Prospective Teachers' STEM Awareness and Information Communication Technologies Usage Levels*

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ABSTRACT

This study aims to investigate the relationship between prospective teachers' STEM awareness and information communication technology usage levels. Additionally, according to some demographic characteristics of prospective teachers, it has been determined whether there are differences between STEM awareness levels and information communication technology (ICT) usage levels. The research was carried out with prospective teachers studying at education faculty of a state university in the northwest of Turkey in four programs (science, mathematics, computer education and instructional technologies, classroom teaching). In order to measure the STEM awareness levels of prospective teachers, "STEM Awareness Scale", which was developed by Buyruk and Korkmaz (2016a). In order to determine the information and communication technology usage levels of the prospective teachers, "Information and Communication Technology Usage Levels Scale'', which was developed by Kutluca, Arslan and Özpınar (2010) were used. According to the results obtained in the study, it has been determined that the STEM awareness levels of prospective teachers were positive, the ICT usage levels were moderate, and there was a positive, weak and significant relationship between their STEM awareness levels and ICT usage levels. In addition, the STEM awareness levels and ICT usage levels of the prospective teachers differ in terms of gender, year of study and department.

Keywords: *STEM, Information and Communication Technologies, Prospective Teachers.*

INTRODUCTION

Scientific and technological developments occurring in the world have affected people's lives remarkably. Today being called as information age, science, technology, mathematics and engineering knowledge and skills must be integrated with each other in order to understand and interpret the developments in the world, to communicate using the technologies introduced to make scientific evaluations and to develop innovations. The National Research Council [NRC], (2011) of United States of America (USA) states that technology production, which is the main pillar of the 21st century economy, is provided by the fields of science, mathematics, engineering and technology. It is therefore vital for education systems to raise individuals with the knowledge and skills needed. The use of these integrated

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technologies has been named in the education literature as STEM Education by abbreviating the words Science, Technology, Engineering and Mathematics. Çorlu, Capraro and Capraro (2014) define STEM education as the structuring of knowledge, skills and thoughts by students and teachers in cooperation with more than one STEM fields. Vasquez, Sneider, and Comer (2013) define STEM education as an interdisciplinary learning and teaching approach that lifts traditional barriers between science, technology, engineering and mathematics disciplines.

The general aim of STEM education is to integrate science, technology, engineering and mathematics fields into all educational levels from kindergarten to university with in-class and extracurricular activities and to direct students to these fields (Gonzales and Kuenzi, 2012). Breiner, Harkness, Johnson and Koehler (2012) defined the purpose of STEM education as training individuals as real life engineers or scientists by integrating STEM fields with each other. According to Williams (2011), the aim of STEM education is to provide individuals with twenty-first century skills, thereby enabling individuals to contribute to their country's economy. It can also be said that the aim of STEM education is to prepare students to solve complex problems. To provide this profiency is increasings students' STEM literacy (Fan & Ritz, 2013).

STEM literate individuals are more successful in finding alternative solutions to the problems they face and they can also create a technological product by using science, engineering and mathematics (Özdemir, 2010; Yıldırım, 2016). In order to achieve STEM literacy, STEM awareness can be increased by providing students with opportunities such as dealing with problems, developing creative thinking skills, using technology in a functional way and producing solutions. One of the main ways to achieve this is to enable students to be trained as individuals who have the ability to use information and communication technologies as technology and education are being more and more integrated with each other day by day. Because teachers and students should acquire information and communication technology skills. From this point, technology can be defined as the application of observational and proven information in reaching certain goals and solving certain problems. White (2014), on the other hand, defines technology as the branch of knowledge that deals with the development and use of technical tools and the relationship of these tools with society. New ways of transferring information have come out with the proliferation of technology-oriented tools. It can be said that the reflection of new technologies on education affects especially students and teachers. Therefore, teachers and prospective teachers should acquire knowledge and skills related to technology (Akpınar, 2003). Information and communication technologies are formed by the combination of information processing, audiovisual tools and technologies for communication. The term information and communication technologies (ICT) refers to technology forms used to transmit, store, create or share information. This broad definition of information and communication technologies includes radio, television, video, DVD, telephone (both fixed line and mobile phones), satellite systems, computer and network hardware and software as well as equipment and services such as video conferencing and e-mail (UNESCO, 2006). Olakulehin (2007) defined information and communication technologies as technologies used in the process of collecting, storing, organizing and transferring information in different ways.

The competencies related to information and communication technologies were also included in the General Competencies for Teaching Profession published in 2006 by the Ministry of National Education. Skills in this field were defined as knowing the legal and moral responsibilities and helping the students adopt these, becoming technology literate, providing professional development, accessing resources related to learning and teaching, preparing appropriate learning environments and materials, developing strategies suitable for different needs of students as well as benefiting from communication technologies to share information (MEB, 2006).

It can be said that there is a direct relationship between STEM and information and communication technologies. That's why STEM brings in mathematical competence, digital competence and basic competencies in science and technology (MEB, 2018). However, the acquisition of these competencies depends on teachers and students' awareness of STEM and their ability to use information and communication technologies. From this point of view, prospective teachers' knowledge and experience

related to STEM education and having sufficient skills or usage levels regarding information and communication technologies can enable them to create more qualified learning environments by using STEM activities with the help of information and communication technologies in their own lessons when they start their teaching career.

From this point forth, this study has aimed to investigate the relationship between STEM awareness and information and communication technologies usage levels of prospective teachers. In addition, according to some demographic characteristics of the prospective teachers, it has been determined whether there are differences between their STEM awareness and their information and communication technologies usage levels.

RESEARCH METHOD

Research Model

This study has been designed with descriptive scanning method, which is one of the quantitative research methods. The universe of the research consists of the prospective teachers studying at a state university in the northwest of Turkey in 2017-2018 academic year. The sample includes the freshmen and senior students of Science Teaching (ST), Elementary Mathematics Teaching (EMT), Computer Education and Instructional Technologies (CEIT) and Classroom Teaching (CT) departments. It consists of a total of 424 prospective teachers who have been selected through convenience sampling method. Table 1 shows the demographic characteristics of the sample.

Table 1. The distribution of the sample by gender, year and department

		f	%
Gender	Female	313	73,8
	Male	111	26,2
	Total	424	100,0
Year	1st grade	197	46,5
	4th grade	227	53,5
	Total	424	100,0
Department	ST	101	23,8
	EMT	105	24,8
	CEIT	101	23,8
	CT	117	27,6
	Total	424	100,0

According to Table 1, 73,8% of the prospective teachers participated in the research are female and 26.2% are male. 46.5% of 424 prospective teachers are freshmen and 53.5% are seniors; 23.8% are studying in ST, 24.8% in EMT, 23.8% in CEIT and 27.6% in CT.

Data Collection Tool

“STEM Awareness Scale” developed by Buyruk and Korkmaz (2016a) and “Information and Communication Technology Usage Levels Scale” developed by Kutluca, Arslan and Özpınar (2010) were used in the research. There are a total of 17 questions with five-point likert scale responses on the STEM Awareness Scale. The scale consists of two factors that are called “Positive View” and “Negative View”. Validity and reliability tests of the scale were performed by Buyruk and Korkmaz (2016a), and Cronbach's Alpha reliability coefficient was determined as 93 for the “Positive view” factor and 81 for the “Negative view” factor and 93 for the entire scale.

There are 30 questions with four-point Likert type responses in the Information and Communication Technology Usage Levels Scale. The scale consists of four factors named "Esteem", "Anxiety", "Confidence" and "Attitude". Validity and reliability tests of the scale were performed by Kutluca, Arslan and Özpınar (2010) and Cronbach's Alpha reliability coefficient was determined as 84; for the “Esteem” factor, 75; for

the “Anxiety” factor, 76; for the “Confidence” factor, 81; for “Attitude” and 91 for the entire scale.

Data Analysis

At the stage of data analysis, the normality of the data was examined first. It was determined that the data did not show a normal distribution and Mann-Whitney U test was used since gender and year level variables had two categories in the analyses conducted according to these variables. Because the department variable had more than two categories, Kruskall-Wallis test was used in the analysis of this variable. The relationship between the variables of “STEM awareness levels” and “information and communication technologies usage levels” was examined by using Spearman Rho coefficient due to the abnormal distribution of data. Relationship ranges as “Too weak” for the range 0.00-0.19; “Weak” for the range 0.20-0.39; "Medium" for the range 0.40-0.59; “Strong” for the range 0.60-0.79 and “Very strong” for the range 0.80-1.0 were used to interpret the relationship correlations (Evans, 1996).

FINDINGS

Normality Test Results of STEM Awareness Scale and “Information and Communication Technology Usage Levels Scale”

Kolmogorov-Smirnov and Shapiro-Wilk normality tests as to whether the dependent variables are normally distributed or not are given in Table 2 and Table 3.

Table 2. Normality test results of STEM awareness scale

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistics	sv.	*p*	Statistics	sv.	*p*
Positive View	,091	424	,000	,958	424	,000
Negative View	,128	424	,000	,956	424	,000

In Table 2, according to the results of Kolmogorov-Smirnov and Shapiro-Wilk normality test performed to determine whether the STEM awareness scale is distributed normally, it has been seen that the data is not normally distributed ($p < 0.05$). Therefore, Mann-Whitney U, Kruskal Wallis and Spearman’s Rank Order Correlation Coefficient analysis methods were used in the analysis of data.

Table 3. Normality test results of information and communication technology usage levels scale

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistics	sv.	*p*	Statistics	sv.	*p*
ICT1	,088	424	,000	,971	424	,000
ICT2	,100	424	,000	,967	424	,000
ICT3	,088	424	,000	,980	424	,000
ICT4	,071	424	,000	,975	424	,000

In Table 3, according to the results of the Kolmogorov-Smirnov and Shapiro-Wilk normality test performed to determine whether the information and communication technology usage levels scale is distributed normally, it has been seen that the data is not normally distributed ($p < 0.05$). Therefore, Mann-Whitney U, Kruskal Wallis and Spearman’s Rank Order Correlation Coefficient analysis methods were used in the analysis of data.

STEM Awareness Levels of Prospective Teachers

Findings related to STEM awareness levels of prospective teachers are given in Table 4.

Table 4. Descriptive statistics of the STEM awareness scale

	N	Min.	Max.	Mean	Std. Mean	Std. Deviation
Positive View	424	16	60	45,92	3,83	6,19
Negative View	424	5	24	12,91	2.58	3,15
Total	424	29	79	58,83	3.46	6,51

p<0,05

When Table 4 is analysed, while there are prospective teachers with a minimum of 16 points and a maximum of 60 points for the positive view sub-dimension of STEM awareness scale, the arithmetic mean of the prospective teachers' scores related to this dimension is 45.92 and the standard deviation is 6.19. While there are prospective teachers who got a minimum of 5 points and a maximum of 24 points for the negative view sub-dimension, the arithmetic mean of the prospective teachers' scores for this dimension has been found to be 12.91 and the standard deviation to be 3.15. While there are prospective teachers who got a minimum of 24 points and a maximum of 78 points from the entire scale, the arithmetic mean of their scores for the entire scale has been found to be 58.83 and the standard deviation to be 6.51. In terms of standard mean scores, it is seen that the positive perspective sub-dimension of the STEM awareness scale (3.83) is higher than the negative perspective sub-dimension (2.58). In a sense, this means that students have a more positive view in terms of positive STEM awareness.

Information and Communication Technology Usage Levels of Prospective Teachers

Table 5. *Descriptive statistics of the information and communication technology usage levels scale*

	N	Min.	Max.	Mean	Std. Mean	Std. Deviation
Esteem	424	8	32	24,64	3.08	4,41
Anxiety	424	9	34	18,13	2.01	5,18
Confidence	424	6	24	16,15	2.69	3,88
Attitude	424	7	28	21,42	3.06	3,94
Total	424	50	110	80,34	2.678	11,00

p<0,05

When Table 5 is analysed, while there are prospective teachers with a minimum of 8 points and a maximum of 32 points for the first dimension of the information and communication technology usage level scale, the arithmetic mean of the prospective teachers' scores for the first dimension is 24.64 and the standard deviation is 4.41. While there are prospective teachers with a minimum of 9 points and a maximum of 34 points for the second dimension, the arithmetic mean of the prospective teachers' scores for the second dimension has been found to be 18.13 and the standard deviation to be 5.18. While there are prospective teachers with a minimum of 6 points and a maximum of 24 points for the third dimension, the arithmetic mean of the prospective teachers' scores for the third dimension has been found to be 16.15 and the standard deviation to be 3.88. While there are prospective teachers with a minimum of 7 points and a maximum of 28 points for the fourth dimension, the arithmetic mean of the prospective teachers' scores for the fourth dimension has been found to be 21.42 and the standard deviation to be 3.94. While there are prospective teachers who got a minimum of 50 points and a maximum of 110 points from the entire scale, the arithmetic mean of their scores for the entire scale has been found to be 80.34 and the standard deviation to be 11.00. When the sub-dimension and total scores of the information and communication technology scale are analysed in terms of average standard deviation, only the Anxiety dimension is close to the "Partially Agree" option, while the other sub-dimension and the total dimension score are close to the "Agree" option. However, the Esteem sub-dimension has the highest standard average (3.08) while the Anxiety sub-dimension has the lowest average (2.01).

The Relationship between STEM Awareness and ICT Usage Levels

The results of Spearman's Rank Order Correlation Coefficient analysis conducted to determine the

relationship between prospective teachers' STEM awareness levels and sub-dimensions as well as their ICT usage levels and sub-dimensions are shown in Table 6.

Table 6. The relationship between STEM awareness and ICT usage levels of the prospective teachers

	Esteem	Anxiety	Confidence	Attitude	ICT
Positive View	0,335**	-0,019	0,195**	0,296**	0,308**
Negative View	-0,105*	0,331**	0,027	-0,124*	0,064
STEM	0,287**	0,127**	0,213**	0,241**	0,342**

* p<0,05
** p<0,01

When the relationship between STEM awareness levels and ICT sub dimension is examined in the Table 6, there is positive, weak and significant (rho = 0,287; p <0.01) relationship with Esteem. There is positive, very weak and significant (rho = 0,127; p <0.01) relationship with Anxiety. There is positive, weak and significant (rho = 0,223; p <0.01) relationship with Confidence and there is positive, weak and significant (rho = 0,241; p <0.01) relationship with Attitude. When the relationship between ICT usage levels of the prospective teachers and STEM sub-dimensions is examined, there is positive, weak and significant (rho = 0,308; p <0.01) relationship with the Positive View and there is positive, very weak and not significant (rho = 0.308; p>0.05) relationship with the Negative View. Finally, there is a positive, weak, and significant (rho = 0,342; p <0.01) relationship between the key variables of STEM awareness and ICT usage levels. This means that there is an increasing or decreasing relationship between the two variables but they are weak in level.

STEM Awareness Levels of Prospective Teachers According to Gender Variable

The results of the Mann-Whitney U test conducted to determine whether the STEM Awareness Scale differs by gender are shown in Table 7.

Table 7. Prospective teachers' STEM awareness levels according to gender

	Gender	**N**	**Rank Mean**	**U**	**p**
Positive View	Female	313	223,71	13863,500	,002*
	Male	111	180,90		
	Total	424			
Negative View	Female	313	198,63	13031,000	,000*
	Male	111	251,60		
	Total	424			

p<0,05

According to Table 7, there is a statistical difference in both sub-dimensions of STEM awareness scale according to gender (p <0.05). For the first dimension, it can be said that the positive opinions of female prospective teachers towards STEM are statistically higher than male prospective teachers. For the second dimension, it can be said that the negative opinions of male prospective teachers towards STEM are statistically higher than female prospective teachers.

Information and Communication Technology Usage Levels of Prospective Teachers According to Gender Variable

The results of the Mann-Whitney U test conducted to determine whether the information and communication technology usage level scale differs according to gender are shown in Table 8.

Table 8. Information and communication technology usage levels of prospective teachers according to gender

	Gender	N	Rank Mean	U	p
Esteem	Female	313	206,08	15361,000	, 069
	Male	111	230,61		
	Total	424			
Anxiety	Female	313	208,92	16252,000	, 312
	Male	111	222,59		
	Total	424			
Confidence	Female	313	194,23	11653,500	, 000*
	Male	111	264,01		
	Total	424			
Attitude	Female	313	205,85	15290,500	, 060
	Male	111	231,25		
	Total	424			

p<0,05

According to Table 8, there is a statistical difference in the third dimension of the information and communication technology usage level scale according to gender (p <0.05). For the third dimension, it can be said that male prospective teachers have higher self confidence in using information and communication technology than female prospective teachers. In the first, second and fourth dimensions, there is no statistically significant difference according to gender (p> 0.05).

STEM Awareness Levels of Prospective Teachers According to Year Variable

The results of the Mann-Whitney U test conducted to determine whether the STEM Awareness Scale differs according to the year in which the prospective teachers study are shown in Table 9.

Table 9. STEM awareness levels according to the year in which prospective teachers study

	Year	N	Rank Mean	U	p
Positive View	1st grade	197	193,73	18662,500	,003*
	4th grade	227	228,79		
	Total	424			
Negative View	1st grade	197	215,03	21860,500	,690
	4th grade	227	210,30		
	Total	424			

p<0,05

According to Table 9, there is a statistical difference in the first dimension of STEM awareness scale according to the year in which prospective teachers study (p <0.05). Accordingly, it can be said that senior students' STEM awareness levels are more positive than freshmen. In the second dimension, there is no statistical difference according to the year in which prospective teachers study (p> 0.05).

Information and Communication Technology Usage Levels of Prospective Teachers According to Year Variable

The results of the Mann-Whitney U test conducted in order to determine whether the information and communication technology usage level scale differs according to the year in which prospective teachers study are shown in Table 10.

Table 10. Information and communication technology usage levels of prospective teachers according to the year in which they are studying

	Year	N	Rank Mean	U	p
Esteem	1st grade	197	210,25	21915,500	, 723
	4th grade	227	214,46		
	Total	424			
Anxiety	1st grade	197	209,45	21758,500	, 632
	4th grade	227	215,15		
	Total	424			
Confidence	1st grade	197	192,42	18403,000	, 002*
	4th grade	227	229,93		
	Total	424			
Attitude	1st grade	197	211,82	22226,000	, 915
	4th grade	227	213,09		
	Total	424			

p<0,05

According to Table 10, in the third dimension of the Information and Communication Technology Usage Level Scale, there is a statistical difference according to the year in which prospective teachers study (p <0.05). As for the third dimension, it can be said that senior prospective teachers have a higher level of self-confidence in using of information and communication technology than freshmen prospective teachers. In the first, second and fourth dimensions, there is no statistically significant difference according to the year in which prospective teachers study (p> 0.05).

STEM Awareness Levels of Prospective Teachers According to Department Variable

The results of the Kruskall Wallis test conducted to determine whether the STEM awareness scale differs according to the department in which the prospective teachers study are shown in Table 11.

Table 11. STEM awareness levels according to the department in which prospective teachers study variable

	Department	N	Rank Mean	Chi-square	p	Difference
Positive View	ST	101	244,77	13,810	,003	ST-CEIT
	EMT	105	206,75			
	CEIT	101	181,64			
	CT	117	216,44			
	Total	424				
Negative View	ST	101	187,62	12,735	,005	ST-CEIT
	EMT	105	202,04			
	CEIT	101	246,18			
	CT	117	214,29			
	Total	424				

p<0,05

As it is seen in Table 11, there is a statistical difference in both factors of STEM awareness scale according to the department in which the prospective teachers study (p <0.05). This difference is between ST and CEIT. In the first factor, the STEM awareness level scores of the prospective teachers studying in ST are highest, while the scores of the prospective teachers studying in CEIT are the lowest. According to this result, it can be said that prospective teachers studying in ST have a positive perspective on STEM, whereas prospective teachers studying in CEIT have a more negative perspective.

Information and Communication Technology Usage Levels of Prospective Teachers According to Department They Study Variable

The results of the Kruskall Wallis test conducted in order to determine whether the information and communication technology usage level scale differs according to the departments in which the prospective teachers study are shown in Table 12.

Table 12. Information and Communication Technology Usage Levels of Prospective Teachers According to Department They Study Variable

	Department	N	Rank Mean	Chi-square	p	Difference
Esteem	ST	101	187,61	22,459	, 000	CEIT-ST
	EMT	105	184,22			CEIT-ST
	CEIT	101	254,08			
	CT	117	223,46			
	Total	424				
Anxiety	ST	101	240,69	11,362	, 010	ST-CT
	EMT	105	218,74			
	CEIT	101	208,93			
	CT	117	185,65			
	Total	424				
Confidence	ST	101	195,95	84,997	, 000	CEIT-ST
	EMT	105	168,42			CEIT-EMT
	CEIT	101	308,79			CEIT-CT
	CT	117	183,22			
	Total	424				
Attitude	ST	101	187,99	31,743	, 000	CEIT-ST
	EMT	105	176,56			CEIT-EMT
	CEIT	101	264,01			CT-EMT
	CT	117	221,45			
	Total	424				

p<0,05

As it is seen in Table 12, there is a statistical difference in all sub-dimensions of the information and communication technology usage level scale according to the department in which prospective teachers study (p <0.05). This difference is between CEIT, ST and EMT in the first dimension. In the first dimension, information and communication technology usage level scores of the prospective teachers studying in CEIT are the highest, while the prospective teachers studying in EMT have the lowest scores. This difference is between ST and CT in the second dimension. In the second dimension, information and communication technology usage level scores of the prospective teachers studying in ST are the highest, while the prospective teachers studying in CT have the lowest scores. The difference in the third dimension is between CEIT and ST, EMT and CT. In the third dimension, information and communication technology usage level scores of the prospective teachers studying in CEIT are the highest, while the prospective teachers studying in EMT have the lowest scores. The difference in the fourth dimension is between CEIT and ST, EMT, CT and EMT. In the fourth dimension, information and communication technology usage level scores of the prospective teachers studying in CEIT are the highest, while the prospective teachers studying in EMT have the lowest scores. According to this result, it can be said that prospective teachers studying in CEIT value information and communication technologies, have self confidence in using these technologies and show a positive attitude on this matter and their anxiety levels to use information and communication technologies are very low. On the other hand, it can be said that the anxiety levels of prospective teachers studying in ST towards the use of these technologies are higher than the prospective teachers in other

departments. The prospective teachers, who have the least self confidence and most negative attitude towards the use of information and communication technologies, are the prospective teachers in the EMT department.

DISCUSSION CONCLUSION AND SUGGESTIONS

The relationship between STEM awareness and ICT usage levels of prospective teachers in terms of gender, year and department has been examined in the study. According to the results obtained in the study, it has been determined that STEM awareness levels of the prospective teachers were positive, the ICT usage levels were moderate, and there was a positive, weak and significant relationship between their STEM awareness levels and ICT usage levels.

The studies conducted for STEM awareness levels (Bakırcı and Karışan, 2018; Buyruk and Korkmaz, 2016b; Yenilmez and Balbağ, 2019; Kızılay, 2016; Kırılmazkaya, 2017; Şahin and Hacıömeroğlu, 2018) found that the awareness levels of prospective teachers were largely positive similar to the results of this research. Moreover, there are studies showing that STEM awareness levels of teachers (Bölükbaşı and Görgülü Arı, 2019; Elayyan and Al-Shizawi, 2019; Ciğerci, 2020; Can and Uluçınar Sağır, 2018; Çevik, Danıştay and Yağcı, 2017), school administrators (Ciğerci, 2020) and university students (Hebebci and Usta, 2017) are positive. Additionally, it was determined that prospective teachers produced completely positive metaphors about STEM education in the metaphor studies related to STEM, they had positive opinions (Ergün and Kıyıcı, 2019a), and all prospective science teachers who got STEM education produced positive metaphors for STEM education (Altun Yalçın and Yalçın , 2018). In the study of Çalışıcı and Özçakır Sümen (2018), it was concluded in the metaphors produced by prospective classroom teachers that most of the prospective teachers believe STEM fields complement each other and are a useful approach. It was determined in Ergün's (2019) study that prospective teachers have positive perspectives towards STEM. It was determined in the work of Boyraz and Bilican (2020) with the class teachers that the teachers could not clarify the concept of STEM but they had positive opinions about STEM teaching that they learned within the scope of the study. In the professional development project carried out by Knowles, Kelley and Holland (2018) with STEM applications for high school teachers, it was concluded that teachers' STEM career awareness increased at the end of the training. Moreover, there are studies concluding that STEM intention levels of prospective teachers are positive (Koçak, Aslan and Capellaro, 2019; Demir Başaran and Temircan, 2018; Hacıömeroğlu, 2018; Hartuç and Sülün, 2017).

In studies on ICT and education technologies conducted with prospective teachers and teachers, it has been seen that similar results to this study were obtained. It has been determined in the studies carried out that, prospective teachers' attitudes towards ICT were moderate (Bakırcı and Günbatar, 2017), they had positive attitudes (Bakırcı, Cancan and Uzunyol, 2017), and they generally had positive opinions about mobile communication technologies (Pan and Akay, 2016), they had a positive technology attitude level (Örün, Orhan, Dönmez & Kurt, 2015), they had the skills of using ICT (Maryuningsih, Hidayat, Riandi & Rustaman, 2020) they felt average in using ICT (Fokides and Kostas, 2020; Murat and Erten, 2018). In addition, it has been determined that the attitudes of the prospective teachers towards instructional technologies were at a good level (Akgün, 2020), prospective science teachers had positive opinions about ICT use (Tanık Önal, 2017) and prospective Physics, Chemistry and Biology teachers had positive opinions about ICT use as well, however; half of the prospective teachers stated that they felt competent in the use of ICT and the other half stated that they did not feel competent enough (Saraç and Özarslan, 2017). It has been determined that prospective teachers had a medium level of self-efficacy perception in terms of educational technology standards (Makhabbat and Çoklar, 2018). It has been determined that the technology acceptance levels of teachers were moderate (Sırakaya, 2019), their level of competence in using educational technologies was high, and they had a moderate average in the integration of technology into teaching sub-dimension (Çelik and Demirtaş, 2019). In the study of Dursun and Saracaloğlu (2017), it has been determined that prospective teachers interested in information technology competencies of the teachers had medium-high level competencies in terms of technological applications and support competencies. In the study conducted by Yenice, Candarlı Arıkoz, Yavaşoğlu, and Alpak Tunç (2019), it has been concluded that prospective science teachers use ICT frequently in the sub dimensions of using ICT in scientific process, using knowledge, research and development, experimental design and application as well

as using scientific process skills and in the scientific process in general. In general, it can be said that prospective teachers evaluate themselves as moderate and moderate-high in terms of ICT usage and have positive attitudes and opinions.

It has been concluded in this study that there is a positive, significant and weak relationship between STEM awareness and ICT usage of the prospective teachers. A study showing the relationship between these two concepts has not been found in the literature. There are studies that associate STEM with technology use, technology attitude and different dimensions of technology in the literature. It has been determined in the study of Şen and Timur (2018) that intention of prospective teachers towards STEM teaching and their attitudes towards technology were positive. In the study conducted by Durr, Kampmann, Hales, and Browning (2020), online learning groups were created for teachers to use technology within the scope of the professional development project for teachers of STEM, and in this way, teachers were able to prepare and share course videos in interaction with each other, university course contents and educational experts. In this learning environment in which communication is carried out through digital means, teachers described their experiences as positive and stated that these practices contributed to their professional development.

In the study by Chai (2019) in which the relationship between STEM education of the teachers and technological pedagogical content knowledge was examined, it was concluded that content knowledge, pedagogy and technology usage status of the teachers were defined as the basic features of professional development for STEM. It has been determined in the study of Elayyan and Al-Shizawi (2019) that science teachers' perceptions of the need for STEM education in the context of 21st century skills were at a high level. To achieve this, the importance of including STEM dimensions such as engineering design steps and educational technology in science education programs was emphasized. In addition, it was stated that necessary trainings were needed for teachers to acquire digital skills that stand out in 21st century skills and to create interactive learning environments such as virtual laboratories.

According to other results of the research, it has been determined that the STEM awareness levels of prospective teachers showed a significant difference according to gender, and this difference was in favour of female prospective teachers. In line with the results of this study, it has been determined that the STEM awareness levels of female prospective teachers (Yenilmez and Balbağ, 2019) and female university students (Hebebci and Usta, 2017) were significantly higher than males. Moreover, it has been determined that STEM perception of female prospective teachers was significantly more positive (Ergün, 2019) and significant differences were found in favour of women in studies related to STEM education intentions and sub-dimensions (Koçak, Aslan and Capellaro, 2019; Demir Başaran and Temircan, 2018; Hartuç and Sülün, 2017). In some studies that did not differ between men and women regarding STEM, the superiority of women was emphasized in terms of scores. It was emphasized in the study of Ciğerci (2020) that there is no significant difference in STEM awareness levels of female and male prospective teachers , but the STEM awareness levels average of female prospective teachers were higher than that of male prospective teachers. It has been determined in the study of Çalışıcı and Özçakır Sümen (2018) that most of the female and male prospective teachers had close and positive views in the metaphors related to STEM, but female prospective teachers had created more metaphors than male teachers that STEM was a necessary approach. In the study of Nguyen and Redding (2018), it has been determined that within the last 24 years, there has been a change in the STEM areas, from the male dominated understanding to the understanding where women came to the fore. It has been determined that the number of female teachers in the STEM areas increased from 43% to 64%. In Dinh and Nguyen (2020) study, it was aimed to improve students' design skills and competencies of organizing experimental activities in the training within the scope of STEM given to university students. It was concluded at the end of the training that male students were more successful than female students in design and organization, and female students were more successful than male students in analysing the experimental process and completing STEM tasks in this context. Although there is gender inequality in this area, it has been emphasized that the rate of women entering STEM fields has increased in the last two decades.

Unlike the results of this research, there are studies in which there is no significant difference

between men and women according to gender variable in STEM awareness levels of prospective teachers (Bakırcı and Karışan, 2018; Buyruk and Korkmaz, 2016b; Koyunlu Ünlü and Dere, 2019), teachers (Çevik, Danıştay and Yağcı, 2017), and STEM intentions of prospective teachers (Kırılmazkaya, 2017; Şen and Timur, 2018). In addition to this, there are also studies in which there are differences in favour of men in the sub-dimensions related to STEM (Koyunlu Ünlü and Dere, 2019; Hacıömeroğlu, 2018).

In the context of this research results and the results of the studies that emphasize the tendencies of women towards STEM, it can be said that women show interest to STEM, this interest has increased over time and will continue to increase in the future. Contrary to the stereotyped views claiming men dominate STEM, women have started to prove that they have a say in these areas. This is supported by the conclusion in Ergün and Kıyıcı's (2019b) study that design-based science education practices for prospective teachers reduced the stereotypical perceptions of prospective teachers that engineers are male. It can be said that education practices related to STEM are needed in order to change the perception of male superiority in STEM fields and prospective teachers to improve themselves in these fields.

It has been concluded in this study that there is a difference in favour of senior prospective teachers for the positive view sub-dimension of STEM awareness scale according to year. STEM awareness levels of the senior prospective teachers are more positive than freshmen prospective teachers. In addition, according to the departments in which prospective teachers study, it has been found that there is a difference in STEM awareness levels between prospective teachers in ST and CEIT departments. According to this result, STEM awareness levels of prospective ST teachers are more positive than prospective CEIT teachers.

When the studies on STEM according to the year in which prospective teachers study, the department they study or the branch variables of the teachers have been examined, there are studies that are in line with the results of this research, as well as those that found different results. It has been determined in the studies of Yenilmez and Balbağ (2019) that as the class level of prospective teachers increased, there was a positive difference in STEM awareness, and the negative views of senior students towards STEM decreased. Similarly, in the study of Koyunlu Ünlü and Dere (2019), it was concluded that STEM awareness scores of the senior prospective teachers were higher. In the study of Hartuç and Sülün (2017), a difference in favour of senior prospective teachers was found between the freshmen and senior prospective teachers for the two sub-dimensions in integrated STEM teaching intentions. In the studies carried out by Çevik, Danıştay and Yağcı (2017) with secondary school teachers, no difference was found in STEM awareness levels according to teachers' branches (Science, Mathematics, Technology Design, Information Technology teachers). It has been determined in the study of Kırılmazkaya (2017) that there is no difference between prospective teachers studying in the 3rd and 4th year in terms of STEM teaching intentions. In the studies of Karışan and Bakırcı (2018), it was concluded that STEM teaching intentions of the freshmen prospective teachers were higher than the further years. According to these results, it can be said that the STEM awareness levels of prospective teachers studying in further years are higher than other year levels.

When the results of the studies are examined in terms of the departments, it has been found in the study of Buyruk and Korkmaz (2016b) showing similar results to this study that prospective teachers studying in ST and CEIT had higher STEM awareness level than those studying EMT and prospective ST teachers had higher STEM awareness level than prospective CEIT teachers. Similarly, in the study of Bakırcı and Karışan (2018), it has been concluded that the STEM awareness levels of prospective ST and CT teachers were higher than that of prospective EMT teachers. In the study of Şen and Timur (2018), it has been determined that there was a difference in favour of ST students among ST, CT, ST and Preschool Teaching departments in integrated STEM teaching intentions of prospective teachers. Similarly, in the study of Koçak, Aslan, and Capellaro (2019), it has been concluded that prospective ST teachers had higher intention compared to prospective CT and EMT teachers in terms of STEM teaching intentions. In the study of Karmaan and Bakirci (2018), it has been found that STEM teaching intentions of the prospective ST and CT teachers was higher than prospective EMT teachers. In contrast to these results, it has been found in the study of Yenilmez and Balbağ (2019) that there was a difference in favour of prospective EMT teachers

between the STEM awareness and positive view scores of the prospective EMT teachers and prospective ST teachers. It can be said that the STEM awareness levels of prospective ST teachers are generally higher than other departments. It can be said that the STEM awareness levels of prospective ST teachers are positively affected because STEM includes the fields of science, technology, engineering and mathematics and the courses directly related to these fields are mainly involved in the science teaching process.

In the study, according to the results obtained regarding the ICT usage levels of prospective teachers, there is no gender difference in the dimensions of esteem, anxiety and attitude while there is a difference in favour of male prospective teachers in the confidence dimension. Male prospective teachers are more confident in using ICT than female prospective teachers. In similar studies, significant differences in favour of male prospective teachers have been found in the ICT attitudes, virtual communication, computer hardware and software usage sub-dimensions (Bakırcı and Günbatar, 2017), technology integration self-efficacy, technology knowledge dimension (Şimşek and Yazar, 2018), attitudes towards technology (Şen and Timur, 2018), information security knowledge levels (Gökmen and Akgün, 2014) views on information technology teacher competencies as well as technological practices and support competencies (Dursun and Saracaloğlu, 2017) of the prospective teachers. Similarly, it has been concluded in the studies conducted with teachers that there was a significant difference in teachers' self-efficacy perceptions of technology (Kartal, Temelli and Şahin, 2018), their technology acceptance levels (Sırakaya, 2019) and their educational technologies usage levels (Çelik and Demirtaş, 2019) in favour of male teachers. Moreover, in the study conducted with prospective teachers on digital literacy, which is defined as accessing information and conducting research using digital technologies and integrated with ICT, it has been determined that male prospective teachers felt more competent in digital literacy than female prospective teachers (Öztürk and Budak, 2019). In addition, in the study conducted by Scherer and Siddiq (2015), there is a significant difference in favour of male teachers in the computer self-efficacy perceptions of primary school teachers who participated in the international computer and information literacy study and in the basic operational skills as well as advanced operational and collaborative skills sub-dimensions, however no significant difference has been found according to gender in the sub-dimension of using computers for educational purposes. Unlike these results, ICT usage levels of the prospective teachers (Murat and Erten, 2018), technology acceptance and usage status (Korucu and Biçer, 2017), ICT usage status in the scientific process (Yenice, Candarlı Arıkoz, Yavaşoğlu and Alpak Tunç, 2019), self-efficacy perceptions towards educational technology standards (Makhabbat and Çoklar, 2018) and attitudes of teachers towards ICT (Bakırcı, Cancan and Uzunyol, 2017) did not change according to gender. In the study of Akgün (2020), it was concluded that the attitudes of prospective teachers towards teaching technologies differ in favour of women, and in the study of Bakırcı and Günbatar (2017), the general ICT tendency and access to information in the virtual environment differ in favour of women. Although the results generally show that men are more advanced in the use of ICT, it should not be overlooked that there are results showing no differences between men and women in ICT and there are studies showing the superiority of women. It can be said that men and women are trying to adapt together to the rapid developments in information, technology, communication and digitalization in constantly changing world conditions. According to Dinç (2017), it is necessary to accept that there are differences between men and women in adapting and using digital opportunities. What is important in this process is that the focus should be on creating opportunities to provide the necessary support in situations where men and women are disadvantaged. In this context, it can be suggested to perform studies on prospective teachers who undertake the responsibility of educating the generations of the future in a way that they will adapt to the future conditions in order to determine their ICT training needs during their own education processes. In these studies on determining the needs, the subjects that male and female prospective teachers are advantageous and disadvantageous can be determined and multidimensional studies such as content, program, application, project etc. that will enable them to develop themselves in the context of the subjects they are disadvantaged can be planned and applied.

According to another result concluded in the study, it was determined that there was a difference in favour of senior prospective teachers only in the dimension of confidence in the ICT usage levels of prospective teachers in terms of year. Senior prospective teachers feel more confident than freshmen prospective teachers in using ICT. It has been concluded in the research that there is a difference in ICT

usage levels according to the departments in which prospective teachers are studying. Prospective teachers in the CEIT department value ICT usage more than the prospective teachers in the ST and EMT departments. Prospective ST teachers are more anxious about using ICT than prospective CT teachers. Prospective CEIT teachers feel more confident in using ICT compared to prospective ST, CT and EMT teachers. Prospective CEIT teachers have a more positive attitude towards ICT usage compared to prospective EMT teachers. Similar to these results, it has been concluded in the study of Korucu and Biçer (2017) that in the technology acceptance and usage of the prospective teachers, there is a significant difference in favour of junior prospective teachers between junior prospective teachers and freshmen prospective teachers, and there is a significant difference in favour of senior prospective teachers between sophomore prospective teachers and senior prospective teachers and there is also a significant difference in favour prospective CEIT teachers between prospective CEIT teachers and other departments (CT, Turkish Education, ST, ELT, EMT, Preschool Education) It has been determined in the study of Murat and Erten (2018) that the ICT usage levels of prospective teachers differed in favour of seniors between junior and senior prospective teachers. Moreover, it has been determined in the study of Sırakaya(2019) that the technology acceptance levels of information technology teachers were higher than other branch teachers (science, classroom teaching, mathematics, Turkish language, social studies, other) in the context of technology acceptance levels of teachers It has been determined in the study of Şen and Timur (2018) that there is a difference in favour of prospective CEIT teachers between prospective CEIT and ST teachers in the attitudes of prospective teachers towards technology in terms of departments in which prospective teachers study. It was seen in the study of Tatlı and Akbulut (2017) that technology usage competencies of the prospective CEIT teachers were significantly higher than the prospective teachers in other fields. It has been concluded in the study of Bakırcı and Günbatar (2017) that ICT attitudes of prospective teachers differ in favour of the prospective teachers in further years among freshmen, sophomore, junior and senior prospective teachers in terms of year levels but there is no difference in terms of their ICT attitudes according to the departments. Öztürk and Budak (2019) found that there was a significant difference in favour of senior prospective teachers between the digital literacy score averages of senior prospective teachers and the digital literacy scores of junior, sophomore and freshmen prospective teachers. However, it was concluded that there was no significant difference in the evaluations of digital literacy for the prospective teachers according to the departments in which they studied. Unlike these results, in the study of Gökmen and Akgün (2014), there is no difference between junior and senior prospective teachers in terms of information security knowledge levels. It was found in the study of Örün, Orhan, Dönmez and Kurt (2015) that there was no difference between the technology attitudes of prospective teachers according to the department in which they studied and that the freshmen prospective teachers had higher technology attitude scores than the senior prospective teachers.

When the results found in this research and the results of previous studies are analysed, it can be said that prospective teachers studying in further years and CEIT teachers are more competent in ICT related subjects as expected. It can be interpreted that, as the prospective teachers study further, the courses they attended during their undergraduate education provide them with opportunities to develop themselves more in ICT. Taking into account that prospective CEIT teachers attended more ICT based courses and studies in terms of professional development, it can be said that this fact enables them to feel more competent in ICT. Considering the conclusion in the study that the prospective teachers generally evaluate themselves at a medium level in using ICT, it is suggested that studies including ICT-related educational practices for all departments and year levels should be conducted in teacher education.

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