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IDENTIFICATION OF THE INTEREST OF TURKISH MIDDLE-SCHOOL STUDENTS IN STEM CAREERS: GENDER AND GRADE LEVEL DIFFERENCES

Ayşegül Ergün

Abstract. *In Turkey, it is predicted that the need for STEM employment in the 2016-2023 period will be close to one million and that about 31% of this need will not be met. Therefore, the identification of students' interest in STEM careers in middle-school is regarded as important. The aim of this research was to identify the interest of middle-school students in STEM careers. The sample of the research was made up of 892 students who received education in four middle-schools in the Aegean region of Turkey. In this research which was of the descriptive survey model, the STEM Career Interest Questionnaire was used to collect data. As a result of research, it was determined that the interest of male students in STEM careers is more positive compared to the female students. It was found that the interest in careers in terms of grade level did not display any differences in the area of technology, whereas it displayed differences in the areas of science, engineering and mathematics. In addition, it was identified that the interest in STEM careers displayed differences in terms of grade level and that as the grade level increases, the interest in STEM careers decreases.*

Keywords: *gender differences, grade level differences, STEM career interest, STEM education.*

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Introduction

Today, the developments in information and communication technologies which took place with globalization have influenced the economies of countries just like all areas of our lives. The need for countries which wish to have a say in global economy for generations which can develop new technologies and have the competence to produce goods of higher value which are also innovative has also increased. In this respect, the primary goal of countries is to educate qualified individuals who have careers in the areas of science, technology, engineering and mathematics (STEM) (Ministry of National Education [MoNe], 2016).

In the USA, STEM has become a government policy (National Research Council [NRC], 2010) and the interest in STEM disciplines and STEM education in many European countries has increased (Corlu, Capraro, & Capraro, 2014). However, a decrease has taken place in the number of students who choose the areas of physical sciences, engineering and mathematics in university education in numerous European countries (European Commission, 2004). Similarly, it is stated that the students who were placed in STEM areas in universities in Turkey from 2000 until 2014 has decreased as well (Akgunduz, 2016). When the rate of those students who have chosen STEM fields in higher education in 2015 in OECD countries is taken a look at, it can be seen that Turkey with 18% has remained below the OECD average of 27%. It has been stated that only 2% of those who have just started higher education have chosen science, mathematics, statistics, while the other 2% have chosen information and communication technologies and that this is the second lowest rate among the OECD countries (OECD, 2017). With respect to the paper of the Turkish Industry and Business Association (TUSIAD) (2017), it is predicted that the need for STEM employment in the 2016-2023 period will be close to one million and that about 31% of this need will not be met.

In Turkey, the STEM areas determined by the Assessment, Selection and Placement Center in line with the International Standard Classification of Education, are positive and natural sciences and engineering are dealt with as production and construction science educational areas (OSYM, 2017). As

examples to departments within these educational areas, physics, chemistry, biology, mathematics, computer, architecture and engineering can be given. In the conducted researches, it has been concluded that the number of students who prefer programs related to STEM fields in higher education institutions and graduate from these programs are quite lower than expected (Morganson, Jones, & Major, 2010; Shapiro & Sax, 2011). Similarly, it has been determined that the rate of students who had just enrolled in higher education and placed in STEM fields in 2016-2017 in Turkey has been quite low. This rate is lower than 1% in the area of information and communication technologies, 3.06% in the fields of natural sciences, mathematics and statistics and 8.66% in the fields of engineering and engineering works. As a result, it has been determined that career rates in STEM fields are in general quite low (Kizilay, 2018; OSYM, 2017). In the USA, the demands about labor force in STEM fields cannot be met in a sufficient manner (Knezek, Christensen, & Tyler-Wood, 2011; Moakler & Kim, 2014). In Turkey, it has been observed that the rate of students who graduated from the STEM areas of universities in 2013-2016 was around 17% and it is estimated that about 31% of STEM labor force demand in 2016-2023 will not be supplied (TUSIAD, 2017).

The interest in STEM fields brings academic success and career preference in STEM fields as well. Therefore, the interest of students in STEM fields being higher is extremely efficient in their making career preferences in these fields. Childhood and juvenescence periods are quite important in the formation and development of career interest. During primary school, children improve their interest in school and extracurricular activities (Tracey & Ward, 1998). In juvenescence, typical interest areas for adults start taking shape in parallel with the development of higher cognitive functions (Tracey & Ward, 1998; Tracey, 2001). It is stated that in particular 13-14 years of age in juvenescence is a crucial period in the development of profession interest (Gottfredson, 1996).

It is stated that decisions about STEM career goals and wishes are taken during the middle-school years. Therefore, informing middle-school students about STEM fields and careers will be effective in developing their STEM career interests and choosing the accurate career (Knight & Cunningham, 2004; Wyss, Heulskamp, & Siebert, 2012). The research results showed that students need to be guided towards their STEM careers starting with middle-school years (Christensen & Knezek, 2017; Wyss et al., 2012). In this respect, identifying STEM career interests of middle-school students was regarded as important.

Literature Review

In recent decades, the number of researches conducted on the relation between students' STEM career interest and STEM career pursuits has increased. One of the reasons for not preferring STEM careers is that students do not get familiar with the career opportunities in STEM fields in early ages and thus, they do not acquire the required knowledge to be able to have a career in a STEM field (Christensen & Knezek, 2017).

Since the researchers think that high-school years are critical in terms of shaping STEM career interest, more researches carried out in the high-school level have been seen in the literature (Bahar & Adiguzel, 2016; Korkut-Owen & Eraslan Capan, 2017; Lichtenberger & George-Jackson, 2013; Owen & Capan, 2018; Sadler, Sonnert, Hazari, & Tai, 2012; Wang, 2013). However, there were also researches in which STEM career interest of middle-school students has been determined (Karakaya, Avgin, & Yilmaz, 2018; Knezek, Christensen, Tyler-Wood, & Gibson, 2015; Unlu & Dokme, 2018; Yerdelen, Kahraman, & Tas, 2016).

Relation between Gender and STEM Career Interest

Numerous researches in the literature have dealt with the effect of gender on success and career interest in STEM areas. In these researches, it was concluded in general that males' STEM career interest is more positive compared to females and that they choose STEM careers more. The result of these researches in which the relation between gender and choosing STEM careers have been determined show that males in general have more of a tendency to choose these areas compared to females (Catsambis, 1994; Christensen & Knezek, 2017; Knezek et al., 2011; Sadler et al., 2012; Su, Rounds, & Armstrong, 2009; Unfried, Faber, & Wiebe, 2014). In recent years, different research results have been seen. For instance, it has been determined in a research that STEM career interest does not display differences in terms of gender (Yerdelen et al., 2016) or that female students' STEM career interest is higher than the male students (Karakaya et al., 2018). In these researches, while the role of gender gap in students' STEM academic success can be questioned by comparing various data and test scores, it is accepted without doubt that women are underrepresented in STEM careers (Blickenstaff, 2005). In Turkey, it has been determined that there were more males in STEM areas in higher education in 2002-2012 and that in particular engineering is seen as a

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male dominant career. However, it has been stated that during these years, the gap between genders in natural sciences within STEM areas has been closed in general (Korkut-Owen, Kelecioglu, & Owen, 2014).

It is stated that the attitudes of female students toward science lessons and careers in the field of science is more negative compared to male students (Cannon & Simpson, 1985; Weinburgh, 1995). In addition, it has been observed that female students' STEM areas interest has decreased in a speedier manner compared to male students during high-school years (Brotman & Moore, 2008; Wells, Sanchez, & Attridge, 2007). Similarly, it has been stated that while the rate of male students who are interested in a STEM career during high-school years remains stable, this rate decreases for female students and that the inequality in STEM careers takes place more in engineering than science in favor of male students (Sadler et al., 2012). In addition, it has been determined that the attitudes of female students toward engineering and technology is less positive in all educational levels compared to male students (Unfried et al., 2014). According to the outcomes of another research, it has been identified that the acquisitions of female students in science, mathematics, technology and engineering fields are higher compared to male students and that the STEM career interest of male students is higher compared to female students (Knezek et al., 2011).

In the outcomes of the research, it has been stated that STEM career areas which female and male students are interested in also display differences. For instance, there are researches which show that females are choosing natural sciences more and that male students choose engineering, production and construction areas more (Korkut-Owen et al., 2014; Sadler et al., 2012). However, it has been determined that female students in general are interested in biological sciences and male students are more interested in physical sciences (Osborne, Simon, & Collins, 2003; Sadler et al., 2012). In another research, it has been defined that the interest of secondary school female students who participate in their universities' summer camp activities organized under the guidance of female role models in science and mathematics developed more and that they showed more interest in possible STEM careers in higher education (Dubetz & Wilson, 2013).

In a research carried out with middle-school students, the impact of female and male students' STEM career interest on their tendencies toward mathematics, science and engineering and creative dispositions has been analyzed. It has been reported that creative tendencies and disposition towards science explains 33% of the variance in STEM career interest for male students and that disposition toward science and mathematics explains 36% of the variance in STEM career interest for female students. It has been determined that tendencies towards engineering have a closer relation with female students' STEM career interest (Knezek et al., 2015). As an outcome of another research, it has been stated that the difference between skills concerned to the perception of career in the field of science is more effective compared to the difference in genders (Knezek et al., 2011).

Relation between Grade Level and STEM Career Interest

In the literature, there are research results which aimed at how STEM career interest differs in different educational levels and different grade levels (Karakaya et al., 2018; Unfried et al., 2014; Unlu & Dokme, 2018; Wiebe, Unfried, & Faber, 2018; Yerdelen et al., 2016). In these researches, it has been determined in general that the attitudes of students towards STEM careers are not constant during elementary and middle-school and that they display differences.

The results of a research in which the attitudes of elementary, secondary and high school students towards STEM fields have been analyzed have displayed that older students have a less positive attitude concerning all STEM fields compared to younger students (Unfried et al., 2014). With respect to the outcomes of another research conducted with a similar sample, it has been determined that the students' STEM career interest decreases with age and tends to get balanced during their high-school years. The researchers stated that these results might have emerged due to the fact that students being more mature during their high-school years and understanding their skills, interest fields and STEM careers better may result in their focusing on certain careers within or outside STEM fields (Wiebe et al., 2018).

In a research carried out in Turkey with 6th, 7th and 8th grade students, a significant difference was determined in grade levels in terms of STEM career interests of students (Karakaya et al., 2018). In a research in which the correlation between STEM profession interest and attitudes of middle-school students from a low socioeconomic level with grade level was analyzed, it was determined that the students had a positive attitude towards STEM and that their attitudes did not display differences in terms of grade level. In addition, it has been determined that STEM profession interest with the exception of physical sciences did not display a significant difference between grade levels. A positive correlation was found between the students' STEM profession interest and attitudes. The

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researchers stated that middle-school students at a low socioeconomic level in Turkey have limited knowledge on STEM career choices and that sufficient guidance should be given to them during their middle-school years on STEM careers (Yerdelen et al., 2016).

It was seen that, the number of researches identifying STEM career interest in middle-school level in the literature is less compared to high-school level. In addition, in researches in which the effect of gender and grade level on STEM career interest are analyzed, different results have been obtained. In this respect, it was aimed at contributing to the related literature with the findings to be obtained in this research which aims at identifying the STEM career interest of Turkish middle-school students. It is expected that the results to be obtained will guide researchers and educational policy makers in terms of what needs to be done about developing STEM career interest in early ages.

Problem Statement

Countries take steps towards the integration of STEM in their educational policies with the purpose of meeting the labor force. Educational policy makers give importance to the acquisition of critical thinking, cooperation, creativeness and communication skills which are required by the labor force of 21st century, besides their attempts in developing the interest in STEM careers. It is being aimed at making the acquisition of 21st century skills by giving place to STEM education in primary, middle and high school curricula as well (NRC, 2010; Rynearson, Douglas, & Diefes-Dux, 2014). In this respect, national policy makers underline developing the interest of students in STEM context, learning and developing their careers more.

In Turkey, the first step in terms of STEM integration has been taken with the 'Science and Technology' lesson syllabus in 2005. In 2017, 'Science and Engineering Applications' unit and 'Engineering and Design Skills' have been included in the engineering component of STEM education of the Physical Sciences Lesson Syllabus (MoNe, 2017). In the program published in 2018, 'Science, Engineering and Entrepreneurship Applications' has been included in all units (MoNe, 2018). One of the general purposes of physical sciences curricula is to develop career awareness and entrepreneurship skills related to physical sciences (MoNe, 2017; MoNe, 2018). The interest of students in STEM careers is an important factor which determines their career preference in the future. The researches have shown that, students' choosing a STEM career and continuing their university education in the same area depends on their interest in STEM careers (Astin & Astin, 1992; Maltese & Tai, 2011). It is stated that students' interest in and objectives about careers in their middle-school years affects both their academic performance and the career they choose in the future (Tai, Liu, Maltese, & Fan, 2006). According to the researchers, the interest and expectations of eighth grade students in career plays a significant role in choosing careers in particular related to science and engineering (Tai et al., 2006). For this reason, the identification of students' interest in STEM careers in middle-school was regarded as important in terms of receiving education in the STEM fields they are interested in during high-school and university and participating in STEM labor force. In this respect, it was aimed at identifying the interest of middle-school students in STEM careers in this research. For this aim, answers to the following research questions were sought:

1. At which level is the STEM career interest of middle-school students?
2. Does the STEM career interest of middle-school students display a significant difference in terms of STEM fields?
3. Does the STEM career interest of middle-school students display a significant difference in terms of gender?
4. Does the STEM career interest of middle-school students display a significant difference in terms of grade level?

Methodology of Research

Design

In the research, the descriptive survey model was used with the purpose of identifying the STEM career interest of middle-school students. Researches conducted in the descriptive survey model which are widely used in social sciences aim at displaying the attitudes, views or behaviors of individuals about the studied subject (Creswell, 2008). The research was carried out in the 2016-2017 academic year. In order to speed up the research in terms of determining the sample group, the convenience sampling method was used. The data of the research was collected through the STEM Career Interest Questionnaire (Kier, Blanchard, Osborne, & Albert, 2014).

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Sample

The sample of the research was made up of 892 students who received education in the 2016-2017 academic year in four middle-schools in a rural district of a city in the Aegean region of Turkey, which has a medium level of socioeconomic structure. In the determination of the sample, the case sampling method among the purposeful sampling types which can be easily accessed was used. In this sampling method, since the researcher chooses a close and easily accessible case, this speeds up the research and makes it practical (Yildirim & Simsek, 2016). The scale prepared by Yazicioglu and Erdogan (2004, p.50) was used to determine the size of the sample. Since there are about 5000 students in the population, the sample size required for a 97% confidence level on the chart of 5000 people is 880 people. Therefore, it was aimed at reaching at least 880 students and 892 volunteering students were reached. The distribution of demographic data related to the research sample is presented in Table 1.

Table 1. Demographic characteristics of the sample.

Grade Level	Female	Male	Total	Percentages
5	100	110	210	23.50
6	118	94	212	23.80
7	102	86	188	21.10
8	166	116	282	31.60
Total	486	406	892	100.0

As it can be seen in Table 1, 54.48% of the sample consisted of female students and 45.52% of the sample consists of male students. 23.50% of the sample consisted of 5th graders, 23.80% consisted of 6th graders, 21.10% consisted of 7th graders and 31.60% consisted of 8th graders.

Data Collection Tool: STEM Career Interest Questionnaire (STEM-CIQ)

In the research, the questionnaire developed by Kier et al. (2014) and adapted in Turkish by Unlu et al. (2016) was used to identify STEM career interest of middle-school students. The questionnaire adapted to Turkish was of a "5-point Likert scale" (strongly disagree to strongly agree) and consisted of four sub-dimensions as science, technology, engineering and mathematics and a total of 40 questions with 10 questions in each sub-dimension. The questionnaire's total Cronbach's alpha value was stated as .93 and the value of the sub-dimensions was stated successively as .86, .88, .94 and .90 (Unlu et al., 2016). In this research, questionnaire was given to 368 8th grade students and its validity and reliability researches were completed. According to the fit indexes obtained as a result of the confirmatory factor analysis done for construct validity (χ^2/df = 3.02, RMSEA= .06, SRMR= .07, CFI= .89, NNFI= .96), it was determined that the conformity of the structure of the model with data was good. As a result of the reliability analysis, the questionnaire's general Cronbach's alpha value was determined as .88 and the values of the sub-dimensions were determined successively as .82, .80, .83 and .86. According to Buyukozturk (2017), since the Cronbach's alpha value being .70 and over means that it is acceptable for the reliability of the measurement tool, it can be stated that the questionnaire is reliable.

Data Analysis

In order to determine whether the data obtained in the research displayed normal distribution or not, the skewness and kurtosis values of data obtained from the questionnaire and the sub-dimensions and the results of the analysis are presented in Table 2.

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Table 2. Skewness and Kurtosis values related to the questionnaire and the sub-dimensions.

Sub-dimensions and the STEM-CIQ	Skewness	Kurtosis
Science	-0.597	0.068
Technology	-0.790	1.054
Engineering	-0.404	0.042
Mathematics	-1.097	1.040
STEM-CIQ	-0.360	0.082

The skewness and kurtosis values being between +1.5 and -1.5 expressed that the data displays normal distribution (Tabachnick & Fidell, 2007). When the values in Table 2 were analyzed, it was determined that the data obtained from the questionnaire and the sub-dimensions displayed normal distribution. Therefore, in the analysis of data, the independent sample t test and One Way ANOVA among the parametric tests were used. In order to determine the effect of gender on STEM career interest, Cohen's *d* value which shows the extent of the effect was calculated. The size of the effect was evaluated as independent from the *d* sign and can have any value; the 0.2, 0.5 and 0.8 values which *d* may have are evaluated successively as small, medium and great effects (Green & Salkind, 2005; p.169). In order to determine the effect of grade level on STEM career interest, the eta square (η^2) value which shows the effect dimensions was calculated. The 0.01 value eta square may have is interpreted as small, 0.06 value as medium and 0.14 value as great effect size (Green & Salkind, 2005, p.157).

Since the score value which belongs to each of the questions in the questionnaire is between 1.00 and 5.00, as the obtained scores get closer to 5.00, level of STEM career interest was accepted as high and as it gets closer to 1.00, it was accepted as low. The average score obtained by dividing the number of marked questions with the sum of the question scores of the marked questions can give an idea to the researchers about the STEM career interest of students (Turgut & Baykul, 1992). Therefore, scores below 2,60 received from the STEM career interest questionnaire point out to negative interest and scores which are 2.60 and over point out to positive interest. The score intervals about the questionnaire questions are presented in Table 3.

Table 3. The score intervals related to the questionnaire questions.

Likert -Type Scale Response	Point	Point Range
Strongly Agree	5.00	4.20-5.00
Agree	4.00	3.40-4.19
Neither Agree nor Disagree	3.00	2.60-3.39
Disagree	2.00	1.80-2.59
Strongly Disagree	1.00	1.00-1.79

Results of Research

Results Related to the First Research Question

In order to determine STEM career interest levels of middle-school students, descriptive analysis was done. The lowest and highest score values the students received from the questionnaire and the sub-dimensions and the mean (*M*) and standard deviation (*SD*) of the scores are presented in Table 4.

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Table 4. Results of descriptive analysis of the middle-school students' STEM career interest.

Sub-dimensions and the STEM-CIQ	*N*	Min	Max	M	SD
Science	892	2.20	5.00	4.06	.564
Technology	892	1.00	5.00	3.97	.619
Engineering	892	1.00	5.00	3.54	.763
Mathematics	892	1.00	5.00	4.11	.695
STEM-CIQ	892	2.33	5.00	3.93	.502

According to the findings in Table 4, it can be stated that average scores of the students' related to the questionnaire and sub-dimensions are over (*M*=2.60) value and thus, their STEM career interest was positive. It was seen that their career interest in terms of the areas were mathematics, science, technology and engineering from the highest to the lowest. The students' career interest levels in terms of STEM fields are shown in Figure 1 in graphics.

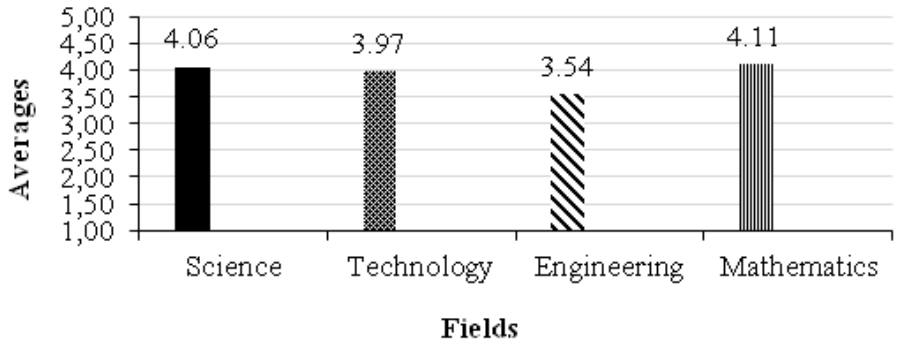

Figure 1. STEM fields career interest levels.

Results Related to the Second Research Question

With the purpose of determining whether STEM career interests of middle-school students display significant differences or not in terms of fields, the One Way ANOVA test was done. The results of the analysis are presented in Table 5.

Table 5. Results of the One way ANOVA test related to STEM fields career interests.

Sources of Variation	*SS*	*df*	*M*	*F*	*p*	Eta square (η2)
Between Groups	179.734	3	59.911	135.378	.0001**	.10
Within Groups	1577.246	3564	.443			
Total	1756.980	3567				

*Note. **Level p-values of < .01.*

According to the analysis results in Table 5, the middle-school students' STEM career interests displayed statistically significant differences in terms of STEM fields [$F_{(3\text{-}3564)}$=135.378; p<.01]. The test result showed that the effect of the calculated effect size (η^2 = .10) of the fields on this difference is of medium scale. In order to determine which STEM fields this difference in question is related to, firstly the equality of the variances was checked. The Levene test result was determined that the variances were equal (p>.05). Therefore, the Post Hoc Tukey test was done and the results of the analysis are presented in Table 6.

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Table 6. Results of the Post Hoc Tukey test related to the difference between the STEM fields career interest scores.

Field	Field	*p*
Science	Technology	.008**
	Engineering	.0001**
	Mathematics	.396
Technology	Science	.008**
	Engineering	.0001**
	Mathematics	.0001**
Engineering	Science	.0001**
	Technology	.0001**
	Mathematics	.0001**

*Note. **Level p-values of < .01.*

According to Table 6, there was no significant difference between the science career interest of middle-school students and their mathematics career interest. On the other hand, a significant difference was found between the interest levels of science and technology and engineering fields in favor of the field of science. A significant difference was found between mathematics field interest and technology and engineering fields interest levels in favor of mathematics field. In addition, a statistically significant difference was found between technology and engineering fields interest levels in favor of the technology field.

Results Related to the Third Research Question

The results of the independent sample t test analysis done with the purpose of determining whether the middle-school students' STEM career interests displayed a significant difference in terms of gender or not are presented in Table 7.

Table 7. Results of the independent sample t test analysis of STEM career interest in terms of gender.

Sub-dimensions and the STEM-CIQ	Gender	*N*	*M*	*SD*	*df*	*t*	*p*	*Cohen's d*
Science	Female	486	4.12	0.55	890	3.03	.002**	0.20
	Male	406	4.00	0.56				
Technology	Female	486	3.89	0.65	890	-3.96	.0001**	0.27
	Male	406	4.06	0.57				
Engineering	Female	486	3.39	0.74	890	-6.86	.0001**	0.46
	Male	406	3.73	0.75				
Mathematics	Female	486	4.16	0.62	890	2.29	.022*	0.15
	Male	406	4.05	0.77				
STEM-CIQ	Female	486	3.89	0.49	890	-2.12	.034*	0.14
	Male	406	3.96	0.52				

Note. *Level *p*-values of < .05. **Level *p*-values of < .01.

According to Table 7, the students' career interest displays a statistically significant difference in the fields of science [$t_{(890)}$=3.03; p<.01], technology [$t_{(890)}$=-3.96; p<.01], engineering [$t_{(890)}$=-6.86; p<.01] and mathematics [$t_{(890)}$=2.29; p<.05]. In addition, it was seen that STEM career interest displayed a statistically significant difference in terms of gender as well [$t_{(890)}$=-2.12; p<.05]. When the Cohen's d effect size (d) values were analyzed, it was found

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that the gender effect on engineering career interest is of medium scale and its effect on career interest in other sub-dimensions and the questionnaire in general is of small scale. The average career interest scores of the students' related to the questionnaire and the sub-dimensions are shown in Figure 2 in graphics.

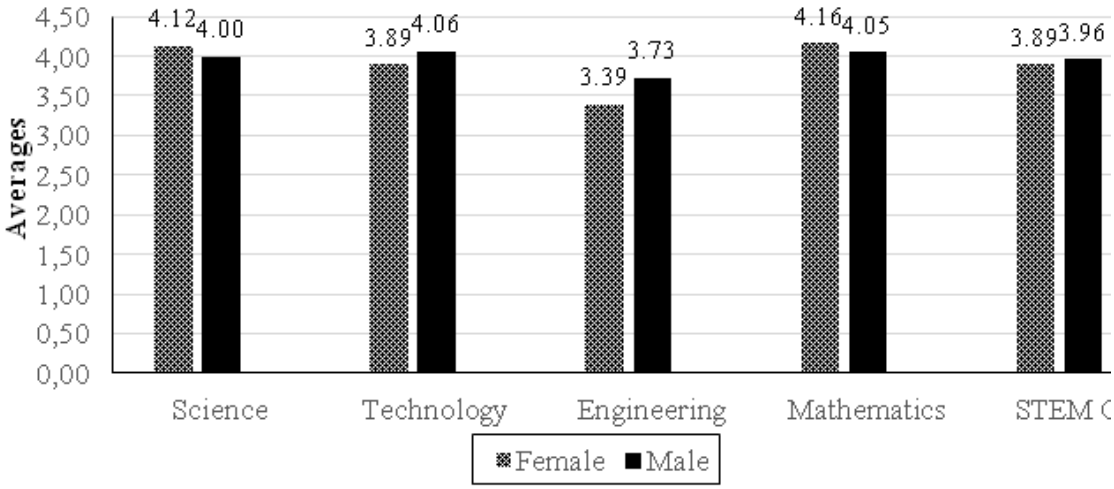

Figure 2. Average career interest scores of female and male students related to the questionnaire and the sub-dimensions.

When the average interest scores in Figure 2 are analyzed, it can be seen that the difference is in favor of female students in science and mathematics fields and in favor of male students in technology and engineering fields. According to the career interest, average scores obtained from the whole questionnaire, STEM career interest of the male students was found to be higher compared to the female students.

Results Related to the Fourth Research Question

Firstly, a descriptive analysis was done to determine whether the middle-school students' STEM career interests displayed differences in terms of grade levels. According to the grade levels, the frequency, mean (*M*) and standard deviation (*SD*) values related to STEM CIQ and sub-dimensions are presented in Table 8.

Table 8. Results of the descriptive analysis results related to STEM CIQ and sub-dimensions in terms of grade level.

Sub-dimensions and the STEM-CIQ	Grade Level	*N*	*M*	*SD*
Science	5th grade	210	4.13	.47
	6th grade	212	4.22	.51
	7th grade	188	4.07	.52
	8th grade	282	3.89	.63
Technology	5th grade	210	4.02	.58
	6th grade	212	4.02	.69
	7th grade	188	3.91	.56
	8th grade	282	3.94	.61

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Sub-dimensions and the STEM-CIQ	Grade Level	*N*	*M*	*SD*
Engineering	5th grade	210	3.74	.61
	6th grade	212	3.55	.72
	7th grade	188	3.45	.88
	8th grade	282	3.45	.77
Mathematics	5th grade	210	4.41	.57
	6th grade	212	4.29	.56
	7th grade	188	4.03	.61
	8th grade	282	3.82	.78
STEM-CIQ	5th grade	210	4.07	.45
	6th grade	212	4.02	.48
	7th grade	188	3.86	.47
	8th grade	282	3.78	.52

The results of the One Way ANOVA test analysis done with the purpose of determining whether there is a statistically significant difference between the average values obtained in Table 8 is presented in Table 9.

Table 9. Results of the One Way ANOVA test related to STEM CIQ and sub-dimensions in terms of grade level.

Sub-dimensions and the STEM-CIQ	Sources of Variation	*SS*	*df*	*M*	*F*	*p*	*Eta square* (η^2)	*Tukey*
Science	Between Groups	14.576	3	4.859	16.025	.0001**	.05	5>8 6>7 and 8 7>8
	Within Groups	269.242	888	.303				
	Total	283.818	891					
Technology	Between Groups	2.010	3	.670	1.750	.155	.01	No significant difference
	Within Groups	340.017	888	.383				
	Total	342.027	891					
Engineering	Between Groups	12.212	3	4.071	7.119	.0001**	.02	5>6-7 and 8
	Within Groups	507.808	888	.572				
	Total	520.020	891					
Mathematics	Between Groups	51.309	3	17.103	39.960	.0001**	.12	5>7 and 8 6>7 and 8 7>8
	Within Groups	380.072	888	.428				
	Total	431.381	891					
STEM-CIQ	Between Groups	13.627	3	4.542	19.067	.0001**	.06	5>7 and 8 6>7 and 8
	Within Groups	211.547	888	.238				
	Total	225.174	891					

*Note. **Level p-values of < .01.*

According to Table 9, a significant difference was not found in technology career interest in terms of grade level [$F_{(3\text{-}888)}$=1.750; p>.05]. Fields in which career interests displayed differences in terms of grade level were determined as science [$F_{(3\text{-}888)}$=16.025; p<.01], engineering [$F_{(3\text{-}888)}$=7.119; p<.01], mathematics [$F_{(3\text{-}888)}$=39.960; p<.01] and STEM [$F_{(3\text{-}888)}$=19.067; p<.01]. The difference in the average interest scores obtained from STEM CIQ and the sub-dimensions in terms of grade levels are shown in Figure 3 in graphics.

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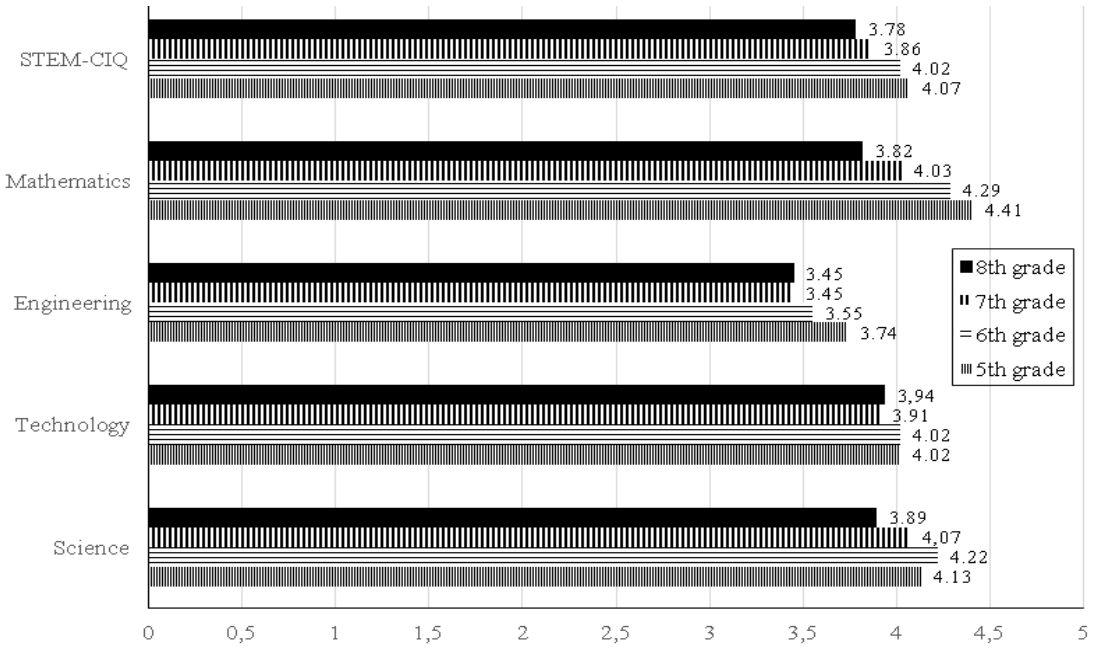

Figure 3. Difference in the average interest scores obtained from STEM CIQ and the sub-dimensions in terms of grade levels.

According to the graphics in Figure 3 and the results of the Tukey test in Table 9, the science career interest of fifth and seventh grades was higher compared to eighth grades, whereas science career interest of sixth grades was higher compared to seventh and eighth grades. A significant difference was not found between science career interests of fifth and sixth grades. According to the results of the analysis related to the career of engineering, it was seen that the fifth grades have the highest interest level and that there is a significant difference between the interest levels of fifth grades and sixth, seventh and eighth grades. While engineering interest levels of seventh and eighth grades is the same, a significant difference was not found between the interest levels of sixth, seventh and eighth grades. According to the results of mathematics career interest, while a significant difference was not found between fifth and sixth grades in terms of interest level, the interest level of fifth grades was found to be higher compared to seventh and eighth grades. Similarly, it was seen that the mathematics interest level of sixth grades is higher compared to seventh and eighth grades. It was determined that the lowest mathematics career interest belonged to eighth grades. When the average scores in Figure 3 are analyzed, it can be seen that as the grade level increases, mathematics career interest decreases.

According to Figure 3, STEM career interest level in general decreased as grade level increased. The interest levels of fifth and sixth grades were found to be higher compared to seventh and eighth grades. According to the eta square (η^2) values in Table 9, while the effect of grade level on mathematics and STEM career interest is of medium scale, its effect on science, technology and engineering career interest is of small scale. Therefore, it can be stated that grade level affects mathematics and STEM career interest more.

Discussion

In this research which aimed at identifying the STEM career interest of middle-school students, the answers to four questions were sought. The first of these was at which level the students' interest in STEM careers was. As a result of the research, it can be stated that the students' STEM career interest is positive according to the career interest average scores related to each of the STEM fields and all of the fields. The interest levels of the fields were identified as mathematics, science, technology and engineering from the highest to the lowest. When it is considered that the students do not receive any education related to engineering in their middle-school years and that they are not familiar to careers in this field, the finding that the lowest interest being in the field of engineering is expected. In

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the results of other researches, it was determined that the knowledge and career wishes of middle-school students about engineering were lower compared to mathematics and science and that a majority of the students did not wish to be engineers similar to the finding of this research (Gulhan & Sahin, 2018; Karakaya et al., 2018; Mooney & Laubach, 2002; Spencer, 2011). In the other researches, a few possible reasons were stated as to why the students did not choose engineering as a career (Besterfield-Sacre, Moreno, Shuman, & Atman, 2001). These are that, a majority of the students had negative stereotypes about engineers (such as nerds become engineers) or that they overly exaggerated the positive stereotypes about engineers (such as, engineers must be geniuses). It is considered that the students not knowing what engineers do is another possible reason why they do not wish to have a profession in the area of engineering.

The second question to which answers have been sought in the research was whether the STEM career interests of middle-school students displayed a significant difference in terms of STEM fields. As a result of the analyses, it was found that the difference between the fields is statistically significant and that the effect of these fields on this difference is of medium scale. As a result of a research, it was identified that the knowledge and career wish of middle-school students about engineering is lower compared to mathematics and science (Mooney & Laubach, 2002). Similarly, it was found in this research that there is no significant difference between the science and mathematics career interests of the students and that their science and mathematics career interests are more positive compared to technology and engineering career interests as well. This result can be clarified with the fact that although science and mathematics lessons are given weight to in the curriculum in Turkey starting with kindergarten, there are not sufficient lessons on technology and engineering fields. It can be stated that the Increasing Opportunities and Improving Technology Movement (FATIH in Turkish) Project initiated in 2010 in Turkey plays a role in the findings obtained in the research about technology career interest being more positive compared to engineering. The aim of this project is to create individuals who have 21st century skills and a society centered on production (MoNe, 2010). Within the scope of the FATIH Project, interactive boards, wide band Internet connections have been provided to schools and students and teachers have been given tablet computers. It is stated that, teachers and students obtained information technology tools which contributed greatly to the environment which can be used for STEM education with this project (MoNe, 2016).

The third question to which answers were sought was whether STEM career interests of middle-school students changed in terms of gender or not. As a result of the analyses, it was determined that the students' career interests about STEM as a whole and about its all fields displayed a difference in terms of gender. It was seen that the effect of gender on the field of engineering is of medium scale and small scale on other STEM fields and STEM careers. It was seen that this difference in career interest is in favor of female students in the fields of science and mathematics and in favor of male students in the fields of technology and engineering. It was concluded that STEM career interest of male students is more positive compared to female students. This finding is in line with the results of many researches in the literature (Catsambis, 1994; Christensen & Knezek, 2017; Knezek et al., 2011; Sadler et al., 2012; Su et al., 2009; Unfried et al., 2014). It was stated that the attitude of female students towards engineering and technology is less positive compared to male students in all of the educational levels (Knezek et al., 2011; Unfried et al., 2014). In this research, the engineering and technology career interests of female students were found to be lower compared to the male students as well. This finding also explained why STEM career interest of female students is lower compared to male students. Similarly, the researchers stated that the tendencies in terms of engineering are more closely related to STEM career interests of female students (Knezek et al., 2015). It was stated that female students prefer traditional careers such as nursing and psychology more and fields such as mathematics, computer sciences and engineering less (NSF, 2013). In other researches, it was stated that male students are more inclined to the field of engineering as well (Korkut-Owen et al., 2014; Korkut-Owen & Mutlu, 2016). One of the reasons why female students' interest in engineering is lower compared to male students might be not having sufficient role models who have a career in STEM fields (McCrea, 2010). In the results of the research, it was stated that individuals who have family members with STEM careers have more of a chance of choosing STEM branches (Moakler & Kim, 2014; Oware, Capobianco, & Diefes-Dux, 2007). The other reasons as to why female students' engineering career interest is lower compared to male students might be that they regard engineering as 'difficult,' 'boring,' 'one-dimensional' and 'male work' and think that engineers only deal with construction work (Gulhan & Sahin, 2018).

The fourth question of the research to which answers were sought was whether STEM career interest of middle-school students displayed differences in terms of grade level. According to the analyses, a significant difference was not found in technology career interest in terms of grade level. It is considered that, students being able to access information technology tools in all classes with the FATIH Project and much electronic content being presented to

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students during lessons do not change their interest in technology. Fields which displayed differences in career interest in terms of grade level were determined as science, engineering, mathematics and STEM. In the research, it was seen that while grade level affected mathematics and STEM career interest in a medium scale, it affected science, technology and engineering career interest in a small scale. It was seen that STEM career interest in general decreased as grade level increased. It was stated in the results of other researches that older students had a less positive attitude towards STEM careers compared to younger students (Unfried et al., 2014), the interest of students towards STEM careers decreased with age and that this interest started to get balanced in their high-school years as well (Wiebe et al., 2018). In a research in the literature, it was stated that STEM career interest did not change in terms of grade level as different from the finding of this research (Yerdelen et al., 2016). The reason why STEM career interest decreases as grade level increases might be the insufficient guidance provided to students about STEM occupations.

Conclusions

Within the scope of this research in which the STEM career interest of middle-school students was identified, it was found that the STEM career interest of the male students is more positive compared to the female students. In addition, it was determined that career interest in the areas of engineering and technology displayed differences in the favor of the male students and career interest in the areas of physical sciences and mathematics displayed differences in the favor of the female students. It is considered that STEM education can be effective in the development of the career interest of the female students in the areas of engineering and technology in a positive manner. Through the STEM education applications to be carried out at schools and environments other than schools, the students need to be taught the connection of engineering with physical sciences, mathematics and technology. It is considered that introducing students with STEM careers at early ages and giving them STEM education to develop their STEM career interest can be an effective approach. Within the scope of the research, it was concluded that the STEM career interest of middle-school students displayed differences in terms of grade level and that STEM career interest decreased as grade level increased. In all grade levels, the STEM career interest of students can be developed in a positive manner by giving them sufficient occupational guidance about their STEM careers. In line with this purpose, students can be introduced with role models who have careers in STEM areas by organizing seminars or video conferences with STEM experts.

Limitations of the Research and Recommendations

This research is limited with 892 middle-school students living in a district of medium level socioeconomic structure in Turkey. Researchers can conduct researches in different countries, different regions and different grade levels to identify or compare STEM career interest. The effect of variables other than gender and grade level on STEM career interest can be identified. In this research, suggestions have been made on the reasons for differences in STEM career interest based on the results of previous studies. Qualitative researches which can support quantitative results related to the subject can be conducted and detailed results might be obtained.

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