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Investigation of secondary school students' attitude towards technology and their STEM perceptions: Turkey sample

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ABSTRACT

STEM (Science, Technology, Engineering, and Mathematics) education is an approach that develops 21st century skills such as career choice in science and engineering, entrepreneurship, innovation, creative and critical thinking. The acronym STEM stands for the disciplines of science, technology, engineering, and mathematics. When looking from the past to the present, it has been observed that there has been an increase in STEM studies. However, there was no study which was conducted on STEM education in Turkey mostly consisted of studies which aimed at determining the interests, attitudes and achievements of students and prospective teachers, and there was no study on the relationship between students' tendencies to technology in STEM education and their STEM perceptions. It is necessary for societies that can rapidly keep up with developing technology and innovations Therefore, in this study, it was aimed to examine the relationship between the perceptions of secondary school students towards STEM fields, determining their attitudes towards technology, students' attitudes towards technology and its use in lessons, and the total perception levels of STEM fields and sub-dimensions. The study was completed in the fall semester of the 2019-2020 academic year. The data of the study were analyzed by quantitative survey model. In the study, 'Attitude towards Technology Scale' and 'STEM Perception Scale' were used as data collection tools. In the tests applied, the data were analyzed using the Independent Sample t-test, ANOVA, Pearson Correlation Analysis and Regression Analysis. According to data analysis and findings, it was determined that there was a moderately significant negative relationship between the students' attitude level towards technology, and the STEM perception level. In the light of the findings, the importance of STEM education was emphasized and recommendations were made to program designers, researchers and practitioners on this subject.

Keywords: STEM, technology, attitude, perception.

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INTRODUCTION

Perception and adoption of any technology dependent on interest of the local people, educational status, availability of resources, and methods of transfer of technology (Bargali et al., 2007; Pandey et al., 2006, 2011). It has become a necessity for countries to follow the developments which make them prosperous in order to have a dominant role in world affairs (Cooper and Heaverlo, 2013; Kennedy and Odell, 2014). In our age, societies are in a constant race in technology and science. Countries realize their development and growth through the advances in science and technology (Fletcher, 2017; Tewari et al., 2018). Future scientists, technologists and engineers are vital to keeping countries' economies afloat (Denton et al., 2021; Scott, 2009). Since education develops a country's economy and society, it is important that education programs closely follow the developments in science and technology (Carin and Bass, 2001; Federal Science, Technology, Engineering, and Mathematics (STEM) Education: 5-Year Strategic Plan, 2013; NRC, 2015). It has become a necessity to follow and implement current and different programs in order to raise individuals who think, produce and interrogate. In this context, developed countries attach importance to increasing the number of qualified individuals working in science, technology, engineering and mathematics disciplines. For this reason, countries are realizing education reforms (Akgündüz and Akpınar, 2018; Chesloff, 2013; Gülhan and Şahin, 2016). For this, it seems necessary to educate the individuals who have high innovation ability, critical thinking and problem-solving skills, science literacy, communication and media literacy, responsibility, namely, have 21st-century skills (Partnership for 21st Century Skills, 2008; Tseng et al., 2013). The newest and most effective of these applications is STEM education practices (Aydın-Günbatar, 2019; Bozkurt Altan, 2017; Bybee, 2010; Chatzopoulos et al., 2019; Dorouka et al., 2020; Erduran and Kaya, 2018; Karahan, 2017; Petousi and Sifaki, 2020; Tanenbaum, 2016; Tsupros et al., 2009; Lacey and Wright, 2009; Vlasopoulou et al., 2021; Yıldırım and Altun, 2015). STEM education is an approach that develops 21st-century skills such as career choice in science and engineering, entrepreneurship, innovation, creative and critical thinking. The acronym STEM stands for the disciplines of science, technology, engineering, and mathematics. In the 21st century, since the knowledge and skills expected from individuals are supported by STEM education, education policies were changed in this direction (Furner and Kumar, 2007; Land, 2013; Stinson et al., 2009).

STEM approach has emerged in America due to educational, economic and political concerns (Aydın-Günbatar, 2019; Benek and Akcay, 2019; Bybee, 2010; Kennedy and Odell, 2014; Martin-Paez et al., 2019). STEM education consists of the conscious combination of methods and knowledge of more than one discipline, at the same time, it aims to make meaningful learning in learning processes and associate the learned information with real-life equivalents and it focuses on critical thinking (Asigigan and Samur, 2021; Craig et al., 2018; Yıldırım and Altun, 2015). According to Roberts (2012) and Wang (2012), it is possible to coordinately use more than one discipline in STEM education. According to Faulkner (2006), STEM education is an educational approach that enables them to develop mathematics and science, two inseparable fields, and to use engineering and technology while doing this. Similarly, according to Bybee (2007), STEM education makes science education content more effective using technology, mathematics and engineering. Bybee (2000) states that Science and engineering complement each other. In addition, STEM education covers all education levels from pre-school to post-university education (Akgündüz and Akpınar, 2018; Gonzalez and Kuenzi, 2012).

The main purpose of STEM education is to raise individuals who make an important impact on their country on the world stage and have the skills required in the age. Another purpose of STEM is to enable students to transform the knowledge they have learned into an experience and to gain the ability to use them to meet the needs in society (Cover et al., 2011; Elliott et al., 2001). STEM education is an approach that aims to make learning permanent and supports creativity and critical thinking in line with this purpose. Declining interest in STEM disciplines and increasing economic competition in the 21st century have increased the need for STEM education (Joyce and Dzoga, 2011; Marginson et al., 2013).

Research problem

Some innovations have been made in the education levels for children who could do important things in the future, so they contribute to their country to have a dominant role in economic terms on dynamic and ever-changing world. In this context, the STEM approach has gained importance with the impact of economic, political and technological developments. For this purpose, it is important to examine students' perceptions and attitudes towards STEM disciplines and technology. When STEM education studies conducted in the national literature are examined, scale development and adaptation studies for STEM, studies examining the theoretical structure of STEM education and experimental studies investigating the effects of STEM education practices on students are encountered (Ayar, 2015; Baran et al., 2016; Gülhan and Şahin, 2016; Karahan et al., 2015; Sümen and Çalışıcı, 2016; Yamak et al., 2014). In addition, some studies examine students' perceptions and attitudes towards STEM fields separately. However, it is seen that STEM perceptions, which are important to guide children to choose the profession of their interest are not examined together. Similarly, very few STEM studies have taken into account students' attitudes towards technology (Altaş, 2018; Aydın et al., 2017; Gülhan and Şahin, 2016). For this reason, this study aims to examine secondary school students' STEM perceptions and their attitudes towards technology together. For this reason, the study aims to determine the STEM perceptions of secondary school students and their attitudes towards technology. Thus, the level of the students' views and cognitive structures on this subject will be examined. In this context, the relationship between STEM disciplines in students' minds, as well as STEM perceptions and attitudes towards technology will be examined. For this purpose, the problem sentence of the study was "What are the attitudes of secondary school students (5th, 6th and 7th grades) towards technology and their STEM perception?" in the form. In line with this purpose, answers will be sought for the sub-problems presented below:

Secondary school students;

1. Is there a significant difference in STEM perception scores in terms of i) gender and ii) grade level variables?
2. Is there a significant difference in technology attitude scores in terms of i) gender and ii) grade level variables?
3. Do STEM perceptions predict technology attitude scores?

METHOD

Research design

The study is a quantitative research and the survey model has been used. Survey researches are based on the opinions of the participants about a subject or event or the characteristics such as their interests, skills, abilities and attitudes, and generally the studies in which the sample is larger than other studies (Büyüköztürk et al., 2013).

Study group

The study group consisted of the fifth, sixth and seventh grades students in secondary schools located in a city center in the Secondary Black Sea region in Turkey in the fall semester of the 2019-2020 academic year. The convenience sampling method was used to determine the study group. Yıldırım and Şimşek, 2008). Convenience sampling is defined as the making sampling of individuals (volunteers) who are in the immediate vicinity, easy to reach and willing to participate in the study (Erkuş, 2009). In addition, choosing the applicable schools provides easy accessibility of the samples due to the limitations of time, money, and workforce (Büyüköztürk et al., 2013: 92). According to the study, the sampling unit in this study is secondary schools that are easily accessible in the immediate vicinity while the observation unit is all fifth, sixth and seventh grade students studying in these schools. In the study, The STEM Perception Scale and the Pupils' Attitudes towards Technology (PATT) were applied to the same students. Gender and grade information of the students participating in The STEM Perception Scale and the Pupils' Attitudes towards Technology are given in Table 1.

When the data in Table 1 is examined, 382 secondary school students participated in the study. 45% of the students participating in the study are female (171) and 55% male (211). 18% (70) of these students are fifth grade, 14% (53), sixth grade, and 68% (259) seventh grade.

Table 1. Demographic information of the study group.

	f	%
Gender		
Female	171	44.76
Male	211	55.24
Class		
5.Grade	70	18.32
6.Grade	53	13.87
7.Grade	259	67.80
Total	382	100

Data collection tools

'The STEM Perception Scale' and 'the Pupils' Attitudes towards Technology (PATT)' were used as the data collection tools in the study. Information about the data collection tools used in the study is given below.

STEM perception test

In order to measure the perceptions of secondary school students towards STEM teaching, a perception test which was developed by Knezek and Christensen (1998) and adapted to Turkish by Gülhan and Şahin (2016) was used. The scale had five items and the items were rated on a 7-point Likert type scale. The sub-dimensions of the STEM Perception Scale consisted of perception towards science, mathematics, engineering, technology and a career in science, mathematics, engineering or technology.

In the test, there were five adjectives for each of the sub-dimensions and five adjectives with their opposite meanings. There were seven options between two opposite poles. Students were asked to mark the option that was close to their thoughts. In the evaluation of the test, positive adjectives scored seven and negative adjectives scored one. Reliability values of sub-dimensions for the STEM perception test were given in Table 2.

When the data in Table 2 were examined, it was determined that the Cronbach Alpha values of the sub-dimensions of the test varied between 0.82 and 0.85 in the reliability analysis made for the "STEM Perception

Table 2. Reliability values of the sub-dimensions of the STEM perception test.

Test sub-dimensions	Reliability values
Science	.85
Mathematic	.84
Engineering	.82
Technology	.82
Career (Profession)	.84
All of the Test	.86

Test". According to these values, it is seen that the scale is a reliable scale at the secondary school level. Since the Cronbach Alpha coefficient is above 0.70 in the study, the scale is valid and reliable (Büyüköztürk et al., 2013; Sönmez and Alacapınar, 2011). In addition, if the Cronbach Alpha coefficient is between 0.60 and 0.80, the scale is considered highly reliable, and if it is between 0.80 and 1.00, the scale is considered highly reliable (Tavşancıl, 2002: 29). The sample question of the STEM Perception Test is as in Figure 1.

In Figure 1, there is a sample question of the STEM perception test. As can be seen in the sample question, there are antonyms in the STEM perception test. According to the numbering among these concepts, students were expected to mark the closest value according to them.

Mark the proper adjective according to your opinion according to its degree.

To me Science;

Fascinating	1	2	3	4	5	6	7	Ordinary
Enjoyable	1	2	3	4	5	6	7	Unenjoyable
Exciting	1	2	3	4	5	6	7	Unexciting
Meaningless	1	2	3	4	5	6	7	Meaningful
Boring	1	2	3	4	5	6	7	Interesting

Figure 1. Sample question for the STEM perception test.

The pupils' attitudes towards technology (PATT)

The Pupils' Attitudes towards Technology was used to determine students' attitudes towards technology and the use of technology in lessons. It was originally developed in the Netherlands, and its English version was developed by Bame et al. (1993) for use in the United States. The scale was adapted to Turkish by Çatak (2003). The overall reliability coefficient of the developed scale was found to be .83. Therefore, it can be said that the measurement tool can be used to measure students' attitudes towards technology and the use of technology in lessons. This scale is a five-point Likert type and consists of 33 items. The sub-dimensions of the pupils' Attitudes Towards Technology included Tendency to Technology, negativeness of technology, contribution and Importance of Technology, prejudice against technology competence, and technology for all. Participants are expected to respond with a grading between "I completely agree" (5), "agree" (4), "undecided" (3), "disagree" (2), and "I do not agree at all" (1).

Analysis of data

In this study, the scales given to the students were examined one by one in the process of analyzing the data. In addition, the researcher checked the data to make sure that it is both sensible and correct and then it is entered into the SPSS software program. The data were analyzed by using the quantitative analysis software program and examined in terms of gender and grade levels. In this study, the negative items were reverse coded in the study.

'Is there a significant difference between the variables of gender and grade level in STEM perception scores of secondary school students (5th, 6th, and 7th grade)?' and 'Is there a significant difference between the variables of gender and grade level in the technology attitude scores of secondary school students (5th, 6th, and 7th grades)?' to answer the research questions the test for normality, independent groups t-test and ANOVA were conducted. To answer the research questions 'is there a significant relationship between the perception scores and technology attitude scores of secondary school students (5th, 6th, and 7th grade) towards STEM fields?' Normality test and Kruskal-Wallis H analysis were conducted. all responses were coded as ; 5 = totally agree, 4 = agree, 3 = undecided, 2 = disagree, 1 = totally disagree for positive worded items while responses were reversed coded as (1 = totally agree, 2 = agree, 3 = undecided, 4 = disagree, 5 = totally disagree).

STEM Perception Test using a seven-point Likert-type scale is Osgood Semantic Scale type test. They can be scored as 1, 2, 3, 4, 5, 6, 7 or -3, -2, -1, 0, 1, 2, 3 (Osgood, 1967; cited in Tavşancıl, 2002). The first recommendation was used in this research. In the evaluation of the test, the score for positive adjectives was 7, and the score for negative adjectives was 1. The secondary category which is equidistant to both adjectives means neutral and is evaluated as 4 points. In this way, the total score for each sub-dimension was calculated. The fact that a student had a high score in a sub-dimension was interpreted as having a positive perception about that sub-dimension.

In the analyzes within the scope of the study, α = 0.05 was taken as a basis for the confidence interval. Reliability analysis refers to how consistently an instrument measures something. For the coefficient to be used in academic studies, it must be at least 0.60 (Kalaycı, 2010). Cronbach's alpha coefficients of the Stem perception scale and the attitude scale towards technology and the use of technology in lessons and their sub-dimensions are given in Table 3.

In Table 3, a shows Cronbach's Alpha coefficient while N indicates the number of items. According to the information in Table 3, it was observed that the internal consistency level of the majority of the Attitude Scale for Technology and the Use of Technology in Lessons and the STEM Perception Scale and their sub-dimensions were sufficiently reliable (α > 0.60). Kalaycı (2010) stated that a value above 0.60 and above is reliable.

Skewness and kurtosis values are one of the methods used to test whether the data show a normal distribution. The Normality Analysis for these tests was made and the skewness and kurtosis values were examined. Parametric analysis is performed when skewness and kurtosis values are obtained between ± 1.5 (Tabachnick and Fidell, 2013). In this study, the skewness and kurtosis values for the variable of the Attitude towards Technology and the Use of Technology in Lessons as skewness = .685 and kurtosis =. For the variable of STEM Perception, skewness = -.633 and kurtosis = -.059. It can be said that these values are in the range of ± 1.5. For this reason, parametric tests (independent samples t-test, one-way analysis of variance (one-way ANOVA), Pearson correlation analysis and regression analysis) and non-parametric test (Kruskal H) were used in the study. In our study, the t-test in the analysis related to gender, ANOVA in relations, and regression analysis to measure the relationship between more variables were used.

In this study, the assumptions for each of the data collection tools given above were carried out by all samples, gender and grade. When the assumptions did not materialize, non-parametric statistical analyzes were preferred and this situation was clearly stated before the analysis. In our study, a non-parametric test (Kruskal H) was used for the 5th-7th, 6th-7th grades because mathematics and career did not show homogeneous distribution (Doymuş, 2009).

Table 3. Cronbach's alpha coefficients of the stem perception scale and The Pupils' Attitudes towards Technology and their sub-dimensions.

	A	N
Attitude towards Technology	.896	33
Tendency to Technology	.827	15
Negativeness of Technology	.729	5
Contribution and Importance of Technology	.653	4
Prejudice against Technology Competence	.610	7
Technology for All	.194	2
STEM Perception level	.897	25
Perception towards Science	.824	5
Perception towards Maths	.908	5
Perception towards Engineering	.876	5
Perception towards Technology	.861	5
Perception towards Science, Maths, Engineering and Career	.872	5

FINDINGS

Students' perceptions toward STEM

The assumptions for the analysis of the STEM Perception Test and the normal Q-Q plot scatter plot of the STEM perception scale were examined. Whether the data belonging to the STEM Perception Test meet the supposition of normality was examined with the help of skewness and kurtosis coefficients and histogram graphics.

When the data in Table 4 are examined, there is no missing data. Q-Q plot scatter graph was used to find out whether the STEM Perception Scale shows normal distribution or not. Figure 2 shows the normality distribution of the STEM Perception Scale.

When Q-Q plot for Normal Distribution of the data in Figure 2 was examined, it was seen that the expected and actual values were distributed close to a line with a

Table 4. STEM perception test normality prediction.

Valid	382
Missing	0
Mean	141.75
Median	145.00
Skewness	-.633
Std.Error - Skewness	-.125
Kurtosis	-.059
Std. Error - Kurtosis	.249

slope of 45 degrees. This situation indicates that the normality of the distribution can be acceptable (Can, 2017).

Investigation of students' stem perception level according to gender

The results of the independent sample t-test used to determine whether the students' Total Perception Scale for STEM Fields and the scores of the sub-dimensions of this scale show a statistically significant difference according to gender is presented in Table 5.

According to the analysis of findings in Table 5; students' STEM perception was ($t(380) = .004$; $p > .05$), perception towards science ($t(380) = -1.113$; $p > .05$), perception towards mathematics ($t(380) = -1.592$; $p > .05$), perception towards technology ($t(380) = .546$; $p > .05$) and perception towards science, mathematics, engineering or technology career ($t(380) = -1.031$; $p > .05$) points. It was determined that there was no significant difference in the mean according to gender. However, it was determined that there was a significant difference according to gender in the mean scores of students towards engineering ($t(379{,}802) = 3.241$; $p < .01$). According to the means, it was observed that female students ($\bar{X} = 28.00$, $SD = 7.50$) had higher perception of attitude towards engineering than male students ($\bar{X} = 25.36$, $SS = 8.43$).

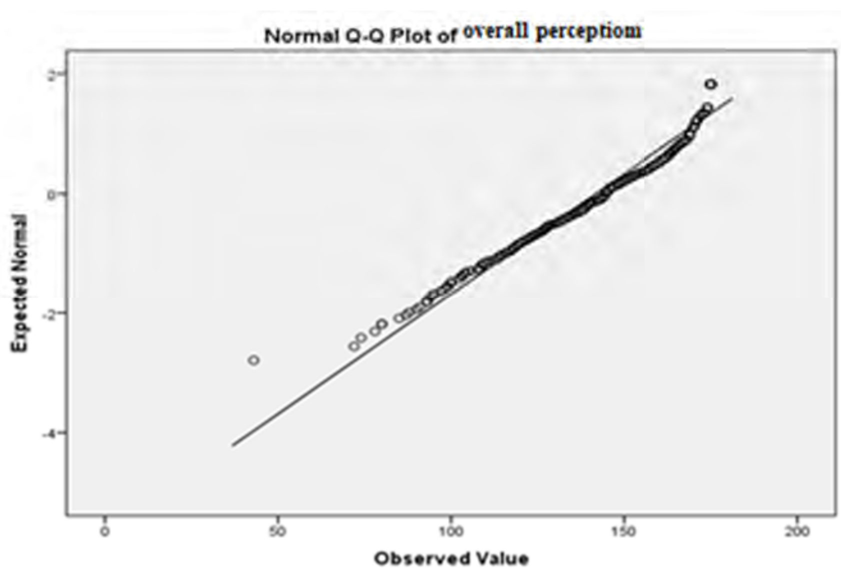

Figure 2. Q-Q plot for normal distribution of STEM perception scale.

Investigation of students' STEM perception according to grade level

One-way ANOVA findings used to determine whether the students' STEM Perception Scale and its sub-dimensions showed a statistically significant difference according to the grade level was presented in Table 6.

According to the findings of analysis in Table 6; it was determined that there was no significant difference in the mean scores of students' perception towards science ($F(2\text{-}379) = 2.226$; $p > .05$), perception towards engineering ($F(2\text{-}379) = .201$; $p > .05$) and perception towards technology ($F(2\text{-}379) = 2.309$; $p > .05$) according to the grade. However, it was determined that there is a significant difference according to the Grade level in the mean scores of students' overall perception of STEM fields ($F(2\text{-}379) = 10.402$; $p < .001$), perception towards mathematics ($F(2\text{-}379) = 17.892$; $p < .001$) and perceptions towards science, mathematics, engineering or technology career ($F(2\text{-}379) = 9.481$; $p < .001$. As a result of the Sheffe test performed to determine the group that caused the significant

Table 5. Comparison of students' STEM perception level according to gender.

	Gender	N	X̄	SS	Sd	T	P
Stem perception level	Female Male	211 171	141.76 141.75	25.93 23.57	380	.004	.997
Perception towards science	Female Male	211 171	29.63 30.36	6.68 5.90	380	-1.113	.266
Perception towards math	Female Male	211 171	25.68 27.22	9.68 8.96	380	-1.592	.112
Perception towards engineering	Female Male	211 171	28.00 25.36	7.50 8.43	380	3.241	.001
Perception towards technology	Female Male	211 171	30.32 29.95	6.77 6.30	380	.546	.585
Perception towards science, math, engineering and career	Female Male	211 171	28.12 28.87	7.85 6.21	379.8	-1.031	.303

Table 6. Comparison of students' STEM perception level according to the grade level.

	Grade	N	X̄	SS	Sd	F	P	Difference
STEM perception level	5. Grade 6. Grade 7. Grade	70 53 259	149.17 150.96 137.86	21.92 20.59 25.53	2-379	10.402	.000	5, 6 > 7
Perception towards science	5. Grade 6. Grade 7. Grade	70 53 259	30.10 31.58 29.58	6.39 5.63 6.44	2-379	2.226	.109	
Perception towards math	5. Grade 6. Grade 7. Grade	70 53 259	30.84 29.66 24.49	6.08 7.27 9.91	2-379	17.892	.000	5, 6 > 7
Perception towards engineering	5. Grade 6. Grade 7. Grade	70 53 259	26.83 27.45 26.68	8.22 7.93 8.02	2-379	.201	.818	
Perception towards technology	5. Grade 6. Grade 7. Grade	70 53 259	30.50 31.79 29.73	7.02 5.10 6.66	2-379	2.309	.101	
Perception towards science, math, engineering and career	5. Grade 6. Grade 7. Grade	70 53 259	30.90 30.47 27.38	5.07 5.14 7.75	2-379	9.481	.000	5, 6 > 7

difference, it was found that 5th grade ($\bar{X}$ = 149.17) and 6th grade ($\bar{X}$ = 150.96) students' STEM perception level and mathematic are higher than 7th grade students.

Investigation of students' attitude level towards technology according to gender

The results of the independent sample t-test used to determine whether students' scores on the scale and sub-dimensions of attitude towards technology showed a statistically significant difference according to gender were presented in Table 7.

According to the findings of analysis in Table 7, it had been determined that there was no significant difference in the mean scores of students' attitude towards technology (t (380) = -.510; p > .05), tendency to technology (t (380) = -.806; p > .05), negativeness of technology (t (380) = -.484; p > .05), contribution and importance of technology (t(380) = -1.320; p > .05), prejudice against technology competence (t(380) = .780; p > .05) and technology for all (t(380) = .483; p > .05) according to gender.

Table 7. Comparison of students' attitude levels towards technology according to gender.

	Gender	N	$\bar{X}$	SS	sd	t	P
Attitude towards technology	Female	211	68.16	17.71	380	-.510	.611
	Male	171	69.12	19.09			
Tendency to technology	Female	211	31.35	9.34	380	-.806	.421
	Male	171	32.13	9.60			
Negativeness of technology	Female	211	10.08	3.93	380	-.484	.629
	Male	171	10.28	4.13			
Contribution and importance of technology	Female	211	8.11	2.97	380	-1.320	.188
	Male	171	8.53	3.21			
Prejudice against technology competence	Female	211	13.75	4.316	380	.780	.436
	Male	171	13.41	4.260			
Technology for all	Female	211	4.86	1.85	380	.483	.629
	Male	171	4.77	2.04			

Investigation of students' attitude level towards technology according to the grade level

The findings of one-way ANOVA used to determine whether the students' scores on the attitude scale and its sub-dimensions towards technology showed a statistically significant difference according to the grade level or not were presented in Table 8.

According to the findings of analysis in Table 8, it was determined that there was no significant difference in the mean scores students' attitude towards technology (F (2-379) = .261; p > .05), tendency to technology (F (2-379) = .208; p > .05), negativeness of technology (F (2-379) = .986; p> .05), the contribution and importance of technology (F (2-379) = .374; p > .05) and technology for all (F (2-379) = 1.939; p > .05) according to the grade level. However, it was determined that there was a significant difference according to the grade level in the mean scores of students' prejudices against technology (F (2-379) = 4.467; p < .05). As a result of the Sheffe test performed to determine the group that caused a significant difference, it was seen that fifth grade students' ($\bar{X}$ = 14.91) prejudice against technology competence are higher than the sixth grade ($\bar{X}$ = 12.85) and seventh grade ($\bar{X}$ = 13.40) students'.

Investigation of the relationship between students' attitude towards technology and STEM perception levels

In this part of the study, before examining the relationship between the students' attitude level towards technology on the STEM perception, the relationship between the variables was examined. The results of the Pearson Correlation analysis carried out to examine whether there is a significant relationship between the Students' Attitude Scale towards Technology, and the STEM Perception Scale were shown in Table 9.

Considering the Pearson Correlation Analysis results presented in Table 9, it was determined that there is a negative medium level significant relationship between the students' attitude level towards technology and the use of technology in lessons and the overall perception level towards STEM fields (r (380) = -.41. p <.001). İt was found that there is a significant negative relationship between students' level of attitude towards technology and the use of technology in lessons, and perception towards science (r (380) = -.32, p < .001), perception towards mathematics (r (380) = -.11, p < .05), perception towards engineering (r (380) = -.20, p < .001), perception towards technology (r (380) = -.57, p < .001) and

Table 8. Comparison of students' attitude level towards technology according to grade level.

	Grade	N	X̄	SS	Sd	f	p	Difference
Attitude towards technology	5. Grade	70	69.97	17.09	2-379	.261	.770	
	6. Grade	53	67.83	17.57				
	7. Grade	259	68.37	18.83				
Tendency to technology	5. Grade	70	31.13	8.79	2-379	.208	.813	
	6. Grade	53	32.21	9.76				
	7. Grade	259	31.75	9.59				
Negativeness of technology	5. Grade	70	10.24	4.02	2-379	.986	.374	
	6. Grade	53	9.45	3.53				
	7. Grade	259	10.30	4.11				
Contribution and importance of technology	5. Grade	70	8.46	2.93	2-379	.374	.688	
	6. Grade	53	8.55	3.19				
	7. Grade	259	8.21	3.11				
Prejudice against technology competence	5. Grade	70	14.91	4.674	2-379	4.467	.012	5 > 6, 7
	6. Grade	53	12.85	4.097				
	7. Grade	259	13.40	4.161				
Technology for all	5. Grade	70	5.23	1.97	2-379	1.939	.145	
	6. Grade	53	4.77	1.77				
	7. Grade	259	4.72	1.95				

Table 9. Investigation of the relationship between students' attitude towards technology and STEM perception levels.

	1	2	3	4	5	6	7	8	9	10	11
1. Attitude towards technology	1										
2. Tendency to technology	.91**	1									
3. Negativeness of technology	.80**	.59**	1								
4. Contribution and Importance of technology	.81**	.74**	.56**	1							
5. Prejudice against technology competence	.66**	.38**	.56**	.37**	1						
6. Technology for all	.61**	.50**	.43**	.43**	.36**	1					
7. Stem perception level	-.41**	-.38**	-.41**	-.28**	-.20**	-.28**	1				
8. Perception towards science	-.32**	-.29**	-.27**	-.24**	-.19**	-.24**	.63**	1			
9. Perception towards math	-.11*	-.10	-.12*	-.06	-.08	-.07	.65**	.19**	1		
10. Perception towards engineering	-.20**	-.21**	-.23**	-.13*	-.03	-.10*	.62**	.20**	.14**	1	
11. Perception towards technology	-.57**	-.52**	-.52**	-.43**	-.33**	-.38**	.60**	.35**	.16**	.25**	1
12. Perception towards science, math, engineering and career	-.24**	-.22**	-.29**	-.13**	-.08	-.20**	.83**	.49**	.47**	.43**	.36**

*** p < .001, * p < .05.*

perception towards a career in science, mathematics, engineering or technology (r (380)) = -.24, p < .001) levels. Students' total perception level of STEM fields and tendency to technology (r (380) = -.38, p <.001), Negativeness of technology (r (380) = -.41, p < .001), contribution and importance of technology r (380) = -.28, p < .001), prejudıce agaınst technology competence (r (380) = -.20, p <.001) and technology for all (r (380) = -.28, p < .001) levels were found to be negatively significant.

The results of Simple Linear Regression analysis applied to examine whether the scores of the Students' Attitude Scale towards Technology and the Use of Technology in Lessons predicted on the Overall perception level towards STEM fields Scale scores are shown in Table 10.

According to the information in Table 10 it was determined that students' attitude level towards technology could be statistically predicted on the total perception level of STEM fields ($F_{(1-380)}$= 75.840; $p < .001$; $R^2 = .166$). According to this, it was observed that students' attitude towards technology and the use of technology in lessons (β = .41) had a moderate predictable negative effect on the STEM perception levels.

Table 10. Investigation of the effect of students' attitudes towards technology on the STEM perception level.

	B	Sh	β	T	p	f	Model(p)	R²
(Steady)	179.732	4.513		39.822	.000	75.840	.000	.166
Attitude towards technology	-.554	.064	-.408	-8.709	.000			
Dependent Variable: STEM Perception								

DISCUSSION

This study aimed to determine secondary school students' attitudes towards technology and their perceptions towards STEM fields, and the relationship between them. Accordingly, correlation analysis of the answers given by 5th, 6th and 7th grade students to the scales was performed. In this section, the findings obtained from the analysis are discussed in relation to other studies.

As a result of the study, it was determined that there was no significant difference in the students' overall perception towards STEM fields, perception towards science, perception towards mathematics, perception towards technology and perception towards science, mathematics, engineering or technology career according to gender. However, it was determined that there is a significant difference according to gender in the mean score of students' perception towards engineering. According to the averages, it was observed that female students' attitude perception towards engineering was higher than male students. It may be because female students have less knowledge about engineering fields in their career preference (Desy et al., 2011; Heaverlo, 2011; English et al., 2013; Kjaernsli and Lie, 2011; Mahoney, 2009; Maltese and Tai, 2011; Murphy et al., 2007; Nazier, 2010). Similarly, in a study conducted by Christensen and Knezek (2017) with secondary school students, it was determined that male students were more interested in making a career in STEM disciplines than female students. The result of another study found that there was no significant difference in the mean scores of the students' perception towards science, perception towards engineering and perception towards technology according to the grade. However, it was determined that there was a significant difference in the mean scores of the students' overall perceptions of STEM fields, their perception towards mathematics and their perceptions towards science, mathematics, engineering or technology career according to the grade. a significant difference is because the overall perceptions of 5th and 6th grade students towards STEM fields and their perception towards mathematics are higher compared to 7th grade students. In this context, it has been determined that the career awareness of the participants has developed with STEM applications and they tend to choose a career from the STEM fields in their future career plans. It can be concluded that the career choice of students can be improved with STEM applications. In addition, it can be said that the application has improved students' knowledge and awareness in terms of orientation to STEM fields. In addition, it can be said that the application has improved the knowledge and awareness of students in the orientation to STEM fields (Bybee, 2010). It has an important place in the career choice of students, especially in the secondary school period because students in this period start making decisions about their future career choices(Arıkan et al., 2020; Wyss et al., 2012). In this context, it can be said that the experiences in the study allowed to the students strengthen their career thinking about STEM fields, allowed them to review their judgments about their career preferences, and helped them to create interest in different professions in the field. For example, Christensen and Knezek (2017) and Gülhan and Şahin (2016) found in their study that STEM applications increased secondary school students' interest and perceptions about STEM fields. Again, Guzey et al. (2019) found in their study that secondary school students' interest in science and engineering improved as a result of their participation in engineering education. Alıcı (2018) concluded that STEM education statistically makes a significant difference in students' STEM career perceptions, their attitudes towards STEM disciplines and their interest in STEM careers. Similarly, Tseng et al. (2013) stated that project-based STEM activities improved students' attitudes towards engineering positively.

As a result of the study examining the relationship between the gender and grade level of technology attitude scores of secondary school students, it has been determined that there is no significant difference in the mean scores of the students' attitude towards technology and ıts use in lessons, the tendency to technology, negativeness of technology, contribution and ımportance of technology, prejudıce agaınst technology competence and technology for all according to gender. With similar findings, in the study conducted by Yıldırım (2015), it was determined that there is no significant difference in primary school students' level of technology use according to gender. Ünal and Bozcan (2010), on the other hand, determined that the university student's thoughts on the use of technology in education did not significantly different according to gender. Similarly, according to the study conducted by Torkzadeh and Dyke (2002), it was found that there was no significant difference between the attitudes of male and female students towards technology use in lessons. In addition, the findings of the studies conducted by Özçelik and Kurt (2007), and Ünal (2010) revealed that teachers' attitudes towards technology use do not differentiate according to gender. In a study conducted by Dağtekin and Artun (2016), which can be associated with this study, it was determined that the level of students' awareness about the use of technology in lessons does not significantly different according to gender.

As a result of the study, it was determined that there was no significant difference in the mean scores of the students' attitude towards technology and its use in lessons, the tendency to technology, negativeness of technology, contribution and importance of technology, and technology for all according to grade. However, it was determined that there was a significant difference in the mean scores of students' prejudice against technology competence according to the grade. Accordingly, it was observed that the fifth grade students' prejudices against technology competence were higher than the sixth and seventh grade students. For this reason, it can be interpreted that as the grade level of the students' increases, they become more familiar with technology and their perceptions about these areas are increasing. Similarly, in the study of Yalmancı and Aydın (2014), and Mıhladız et al. (2011) that examined students' attitudes towards technology according to their grade level, and it was found that there was a significant difference between sixth and seventh grade students and sixth and eighth grade students, and this difference was in favor of the seventh and eighth grade. In this case, it can be said that as the grade level increases, there is a positive differentiation in students' attitudes towards technology.

It was determined that there was a significant negative relationship between students' attitude level towards technology and its use in lessons, and their overall perception level towards STEM fields. At the same time, it was found that there was a moderately significant negative relationship between students' attitude level towards technology and the use of technology in lessons, and their perception towards science, perception towards mathematics, perception towards engineering, perception towards technology and their perception level towards science, mathematics, engineering or technology career. As a result of the study, it was determined that there is a moderate negative relationship between students' total perception level towards STEM fields and technology tendency, technology negativity, the contribution and importance of technology, proficiency prejudices towards technology, and technology levels for everyone. While students' perception in STEM areas is improving, the decrease in their attitude levels of the tendency to technology, negativeness of technology, contribution and ımportance of technology, prejudıce agaınst technology competence and technology for all according to gender may indicate that the learning that takes place in these areas does not reflect enough on the development of attitudes and skills. It is emphasized in various studies (Russell et al., 2003; Van Braak et al., 2004) that the use of technology and attitude towards technology develop positively depending on the class level. However, there is no study examining their perceptions in STEM fields and their attitudes towards technology.

CONCLUSIONS

From the present study, it is concluded that there was no significant difference between the student's perception towards science, perception towards engineering and technology perception points according to the grade level. However, it could be stated that there was a significant difference in the students' overall perception towards STEM fields, their perception towards mathematics and their perception towards science, mathematics, engineering or technology career according to the grade level. Accordingly, it was observed that the overall perception of STEM fields and their perceptions of mathematics of fifth and sixth grade students were higher than seventh grade students. In other studies examined, it was seen that STEM education had positive effects on students' academic achievement, attitude, science process skills and career choices. These results are in line with similar studies in STEM field (Elmalı et al., 2017; Honey et al., 2014; Göztepe Yıldız and Özdemir, 2015; Wyss et al., 2012; Yıldırım, 2016). As the grade level increases, the attitude towards STEM fields decreases; it can be explained by the increase in exam anxiety of students depending on the exam taken at the end of secondary school. When approaching the end of secondary school, students studying for the exam is different from the interactive learning method they were included in in the first years of secondary school. It can be said that it may cause negative changes in students' attitudes towards STEM fields.

RECOMMENDATIONS

It can be suggested to carry out studies that will include all other regions of Turkey, cover all other school levels, provide broader participation and use richer data collection tools, as it may be effective in making more general comments to reveal students' cognitive structures regarding STEM fields. It can be ensured that different strategies such as STEM education are included in the support education rooms and the training of the relevant teachers on this subject can be supported. At the same time, studies examining the relationship of STEM education with other skills are still being conducted. When the relationship of these skills with STEM education is understood, steps can be taken to improve them in curricula and school practices, and these steps can increase the effectiveness of STEM education. Similar studies can be conducted with the STEM attitude scale. The environments where engineers and scientists work can be visited by organizing out-of-school trips. In this way, students can have the opportunity to observe engineers and scientists in the environment where they work, and this can be effective in students' career choices in the STEM field. The study was conducted on a group of middle school students. It may be suggested to enrich similar studies with different samples and designs. The same study can be conducted with prospective teachers and teachers in terms of different samples. The study can also be repeated considering different demographic characteristics.

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