective teachers' enrolled at pedagogical formation course toward web pedagogical content knowledge. *Turkish Studies - International Periodical For The Languages, Literature and History of Turkish or Turkic, 6*(4), 593-620.

Guzey, S. S., & Roehrig, G. H. (2009). Teaching science with technology: Case studies of science teachers' development of technology, pedagogy, and content knowledge. *Contemporary Issues in Technology and Teacher Education*, *9*(1), 25-45.

Horzum, M. B. (2010). Investigating teachers' Web 2.0 tools awareness, frequency and purposes of usage in terms of different variables. *Journal of Human Sciences, 7*(1), 603-634.

Horzum, M. B. (2011). Adaptation of web pedagogical content knowledge survey to Turkish. *Elementary Education Online, 10*(1), 257-272.

Hung, H., & Yuen, S. (2010). Educational use of social networking technology in higher education. *Teaching in Higher Education, 15*(6), 703-714.

Jang, S.J., & Chen, K.C. (2010). From PCK to TPCK: Developing a transformative model of pre-service science teachers. *Journal of Science Education and Technology*, *19*(6), 553-564.

Kabakçı-Yurdakul. I. (2011). Examining technopedagogical knowledge competencies of pre-service teachers based on ICT usage. *Hacettepe University Journal of Faculty of Education, 40,* 397-408.

Kabakçı-Yurdakul. I., Odabaşı, H. F., Kılıçer, K., Çoklar, A. N., Birinci, G., & Kurt, A. A. (2014). Constructing technopedagogical education based on teacher competencies in terms of national standards. *Elementary Education Online*, *13*(4), 1185-1202.

Kanadlı, S. (2017). Prospective teachers' professional self-efficacy beliefs in terms of their perceived autonomy support and attitudes towards the teaching profession: A mixed methods study. *Educational Sciences: Theory & Practice, 17*, 1847–1871. http://dx.doi.org/10.12738/estp.2017.5.0597.

Karataş, F. İ. (2014). *An examination of in-service secondary mathematics teachers' technological pedagogical content knowledge and their technology integration self-efficacy*. Unpublished PhD Thesis, Boğaziçi University, İstanbul.

Keengwe, J., Onchwari, G., & Wachira, P. (2008). Computer technology integrations and student learning: Barriers and promise. *Journal of Science Education and Technology, 17*(6), 560-565.

Koehler, M., Mishra, P., & Yahya, K. (2007). Tracing the development of teacher knowledge in a design seminar: integrating content, pedagogy and technology. *Computers and Education, 49*(3), 749–762.

Köseoğlu, P., Yılmaz, M., Gerçek, C., & Soran, H. (2007). Effects of computer courses on achievement, attitudes and self-efficacy beliefs regarding computers. *Hacettepe University Journal of Education 33*, 203-209.

Kumar, N., Rose, R. C. & D'Silva, J. L. (2008). Teachers' readiness to use technology in the classroom: an empirical study. *European Journal of Scientific Research, 21*(4), 603–616.

Kutluca, T., & Ekici, G. (2010). Examining teacher candidates' attitudes and self-efficacy perceptions towards the computer assisted education. *Hacettepe University Journal of Education, 38*. 177-188.

Lee, M.H. ve Tsai, C.C. (2010). Exploring teachers' perceived self-efficacy and technological pedagogical content knowledge with respect to educational use of the World Wide Web. *Instructional Science: An International Journal of the Learning Sciences, 38*(1), 1-21.

Lim, C. P., Yan, H., & Xiong, X. (2015) Development of pre-service teachers' information and communication technology (ICT) in education competencies in a mainland Chinese university, *Educational Media International*, *52*(1), 15-32, DOI: 10.1080/09523987.2015.1005425.

Littrell, A., Zagumny, M., & Zagumny, L. (2005). Contextual and psychological predictors of instructional technology use in rural classrooms. *Educational Research Quarterly, 29*(2), 37-47.

Martin, A. J. (2006). The relationship between teachers' perceptions of student motivation and engagement, and teachers' enjoyment of and confidence in teaching. *Asia-Pacific Journal of Teacher Education, 34*, 73–93.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis* (2. Ed). London: Sage.

Ministry of National Education [MEB]. (2017). FATIH web page. Retrieved, 12 September, 2017, from http://fatihprojesi.meb.gov.tr/en/?page_id=10.

Mishra, P., & Koehler, M.J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *The Teachers College Record, 108*(6), 1017–1054.

Nathan, E. J. (2009). *An examination of the relationship between pre-service teachers' level of technology integration self-efficacy (TISE) and technological pedagogical content knowledge (TPACK). Unpublished* PhD Thesis, University of Houston.

Niess, M. L., Van-Zee, E. H., & Gillow-Wiles, H. (2011). Knowledge growth in teaching mathematics/science with spreadsheets: Moving PCK to TPACK through online professional development. *Journal of Digital Learning in Teacher Education*, *27*(2), 42-52.

O'Reilly T. (2007). What is web 2.0: design patterns and business models for the next generation of software. *Communications & Strategies*, *65*(Jan), 17-37.

Ovez, F. T. D., & Akyüz, G. (2013). İlköğretim matematik öğretmeni adaylarının teknolojik pedagojik alan bilgisi yapılarının modellenmesi. *Eğitim ve Bilim*, *38* (170), 321-334.

Pajares, F. (1996). Self-efficacy beliefs in academic settings. *Review of Educational Research, 66*, 543–578.

Plourde, L. A. (2002). The influence of student teaching on pre-service elementary teachers' science self-efficacy and outcome-expectancy beliefs. J*ournal of Instructional Psychology, 29*(4), 245–253.

Pratt, D. (2002). Understanding the role of self-efficacy in teachers' purposes for using the internet with students. Retrieved September 4, 2017, from ERIC databases.

Rosen, D., & Nelson, C. (2008). Web 2.0: A new generation of learners and education. *Computers in the Schools*, *25*(3/4), 211–225.

Sahin, I., Akturk, A., & Schmidt, D. (2009). Relationship of preservice teachers' technological pedagogical content knowledge with their vocational self-efficacy beliefs. In C. D. Maddux (Ed.), *Research Highlights in Technology and Teacher Education*, 293–301.

Şahin, İ., Çelik, İ., Aktürk, A. O. ve Aydın, M. (2013). Analysis of relationship between Technological Pedagogical Content Knowledge and educational Internet Use. *Journal of Digital Learning in Teacher Education, 29*(4), 110-117.

Sarı, A. A., Bilici, S. C., Baran, E., & Özbay, U. (2016). Investigating the relationship between teachers' technological pedagogical content knowledge (TPACK) competencies and attitudes towards information and communication technologies. *Educational Technology Theory and Practice, 6*(1), 1-21.

Schmidt, D. A., Baran, E., Thompson, A. D., Mishra, P., Koehler, M. J., & Shin, T. S. (2009). Technological pedagogical content knowledge (TPACK): The development and validation of an assessment instrument for preservice teachers. *Journal of Research on Technology in Education, 42*(2), 123-149.

Tabachnick, B.G. & Fidell, L.S. (2012). *Using Multivariate Statistics* (6th Ed.). New Jersey: Pearson Education.

Tatlı, Z., İpek Akbulut, H. & Altınışık, D. (2016). The impact of Web 2.0 tools on pre-service teachers' self-confidence levels about TPCK. *Turkish Journal of Computer and Mathematics Education, 7*(3), 659-678. DOI: 10.16949/turkbilmat.277878.

Teo, T. (2009). Examining the relationship between student teachers' self-efficacy beliefs and their intended uses of technology for teaching: A structural equation modeling approach. *The Turkish Online Journal of Technology, 8*(4), 7-16.

Thompson, J. (2007). Is Education 1.0 ready for Web 2.0 students?. *Innovate: Journal of Online Education, 3*(4), No: 5. Retrieved 18 December, 2017 from http://nsuworks.nova.edu/cgi/viewcontent.cgi?article =1095&context=innovate

Tschannen-Moran, M., & Woolfolk-Hoy, A. (2002). *The influence of resources and support on teachers' efficacy beliefs*. Paper presented at the Annual Meeting of the American Educational Research Association, New Orleans, LA.

Uygun, E. (2013). *Learning by design: An integrated approach for technological pedagogical content knowledge development*. Unpublished Master Thesis, ODTU, Ankara.

Vaughan, N. (2010). Student engagement and Web 2.0: What's the connection? *Education Canada, 50*(2), 52-55.

Voogt, J., Fisser, P., Pareja Roblin, N., Tondeur, J., & van Braak, J. (2012). Technological pedagogical content knowledge–a review of the litature. *Journal of Computer Assisted Learning, 29*(2), 109-121.

Wang, L., Ertmer, P. A., & Newby, T. J. (2004). Increasing preservice teachers' self-efficacy beliefs for technology integration. *Journal of Research on Technology in Education, 36*(3), 231-250.

Yıldırım, A. & Şimşek, H. (2011). *Sosyal bilimlerde nitel araştırma yöntemleri* [Qualitative research methods in the social sciences] (8. Ed.). Ankara: Seçkin Publishing.