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Investigation of prospective Math teachers' perceptions about the use of technology in mathematics teaching

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This study aims to examine whether there are significant differences in the perception of prospective Mathematics teachers about the use of technology in teaching mathematics based on their gender and grade level. The study group is consisted of 271 prospective elementary mathematics teachers studying at Balıkesir University and selected by means of a simple random sampling method. Data were gathered using the perception scale developed by Öksüz, Ak and Uça (2009). A qualified descriptive scan model that aims at revealing the existing state in the research as it should be was adopted. Based on grade level, there was a significant difference in the perception of the prospective Mathematics teachers in the use of technology in teaching mathematics. According to the gender variable, it was determined that the technological perceptions of the prospective teachers did not change. There was a significant difference in disadvantage dimension, while there was no difference in terms of gender in the sub-dimensions of necessity and advantage. Significant differences were also observed between the grade levels in terms of the determined headings.

Key words: Mathematics teaching, prospective teacher, teacher training, teaching technologies, technology integration, technology use perception.

INTRODUCTION

Raising the competency of the teaching profession is possible if firstly the general and special field competencies that teachers should have are known and if teaching competencies are acquired with pre-service and in-service training curriculums of prospective teachers and teachers respectively. The dynamic structure of education and training in all its dimensions makes it essential for teachers to be qualified and undergo constant development. For this reason, the Ministry of National Education has continued its studies on teacher qualifications by collaborating with universities (General Competencies for Teaching Profession, 2017).

Teacher competency is defined as "the knowledge, skills and attitudes that teachers have to possess in order to be able to fulfill the teaching profession effectively and efficiently". The scope of this qualification includes: teaching curriculums and subject area, ways to teach the curriculum, relation of the field with other fields, the latest developments in the area, basic concepts, means and structures of the field and having knowledge about the

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integration of the content taught with technology (Ministry of Nation Education-MNE, 2008).

Social, economic and technological developments and new approaches in education are changing the traditional roles and functions of teachers (Teacher Competencies, 2009). The raising of individuals who can use technology in schools depends on the ability of teachers to use technology effectively in teaching activities (Yanpar-Yelken et al., 2013). At this point, Mishra and Koehler (2006) present the framework of Technological Pedagogical Content Knowledge (TPCK) as a theoretical background. The framework of TPCK includes the 3 types of knowledge that teachers and prospective teachers have to possess (technological knowledge, pedagogical knowledge and content knowledge) and the knowledge types (technological pedagogical knowledge, pedagogical content knowledge and technological content knowledge) derived from intersection of these. Koehler et al., 2007) described this definition as "dynamic, interactive relationship between field, pedagogy and technology". Similarly, studies on teaching profession standards are in constant development and conversion. The "teaching qualifications" defined by the behavioral approach of the 1960s presents a conversion towards the perspective of TPCK. Research revealed that teacher qualifications significantly affect students' achievement (Darling-Hammond, 2000; Rockoff, 2003; Goe and Stickler, 2008; Teacher Competencies, 2009).

The National Council of Teachers of Mathematics (NCTM) emphasizes the importance of using digital technologies in mathematics teaching and practice as part of the technology policy. According to technology principle, mathematics learning is deepening with technology, it is contributing to teaching of mathematics subjects effectively and quality of mathematics teaching is increasing (NCTM, 2000). Association of Mathematics Teacher Educators (AMTE) indicates that teacher education curriculum should provide opportunities for teachers to acquire the knowledge and experience necessary to put technology into teaching and learning content of mathematics (AMTE, 2006).

Mathematical competence, basic competence in science/technology and digital competence in Mathematics Course Teaching Program draw attention to perception of developing technology today. In the curriculum, it is also aimed to develop basic skills in problem solving, mathematical process skills (communication, reasoning, mathematical modeling, correlation), affective skills, psychomotor skills and information and communication technologies skills (Mathematics Course Teaching Programs, 2018).

The FATİH (Movement of Enhancing Opportunities and Improving Technology) Project, designed for each student to achieve the best possible education, achieve the highest quality educational content, and ensure equal opportunities in education is the largest and most comprehensive education action in the world on the use of technology in education. The FATİH Project has started to ensure equal opportunities in education and as an information technology tool, it addresses more sensitive organs in learning- teaching processes to improve the technologies in our schools and for effective use in lessons. With this system, classroom management will be used to provide a blackboard- tablet interaction with teacher-student interaction; information acquisition / learning processes will be used more effectively, teachers will be able to share learning materials produced in class and send homework with classroom management, and the learning levels of students can measured and more controlled. With the FATİH Project in Education, the student can access the lecture notes, in-class projects and home works that given by the teacher as independent from the environment in which he / she is, and to share his / her knowledge with the teacher and other friends and also can reinforce the subject that he / she has learned with auxiliary documents (Movement of Enhancing Opportunities and Improving Technology-FATIH Project, 2016).

It is emphasized that the computer-use-skills of prospective teachers are important in terms of effectiveness and productivity of education process (Altun, 2003; Seferoğlu, 2004). Tekinarslan (2008) emphasizes that it is important to have prospective teachers with sufficient knowledge and skills in the field of computer technology and information literacy, including self- developed teachers and those that can direct and train their students when they become teachers. This situation is very important in terms of the institutions that educate teachers (Flowers and Algozzine, 2000; Tekinarslan, 2008). With the widespread use of technology in the education process, the educational curriculums of faculties of education that educate teachers changed and the number and hours of computer and instructional technology lessons increased. However, the vast majority of academicians and researchers agree that technology should be used as a tool rather than an educational goal (Strudler and Wetzel, 1999; Usta and Korkmaz, 2010).

When a teacher chooses a computer software, he/she should pay attention to whether the software is easy to use, especially by children, whether it teaches the information step by step, whether the exercises vary or not, whether it is interactive, and whether the feedbacks are favorable and appropriate (Sığırtmaç et al., 2007). Yilmaz et al. (2015) found that the prospective teachers evaluate their computer skills as moderate and that their perceptions about the use of technology in education were sufficient. It has been determined that the majority of prospective teachers who have high computer skills also have high technological perception averages.

Saygıner (2016) found that there was not significant difference between the scores of the prospective

teachers' perception of technology use in education, depending on the gender variable. In Şendurur et al. (2012) studies, the attitudes and interest of students towards technology are very high and their resistance towards technology is very low. It also emerged that the perception of technology differs in terms of gender variable. In the study of Şad and Nalçacı (2015), there was a significant difference in the perception of competence of information and communication technologies in terms of variables of educated program and having computer, but no significant differences were found in terms of gender and internet use frequency.

In today's education system, it is emphasized that teachers should be able to integrate technology to teaching. This development and spread of technology in daily life has necessitated diversity and innovations in learning and teaching methods. For this reason, in today's education, teachers have to improve themselves well in the use of technological tools in order to obtain the necessary competences needed in their profession. The studies of recent years generally emphasize teacher's technological pedagogical content knowledge. It is expected that today's teachers should be well informed about curriculum, how the curriculum will be taught and relation of the field with other fields, latest developments in the field, basic concepts, means and structures of the field and integration of the content that will be taught with technology.

In addition, the mathematics lesson draft curriculum supports the use of information and communication technologies in mathematics learning and teaching. While students are making sense of the concepts, the students benefit from information and communication technologies as they help them discover relationships between these concepts. It was emphasized that these technologies help students to develop different approaches, reasoning, and make mathematical generalizations when solving problems (Mathematics Course Teaching Programs, 2018).

Studies show that teachers' decisions, experiences, approaches, beliefs and attitudes affect the use of technology in teaching (Andris, 1995; Çağıltay et al., 2001; MacArthur and Malouf, 1991; Marcinkiewicz, 1993; Yaghi, 1996). In this context, determining the perceptions of prospective teachers who will train future generations about integration of technology into curriculum will strengthen bachelor education programs to support technological pedagogical content knowledge. As a matter of fact, it is observed that the updated mathematics bachelor programs are supported with courses such as open and distance learning, media literacy, computer aided mathematics teaching and within the scope of compulsory courses such as information technologies, algorithm and programming as well as within the context of optional courses such as general knowledge, profession knowledge and field education. It is inevitable to investigate how the perceptions of prospective teachers are affected by the increasing importance of teaching technologies. With this aim, the technology use perceptions of prospective mathematics teachers in mathematics teaching are investigated with sub-dimensions of the scale and determined headings to know whether there is a significant difference in terms of grade level and gender.

Research questions

1) How significant is the difference in perceptions of prospective teachers in different genders on use of technology in mathematics teaching?
2) How significant is the difference in perceptions of prospective teachers in different grade levels on use of technology in mathematics teaching?
3) How significant is the difference in perceptions of prospective teachers in different grade levels on general contributions of the use of technology in mathematics teaching?
4) How significant is the difference in perceptions of prospective teachers in different grade levels on contributions to teacher of the use of technology in mathematics teaching?
5) How significant is the difference in perceptions of prospective teachers in different grade levels on contributions to students of the use of technology in mathematics teaching?
6) How is the prospective teachers' perception related to necessity of the technology used in mathematics teaching?
7) How is the prospective teachers' perception related to necessity of the software used in mathematics teaching?
8) How significant is the difference in perceptions of prospective teachers in different grade levels of the use of technology in mathematics education program?
9) How significant is the difference in perceptions of prospective teachers in different actions to be taken for the realization of technology use in mathematics teaching effectively?

METHODOLOGY

The model of the study

In the research, descriptive survey model from quantitative research methods was used. This model is intended to describe the views and characteristics of large masses that allow the collection, description and presentation of numeric values related to past or present conditions or variable (Büyüköztürk, 2006; Karasar, 1995; Wellington, 2006).

Study group

In the study, simple random sampling method was used. In a simple

Table 1. Frequency and percentage values of prospective teachers based on gender.

Gender	f	%
Female	209	77.1
Male	62	22.9
Total	271	100

random sample, every element that form the universe has equal chance of getting into the sample. Therefore, the significance to be given to each element in calculations is the same (Arıkan, 2004).

The study group is formed from 271 (209 female, 62 male) prospective elementary mathematics teachers studying at Faculty of Necatibey Education in Balıkesir University in 2017-2018 academic year. 23.6% of the prospective teachers participating in the study are first grade, 31.4% of them are second grade, 24.7% of them are third grade and 20.3% of them are fourth grade. In this study, 86% of the 314 (242 females and 72 males) students doing the bachelor program were reached. This rate was also reflected as 86% in the participation rates of male and female students.

Data collection and analysis process

In the study, data were gathered using the perception scale related to the use of technology in elementary education mathematics lessons by the prospective teachers developed by Öksüz et al. (2009). The scale consists of totally 73 items that includes 63 positive and 10 negative items and exhibits a three factor structure. The scale involves three factors explaining 49.70% of the total variance. The overall Cronbach-alpha coefficient of the scale was high (α= 0.96) indicating that it was a fairly consistent measure. Cronbach-alpha coefficients for sub-scales were found as 0.95, 0.96 and 0.84. The results of the study indicate that the scale named as a perception scale for technology use in the teaching of elementary mathematics (OSTU) has good psychometric properties and is reliable and valid (Öksüz et al., 2009)

The factors are necessity, advantage and disadvantage. Items from 41 to 55 and from 60 to 73 are related to dimension of *necessity*. Items related to *advantage* dimension are from 1 to 11, from 15 to 23 and from 26 to 39. The items related to the disadvantage dimension are the 12^{th}, 13^{th}, 14^{th}, 24^{th}, 25^{th}, 40^{th} and from 56 to 59. When the factors and total scores are considered, it can be seen that the scale can distinguish the groups with different characteristics. The scale identifies perceptions of technology use in elementary education mathematics teaching. As the result of the negative questions scores was the reverse of it (in terms of total score and each factor), the high score that can be taken from the scale describes positive perception and the low score that can be taken from the scale describes negative perception. In this context, the scale allows the possibility of general survey and situation determination and date comparison.

The scale includes three dimensions. However, it is seen that certain items of the scale are gathered under certain headings. Starting from this, it is thought that examining the scale under these headings will contribute more to the field in terms of reflecting the general situation in depth in revealing the technological perceptions of the prospective teachers. When the data were analyzed, these headings were defined by the researcher. From the headings of the general contributions of using technology in elementary mathematic teaching for first 14 items of the scale, the followings were determined: the use of technology in teaching teachers mathematics for the items from 15 to 25, the contribution of using technology to teach students mathematics for the items from 26 to 40, the necessity of using technologies in mathematics teaching for the items from 41 to 47, the necessity of using software in mathematics teaching for the items from 48 to 54, the evaluation of technology use in mathematics teaching in terms of elementary education mathematics program for the items from 55 to 59, actions to be taken for the realization of technology use in mathematics teaching effectively for the items from 60 to 73. As a result, the technological perception of prospective teachers in mathematics teaching was investigated under these headings. Descriptive and inferential statistical techniques were used when the data related to the perception of the prospective teachers about the use of technology in elementary education mathematics lessons were analyzed. Descriptive statistics includes data identification and presentation, and inferential statistics includes the processes of understanding, decision, or inferring about the characteristics of the distribution of the data (Gay and Airasian, 2000). In the study, data were analyzed using independent samples t-test and one-way variance analysis from inferential statistical techniques in the SPSS 21 statistical program.

FINDINGS AND DISCUSSION

Descriptive statistics

Tables 1 and 2 show the perceptions of prospective teachers about the use of technology in mathematics teaching based on frequency distributions of gender and grade level variables.

According to Table 1, it is seen that 271 of the prospective teachers who participated in the study constitute 77.1%, which means 209 of females and 22.9% which means 62 males.

It is seen that 64 (23.6%) of the 271 of prospective teachers who participated in the study are studying at first grade, 85 (31.4%) of them are studying at second grade, 67 (24.7%) of them are studying at third grade and 55 (20.3%) of them are studying at fourth grade.

Interpretive statistics

How significant is the difference in perceptions of prospective teachers in different genders on use of technology in mathematics teaching?

t-Test was used to analyze if there is a significant

Table 2. Frequency and percentage value of teacher candidates based on grade levels.

Grade levels	f	%
1_{st} grade	64	23.6
2_{nd} grade	85	31.4
3_{rd} grade	67	24.7
4_{th} grade	55	20.3
Total	271	100

Table 3. The results of the t-test on the perceptions of technology use in the mathematics teaching of the prospective teachers according to gender variables.

Gender	N	$\bar{x}$	Sd	df	t	Sig.
Female	209	272.6077	40.07792	269	1.703	0.090*
Male	62	262.5323	43.59076			

*p>.05.

difference in terms of gender in the perceptions of prospective teachers about the use of technology in mathematics teaching for independent samples. The results of the t-test on the prospective teachers' perceptions of technology use in mathematics teaching according to gender variables are presented in Table 3.

There is a difference of 8.49475 points in countenance of female prospective teachers' perception about the use of technology in mathematics teaching. The unrelated samples of whether this difference was significant were examined by t test and there was no significant difference between the technology use perception scores of prospective teachers [t(269) = 1,703, p > .05]. As a result, the perception scores of technology use of prospective teachers did not change significantly according to gender (Büyüköztürk, 2006). Similar results were obtained by Gök and Erdoğan (2010), Saygıner (2016), Şad and Nalçacı (2015) and Tsai et al. (2001) when the technology usage perception of prospective teachers was considered. For instance, Saygıner (2016) found that there was no significant difference between the scores of the prospective teachers' perception about the use of technology in education, depending on the gender variable. Some study results indicate that individual factors such as gender, grade point average, class/ faculty rank, and length of tenure influence orientation toward technology from some aspects (Şendurur et al., 2012; Parker et al., 2008).

While there was no significant difference in the necessity and advantage sub dimensions of the scale in terms of gender, there was a significant difference in countenance of female prospective teachers in disadvantage dimension ([tnecessity (269) = 1.891: p > .05], [tadvantage (269) = .914: p > .05], [tdisadvantage (269) = 2,409: p < .05]). As a result, the perceptions of female and male prospective teachers are similar in terms of the necessity and advantages of using technology in elementary education mathematics teaching. In terms of the disadvantages of the use of technology in elementary education mathematics teaching, the perception scores of female prospective are higher. Higher scores indicate a more positive perception as negative scores were made inversely (strongly disagree: 5,.... strongly agree: 1). At this point, it can be said that the male prospective teachers emphasize more the disadvantages of the use of technology in elementary education mathematics teaching.

How significant is the difference in perceptions of prospective teachers in different grade levels on use of technology in mathematics teaching?

In the mathematics teaching of prospective teachers, one-way ANOVA was used to analyze whether the perceptions of technology use vary according to grade level. The results on the prospective teachers' perceptions of technology use in mathematics teaching according to grade level variables are presented in Table 4.

According to the results of the analysis, there is a significant difference between the technology use perception scores of the prospective teachers. In other words, perceptions of technology use of prospective teachers vary significantly according to grade level. According to the results of the Scheffe test to find out the difference in which groups, the technology use perceptions of the prospective teachers who are studying at second grade ($\bar{x}$ =284,6118), who are studying at third grade ($\bar{x}$=288,1194) and who are studying at fourth grade ($\bar{x}$=292,8182) is detected as more positive than first grade prospective teachers ($\bar{x}$=213,2969). This significant difference observed between the technology perceptions of the prospective teachers who are studying at first grade and the technology perceptions of the second, third and fourth grade prospective teachers is not observed from the second grade. This can be explained with the fact that the prospective teachers are receiving computer-aided education from the second grade and their computer use is gradually increasing in lessons thus, the difference is gradually decreasing. Internet applications and web design as optional courses in the fourth grade, Technology Integration in Mathematics Education and Teaching Technologies and Material Design as a compulsory course in the third grade and besides this, the integration of mathematics education

Table 4. The results of the Anova on the prospective teachers' perceptions of technology use in mathematics teaching according to grade level variables.

Source of variance	Sum of Squares	df	Mean Square	F	p	Sig.
Between Groups	274532.414	3	91510.805	135,494	0.000	4-1, 3-1, 2-1
Within Groups	180328.774	267	675.389			
Total	454861.188	270				

*p<.05.

with technology in second grade is the subject as major area course. In the first grade, there are mainly general culture and mathematics major area courses and also there are computer lessons but it is limited by software and hardware knowledge.

There was a significant difference in grade level in three sub-dimensions as necessity, advantage and disadvantage of the scale ([Fnecessity (3-267)= 199.949: p< 0.05], [Fadvantage (3-267)= 53.122: p< 0.05], [Fdisadvantage (3-267)= 63.477: p< 0.05]). In order to see which grade levels that this difference is from, Scheffe test that allows multiple comparisons was conducted. There was a significant difference between technology perceptions of first grade prospective teachers and technology perceptions of second, third and fourth grade prospective teachers in each dimension. As a result, perceptions of technology use of first grade prospective teachers in mathematics teaching are less than prospective teachers in other grade levels. There was no significant difference between the technological perceptions of the prospective teachers at the second, third and fourth grade levels.

Having a more positive opinion according to the necessity and advantage dimensions of the scale is observed in the second, third and fourth grade students. It is seen that first-grade students with lower scores in terms of disadvantages emphasize more the disadvantages of using technology compared to second, third, and fourth graders. Similarly, Akkaya (2016) identified that while training on technology integration increased middle school mathematics pre-service teachers' perceptions on the requirement and advantages of technology use in mathematics lessons, it did not affect their perceptions in terms of disadvantages of technology use in mathematics teaching.

How significant is the difference in perceptions of prospective teachers in different grade levels on general contributions of the use of technology in mathematics teaching?

This part of the work consists of findings of the data obtained with the responses of the prospective teachers in the first 14 items (11 positive, 3 negative) of the perception scale. When the perceptions of prospective teachers in terms of general contributions to the use of technology in mathematics teaching are examined, it is seen that the views of facilitating teaching, making teaching enjoyable and facilitating access to information resources are in the forefront. These opinions are expressed by 70% and above of the prospective teachers. These findings are supported with the finding that most of the students found technology in educational settings useful and effective as obtained by Guerrero et al., 2004) and Gök and Erdoğan (2010). In the study carried out by Li (2007), it was stated that 87.3% of the students enjoyed using technology and believed that technology is an effective tool in learning and teaching process.

There are negative items in this section, but it is only one item that attracts attention. The rate of those who have positive opinions and those who do not have an opinion that the use of technology may cause problems were determined as 71.2%. As a result, it can be said that prospective teachers have positive perceptions in terms of general contributions of using technology in elementary education mathematics teaching. In order to see whether prospective teachers differ in terms of grade levels with regard to their general contributions to the use technology in mathematics teaching were analyzed with one-way Anova and findings are presented in Table 5.

According to the results of the analysis, there is a significant difference between the perception scores of the prospective teachers in terms of general contributions of technology use [F(3-267)= 341,663: p< 0.05]. In other words, perceptions of prospective teachers in terms of general contributions of technology use significantly vary according to grade levels. According to the results of the Scheffe test to find out the difference in which groups, the technology use perceptions of the prospective teachers who are studying at second grade ($\bar{x}$=53,7294), who are studying at third grade ($\bar{x}$=54,2836) and who are studying at fourth grade ($\bar{X}$=55,4727) is detected as more positive than first grade prospective teachers ($\bar{X}$=26,5469) (Büyüköztürk, 2006). Unlike first-graders,

Table 5. The results of the one way Anova on the perceptions of prospective teachers in terms of general contributions of technology use in mathematics teaching according to grade level variables.

Source of variance	Sum of squares	df	Mean square	F	P	Sig.
Between Groups	37951,283	3	12650.428	341.663	0.000	4-1, 3-1, 2-1
Within Groups	9885,957	267	37.026			
Total	47837,240	270				

*p<0.05.

Table 6. The results of the one way Anova on the perceptions of prospective teachers in terms of contributions of technology use in mathematics teaching to teacher according to grade level variable.

Source of variance	Sum of squares	df	Mean square	F	P	Sig.
Between Groups	442,807	3	147.602	3.685	0.000	4-1
Within Groups	10693.532	267	40.051			
Total	11136.339	270				

*p<0.05.

second-, third- and fourth-grade prospective teachers think that the general contribution of technology is higher.

How significant is the difference in perceptions of prospective teachers in different grade levels on contributions to teacher of the use of technology in mathematics teaching?

This part of the work consists of findings of the data obtained with the responses of the prospective teachers from 15th to 25th items (9 positive, 2 negative) of the perception scale. When the perceptions of prospective teachers in terms of contributions of technology use in mathematics teaching to teachers are examined, it is seen that the views that it allows lessons to be planned and organized more, allows correlation of the subject with real life, increases motivation and creativity are at the forefront. These opinions are expressed by 70% and above of the prospective teachers. There are two negative items, but there was no remarkable item, and almost half of the prospective teachers were positive for the two items. As a result, it can be said that prospective teachers have positive perceptions in terms of contributions of using technology in mathematics teaching to teachers. In order to see whether prospective teachers differ in terms of grade levels with regard to contributions of technology use in mathematics teaching to teacher were analyzed with one- way Anova and findings are presented in Table 6.

According to the results of the analysis, there is a significant difference between the perception scores of the prospective teachers in terms of contributions of technology use to teacher [F(3-267)= 3,685:p< 0.05]. In other words, perceptions of prospective teachers in terms of contributions of technology use to teacher significantly vary according to grade levels. According to the results of the Scheffe test for finding out the difference between the groups, the technology use perceptions of the prospective teachers who are studying at fourth grade ($\overline{X}$=42,1273) are more positive than first grade prospective teachers ($\overline{X}$=38,3125) (Büyüköztürk, 2006). Fourth grade prospective teachers have the opportunity to familiarize teaching profession and observe/ experience of the teaching profession personally with the school experience and teaching practice lessons. In this context, it can be said that the fourth grade prospective teachers think that technology use contributes more to teachers.

How significant is the difference in perceptions of prospective teachers in different grade levels on contributions to students of the use of technology in mathematics teaching?

This part of this work consists of the findings of the data obtained with the responses of the prospective teachers from the 26th to 40th items (14 positive, 1 negative) of the perception scale. When the views of the prospective teachers about the contributions of technology to students are examined, it was seen that they expressed positive opinions at 77% and above about the statements

Table 7. The results of the one way Anova on the perceptions of prospective teachers in terms of contributions of technology use in mathematics teaching to students according to grade level variables.

Source of variance	Sum of squares	df	Mean square	F	p	Sig.
Between Groups	858.042	3	286.014	5.509	0.000	4-1, 3-1
Within Groups	13860.918	267	51.914			
Total	14718.959	270				

*p<0.05.

that facilitate the understanding of the content, offering the opportunity to apply what they learnt, easier correlation of math with daily life, producing alternative solutions, providing like the lesson, increasing motivation and making one to enjoy lessons. Several studies (Ng and Gunstone, 2002; Kim et al., 2003; Nugent et al., 2006; Shyu, 2000) explored the influence of technology and concluded that technology could motivate students to learn mathematics.

While 32 prospective teachers were found to have negative opinions about having difficulty in learning basic concepts, 83 prospective teacher expressed that they are indecisive about this subject. Prospective teachers who are indecisive are predominantly studying in first and second grades. At this point, the fact that the field education lessons are limited at this grade level can be explained by the fact that the prospective teachers' general beliefs about mathematics education are newly formed. Schmidt and Callahan (1992) and Drier (2001a,b) indicated that many teachers feared that using technology would harm students' understanding of basic math concepts, make them overly dependent on technology, and not be effective as an instructional tool.

In order to see whether prospective teachers differ in terms of grade levels with regard to contributions of technology use in mathematics teaching to teacher were analyzed with one- way Anova and findings are presented in Table 7.

According to the results of the analysis, there is a significant difference between the perception scores of the prospective teachers in terms of contributions of technology use to students [F(3-267)= 5,509:p< 0.05]. In other words, perceptions of prospective teachers in terms of contributions of technology use to students significantly vary according to grade levels. According to the results of the Scheffe test to find out the difference in which groups, the technology use perceptions of the prospective teachers who are studying at second grade ($\bar{x}$=57,6418) and who are studying at fourth grade ($\bar{x}$=59,0545) is detected as more positive than first grade prospective teachers ($\bar{x}$=53,9844) (Büyüköztürk, 2006). Third and fourth grade prospective teachers have a more positive view on contributions to student than the first grade.

How is the prospective teachers' perception related to necessity of the technology used in mathematics teaching?

93.7% of elementary education mathematics prospective teachers expressed positive opinion on necessity use of internet, 85.6% of them of computer, 76% of them of video players, 66.1% of them of opaque projector, 57.2% of them of data projector, 50.5% of them of calculator, 38.8% of overhead projector. At this point, it is seen that prospective teachers indicate the necessity of internet and computer usage predominantly in teaching mathematics. This finding is consistent with the findings of previous studies. In the study carried out by Whetstone and Carr-Chellman (2001), it was seen that pre-service teachers considered computers as important tools. The most commonly implemented applications are those accessible on desktop computers, the Internet, and media, including programs such as PowerPoint, Word, Excel and other programs, both software and hardware. In the context of these changes, mobile phones can be used as a useful teaching device, providing teachers and learners with modern and automated techniques for achieving an educational target (Boyle, 2013).

Descriptive findings related to this situation are presented in Table 8. Prospective teachers were evaluated at their own grade level while frequency and percentage values were determined. For example, 38 of the 64 elementary education prospective teachers who participated in the study expressed positive opinions about the necessity of using the computer.

When Table 8 is examined, it is seen that the first grade prospective teachers on necessity of calculator use and prospective teachers at other grade levels on necessity of overhead projector use expressed lowest opinions. In addition, as the grade level increases, it is observed that it increases the percentage of opinions about the necessity of computer and internet use in teaching mathematics and decreases other technologies. It is noteworthy that from the second grade, the perceptions of prospective teachers about the necessity of computer and internet use in teaching mathematics were high and consistency.

It can be said that 93.7% which means the majority of

Table 8. Descriptive findings related to necessity of technologies in elementary education mathematics teaching.

Grade level	Computer		Calculator		Video players		Opaque projector		Data projector		Overhead projector		Internet	
	f	%	f	%	f	%	f	%	f	%	f	%	F	%
1st grade	38	59.3	36	56.3	54	84.4	59	92.2	42	65.6	39	61	55	85.9
2nd grade	79	93	51	64	63	74.1	54	63.6	47	55.3	27	31.8	81	95.3
3rd grade	63	94	24	35.9	50	74.6	32	47.7	33	49.2	21	31.4	64	95.5
4th grade	52	94.5	26	47.2	39	70.9	34	61.9	33	60	18	32.8	54	98.2
Total	232	85.6	137	50.5	196	76	179	66.1	155	57.2	105	38.8	254	93.7

Table 9. Descriptive findings related to necessity of software in elementary education Mathematics teaching.

Grade level	Spreadsheet		Data presentation		Drawing /Coloring		Application software		Education software		Animations		Modellings	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%
1st grade	59	92.2	59	92.2	59	92.2	59	92.2	51	79.7	41	64.2	**42**	**65.6**
2nd grade	65	76.5	75	88.2	67	78.9	75	88.3	78	91.7	79	92.9	80	94.1
3rd grade	53	89.1	52	77.6	38	56.7	61	91.1	65	97	63	94.1	62	92.5
4th grade	47	85.5	43	78.2	39	71	52	94.6	52	94.5	53	96.4	53	96.4
Total	224	82.6	229	84.5	203	74.9	**247**	**91.1**	**246**	**90.7**	236	87.1	237	87.5

prospective teachers emphasize the necessity of internet use and that internet use is an important factor in teaching mathematics. Approximately half of the prospective teachers have a positive perception in the use of calculator. This may be presented as a reason why calculator needs to be used at a simple level and in certain courses (for example statistics and probability, physics lessons). However, the rate of calculator use in first grade prospective teachers is lower than other technologies. This can be explained by the limited or no use of calculator in the lessons in the curriculum for the first graders. It can be said that first graders are familiar with the use of other technologies except calculator for education lessons and research assignments given by professors. At this point, it is possible to reach the conclusion that applications should be given more place in education in order to use calculator effectively.

How is the prospective teachers' perception related to necessity of the software used in the elementary education mathematics teaching?

82.6% of prospective teachers expressed positive opinions on usage of spreadsheet, 84.5% of them on data presentation, 74.9% of them on drawing and coloring, 91.1% of them on application software (cabrietc.) special to mathematics field, 90.7% of them on various education software (vitamin, skoool etc) about mathematics field, 87.1% of them on animations and 87.5% of them on modeling necessary in mathematics teaching. Findings related to these are given in Table 9.

When the data in Table 9 are examined, it is seen that 74% and above of the prospective teachers need to use all software in mathematics teaching. However, these ratios have increased in application and educational software. This may be presented as a reason to use this kind of software effectively in education lessons. For drawing and coloring, which has the lowest rate, as the grade level increases, it could be that these applications are less included or needed in the lessons for third and fourth grades. Contrary to other grade levels, drawing and coloring requirements are higher in first grade. It can be said that in this result, Analysis and Geometry lessons are mainly determined as effective in the first class program. Lack of field education lessons and practices that will allow them to have knowledge of how to use animations and modeling in mathematics teaching at first grade may have reduced the need for these. Spreadsheet and drawing / coloring requirements for second grade prospective teachers have low rates. It can be said that they see how to use other software in education with practices with the newly taken field education lessons were reinforced the views of second grade prospective teachers on necessity of these. As an example of drawing / coloring technology, Herdem et al. (2014) explored the concept cartoons and technology use perceptions and found out that the positive aspects of the

Table 10. The results of the one way Anova on the perceptions of prospective teachers in terms of technology use in the elementary education mathematics curriculum according to grade level variable.

Source of variance	Sum of Squares	df	Mean Square	F	p	Sig.
Between Groups	1246.081	3	415.360	32.943	0.000	4-1, 3-1, 2-1
Within Groups	3366.458	267	12.608			
Total	4612.539	270				

*p<0.05.

technology were emphasized by the students. Li (2007) stated that students' view about specific software in mathematics and science learning was another topic of exploration and Akkaya (2016) stated that teachers are also expected in the mathematics teaching program to effectively and relevantly use information and communication technologies (dynamic geometry software, virtual learning objects, graphing calculators, smart board etc). Previous studies indicate that although mathematics teachers and pre-service teachers have positive perceptions about technology, they can partially use technology during class (Bauer and Kenton, 2005; Bozkurt and Cilavadroğlu, 2011; Demiraslan and Usluel, 2005; cited by Akkaya, 2016).

How significant is the difference in perceptions of prospective teachers in different grade levels of the use of technology in mathematics education program?

This consists of the findings of the data obtained with the responses of the prospective teachers from the 55th to 59th items (1 positive, 4 negative) of the perception scale. Prospective teachers' perceptions about the program support the use of technology positively. When the responses given to the negative items are examined, it is seen that 70% of the prospective teachers expressed that when the program is conducted time could be a limiting factor. This finding obtained in the study are in parallel with the findings that most of the teachers considered technology as extra work load for both teachers and students; and its educational value was low in terms of the spent time and effort (Gök and Erdoğan, 2010).

To know whether technology use in teaching mathematics changed according to the grade level in terms of elementary education mathematics curriculum, the collected data were analyzed with one- way Anova and findings are presented in Table 10.

According to the results of the analysis, there is a significant difference between the perception scores of prospective teachers in terms of technology use in elementary education mathematics curriculum [F(3-267)= 393,337:p< .05]. In other words, the perceptions of prospective teachers about things to be done for effective use of technology significantly vary according to grade level. According to the results of the Scheffe test for finding out the difference between the groups, the technology use perceptions of the prospective teachers who are studying at second grade ($\bar{X}$=17,2353), third grade ($\bar{X}$=18,5672) and fourth grade ($\bar{X}$=17,6182) are more positive than first grade prospective teachers ($\bar{X}$=12,8594) (Büyüköztürk, 2006).

How significant is the difference in perceptions of prospective teachers in different actions to be taken for the realization of technology use in mathematics teaching effectively?

This consists of the findings of the data obtained with the responses of the prospective teachers from 60th to 73th items of the perception scale. When the opinions of the prospective teachers about the perceptions on the things to do for the effective use of technology in elementary mathematics education are examined, it is seen that the perceptions are in the positive direction, but two items are noticeable: the development of technology competencies of teachers / prospective teachers and the provision of adequate support to the teachers of technology by schools. As a result, it is seen that the prospective teachers clearly reveal the things to be done to effectively use technology in mathematics teaching as increasing of in-service training and providing school technological equipment. To know whether the perceptions of prospective teachers about the things to be done for effective use of technology in mathematics teaching differ according to grade levels, the data collected were analyzed with one way Anova and findings are presented in Table 11.

According to the results of the analysis, there is significant difference between the perception scores of prospective teachers about things to be done for technology to be used effectively [F(3-267)= 393,337: p< .05]. In other words, the perceptions of prospective teachers about things to be done for technology to bed used effectively significantly vary according to grade level. According to the results of the Scheffe test for

Table 11. The results of the one way Anova on the perceptions of prospective teachers related to things to be done for the realization of effective technology use in mathematics teaching according to grade level variable.

Source of variance	Sum of squares	df	Mean square	F	p	Sig.
Between Groups	57695.464	3	19231.821	393.337	0.000	4-1, 3-1, 2-1
Within Groups	13054.713	267	48.894			
Total	70750.177	270				

*p<0.05.

finding out the difference between the groups, the technology use perceptions of the prospective teachers who are studying at second grade ($\bar{X}$=61,0941), third grade (=62,7015) and fourth grade ($\bar{X}$=62,3455) are more positive than first grade prospective teachers ($\bar{X}$ =27,6250) (Büyüköztürk, 2006).

RESULTS AND SUGGESTIONS

Researchers (Demetriadis et al., 2002; Pelgrum, 2001) also identified teachers' perceived obstacles. The most commonly cited obstacles to the integration of technology in education were: (1) material conditions (including an insufficient number of computers and technology expertise among teachers); (2) difficulty integrating technology into the regular curriculum and instruction; and (3) lack of supervisory and technical staff. In order to prepare students for the future and help them learn how to think, learn, and gain different perspectives, technology has to be integrated into the classroom (Eyyam and Yaratan, 2014; Sezginsoy-Şeker, 2018). Technology is constantly changing; the need for school systems to create effective technology integration into the classroom requires that teachers be adequately trained (Brooks-Young, 2007; ChanLin, 2005; Gordon, 2011; Pepe, 2016). In this respect, it has become crucial to equip prospective teachers with combined knowledge on technology, content knowledge and pedagogical knowledge (Akkaya, 2016; Mishra and Koehler, 2006; Niess and Garofalo, 2006; Öksüz et al., 2009; Öksüz and Ak, 2009). There was a need for this study because it informs educators regarding technology use perceptions of prospective teachers in mathematics teaching programs. A clearer understanding of how prospective teachers perceived technology integration mathematics teaching may improve prospective teachers' participation in technology integrated mathematics lessons.

In the study, data were gathered using the perception scale including the necessity, advantage and disadvantage related to the use of technology in elementary mathematics lessons by the teachers / prospective teachers developed by Öksüz et al. (2009). The data have also been analyzed under these determined headings, in the light of these sub-dimensions as well as the idea that they will allow a detailed examination of the technological perceptions of the prospective teachers.

The results obtained from this study are:

1. The general contributions of technology use in mathematics teaching, its contributions to teacher and students; the necessity of using technologies; the necessity of using software; the evaluation of technology use in terms of elementary school mathematics curriculum and the necessary steps that must be taken to ensure that technology is effectively used.
2. The technology use perception of prospective teachers who are studying at different grade levels showed a significant difference in elementary education mathematics lessons. This situation is also similar with the necessity, advantage and disadvantage sub-dimensions of the scale.
3. The technology use perceptions of the second, third and fourth grade prospective teachers are more positive in terms of necessity and advantage sub-dimensions than the first grade prospective teachers. Contrary to this, the first grade prospective teachers emphasize more on the disadvantages of technology use.
4. According to the gender variable, it was determined that the technological perceptions of the prospective teachers did not change. However, there was a significant difference in disadvantage dimension while there was no difference in terms of gender in sub-dimensions of necessity and advantage. In this context, it was achieved that male prospective teachers emphasize more on the disadvantages of technology use.
5. When the contributions of technology use to students in mathematics teaching are examined, it was determined that second, third and fourth grade prospective teachers have more positive perceptions of technology use than the first grade prospective teachers.
6. When the contributions of technology use in mathematics teaching to teacher was examined, significant difference came from the first and fourth grade prospective teachers. As a result, it is seen that fourth grade prospective teachers think that using technology in mathematics teaching contributes more to teacher.

7. When the contributions of technology use to students in mathematics teaching are examined, it was determined that third and fourth grade prospective teachers have more positive perceptions of technology use than the first grade prospective teachers.
8. When technologies use in mathematics teaching are examined, almost all of the prospective teachers indicate the necessity of internet use. The first grade prospective teachers expressed opinions on necessity of calculator use and prospective teachers in other grade levels expressed opinions on necessity of overhead projector use.
9. It has been determined that 74% of the prospective teachers need all the software in mathematics teaching. Prospective teachers prefer to use more applications and educational software, animations and modeling in mathematics teaching.
10. In terms of things to be done to use technology for both mathematics curriculum and being more effective, second, third and fourth grade prospective teachers are more positive than first grade prospective teachers. Prospective teachers emphasized that the program is suitable for technology use, time factor can be a negative effect and that the use of technology can be more effective by increasing the in-service training and providing the school with technology equipment.

The mathematics curriculum, which has been updated in recent years, highlights the development of individuals with digital competence who can effectively use technology and mathematics in their daily lives. At this point, it is emphasized that instructional technologies play a complementary role, not an option for teaching mathematics (Mathematics Course Teaching Programs, 2018). Taking into account the effective use of technology in teaching mathematics, the followings are considered: 1) Technology-supported material and resources to be used by teachers, prospective teachers and students are prepared in Turkish and pursue updated mathematics curriculum; 2) prospective teachers have sufficient level of technological pedagogical content knowledge in their first degree; 3) in the context of teaching practice lesson, they gain experience by forming environments that will enable them to develop this knowledge by designing education with the help of mutual studies, practical teachers and lecturer; 4) providing technological equipment to schools; 5) the ability to use powerful computer software and digital materials in the teaching of subjects that students have difficulty in such as algebra, geometry, statistics and probability; 6) dissemination of e-content within the scope of EIN.

While changes and reform are needed in schools to effectively implement technology integration into the classroom, there must be sufficient pre service/ in service training available for educators, teachers and also prospective teachers. Integrating technology into the classroom can be achieved by developing projects that help teachers meet curriculum standards, cover content, and implement school policies. To be successful, projects that use technology should have clear, targeted teaching and learning outcomes that are consistent with the technology in use (Debele and Plevyak, 2012); that is, the use of the technology aligns with, or is compatible with instructional practice. Examples of integrating technology into the curricula include prospective teachers using software and devices in mathematics teaching. Ritzhaupt et al. (2012) stated that the number of years teaching and school level of professional development both had direct, significant effects on technology use or integration at the classroom level and student use of technology. As the grade level increases, the idea of computer and internet use in mathematics teaching should be more included. With this, it can be said that the study revealed the general situation in terms of each grade level of technology use perception of prospective teachers in mathematics teaching. In the scope of teaching practical lesson, as a continuation of this study, lesson plans based on instructional technologies can be developed, practical examples can be presented, and prospective teachers' technology perceptions in mathematics teaching can be investigated through in-depth interviews and observations. In addition to this study, teacher's perceptions of technology use in schools and teachers' perceptions of factors influencing technology integration in mathematics teaching could be other research topics.

CONFLICT OF INTERESTS

The author has not declared any conflict of interests.

REFERENCES

Akkaya R (2016). Research on the development of middle school mathematics pre-service teachers' perceptions regarding the use of technology in teaching mathematics. Eurasia Journal of Mathematics, Science and Technology Education 12(4):861-879.

Altun A (2003). Ögretmen adaylarının bilissel stilleri ile bilgisayara yönelik tutumlari arasindaki iliskinin incelenmesi. TOJET: The Turkish Online Journal of Educational Technology 2(1).

Andris ME (1995). An examination of computing styles among teachers in elementary schools. Educational Technology Research and Development 43(2):15-31.

Arıkan R (2004). Araştırma teknikleri ve rapor hazırlama. Ankara: Asil Yayın.

Association of Mathematics Teacher Educators (AMTE) (2006). Preparing teachers to use technology to enhance the learning of mathematics: A position of the Association of Mathematics Teacher Educators. Online: https://amte.net/sites/default/files/amtetechnologypositionstatement.pdf (25.06.2018).

Boyle R (2013). Media convergence: Networked digital media in everyday life. Media, Culture and Society 35(5):666.

Brooks-Young S (2007). Digital-age literacy for teachers: applying

technology standards to everyday practice. Online: http://www.iste.org/docs/excerpts/DALITT-excerpt.pdf (25.06.2018)
Büyüköztürk Ş (2006). Sosyal bilimler için veri analizi el kitabı. Ankara: Pegem Yayıncılık.
ChanLin LJ (2005). Development of a questionnaire for determining the factors in technology integration among teachers. Journal of Instructional Psychology 32(4):287-292.
Çağıltay K, Çakıroğlu J, Çağıltay N, Çakıroğlu E (2001). Öğretimde bilgisayar kullanımına ilişkin öğretmen görüşleri. Hacettepe Üniversitesi Eğitim Fakültesi Dergisi 21:19-28.
Darling-Hammond L (2000). Teacher quality and student achievement: a review of state policy evidence. Education Policy Analysis Archives 8(1).
Debele M, Plevyak L (2012). Conditions for successful use of technology in social studies classrooms. Computers in the Schools 29(3):285-299.
Demetriadis S, Barbas A, Molohides A, Palaigeorgiou G, Psillos D, Vlahava I, Tsoukalas I, Pombortsis A (2002). Cultures of negotiation: Teacher's acceptance/resistance attitudes considering the infusion of technology into schools. Computers and Education 41:19-37.
Drier HS (2001a). Teaching and learning mathematics with interactive spreadsheets. School science and mathematics 101(4):170-179.
Drier HS (2001b). Beliefs, experiences, and reflections that affect the development of techno-mathematical knowledge. In G. Marks, Annual meeting of the Society of Information Technology and Teacher Education. Charlottesville, VA: AACE. pp. 1103-1106.
Eyyam R, Yaratan HS (2014). Impact of use of technology in mathematics lessons on student achievement and attitudes. Social Behavior and Personality: An International Journal 42(1):31S-42S.
Flowers CP, Algozzine RF (2000). Development and validation of scores on the basic technology competencies for educators inventory. Educational and Psychological Measurement 60(3):411-418.
Gay LR, Airasian P (2000). Educational research: Competencies for analysis and experience.
General Competencies for Teaching Profession (2017). Online: http://oygm.meb.gov.tr/meb_iys_dosyalar/2018_06/29111119_TeachersGeneralCompetencies.pdf (25.06.2018)
Goe L, Stickler LM (2008). Teacher quality and student achievement: making the most of recent research. Washington, D.C.: National Comprehensive Center for Teacher Quality.
Gordon D (2011). Big-city rules: When large urban school districts undertake technology implementation. T.H.E. Journal 38(8):26-28. Retrieved from http://www.questia.com/PM.qst?a=o&d=5051991672 (25.06.2018)
Gök B, Erdogan T (2010). Investigation of pre-service teachers' perceptions about concept of technology through metaphor analysis. TOJET: The Turkish Online Journal of Educational Technology 9(2).
Guerrero S, Walker N, Dugdale S (2004). Technology in support of middle grade mathematics: what have we learned? Journal of Computers in Mathematics and Science Teaching 23:5-20.
Herdem K, Aygün H, Çinici A (2014). Sekizinci sınıf öğrencilerinin teknoloji algılarının çizdikleri karikatürler yoluyla incelenmesi. Amasya Üniversitesi Eğitim Fakültesi Dergisi 3(2):232-258.
Karasar N (1995). Bilimsel araştırma yöntemi: kavramlar, ilkeler, teknikler (6. Baskı).Ankara: 3A Araştırma Eğitim Danışmanlık
Kim Y, Grabowski B, Song H (2003). Science teachers' perspectives of web-enhanced problem-based learning environment: A qualitative inquiry. Annual Meeting of the American Educational Research Association, Chicago, IL.
Koehler MJ, 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):740-762.
Li Q (2007). Student and teacher views about technology: a tale of two cities? Journal of Research on Technology in Educatıon 39(4):377-397.
MacArthur CA, Malouf DB (1991). Teachers' beliefs, plans and decisions about computer-based instruction. The Journal of Special Education 25(5):44-72.
Marcinkiewicz HR (1993). Computers and teachers: Factors influencing computer use in the classroom. Journal of Research on Computing in Education 26(2):220-237.
Mathematics Course Teaching Programs (2018). Online: http://mufredat.meb.gov.tr/ProgramDetay.aspx?PID=329 (25.06.2018)
Ministry of Nation Education (MNE) (2008). Öğretmen yeterlikleri: Öğretmenlik mesleği genel ve özel alan yeterlikleri. Ankara: Devlet Kitapları Müdürlüğü.
Mishra P, Koehler MJ (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. Teachers college record 108(6):1017.
Movement of Enhancing Opportunities and Improving Technology (FATIH) (2016). Online: http://fatihprojesi.meb.gov.tr/en/?page_id=10 (25.06.2018).
National Council of Teachers of Mathematics (NCTM). (2000). Principles and Standards for School Mathematics. Reston Virginia: NCTM.
Ng W, Gunstone R (2002). Students' perceptions of the effectiveness of the World Wide Web as a research and teaching tool in science learning. Research in Science Education 32:489-510.
Niess M, Garofalo J (2006). Preparing teachers to teach mathematics with technology: Key issues, concerns and research questions. Proceedings of the Society for Information Technology and Teacher Education International Conference (pp. 3796-3801). Chesapeake, VA: Association for the Advancement of Computing in Education (AACE).
Nugent G, Soh L, Samal A (2006). Design, development, and validation of learning objects. Journal of Educational Technology Systems 34(3):271-281.
Öksüz C, Ak Ş, Uça S (2009). İlköğretim matematik öğretiminde teknoloji kullanımına ilişkin algı ölçeği. Yüzüncü Yıl Üniversitesi Eğitim Fakültesi Dergisi 6(1).
Öksüz C, Ak Ş (2009). Preservice teachers' perceptions for technology use in the teaching of mathematics in elementary schools. Yüzüncü Yil University Journal of Education 6(2):1-19.
Parker RE, Bianchi A, Cheah TY (2008). Perceptions of instructional technology: factors of influence and anticipated consequences. Educational Technology & Society 11(2):274-293.
Pelgrum W (2001). Obstacles to the integration of ICT in education: Results from a worldwide educational assessment. Computers and Education 37:163-178.
Pepe TM (2016). Teacher Perceptions and Attitudes of Classroom Technology Integration Related to iPad Training (Doctoral dissertation, Walden University).
Ritzhaupt AD, Dawson K, Cavanaugh C (2012). An investigation of factors influencing student use of technology in K-12 classrooms using path analysis. Journal of Educational Computing Research 46(3):229-254.
Rockoff JE (2003). The evidence of individual teachers on student achievement: evidence from panel data. Report published by the Kennedy School of Government, Harvard University, ED, 475274.
Saygıner Ş (2016). Öğretmen adaylarının bilgisayar yeterlilik düzeyleri ile teknolojiye yönelik algıları arasındaki ilişkinin çeşitli değişkenler açısından incelenmesi. Mustafa Kemal Üniversitesi Sosyal Bilimler Enstitüsü Dergisi 13(34).
Schmidt M, Callahan L (1992). Teachers' and principals' beliefs about calculators in elementary mathematics. Focus on Learning Mathematics in School 14:17-29.
Seferoğlu SS (2004). Öğretmen yeterlilikleri ve mesleki gelişim. Bilim ve Aklın Aydınlığında Eğitim 58:40-45.
Sezginsoy-Şeker B (2018). Sosyal bilgiler öğretiminde öğretim araç-gereç ve materyalleri. Sosyal Bilgiler Öğretimi (1.baskı). Istanbul: Lisans Yayıncılık.
Shyu HY (2000). Using video-based anchored instruction to enhance learning: Taiwan's experience. British Journal of Educational Technology 31(1):57-69.
Sığırtmaç AD, Yılmaz E, Solak N (2007). General situation of computer enhanced education in pre-school education institutions. In The future of pre-school education in European Union membership

process symposium (Vol. 2). Cyprus: YA-PA Publishing.
Strudler NB, Wetzel K (1999). Lessons from exemplary colleges of education: factors affecting technology integration in preservice programs. Educational Technology Research and Development 47(4):63-81.
Şad SN, Nalçacı Öİ (2015). Öğretmen adaylarının eğitimde bilgi ve iletişim teknolojilerini kullanmaya ilişkin yeterlilik algıları. Mersin Üniversitesi Eğitim Fakültesi Dergisi 11(1).
Şendurur P, Şendurur E, Mutlu N, Başer V (2012). Perceptıons of students about technology integratıon. eJournal of New World Sciences Academy 7(2):591-598.
Teacher Competencies [Öğretmen Yeterlikleri] (2009). Türk Eğitim Derneği. Ankara. Online: http://portal.ted.org.tr/yayinlar/Ogretmen_Yeterlik_Kitap.pdf (25.06.2018)
Tekinarslan E (2008). Eğitimciler için temel teknoloji yeterlikleri ölçeğinin geçerlik ve güvenirlik çalışması. Elektronik Sosyal Bilimler Dergisi 26(26).
Tsai CC, Lin SSJ, Tsai MJ (2001). Developing an internet attitude scale for high school students. Computers and Education 37(1):41-51.
Usta E, Korkmaz Ö (2010). Öğretmen adaylarının bilgisayar yeterlikleri ve teknoloji kullanımına ilişkin algıları ile öğretmenlik mesleğine yönelik tutumları. Uluslararası İnsan Bilimleri Dergisi 7(1):1335-1349.
Wellington J (2006). Educational research: contemporary issues and practical approaches. London: Continuum.
Whetstone L, Carr-Chellman AA (2001). Preparing preservice teachers to use technology: survey results. TechTrends 46(4):11-17.
Yanpar-Yelken T, Özgelen S, İncikabı L, Sancar-Tokmak H (2013). Fen ve matematik eğitiminde teknolojik pedagojik alan bilgisi temelli öğretim tasarımları (1.baskı). Ankara: Anı Yayıncılık.
Yılmaz M, Üredi L, Akbaşlı S (2015). Sınıf öğretmeni adaylarının bilgisayar yeterlilik düzeylerinin ve eğitimde teknoloji kullanımına yönelik algılarının belirlenmesi. Uluslararası Beşeri Bilimler ve Eğitim Dergisi 1(1):105-121.
Yaghi H (1996). The role of the computer in the school as perceived by computer using teachers and school administrators. Journal of Educational Computer Research 15(2):137-155.