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Investigation of Prospective Science Teachers' 21st Century Skill Competence Perceptions and Attitudes Toward STEM[1]

Research Article

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ABSTRACT

The aim of this study is to examine the 21st century skills competencies perceptions of prospective science teachers and their attitudes towards STEM as well as the relationship between these. In the study, relational screening model was used. The sample of the research consists of senior students from Science Education Departments of Fırat, Cumhuriyet, Erciyes, Muş Alparslan, Nevşehir Hacı Bektaş Veli Universities enrolled for 2016-2017 academic year. In order to collect data for the study, "21st Century Skills Competencies Perception Scale for Teacher Candidates", developed by Anagün, Atalay, Kılıç and Yaşar (2016), was used for determination of 21st century skills perceptions and "STEM Attitude Scale", developed by Faber et al. (2013) and adapted to Turkish by Yıldırım and Selvi (2015), was used for determination of attitude towards STEM. In the analysis of the data, diagnostic analyses, t-test, Mann Whitney U test (MWU) and Pearson Correlation analyses were used. According to research findings, it was determined that prospective teachers agree, in a level higher than moderate, with "learning and innovation skills", "life and career skills" and "information, media and technology skills" which are dimensions of the 21st century skills. Significant results were obtained based on gender variable regarding perception of "life and career skills" and "information, media and technology skills" dimensions of 21st century skills competencies, in favor of female prospective teachers. It was determined that prospective teachers have positive attitude towards STEM. No significant difference was observed based on gender regarding attitude towards STEM. It was found that there is a low and moderate positive relationship between "Teacher Candidates' 21st century Skills Competence Perception and "STEM Attitude Scale" subscales. Based on the findings of the research, proposals for improving 21st century skills and STEM trainings were presented in teacher training programs.

Keywords:
21st century skills, STEM, Prospective Science Teacher

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Introduction

In addition to basic skills, individuals need to have high level skills and competencies in order to catch up with the changes, to catch technology, to acquire knowledge by choosing from, analyzing and evaluating information that is quickly produced, to use this acquired knowledge in everyday life and convert it into product. These skills and competencies that individuals should have in the information society are called 21st century skills (Anagün, Atalay, Kılıç and Yaşar, 2016).

The skills of the 21st century include neither skill nor knowledge alone. 21st century skills include understanding and performance. In other words, it is a blend of knowledge and skill (Dede, 2010). 21st century skills were classified differently by institutions and organizations such as (ATCS (Assessment and Teaching of 21st Century Skills), P21 (Partnership for 21st Century Learning), OECD (Organization for Economic Co-operation and Development), ASIA Society (Asia Society Partnership for Global Learning), ISTE (International Society for Technology in Education), NCREL (North Central Regional Educational Laboratory), EU (European Union) (Voogt and Roblin, 2010). Even though 21st century skills are classified in different forms, there are some common features in these classifications. In the 21st century skills, there is an emphasis on creativity, critical thinking, collaborative work and problem solving. 21st century skills involve reaching information and using knowledge, rather than knowing it, respecting different cultures, and living together with different cultures. In the 21st century skills, there is an emphasis on effective citizen instead of a good citizen. The ability to use technological tools and literacy (knowledge, media, and digital age) are important. Individuals with these skills maintain their lives in a higher quality and more productive. Therefore, it can be said that these skills must be included in the training programs to enable individuals to acquire these skills through education (Anagün, Atalay, Kılıç and Yaşar, 2016).

The 21st century skills are found in training programs of countries such as Australia, Canada, Finland, Belgium, Ireland, Italy, Norway and New Zealand. In Turkey, in primary education programs implemented in 2004, critical thinking as common skills, creative thinking, communication, research, problem solving, decision making, using information technology, and entrepreneurial skills were given place in all subjects (OECD, 2009: s.24- 26).

STEM education is one of the most popular education models that have been mentioned a lot in the world in recent years. The United States has begun to lose its competitiveness in technology and engineering due to the decreasing number of students choosing studies in science, mathematics and engineering, and has therefore initiated a reform called STEM education to increase both the number of students choosing these fields and the quality of education in these fields (Dugger, 2010) . The term "STEM" consists of abbreviations of the words Science, Technology, Engineering and Mathematics (Gonzalez and Kuenzi, 2012; Moomaw, 2013; Yıldırım and Selvi, 2015). In Turkish, abbreviations of these words correspond to *"FeTeMM"* (Fen, Teknoloji, Mühendislik and Matematik) (Çorlu, 2014). STEM education is an educational approach that involves teaching science, technology, engineering and mathematics in an integrated manner and comprises the process starting from pre-school to higher education. Although STEM education includes many disciplines, it mainly focuses on engineering and technology. In STEM education, four important disciplines can be brought together or a holistic approach based on two disciplines can be adopted (Hacıömeroğlu and Bulut, 2016). It is emphasized that instead of associating the STEM with a single field, the fields must be combined and integrated (Aslan-Tutak, Akaygün and Tezsezen, 2017). The integrated nature of STEM can be interpreted as an approach that does not confine education in classroom and school environment, and as an integrated process-product, focuses on information and solution of problems in life (Akgündüz, Aydeniz, Çakmakçı, Çavaş, Çorlu, Öner and Özdemir, 2015: p.24). In other words, STEM is an approach that is based on the integration of different fields and disciplines for the same purpose, independent of conventional class hours and classroom practices and focused on solution of real life problems.

It is very important for STEM education to train qualified individuals in order to provide economic advantages for countries and be able to produce innovations that can keep pace with what the current age and in order not to stay behind developments. Skills such as research, inquiry, creativity, critical and analytical thinking and decision making are some of the attributes that are sought in qualified individuals. It can be said that science and mathematics fields and therefore, engineering and technology fields play an important role in gaining these skills (Yamak, Bulut and Dündar, 2014).

Individuals must have 21st century skills such as creativity, critical thinking and problem solving in order to be able to choose among the information they receive, interpret the information and to produce new knowledge from the results (Partnership for 21st Century Learning, 2015). Educating individuals with these skills took its place in the in the tenth development plan and teaching programs were changed according to this understanding. The science curriculum was modified in 2005, 2013 and 2017 in line with this understanding, with the aim of raising individuals who own 21st century skills such as research, questioning, creative thinking, critical thinking, decision making and problem solving (MEB, 2013; MEB, 2017).

Today, the need for individuals who think, produce, question and who are creative in the fields of science, technology, engineering and mathematics is increasing day by day. For this reason, it has become compulsory to implement new and different programs for teaching-learning processes in these fields. The most recent of these applications are STEM education and its applications (Yıldırım and Altun, 2015). STEM education offers young researchers many opportunities such as becoming a pioneer in a newly developing area and contributing to this area both in Turkey and in global scale (Çorlu, 2014). STEM education is also important in terms of its dimension that enables the application of information learned. In the future, individuals are expected to have deep knowledge, to be productive and competent in engineering field. Focusing on the interaction between science and mathematics, it can be concluded that our teachers having only the knowledge of their own field will not be sufficient to raise the human resource that our country needs (Çorlu, Capraro and Capraro, 2014). Based on these facts, it is highly important for the teachers who will build up the future and for the students that will be raised by these teachers to be educated in accordance with the bases of STEM education and to develop positive attitude towards STEM. For this reason, it was found to be necessary to carry out this study.

The purpose of this study is to examine the 21st century skills competencies perceptions of Prospective Science Teacher in 2016-2017 academic year and their attitudes towards STEM as well as the relationship between these. In line with the general purpose of the study the following sub-goals are listed;

1. To identify the perception of Prospective Science Teachers regarding the 21st century skills competencies
2. To compare perception of Prospective Science Teachers regarding the 21st century skills competencies based on gender
3. To identify the attitude of the Prospective Science Teachers towards STEM
4. To compare attitude of Prospective Science Teachers towards STEM, based on gender
5. To identify relationship between the perception of Prospective Science Teachers regarding 21st century skills competencies and their attitude towards STEM.

Method

This research was conducted based on descriptive research method and screening model. Descriptive work is done to clarify a situation, to make assessments and to reveal possible relations between events, to explain and describe the situation under study (Çepni, 2007). This research was designed according to the relational screening model among other screening models. The screening model is the totality of the

processes that examine a situation with its past and present, that are implemented for the development of the desired attitudes and for the realization of the learning. The relational screening model is a screening approach that aims to determine the presence of changes that occur at the same time in two or more variables. In the relational screening model, it is tried to determine whether the variables are changing together; and if they change together, how this change occurs (Karasar, 2011).

Population and Sample

The sample of the research consists of prospective teachers studying at Science Education Departments of Fırat, Cumhuriyet, Erciyes, Muş Alparslan, Nevşehir Hacı Bektaş Veli Universities, in 2016-2017 academic year. Incidental sampling was used when selecting the sample. The appropriate sampling method is choosing the sample from easily accessible and practicable units due to time, money, and work force limitations (Büyüköztürk, Kılıç, Akgün, Karadeniz and Demirel, 2009: 92). In the scope of this research, the senior students from Science Education Departments of Fırat, Cumhuriyet, Erciyes, Muş Alparslan, Nevşehir Hacı Bektaş Veli Universities were included in the sample.

The distribution of the research sample included in the sample according to the variables is shown in Table 1.

Table 1. Research sample

		n	%
Gender	Female	147	76.2
	Male	46	23.8
	Total	193	100
University	Nevşehir Hacı Bektaş Veli University	30	15.5
	Erciyes University	49	25.4
	Cumhuriyet University	37	19.2
	Fırat University	52	26.9
	Muş Alparslan University	25	13.0
	Total	193	100

When Table 1 is considered, it is observed that female constitutes 76.2% of the participants, while male form 23.8%. 15.5% of the prospective teachers participated in the research is from Nevşehir Hacı Bektaş Veli University, while 25.4% is from Erciyes, 19.2% from Cumhuriyet, 26.9% from Fırat and 13% is from Muş Alparslan University.

Data Collection Tools

In order to collect data for the study, "21st Century Skills Competencies Perception Scale for Teacher Candidates", developed by Anagün, Atalay, Kılıç and Yaşar (2016), was used for determination of 21st century skills perceptions. The scale consists of 42 items in total. These items are grouped under 3 factors: "learning and innovation skills", "life and career skills", "information, media and technology skills". As a result of the reliability analyzes the Cronbach Alpha value of all scales was obtained as .889. When the Cronbach Alpha coefficients of the sub-dimensions were examined, 0.845 for Factor 1, 0.826 for Factor 2 and 0.810 for Factor 3 were calculated. For this study, the KMO value of the scale was .85, the Bartlett test was 3601,196 p = .000 and the Cronbach Alpha was .92. The evaluation was done for each item in a scale from 1 to 5: Never (1) Rarely (2), Sometimes (3), Frequently (4), Always (5).

As the other data collection tool, "STEM Attitude Scale", developed by Faber et al. (2013) and adapted to Turkish by Yıldırım and Selvi (2015), was used for determination of attitude towards STEM. The Turkish

version of the STEM Attitude Scale consist of 4 factors including "science", "engineering", "21st century talents "and" mathematics " and a total of 37 items. The science and engineering factors cover 9 items, the 21st century skills factor includes 11items, and the mathematics factor has 8 items. The validity and reliability studies of the STEM Attitude Scale were carried out by Yıldırım and Selvi (2015) and internal consistency coefficients for science, engineering, 21st century skills, math factors and the global scale were found to be .86, .86, .89, .89 and. 94, respectively. For this study, the KMO value of the scale was determined as .87, the Bartlett test was 4069,892 p = .000 and Cronbach alpha was .91. Each item of the STEM Attitude Scale, were evaluated in a scale from 1 to 5: Strongly Disagree (1) Disagree (2), Undecided (3), Agree (4), Strongly Agree (5).

Data Analysis

Likert type items were analyzed using quantitative research methods. The data obtained from the personal information and likert type items were processed in SPSS 18.0 package program. In calculations related to gender variable, frequency and percentage techniques were used. Arithmetic mean and standard deviation methods were used for the analysis of likert type items intended to determine the attitude of prospective teachers towards 21st century skills and towards STEM. Independent t test analysis was conducted to determine whether there is a significant difference between the opinions of the prspective teachers participating in the research according to the gender variable. The Pearson Product-Moment Correlation Coefficient (r) analysis technique was used to determine the relationships between prospective teachers' 21st century skills competence perceptions and STEM attitudes. According to Büyüköztürk (2010), a correlation coefficient between 0.70-1.00 indicates a “high” level positive correlation; if it is between 0.70-0.30, there is a “medium” level positive correlation and for coefficients between 0.30-0.00 the positive relationship in "low" level. As per the level of significance, p = 0.05 was accepted in the study. If distribution is observed as non-parametric (non-homogeneous items) in the homogeneity test, Mann Whitney U test (MWU) was applied in pair comparisons (Büyüköztürk, 2010).

Findings

In this section, analysis results are given regarding 21st century skills competencies perception of the prospective science teachers and their attitude towards STEM, as well as the relation between these two. The findings are presented in tabulated form.

1. Findings on 21st century skills competencies perception of the prospective science teacher

The findings on the 21st century skills competencies perception of the prospective science teacher were examined according to the three sub-dimensions of the scale. These are “*learning and innovation skills*”, “*life and career skills*” and “*information, media and technology skills*” subscales (Table 2, Table 3, Table 4).

Table 2. Views of prospective teachers about “learning and innovation skills” dimension

No	Statements	n	$\overline{X}$	ss
1	I develop original ideas for solving the problems I encounter.	193	3.94	.723
2	I use different thinking techniques (brainstorming, six thinking hat) to create original ideas in my life.	193	3.25	.931
3	I try different solutions to bring a problem to a conclusion.	193	3.86	.744
4	I establish out of the ordinary relations between part and the whole (meronymy)	193	3.32	.873
5	I use imagination to solve problems.	193	3.92	.946

6	I evaluate new ideas by using analysis.	193	3.76	.774
7	I try to understand the different dimensions of about a topic.	193	3.84	.818
8	When solving the problem, I ask questions to determine the different points of view.	193	3.64	.930
9	I work patiently to produce solutions to the problems.	193	3.53	1.02
10	I search for the basis of a view by questioning the claim.	193	3.60	.913
11	I use reasoning methods to solve problems.	193	3.91	.799
12	In problem solution, I analyze the relation between the part and the whole.	193	3.62	.833
13	I consider different points of view.	193	3.94	.804
14	I create synthesis by establishing relations between information and arguments.	193	3.55	.858
15	I reach conclusions by analyzing information.	193	3.72	.844
16	I share the knowledge I acquire with others in different ways (written, oral, etc.)	193	3.75	.945
17	I use time effectively.	193	3.54	.940
18	I take steps to improve my skills.	193	3.63	.975
	Learning and Innovation Skills	**193**	**3.68**	**.506**

When the mean values given in Table 2 regarding "learning and innovation skills" dimension of 21st century skills are considered, the items with the highest level of agreement are "I develop original ideas for solving the problems I encounter." ($\overline{X}$ =3.94), "I consider different points of view" ($\overline{X}$ 13= 3.94) and "I use imagination to solve problems" ($\overline{X}$ 5=3.92). The lowest level of agreement, on the other hand, were observed for items "I use different thinking techniques (brainstorming, six thinking hat) to create original ideas in my life" ($\overline{X}$ 2= 3.25), "I establish out of the ordinary relations between part and the whole" ($\overline{X}$ 4= 3.32) and "I work patiently to produce solutions to the problems"($\overline{X}$ 9= 3.53). According to research findings, participant prospective teachers responded "frequently" to all the eighteen items in the 21st century skills competence perceptions "learning and innovation skills" dimension. When the general arithmetic mean value ($\overline{X}$ = 3.68) is examined, a similar situation is observed.

Table 3. Views of prospective teachers about "life and career skills" dimension

No	**Statements**	**n**	$\overline{X}$	**ss**
19	I listen to other's opinion about a subject.	193	4.04	.849
20	I have effective communication skills.	193	3.84	.933
21	I have the ability to work effectively in group work.	193	4.09	.944
22	I work in harmony with group members.	193	4.27	.812
23	I take responsibility in group work.	193	4.34	.839
24	I value individual contributions in group work.	193	4.32	.810
25	I am flexible in changing my ideas based on others' suggestions.	193	3.58	.965
26	I adapt to different roles (friends, citizens, economic, power, family members) in my life.	193	4.19	.828
27	I am not comfortable with adapting to new situations.	193	2.62	1.10

28	I am open to criticism.	193	3.59	.942
29	I consider the different points of view to solve the problems.	193	4.01	.777
30	I know that learning is a lifelong process.	193	4.41	.759
31	I make use of past experiences to predict future events.	193	4.19	.805
32	I know when to talk and when to listen.	193	4.24	.810
33	I am respectful in my communication with others.	193	4.44	.705
34	I respect to other cultures.	193	4.42	.845
	Life and Career Skills	**193**	**4.04**	**.458**

Views of prospective teachers on "life and career skills" dimension of the 21st century skills competencies scale are presented in Table3. When the means related to this dimension are considered, the items with the highest level of agreement are "I am respectful in my communication with others" ($\overline{X}$ 33= 4.44), "I respect to other cultures" ($\overline{X}$ 34= 4.42) and "I know that learning is a lifelong process" ($\overline{X}$ 30=4.41). The lowest level of agreement, on the other hand, were observed for items "I am not comfortable with adapting to new situations" ($\overline{X}$ 27= 2.62), "I am flexible in changing my ideas based on others' suggestions" ($\overline{X}$ 25= 3.58) and "I am open to criticism" " ($\overline{X}$ 28= 3.59) . According to research findings, participant prospective teachers responded "frequently" to most of the items in the 21st century skills competence perceptions "life and career skills" dimension. In line with this result, the general arithmetic mean value regarding the 21st century skills competence perceptions "life and career skills" dimension was determined as $\overline{X}$ = 4.04. When this mean is considered, it can be observed that the prospective teachers generally responded as "frequently".

Table 4. Views of prospective teachers about "information, media and technology skills" dimension

No	**Statements**	**n**	$\overline{X}$	**ss**
35	I effectively use media and technology to communicate with others.	193	3.98	.943
36	I know the purpose of the messages in media.	193	3.87	.847
37	I know that media is effective in directing people's opinion.	193	3.97	.951
38	I use appropriate media tools to get information.	193	3.92	.886
39	I use a diversity of media tools.	193	3.79	.938
40	I use technological tools to acquire information.	193	4.10	.929
41	I use technological tools to analyze information.	193	4.01	.909
42	I use social network for sharing information.	193	3.86	1.02
	Information, Media and Technology Skills	**193**	**3.94**	**.652**

When the findings given in Table 2 regarding "information, media and technology skills" dimension of the scale are considered, the items with the highest level of agreement are "I use technological tools to

acquire information." ($\overline{X}$ 40= 4.10), "I use technological tools to analyze information." ($\overline{X}$ 41= 4.01) and "I effectively use media and technology to communicate with others." ($\overline{X}$ 35=3.98).

The lowest level of agreement, on the other hand, were observed for items "I use a diversity of media tools." ($\overline{X}$ 39= 3.79), "I use social network for sharing information." ($\overline{X}$ 42= 3.86) and "I know the purpose of the messages in media." ($\overline{X}$ 36= 3.87).

According to research findings, participant prospective teachers responded "frequently" to all of the eight items in "information, media and technology skills" dimension. It is observed that the mean value ($\overline{X}$ = 3.94) corresponds to a similar range.

2. Findings on Evaluation of Prospective Science Teachers Perception of 21st Century Skills Competencies based on Gender Variable

The results of the t-test that was carried out to understand whether the Prospective Science Teachers' Perception of 21st Century Skills Competencies vary based on gender, are presented in Table 5.

Table 5. The results of the t-test in which the prospective science teachers' perceptions of 21st century skills competencies are compared based on gender

	Sub Scale	Gender	n	$\overline{X}$	ss	Levene Test F	Levene Test p	sd	t	p
Perception of 21st Century Skills Competencies	Learning and Innovation Skills	Female	147	3.70	.46	3.03	.083	191	.863	.389
		Male	46	3.63	.61					
	Information, Media and Technology Skills	Female	147	3.99	.64	.241	.624	191	2.057	.041*
		Male	46	3.71	.66					

As can be seen in Table 5, no significant difference was observed between the female and male prospective teachers for the "learning and innovation skills" sub dimension according to the t-test conducted based on gender variable t(191)= .863; p=.083]. Both female and male prospective teachers responded as "frequently" with mean values of ($\overline{X}$ =3.70) and ($\overline{X}$ =3.63).

A significant difference was observed between female and male participants, in favor of the female prospective teachers ($\overline{X}$ = 3.99), in the statistical analysis carried out regarding "information, media and technology skills" dimension of the scale [t(191)= 2.057; p=.041]. Accordingly, it can be said that the female prospective teachers believe in "information, media and technology skills" sub-dimension more than the male prospective teachers.

Table 6. MWU test results in which prospective teachers' 21st century skills competencies perceptions were compared based on gender.

Sub scale	Gender	n	$\overline{X}$	ss	Levene Test F	Levene Test p	MWU	p
Life and Career Skills	Female	147	4.10	.406	9.721	.002	2455.500	.005*
	Male	46	3.84	.558				

A significant difference was observed between female and male participants in the statistical analysis carried out regarding "life and career skills" dimension of the scale (U: 2455.500; p<.05). The difference is in favor of female prospective teachers.

3. Findings Regarding Attitude of Prospective Science Teacher towards STEM

Findings related to STEM are presented in separate tables for each sub-dimension, which are "mathematics", "science", "engineering", and "21st century skills".

Table 7. Views of prospective teachers about "mathematics" as a sub-dimension of STEM attitude scale

No	Statements	n	$\overline{X}$	ss
1	Mathematics is the worst course of mine.	193	3.78	1.20
2	I can think of choosing a career in which your mathematics is used.	193	3.36	1.06
3	Mathematics is hard for me.	193	3.61	1.14
4	I am a student who can be successful in mathematics.	193	3.80	1.02
5	I can handle many courses, but I cannot cope with mathematics.	193	3.88	1.10
6	I am confident that I can study advanced mathematics.	193	3.00	1.06
7	I can get good grades in mathematics.	193	3.76	1.00
8	I'm good in mathematics.	193	3.68	.961
	Mathematics	**193**	**3.61**	**.794**

When the means given in Table 7 regarding "mathematics" dimension of the scale are considered, the items with the highest level of agreement are "I can handle many courses, but I cannot cope with mathematics." ($\overline{X}$ 5=3.88), "I am a student who can be successful in mathematics." ($\overline{X}$ 4=3.80) and "I can get good grades in mathematics." ($\overline{X}$ 7= 3.76). The lowest level of agreement, on the other hand, were observed for items "I am confident that I can study advanced mathematics." ($\overline{X}$ 6= 3.00), "I can think of choosing a career in which your mathematics is used." ($\overline{X}$ 2= 3.36) and "I'm good in mathematics." ($\overline{X}$ 8= 3.68).

According to research findings, participant prospective teachers responded as "agree" to most the items in "mathematics" dimension of the scale. It is observed that mean value ($\overline{X}$ = 3.61) corresponds to a similar range. Based on these findings, it can be concluded that the prospective teachers' agreement with STEM in mathematics dimension is higher than average.

Table 8. Views of prospective teachers about "science" as a sub-dimension of STEM attitude scale

No	Statements	n	$\overline{X}$	ss
9	I am confident when I am dealing with science.	193	3.89	.742
10	I can think of a career in science.	193	4.05	.896
11	I hope that I will be using science after I graduate from the school.	193	4.27	.817
12	Having scientific knowledge will help me to earn my life.	193	4.31	.802
13	I will need science for my future works.	193	4.34	.802
14	I know that I can be successful in science.	193	4.19	.765
15	Science will be very important for my work.	193	4.18	.964
16	I can handle many courses, but I cannot cope with science.	193	4.05	1.10
17	I am confident that I can study advanced science.	193	3.68	.928
	Science	**193**	**4.11**	**.643**

When the views regarding "science" dimension of the scale are considered, the items with the highest level of agreement are "I will need science for my future works." (13= 4.34), "Having scientific knowledge will help me to earn my life." (12= 4.31) and "I hope that I will be using science after I graduate from the school." (11=4.27). The lowest level of agreement, on the other hand, were observed for items "I can handle many courses, but I cannot cope with science." ($\overline{X}$ 16= 1.94), "I am confident that I can study advanced science." ($\overline{X}$ 17= 3.68) and "I am confident when I am dealing with science." ($\overline{X}$ 9= 3.89). According to research findings, participant prospective teachers responded as "agree" to most the items in "mathematics" dimension of the scale. When the items in the Science dimension of the scale are taken into consideration in general, it is remarkable that prospective teachers mostly answered as "agree" and "strongly agree". Indeed, the general arithmetic mean was found as $\overline{X}$ = 4.11 and this corresponds to "agree" range.

Table 9. Views of prospective teachers about "engineering" as a sub-dimension of STEM attitude scale

No	Statements	n	$\overline{X}$	ss
18	I like to imagine new products.	193	4.21	.678
19	If I learn engineering then I can improve things that people use in their daily life.	193	3.79	.821
20	I am good at developing and repairing things.	193	3.52	1.02
21	I am interested in how the machines work.	193	3.19	1.05
22	It is going to be important for my future work to design products and structures.	193	3.52	.924
23	I am curious about how electronic devices work.	193	3.65	.967
24	I would like to use creativity and innovation in my future work.	193	4.04	.765
25	Knowing how to use Mathematics and Science together will provide me the opportunity to invent useful things.	193	3.98	.819
26	I believe that I can have a successful career in Engineering.	193	2.89	1.05
	Engineering	**193**	**3.64**	**.586**

In calculations regarding "engineering" dimension of the scale, the items with the highest level of agreement are "I like to imagine new products." ($\overline{X}$ 18=4.21), "I would like to use creativity and innovation in my future work." ($\overline{X}$ 24= 4.04) and "Knowing how to use Mathematics and Science together will provide me the opportunity to invent useful things." ($\overline{X}$ 25=3.98). The lowest level of agreement, on the other hand, were observed for items "I believe that I can have a successful career in Engineering." ($\overline{X}$ 26= 2.89), "I am interested in how the machines work." ($\overline{X}$ 21= 3.19) and "It is going to be important for my future work to design products and structures." ($\overline{X}$ 22= 3.52). When the items in the scale are taken into consideration in general, it is remarkable that prospective teachers mostly answered as "agree". Indeed, the general arithmetic mean was found as $\overline{X}$ = 3.64 and this shows a tendency in "agree" level towards statements in "engineering" dimension.

Table 10. Views of prospective teachers about "21st century skills" as a sub-dimension of STEM attitude scale

No	Statements	n	$\overline{X}$	ss
27	I trust myself that I can lead others to reach a goal.	193	3.86	.893
28	I believe that I can encourage others to do their best.	193	4.04	.809
29	I am sure I can work at high quality.	193	3.66	.850
30	I'm sure I will be respectful of the differences of my peers.	193	4.22	.808
31	I'm sure I can help my peers.	193	4.23	.787
32	I am sure I will consider the opinions of others while making a decision.	193	4.13	.811
33	I'm sure I can make changes if things do not go as planned.	193	4.08	.808
34	I believe that I can set my own learning goals.	193	4.13	.751
35	I'm sure I can manage my time wisely while working on my own.	193	3.98	.816
36	When there are tasks I have to do, I can choose which should be done first.	193	4.22	.740
37	I am confident that I can work well with students with different backgrounds.	193	4.02	.847
	21st Century Skills	**193**	**4.05**	**.568**

When the mean values given in Table 10 regarding "21st century skills" dimension of the scale are considered, the items with the highest level of agreement are "I'm sure I can help my peers." ($\overline{X}$ 31=4.23), "I'm sure I will be respectful of the differences of my peers." ($\overline{X}$ 30= 4.22) and "I When there are tasks I have to do, I can choose which should be done first." ($\overline{X}$ 36=4.22). The lowest level of agreement, on the other hand, were observed for items "I am sure I can work at high quality." ($\overline{X}$ 29= 3.66), "I trust myself that I can lead others to reach a goal." ($\overline{X}$ 27= 3.86) and "I'm sure I can manage my time wisely while working on my own." ($\overline{X}$ 35= 3.98). According to calculations, participant prospective teachers responded as "agree" to most the items in "21st century skills" dimension of the scale and the general arithmetic mean value regarding this sub dimension ($\overline{X}$ = 4.05) corresponds to a "agree" range.

4. Findings on Evaluation of Prospective Science Teachers' Attitude towards STEM based on Gender Variable

Findings on evaluation of prospective science teachers' attitude towards STEM based on gender variable are presented in Table 11 and Table 12.

Table 11. The results of the t-test in which the prospective science teachers' attitude towards STEM are compared based on gender

	Sub Scale	Gender	n	$\overline{X}$	ss	Levene Test		sd	t	p
						F	p			
STEM	Engineering	Female	147	3.61	.561	2.25	.135	191	-1.603	.143
		Male	46	3.76	.652					

No significant difference was observed between the attitudes of male and female prospective teachers according to the statistical analysis carried out regarding "engineering" sub-dimension of the scale [t(191)=-1.603; p=.143]. Both female ($\overline{X}$ =3.61) and male ($\overline{X}$ =3.76) prospective teachers responded as "agree".

Table 12. MWU test results in which prospective teachers' attitudes towards STEM were compared based on gender.

					Levene test			
Sub Scale	**Gender**	**n**	$\overline{X}$	**ss**	**F**	**p**	**MWU**	**p**
Mathematics	**Female**	147	3.63	.323	4.006	.047*	2958.000	.197
	Male	46	3.56	.401				
Science	Female	147	4.14	.510	4.969	.027*	3094.500	.385
	Male	46	4.00	.631				
21st Century Skills	Female	147	4.10	.502	11.308	.001*	2891.000	.138
	Male	46	3.88	.720				

No significant difference was observed based on gender variable in the evaluations conducted for STEM Attitude Scale sub dimensions "mathematics"(U=2958.000, p>.05); "science" (U=3094.500, p>.05); and "21st century skills" (U=2891.000, p>.05). It is remarkable that the mean of both female and male prospective teachers' attitude towards STEM are above average.

5. Findings on Relationship between Prospective Science Teachers' 21st Century Skills Competencies Perception and Attitude towards STEM

The scores obtained from the subscales of 21st Century Skills Competencies Perceptions Scale and STEM Attitude Scale were analyzed using Pearson correlation coefficient and the results obtained are presented in Table 13.

Table 13. Results of correlation analysis regarding relationship between prospective science teacher' 21st century skills competencies perception and attitude towards STEM

Variable	Learning and Innovation Skills	Life and Career Skills	Information, Media and Technology Skills	Mathematics	Science	Engineering	21st Century Skills
Learning and Innovation Skills	1	.595**	.520**	.199*	.329**	.396**	.524**
Life and Career Skills	.595**	1	.515**	.211**	.389**	.321**	.575**
Information, Media and Technology Skills	.520**	.515**	1	.087	.390**	.353**	.481**
Mathematics	.199*	.211**	.087	1	.080	.271**	.232**
Science	.329**	.389**	.390**	.080	1	.380**	.552**
Engineering	.396**	.321**	.353**	.271*	.380**	1	.491**
21st Century Skills	.524**	.575**	.481**	.232**	.552**	.491**	1

*p<.05, **p<.01

Correlational distributions were studied in order to determine whether there is a statistical relationship between 21st century skills competencies perceptions and attitudes towards STEM. When Table 13 is examined, statistically significant relationship between 21st century skills competencies perceptions of prospective science teacher and attitudes towards STEM were determined in some of the sub dimensions.

When the relations between the 21st century skills competencies perception sub dimension are examined, it is seen that there are positive relations. It is seen that the highest correlation among the 21st century skills competencies perception sub dimension is between "learning and innovation skills" and "life and career skills" (r = 0.595, p <.01). It is seen that there are positive moderate relations between the 21st century skills competencies perception sub-dimensions.

Relations among sub dimensions of STEM Attitude Scale were found to be related positively in moderate and low levels. The highest correlation among the STEM Attitude Scale sub dimensions is between the "science" dimension and "21st century skills "(r = 0,552, p <.01). There is no relation between the "mathematics" sub-dimension and the "science" sub-dimension.

According to Table 13, it is observed that there are relations between the sub-dimensions of 21st century skills competencies perception and sub-dimensions of attitude towards STEM. The highest relationship was detected between "life and career skills" and "21st century skills" sub-dimensions (r = 0,575, p <.01). This relationship can be interpreted as positive and moderate. This is followed by the relation between "learning and innovation skills" and "21st century skills "dimensions (r = 0.524, p <.01). It is also seen that there is no relation between "knowledge, media and technology" sub-dimension and "mathematics" sub-dimension.

DISCUSSION, RESULTS AND SUGGESTIONS

This research was conducted in order to determine both the 21st century skill perceptions of prospective science teachers and their attitude towards STEM, as well as the relationship between 21st century skill perceptions and STEM attitudes. According to the research findings, it was determined that the

prospective science teachers agree with the "learning and innovation" dimension of the 21st century skills competencies perceptions at a level higher than the average. Based on this finding, it can be said that the prospective teachers who have participated in the research can develop original and creative ideas, can try different ways to solve problems, and have the ability to analyze and evaluate their thoughts. In other words, it can be said that the prospective teachers' perception of learning and innovation is high. In a similar study conducted on the context of 21st century skills, it was concluded that the students participated in the research performed well on active learning, problem solving, learning how to learn, cooperation and communication skills (Gülen, 2013). In another study on learning and innovation skills, it was concluded that in a science class, depending on the subject, students used critical thinking and problem solving skills, communicated with their friends, asked each other questions within the group, and collaborated with each other (Atalay, 2015). In another study conducted on 21st century skills, it was concluded that students cared about doing research for reaching information and interpreting and structuring this information, and communicating with others throughout this process. In the same study, it was determined that trying to solve the problems encountered calmly yielded more positive results (Karakaş: 2015).

Participants in this study reported a modest level of "life and career skills" dimension of 21st century skills. In other words, it can be said that prospective science teachers have a positive perception about themselves in terms of flexibility, effective communication, conformity, taking responsibility, and respecting different cultures.

Prospective teachers reported positive opinion at a level higher than average regarding 21st century skills competencies "information, media and technology skills" dimension; in other words, it can be said that prospective teachers have a positive perception about themselves in terms of effective use of technology, making use of technology for acquiring information, making use of technology for analyzing information and effective use of social media. In several studies in different fields but similar in context also arrived at similar conclusions. In the study Atalay (2015) emphasized that the students were able to use skill of using new technologies which was defined as a sub-item of creativity and innovation skill. In a research conducted by Erol and Taş (2012), it was revealed that there was a significant relation between students' frequency of using information and communication in different dimensions and their creativity. In his perspective, it is possible to state that employment of new technologies is effective on use and improvement of creativity and innovation skills by the students. Erol and Taş (2012) emphasize that the reason for students' high level of 21st century skills may be arising from the efforts for integrating Turkish proficiency, problem solving, scientific research, creative thinking, entrepreneurship, communication, use of information and technology, critical thinking in all courses which was included in 2005 program. Indeed, is Kan's study (2006), it was concluded that the curriculum included these skills were successful at raising these skills.

According to research findings, there was no significant difference between female and male participants in terms of "learning and regeneration skills" sub dimension of the 21st century skills competencies perception scale. However, in terms of "life and career skills" and "information, media and technology skills" sub-dimensions of the scale, significant results in favor of female prospective teachers were obtained based on gender variable. According to this, it can be said that the perceptions of female prospective teachers about possessing and using 21st century skills in themselves are more positive. It can be said that this finding of the research is similar to other studies in the literature. According to Gülen (2013), female students' level of active learning, problem solving, learning how to learn, use activities incorporating cooperation and communication skills is higher than male students. Again according to Karakaş's (2015) research, it was determined that 21st century skill scores of students differed significantly in favor of female students. Depending on these results, it can be said that the 21st century skills of female students are more positive than male students. Şişman, Aypay, Acat and Karadağ (2011) prepared the TIMSS 2007 Turkey

national report, in which they emphasized that success level of female students in science is higher than male students among those participated in TIMSS 2007 examination from Turkey, and it can be said that female students with higher success level in science when compared to male students develop a more positive attitude towards 21st century skills.

According to research findings, it was determined that prospective science teachers agree with STEM in the sub-dimensions of "mathematics", "science", "engineering" and "21st century talents" at a level higher than moderate, which means they have a positive attitude towards these areas. This result is in line with the results of studies conducted by Yıldırım and Selvi (2015), Yenilmez and Balbağ (2016), Kızılay (2016) and Hacıömeroğlu, (2018). In another study, it was concluded that the computer teachers who took part in teaching practice were positive towards STEM-oriented teaching (Kan and Erçetin, 2018), which supports current study. In another study carried out on preschool teachers, it was set forth that teachers reported positive view on the STEM teaching approach that it will give an interdisciplinary point of view and improve problem solving, engineering, scientific process and 21st century skills and also that it will increase students' interest in the lectures (Uğraş, 2017). In another study, the views of teachers who received STEM training were examined and it was observed that the teachers had a positive opinion in general, and they emphasized that STEM education developed awareness and improved their perspective (Kan, Dadaş and Erçetin, 2018).

When the attitudes of prospective teachers towards STEM were examined on the basis of sub-dimensions, it was determined that attitudes towards "21st century skills" and "science" are more positive than those of "mathematics" and "engineering" fields. Especially the fact that the attitude towards STEM is higher in the field of "science" can be explained by the prospective teachers' positive attitudes about their own field. There was no significant difference in the attitudes of female and male prospective teachers towards STEM when the scale sub-dimensions were taken into consideration. The lack of significant differences among gender groups is in line with the result of Karakaya and Avgın (2016). Yenilmez and Balbağ (2016) emphasized similar results, as well, in terms sub-dimensions other than "engineering".

When the relations between sub-dimensions of Science Teacher Candidates' 21st Century Skills Competencies Perceptions scale were examined, it was observed that there were positive and moderate relations. Relations among sub-dimension of STEM Attitude Scale were found to be moderate and low positive attitudes. Among 21st century skills competencies perceptions and STEM attitude sub-dimensions the highest relation was found to be between "life and career skills" and "21st century skills" dimensions. This result is similar to the studies in the literature. Gülen (2013) stated that there is a moderately positive and significant relationship between the level of students' use of 21st century learning skills and the level of supporting these learning skills with information technology. Nevgi, Virtanen and Niemi (2006) reported that using technology in the teaching process influenced positively the active and collaborative learning. In a similar study, it is found that there is a moderately positive and significant relationship between both "engineering" and "techonology" and also "science" and "techonology" (Kızılay, 2006). It is also found by Eroğlu and Bektaş (2016), STEM activities are influential in creativity, productivity, teamwork, responsibility awareness. It has been determined that STEM-based applications have a great influence on improving the scientific process skills of the prospective teachers. (Gökbayrak and Karışan, 2017). Similar results were achieved in different studies (Tarkın-Çelikkıran and Aydın-Günbatar, 2017; Tezel and Yaman, 2017). In another study it was emphasized that, STEM based activities enable individuals to work together and obtain information from different sources (Aslan-Tutak, Akaygün and Tezsezen, 2017). In a study on prospective teachers, it has been determined that the increase in STEM awareness also positively affects entrepreneurship and innovation (Deveci, 2018).

Research shows that technology-enriched learning environments are effective in enabling students to gain high-level thinking skills. Information technologies support students in the process of acquiring information and restructuring it according to needs (Hopson, Simms and Knezek, 2002). Therefore, it can be said that Information Technologies has influenced the 21st century skills positively.

Some suggestions were developed in the light of findings obtained in the research. STEM, 21st century skills and practice of these two can be included within the scope of teacher training programs. Prospective teachers can be integrated in different fields other than their own field of education, thus, an education suitable for the spirit of STEM can be made possible. Thereby, the importance of interdisciplinary studies is emphasized. Studies can be conducted to investigate the factors that affect the development of 21st century skills in the education process of prospective teachers. More quantitative and qualitative studies on STEM and 21st Century skills should be carried out on prospective teachers who will start their profession soon and who are the executives of curriculum in schools. Thus, it is thought that an awareness can be raised among prospective teachers, in addition to contributing to the field.

Genişletilmiş Özet

Fen Bilgisi Öğretmen Adaylarının 21.Yüzyıl Beceri Algıları İle STEM'E Yönelik Tutumlarının İncelenmesi

Giriş

Bireylerin meydana gelen değişimlere ayak uydurabilmesi ya da tepki vermesi, teknolojiyi yakalayabilmeleri, hızla üretilen bilgiler arasında bilgiyi seçerek, analiz ederek ve değerlendirerek elde etmeleri, elde ettikleri bilgiyi günlük yaşamlarında kullanabilmeleri ve ürüne dönüştürebilmeleri için temel becerilerinin yanı sıra üst düzey beceri ve yeterliliklere sahip olması gerekmektedir. Bilgi toplumunda bireylerin sahip olması gereken bu beceri ve yeterlilikler 21. yüzyıl becerileri olarak adlandırılmaktadır (Anagün, Atalay, Kılıç ve Yaşar, 2016).

21. yüzyıl becerileri farklı biçimlerde sınıflandırılmaktadır. Bu sınıflandırmalarda bazı ortak özellikler vardır. 21. yüzyıl becerilerinde, yaratıcılığa, eleştirel düşünmeye, işbirliği içinde çalışmaya ve problem çözmeye vurgu vardır. 21. yüzyıl becerileri; bilgiyi bilmeyi değil bilgiye ulaşmayı ve bilgiyi kullanmayı, farklı kültürlere saygı ve farklı kültürlerle bir arada yaşamayı kapsar. 21. yüzyıl becerilerinde iyi bir vatandaş yerine etkin bir vatandaş vurgusu vardır. Teknolojik araçları kullanabilme ve okuryazarlıklar (bilgi, medya, dijital çağ) önemlidir. Bu becerilere sahip olan bireyler yaşamlarını daha nitelikli ve üretken sürdürürler. Dolayısıyla bireylerin bu becerileri eğitim yoluyla edinebilmeleri için bu becerilerin eğitim programlarında yer alması gerektiği söylenebilir (Anagün, Atalay, Kılıç ve Yaşar, 2016).

Günümüzde fen, teknoloji, mühendislik ve matematik alanlarında düşünen, üreten, sorgulayan ve yaratıcı bireylere olan ihtiyaç gün geçtikçe artmaktadır. Bu nedenle, bu alanlarda öğretme-öğrenme süreçleri için yeni ve farklı programların uygulanması zorunlu olmuştur. Bu uygulamaların en yeni olanı STEM eğitim ve uygulamalarıdır (Yıldırım ve Altun, 2015). STEM olarak ifade edilen kavram, Bilim (Science), Teknoloji (Technology), Mühendislik (Engineering) ve Matematik (Mathematics) kelimelerinin baş harflerinin kısaltmasından oluşmaktadır (Gonzalez & Kuenzi, 2012; Moomaw, 2013; Yıldırım ve Selvi, 2015). Türkiye'de STEM eğitiminin karşılığı olarak Fen, Teknoloji, Mühendislik ve Matematik disiplinlerinin kısaltması olan FeTeMM eğitimi kullanılmaktadır (Çorlu, 2014). STEM eğitimi, okul öncesi dönemden başlayıp yükseköğretime kadar sürecin tümünü kapsayan, fen, teknoloji, mühendislik ve matematik disiplinlerinin birbirleriyle entegre bir şekilde öğretilmesini içeren bir eğitim yaklaşımıdır (Hacıömeroğlu ve Bulut, 2016).

Bu araştırmanın amacı; 2016-2017 Eğitim Öğretim yılında Fen Bilgisi öğretmen adaylarının 21. yüzyıl beceri algıları ile STEM'e yönelik tutumları arasındaki ilişkiyi incelemektir. Ayrıca bu araştırma ile cinsiyet değişkenine göre bu algı ve tutumların farklılık gösterip göstermediğini belirlemek de amaçlanmıştır.

Yöntem

Bu araştırma betimsel araştırma yöntemi ve tarama modeline dayalı olarak yürütülmüştür. Tarama modellerinden ilişkisel tarama modeline göre desenlenmiştir. İlişkisel tarama modeli, iki ve daha çok sayıdaki değişken arasında birlikte değişimin varlığını belirlemeyi amaçlayan tarama yaklaşımına denir. İlişkisel tarama modelinde, değişkenlerin birlikte değişip değişmediği; değişme varsa bunun nasıl olduğu belirlenmeye çalışılır (Karasar, 2011). Bu araştırmanın katılımcılarını 2016-2017 eğitim öğretim yılında öğrenimine devam eden Fırat, Cumhuriyet, Erciyes, Muş Alparslan, Nevşehir Hacı Bektaş Veli Üniversitelerinin Eğitim Fakültesi Fen Bilgisi bölümünde okuyan son sınıf öğretmen adayları oluşturmuştur. Araştırmada veri toplamak amacıyla 21. Yüzyıl beceri algılarını belirlemeye yönelik Anagün, Atalay, Kılıç ve Yaşar (2016) tarafından geliştirilen "Öğretmen Adaylarına Yönelik 21. Yüzyıl Becerileri Yeterlik Algısı Ölçeği" ve STEM'e yönelik tutumlarını belirlemek amacıyla Faber ve diğ. (2013) tarafından geliştirilen ve

Yıldırım ve Selvi (2015) tarafından Türkçe'ye uyarlanan "STEM Tutum Ölçeği (STEM Attitude Scale)" kullanılmıştır. Araştırmada likert türü maddeler nicel araştırma yöntemleri kullanılarak analiz edilmiştir. Ölçekteki kişisel bilgiler ve likert türü maddelerle elde edilen veriler, SPSS 18.0 paket programına yüklenerek işlenmiştir. Öğretmen adaylarının cinsiyet değişkeni için, frekans ve yüzde teknikleri kullanılmıştır. Öğretmen adaylarının 21. Yüzyıl Becerileri ve STEM' e yönelik tutumlarını belirlemeye yönelik likert tipi maddelerin çözümü için ise aritmetik ortalama ve standart sapma yöntemleri kullanılmıştır. Araştırmaya katılan öğretmen adaylarının cinsiyet değişkenine göre, görüşleri arasında anlamlı fark olup olmadığını belirlemek üzere "t" testi analizi yapılmıştır. Öğretmen adaylarının 21. Yüzyıl Becerileri Yeterlik Algıları ile STEM'e yönelik tutumları arasındaki ilişkilerin belirlenmesi için Pearson Momentler Çarpımı Korelasyon Katsayısı (r) analizi tekniğinden yararlanılmıştır. Yapılan homojenlik testi sonucunda dağılım non-parametrik (homojen olmayan maddeler) ise, ikili karşılaştırmalarda Mann Whitney U testi (MWU) uygulanmıştır (Büyüköztürk, 2010).

Tartışma, Sonuç ve Öneriler

Araştırma bulgularına göre, fen bilgisi öğretmen adaylarının 21. Yüzyıl becerileri yeterlik algılarının "öğrenme ve yenilenme becerileri" boyutundaki önermelere sık sık düzeyinde katıldıkları saptanmıştır. Bu bulgudan hareketle şu sonuca ulaşılabilir: Araştırmaya katılan öğretmen adaylarının yaratıcı fikirler üretebileceği, karşılaştıkları problemleri çözmek için farklı yollar deneyebileceği, düşüncelerini analiz edip değerlendirme becerilerine sahip oldukları söylenebilir.

Araştırmada, katılımcı fen bilgisi öğretmen adayları 21. Yüzyıl becerileri yeterlik algıları "yaşam ve kariyer becerileri" boyutundaki önermelere sık sık düzeyinde katıldıkları saptanmıştır. Bu bulgudan hareketle, araştırmaya katılan öğretmen adayları çalışma ortamındaki belirsizliklerin üstesinden gelebilirler, kendi çalışma motivasyonlarını sağlayabilirler, bağımsız çalışabilirler, özgün projeler üretebilirler sonucuna ulaşılabilir.

Fen bilgisi öğretmen adaylarının 21. Yüzyıl becerileri yeterlik algılarının "Bilgi, medya ve teknoloji becerileri" boyutundaki önermelere sık sık düzeyinde katıldıkları saptanmıştır. Bu bulgudan hareketle fen bilgi öğretmen adaylarının bilgiye daha hızlı ulaştıklarını, bilgi akışını çeşitli kaynaklardan sağlayabileceğini, bilgiyi araştırmak ve değerlendirmek için farklı teknolojik araçlardan faydalanabilecekleri sonucuna ulaşılabilir.

Araştırma bulgularına göre 21. Yüzyıl becerileri yeterlik algısı ölçeği öğrenme ve yenilenme becerileri alt boyutu cinsiyet değişkeni açısından anlamlı bir farklılık ortaya çıkmamıştır. Ölçek alt boyutları, yaşam ve kariyer becerileri ile bilgi, medya ve teknoloji becerileri alt boyutlarında cinsiyet değişkenine göre kadın fen bilgisi öğretmen adayları lehine anlamlı sonuçlar bulunmuştur.

Araştırma bulgularına göre, Fen Bilgisi öğretmen adaylarının STEM'e yönelik tutumlarının Matematik, fen, mühendislik ve 21. Yüzyıl yetenekleri alt boyutlarındaki önermelere katılıyorum düzeyinde görüş bildirdikleri saptanmıştır. Edinilen betimsel istatistik sonuçlarına göre Fen Bilgisi öğretmen adaylarının STEM'e yönelik tutumları genel olarak olumlu yöndedir. Kadın ve erkek öğretmen adaylarının STEM'e yönelik tutumları arasında ölçek alt boyutları dikkate alındığında anlamlı farklılık olmadığı görülmüştür. 21. yüzyıl becerileri yeterlik algıları ile STEM'e yönelik tutum alt boyutları arasında en yüksek ilişkinin, yaşam ve kariyer becerileri ile 21. Yüzyıl yeterlikleri alt boyutları arasında orta düzeyde pozitif yönlü ilişki olduğu tespit edilmiştir.

Araştırmada elde edilen bulgular ışığında bazı öneriler geliştirilmiştir. Öğretmen yetiştirme programları kapsamında STEM'e, 21. Yüzyıl becerilerine ve bunlara ilişkin uygulamalı çalışmalara yer verilebilir. Öğretmen adaylarının öğrenim gördükleri bölüm dışındaki STEM alanlarına yönelik daha çok disiplinler arası çalışmalar yapmaları sağlanabilir. Nitel veriler de kullanılarak öğretmen adaylarının STEM

ve 21. Yüzyıl beceri algıları daha ayrıntılı irdelenebilir. 21. yüzyıl becerilerinin öğretmen adaylarına kazandırılması ve geliştirilmesine yönelik eğitim programlarının yapılandırılmasında öğretmen, idareci ve öğrencilerin rolünü inceleyen çalışmalar yapılabilir.

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