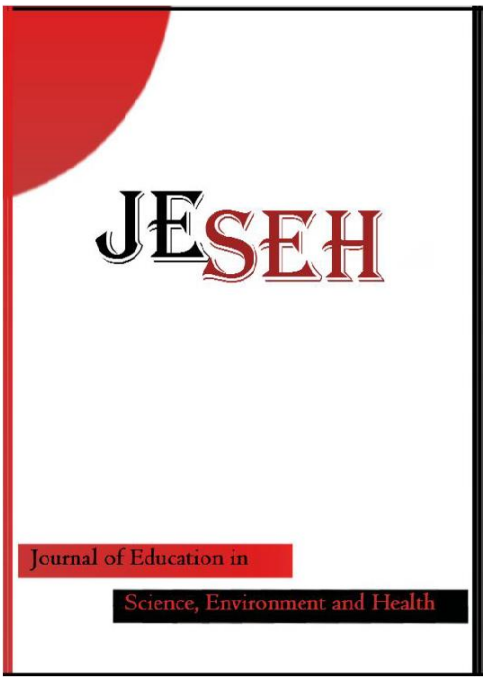

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Nejla Atabey[1], Mustafa Sami Topcu[2]
[1]Mus Alparslan University
[2]Yildiz Technical University

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Nejla Atabey, Mustafa Sami Topcu

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Abstract

Several conceptual and theoretical studies on the importance of science-technology-engineering-mathematics (STEM) careers and the 21st century skills required for these careers have been carried out; because they have been accepted as important for the improvement of society and maintenance of economic growth. However, there has not been research within the current educational literature examining the relationship between 21st century skills and STEM career interests of middle school students. Therefore, the main aim of this study is to examine the presence and level of the relationship between middle school students' 21st century skills and their interest in pursuing a STEM career. In addition, the presence of significant differences between male and female students' STEM career interest and 21st century skills was also investigated. The participants of the study were 282 middle school students. The research was completed via a quantitative study based on the relational survey model; data collection tools were STEM career interest survey and 21st century skills scale. A Pearson product-moment correlation method was used to explore the presence and level of the relationship between students' 21st century skills and STEM career interest. In addition, an independent samples t-test was used to answer whether there are significant differences between students' STEM career interest and/or 21st century skills in terms of gender. The findings showed that there is a statistically significant relationship between students' 21st century skills and STEM career interest. In addition, there is not a significant difference between female and male students' STEM career interest, while there is a significant difference between their 21st century skills.

Introduction

Science, Technology, Engineering, Mathematics (STEM) education is described as combining at least two STEM subjects or applying each of the STEM subjects together to solve problems of real life (Harwell et al., 2015). STEM education is necessary because it supports economic development, competitiveness in international fields, and job opportunities (Ismail, 2018). In fact, many researchers have argued STEM education's importance in economic growth (Asunda, 2011; Croak, 2018; Kaing, 2016), noting that STEM will continue to be a force for sustainable development (Ndinechi & Okafor, 2016) as it contributes to the fields of health, economy, and welfare (Cohen et al., 2013).

Despite the bright future that STEM fields promise, there has been a decrease in the number of students who are interested in STEM careers in different countries, including the United States and Turkey. For example, the rate of students graduating from undergraduate education from STEM fields in United States was 32% in 1995; it dropped to 27% in 2004 (Hall et al., 2011). Similarly, in Turkey, while undergraduate enrollment in STEM fields was 85.63% in 2000, it dropped to 27.88% in 2010, and increased only to 38.23% in 2014 (Akgündüz et al., 2015). Although an increase was observed in 2014 compared to 2010, the rate is still quite low compared to the previous enrollment 14 years earlier. To ensure economic growth, it is necessary to increase enrollment in STEM fields by increasing student interest in these careers (ArcherKer et al., 2013). The first step in this process is identifying students' current STEM career interest to ensure an increase in interest in those fields. Determining the students' STEM career interest and effects of different factors on this interest is important to lead more students to STEM careers (Koyunlu-Ünlü, & Dökme, 2018).

In Turkey as elsewhere, economic development requires people who are capable of working in STEM fields (Turkish Industry and Business Association [TÜSİAD], 2017). Individuals working in STEM should have certain skills, such as problem solving, questioning, and producing original ideas (TÜSİAD, 2017)—these skills

are referred to as "21st century skills" (Binkley et al., 2010; Partnership for 21st Century Skills, 2013). These 21st century skills are grouped under three themes: Learning and innovation skills; information, media, and technology skills; and life and career skills (Partnership for 21st Century Skills, 2013). Learning and innovation skills refer to one's ability to be prepared for today's life and work conditions and include communication, collaboration, problem solving, and critical thinking skills. Information, media and technology skills refer to the ability to collaborate and make individual contributions to technology and media-driven environments and include information literacy, media literacy, and ICT (Information, Communications, and Technology) literacy. Life and career skills refer to the skills that are necessary to navigate complex life and work environments. Flexibility and adaptability, initiative and self-direction, social and cross-cultural skills, productivity and accountability, and leadership and responsibility are considered life and career skills. Therefore, 21st century skills are ways of thinking, ways of working, and skills for living in today's world (Binkley et al., 2012).

Researchers have argued that students looking to work in STEM careers must graduate with 21st century skills (Aydeniz, 2017; TUSİAD, 2014) because there is a natural match between 21st century skills and the basic principles of STEM (Beers, 2013). In addition, the most important driver of success and happiness in a career is to have the skills and interests required by the career (Vurucu, 2010). Skills and interests are also important factors in individuals' career decisions (Ahmed et al, 2017; Kaneez & Medha, 2018). People prefer working in jobs appropriate for their skills (Savickas, 1991) and are more likely to succeed in those careers (Baran et al., 2015). Because one of the factors affecting choice of career is skills (Dinç, 2008), students with 21st century skills can be expected to have more interest in and to prefer STEM careers, which require 21st century skills. Thus, having and improving 21st century skills has been defined as a way to increase students' interest in and tendency toward STEM careers (Baran et al., 2015).

In his study, Jang (2016) identified the following important STEM skills: critical thinking, reading comprehension, active listening, speaking, complex problem solving, judgment and decision making, writing, monitoring, active learning, time management, coordination, system analysis, mathematics, social perceptiveness, systems evaluation, instructing, science, and learning strategies. Considering that critical thinking, problem solving, active listening and speaking (as requirements of communication), and coordination and social perceptiveness (as requirements of collaboration) are accepted as 21st century skills within different frameworks (The Assessment and Teaching of 21st Century Skills, Partnership for 21st century skills), Jang showed that 21st century skills are important for STEM careers. Reeve (2016) also evaluated STEM skills as key 21st century skills; in fact, 21st century skills have been consistently identified and emphasized within the context of STEM learning (Jamaludin & Hung, 2017). Therefore exploring and explaining the relationship between students' 21st century skills and their STEM career interest would contribute to the literature. Previous studies have not determined whether emphasizing and improving students' 21st century skills is one way to support their STEM career interest. The related literature review indicates that there is a gap in the literature: there has been no research exploring the relationship between students' 21st century skills and their STEM career interest. Therefore, the current study aims to investigate the presence and level of the relationship between 21st century skill and STEM career interest of students, in particular, middle school students.

The age of 13 is considered a turning point in the formation of interests and in 8th grade, students begin to think about their future education life and career choices (Babarović et al., 2018). Because students develop their own interests and recognize their academic strengths at the middle school level, efforts for students to increase their interest in STEM careers should begin at that time (Kier et al., 2013). During middle school, students begin to decide their career plans and determine the ways to achieve these goals (Sanders et al., 2017). The interests and skills gained in the STEM fields during the middle school time period may form the basis of a successful career in STEM fields (Woolley et al., 2010). Therefore, grades 7 through 9 (ages 12 through 15) are seen as the key time period for influencing STEM career interest (Blotnicky et al., 2018). Exploring middle school students' STEM career interest at this age is important to lead more students to STEM subjects during the high school period. In addition, career interests at high school age seem to be stable (Wiebe et al., 2018). The results of the study conducted by Sadler et al. (2012)—which demonstrated that students' STEM career interest at the beginning of the high school is a key factor predicting their STEM career interest at the end of high school—confirm this stability. Considering the importance of the middle school time frame for career choices, and the feeling that students' 21st century skills should be improved in middle school education (Kay, 2009), this study focused on middle school students' STEM career interest and 21st century skills.

The more individuals who have STEM field knowledge, who can think critically, cooperate, produce original solutions—that is, the more individuals with 21st century skills—the easier it will be to develop and improve a society (Aydeniz, 2017). Therefore, students of both genders should be supported on the path toward STEM careers and 21st century skills. However, in Turkey, a developing country with a need for economic growth

through STEM leaders of all types, the number of studies investigating 21st century skills and STEM career interest of students of both genders is very limited (Aydın et al., 2017; Karakaş, 2015; Karakaya et al., 2018; Korkut-Owen & Mutlu, 2016). Therefore, the present study also aims to investigate whether gender plays a role in students' 21st century skills and their STEM career interest.

Gender Differences and STEM Career Interest

For years, women have been conspicuously absent and under-represented in STEM studies and careers worldwide (Kesar, 2018; Sarseke, 2018). Data from the Measuring, Selection, and Placement Center (ÖSYM) in Turkey shows that among the first 1000 students enrolled in university science and mathematics departments, the rate of male student enrollment is 81.39%, while the rate of female student enrollment is 18.61% (Akgündüz et al., 2015). One of the reasons women are underrepresented in STEM fields might be that they have chosen to avoid those fields. Studies show that men have more interest in STEM careers than women, especially in the fields of technology and engineering (Babarović et al., 2018). A study conducted by Su and Rounds (2015) shows that gender makes a remarkable impact on STEM career choices. The biggest difference is seen in engineering disciplines, in favor of the male students; female students are more likely to study social services and health services. A similar study conducted by Gülhan and Şahin (2018) also showed that female students do not want to work in technology-based careers, though male students do. In addition, Korkut-Owen and Mutlu (2016) found that women prefer natural sciences, mathematics, and statistics; men prefer computer science and engineering.

However there are studies revealing that girls' STEM career interest is in fact higher than boys' interest (Karakaya et al., 2018), or in which there was no significant gender difference in STEM career interest (Aydın et al., 2017; Wyss et al., 2012). Data obtained from the ASPIRE project, which was conducted in order to determine the factors that affect the career choices of students between the ages of 10 and 14 and shaped their expectations, indicated that 18% of the boys and 12% of the girls wanted to be a scientist. Considering different results of the studies in the literature and insufficient study investigating gender's effect on Turkish students' interest in STEM careers, it is worth researching how STEM career interests differ according to gender in that cultural and geographic context.

Turkey is a developing country with a need for economic growth through STEM leaders of all genders. The Region of Eastern Anatolia, where the study was conducted, is a region that gives great importance to traditional values. Responsibilities and duties imposed on girls and boys are determined by these traditional values. The gender-based division of labor formed by these values has a significant effect on shaping what jobs women can do and in which jobs they can work (Parlaktuna, 2010). For example traditional gender roles indicate that women are typically mothers and wives and men are breadwinners (Sarseke, 2018). These cultural expectations and conservative social norms may decrease the number of girls who choose STEM courses—and affect the performance of those who do pursue STEM classes and careers (Jiang et al., 2018). Therefore, the traditional gender roles that cause cultural pressure on girls, is one of the reasons that women are underrepresented in STEM careers (Blickenstaff, 2005).

Langen and Deckers (2005) also categorized four factors that affect choosing STEM courses: education system characteristics, job market and economy, social views and traditions, and government policy. Confirming Langen and Deckers' (2005) study, in developed countries the percentage of STEM graduates in the total labor force is 53% for the United Kingdom, 42% for Germany, 40% for Australia, 39% for Denmark, 35% for Israel, and 29% for the United States. Turkey, as a developing country with both traditional and modern approaches, falls under these ratios with 27% STEM graduates (TÜSİAD, 2017). At the same time, serious efforts made toward gender equality in education in Turkey, including the extension of compulsory education to 12 years and the application of legal penalty to parents who do not sent their children to school, moved the number of female students closer to the number of male students. Considering that traditional perspectives are resistant to change, in this region, it is worth investigating the interest of female and male students in STEM careers. It is still unclear whether female Turkish students would prefer to move into the careers that are considered suitable for girls in traditional societies (such as being a teacher) or to pursue STEM careers. Because they now benefit from equal educational rights, female Turkish students may either take on the traditional values and careers of the society where they grew up, or they may become bored with what traditional society sees fit for them and ask for more opportunities. Thus, the research results will provide important information about the career interests of middle school girls in today's Turkey, where traditional values are more dominant but, in addition, modern approaches have begun to be applied.

Gender Differences and 21st Century Skills

Employers, politicians, and educators agree on the importance of 21st century skills in today's successful students (Rotherham & Willingham 2010). However, studies in the literature rarely measure these skills, instead focusing on building definitions, arguing for the skills' importance, and promoting their development in school settings (Ananiadou & Claro, 2009; Beers, 2013; Rotherham & Willingham, 2010; Saavedra & Opfer, 2012). Of those studies that do measure 21st century skills, there are few researching gender differences. One of these studies, carried out by Arevalo and Ignacio (2018), found that the level of 21st century skills for both male and female students is mid-level. Another study, conducted by Bozkurt and Çakır (2016), indicated that female students' active learning skills, "learning to learn" skills, and problem-solving skills are significantly different from male students, while their communication and collaboration skills do not significantly differ from the male students' skills. Köksal and Çöğmen (2018) indicated, however, that female students' communication and critical thinking skills (in the dimensions of evaluation, deduction, commenting, explanation, and self-regulation) are significantly different—and higher—than male students' communication and critical thinking skills.

A review of the literature demonstrated that 21st century skills are typically evaluated within the scope of specific attributes—active learning, learning to learn, problem solving, communication, and critical thinking skills—instead of as a whole. In addition, problem solving and critical thinking scales are generally used to measure 21st century skills. Therefore, this study would contribute to the literature by using a 21st century skills scale in examining middle school students' skills and the gender differences in those skills. Study findings can then, ideally, be utilized in the process of arranging educational environments and taking gender-specific measures to develop 21st century skills in all students.

Theoretical Framework

Working from Bandura's (1986) general social cognitive theory, Lent et al. (1994) developed the social cognitive career theory (SCCT). This theory emphasizes the personal, contextual, and experiential factors that affect our career choices, including self-efficacy, outcome expectancy, and personal goals. According to this theory, outcome expectancy refers to physical or social rewards; self-efficacy is the belief that one can succeed. Both are critical indicators of interest in a career path. Personal traits such as predisposition, gender, ethnicity, and health status contribute to individuals' perceived self-efficacy.

According to this theory, people's environment exposes them to various activities that may affect their career interests during childhood and adolescence. Through repeated activity participation and feedback from people in the environment, children and adolescents develop their abilities, achieve personal performances, feel that they can accomplish certain tasks, and gain expectations about the results of their performance. Result expectations, such as physical or social rewards, reinforce the interests of children and adolescents. In addition to environmental effects, gender and race affect our interests and choices. Lent et al. (2000) gave the following example of how these factors influence career choice: A female student may believe that she has strong mathematics and science skills, but lack confidence because of the pressure of gender bias that women in mathematics or science face. In relation to the present study, differences in self-efficacy and interest between genders can affect the number of women and men who choose STEM fields (Wang & Debol, 2013). In the present study, taking the critical impacts of interest and gender on career choice/acquisition into account (Lent et al., 1994; Su & Rounds, 2015), we investigated students' STEM career interest and the presence of gender differences. The researchers were particularly interested in whether outcome expectancy—including physical or social rewards from society, like the region of Eastern Anatolia of Turkey where the study was conducted and where personal traits like gender are highly valued—make a significant difference in STEM career interest and 21st century skills of male and female students.

Social cognitive career theory also explains the influences of abilities on succeeding and persisting in a task (Lent et al., 2002). According to this theory, people are likely to be interested in an activity/task when they think they have the ability to do it. So, they set goals in line with their thoughts about their abilities. Thus ability directly influences student performance and persistence in a task. In addition, abilities affect self-efficacy and outcome expectations, which work in harmony with abilities directly. Figure1 shows how ability influences self-efficacy and outcome expectations, and so performance goals and performance attainment level.

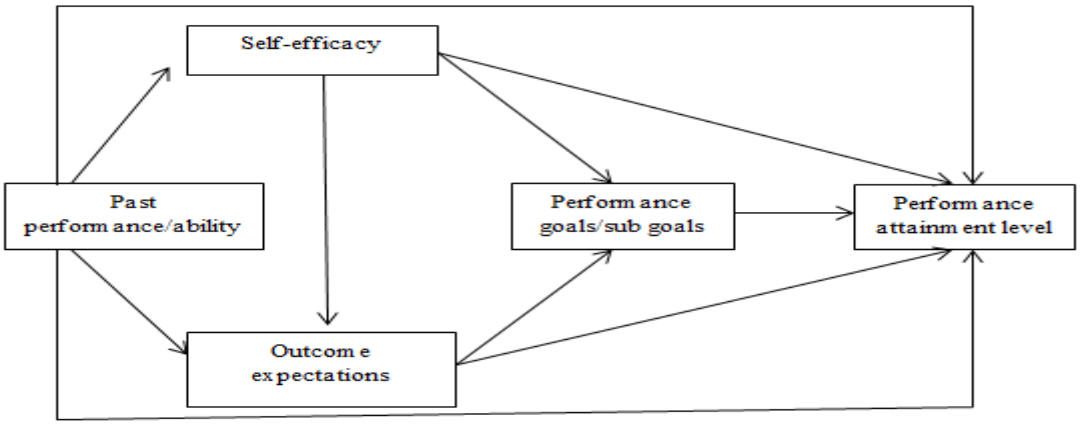

Figure 1. Predicting task performance in social cognitive career theory (Lent et al., 1994)

According to Figure 1, abilities are one of the factors influencing performance goals in terms of affecting self-efficacy and outcome expectations. In this model, "goals" refers to career plans, decisions, and choices (Lent et al. 1994). In fact, according to this model self-efficacy and outcome expectations cause an increase in interest. Then interest supports cognitive career choice goals, including intentions, plans, or turning to a specific career. Choice actions then lead to specific performance areas and success experiences. To summarize these relationships between abilities, self-efficacy, outcome expectations, interest, and career choice, Perkmen (2009) created a model. This model is presented in Figure 2.

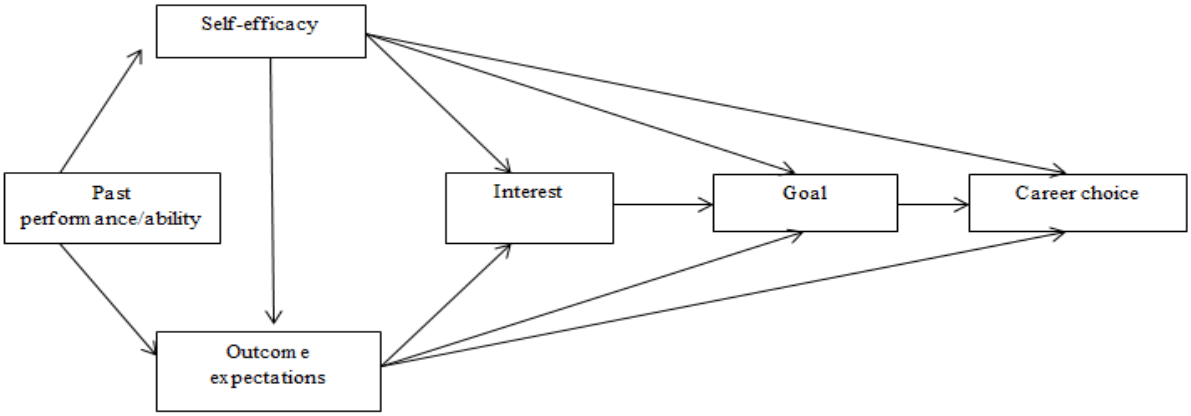

Figure 2. Partial career choice model of social career theory (Perkmen, 2009)

As it is seen in Figure 2, abilities, self-efficacy, outcome expectations, interests, and goals are factors affecting career choice. Perkmen (2009) explains the relationship between these factors with an example. When we consider a woman who chooses to be a lawyer, we can say that this person has the ability to defend herself very well based on the available data. Her ability can make her feel confident about her career and give her positive expectations about her career. As a result of this high self-efficacy and positive outcome expectations, this person may become interested in being a lawyer and ultimately choose to be a lawyer.

Based on the social cognitive career theory, which explains individuals' career paths by addressing personal input such as abilities (Lent & Brown, 2017), we aim to explore the relationship between 21st century skills, which are accepted as necessary skills for STEM careers, and STEM career interest of middle school students, taking gender into account.

The Purpose and Research Questions of the Study

The main aim of the study is to examine the presence and level of the relationship between 21st century skills and STEM career interest. The questions guiding our study are as follows:

> (1) Is there a relationship between middle school students' 21st century skills and their STEM career interest?

(2) Are there any significant differences between male and female students' STEM career interest and/or their 21st century skills?

Method

The relational survey model was used in this study. This model investigates the relationship between two or more variables (Cohen et al., 2002). The main aim of the present study was to investigate the presence and level of the relationship between students' 21st century skills and STEM career interest.

Participants

The participants of the study were 282 middle school students. These students attended two different public schools, both located in the Eastern Anatolia region of Turkey. Both schools are in the center of the city and similar in terms of socioeconomic conditions and academic performance. One school provided 138 of the students and the remaining 144 were at the other school. The students were in the 6th , 7th, and 8th grades; 174 were female (61.7%) and 108 were male (38.3%). In Turkey, 1st through 4th grade students attend elementary school, children between grades 5 and 8 attend middle school, and children between grades 9 and 12 attend high school. Detailed information on the grade levels and gender of the students in the study is given in Table1.

Table 1. Gender and grade levels of the participants

Gender	Grade levels	N	%
Girl	6	65	23.04
	7	65	23.04
	8	44	15.60
Total		174	61.7
Boy	6	52	18.43
	7	31	10.99
	8	25	8.86
Total		108	38.3

Data Collection Tools

The data used in this study was collected via the STEM Career Interest Survey and 21st Century Skills Scale. Information on these data collection tools is given below.

Science, Technology, Engineering and Mathematics Career Interest Survey

The STEM Career Interest Survey was developed by Kier et al. (2013) to determine students' STEM career interest. The survey, which is based on Bandura's social cognitive learning theory, was adapted to Turkish by Koyunlu-Ünlü and Dökme (2018). The original form includes 44 items and the adapted version includes 40 items; both use a five-point Likert-type scale. The options are strongly agree (5), agree (4), neutral (3), disagree (2), and strongly disagree (1). The survey consists of four sub-dimensions: science, technology, engineering, and mathematics. The total reliability coefficient was calculated as 0.93 for Koyunlu-Ünlü and Dökme's adaptation. In addition, the reliability coefficients for the science, technology, engineering, and mathematics subscales were 0.86, 0.88, 0.94, and 0.90, respectively.

21st Century Skills Scale

This scale was developed by Kang et al. (2012) to determine 21st century skills. The scale was adapted to Turkish by Karakaş (2015). It includes 32 items and uses a five-point Likert-type scale. Options are strongly agree (5), agree (4), neutral (3), disagree (2), and strongly disagree (1). The scale has three sub-dimensions: cognitive skills, affective skills, and sociocultural skills. The cognitive skills sub-dimension includes 12 items; the affective skills and sociocultural skills sub-dimensions include 10 items each. The cognitive sub-dimension comprises cognitive domains such as questioning, critical thinking, problem solving, metacognition, and

creative thinking. The sociocultural sub-dimension includes areas such as community sentiment, social values, and global citizenship. The affective sub-dimension includes skills such as self-efficacy, self-esteem, and self-responsibility. The three sub-dimensions—cognitive skills, affective skills, and sociocultural skills—have 0.77, 0.70 and 0.67 Cronbach's alpha reliability coefficients, respectively. The total Cronbach's alpha reliability coefficient was calculated as 0.90 by the researchers; Karakaş (2015), who adapted the scale, did not present the total alpha value.

Data Collection Process

The two schools that researchers could easily access were investigated and the directors of these schools were contacted. The researchers asked to give the STEM career interest survey and 21st century skills scale to students. After getting permission for data collection, the data were collected from 282 middle school student participants. First, the purpose and importance of the study were shared with the 6th, 7th, and 8th grade students. Then, the student participants voluntarily answered the questions from the data collection tools at times chosen by school administration. Students spent an average of 40 minutes answering the questions.

Data Analysis

The first research question aimed to determine the presence and level of the relationship between 21st century skills and students' STEM career interest. For this purpose, Pearson Product-Moment Correlation analysis was used. In this process, series mean was used for missing values. The second research question was "Are there any significant differences between male and female students' STEM career interest and/or their 21st century skills?" In order to find an answer to this research question, the assumption of normality was checked, then an independent samples t-test was used (the assumption of normality was met for both STEM career interest and 21st century skills variables). In cases when the variances were not homogeneous, p-values in the related column were taken into consideration.

Results

In this section, the findings of the analysis are given in accordance with the research questions.

Relationship between 21st Century Skills and Interest in STEM Careers

Before answering the first research question, tests for the assumption of normality were carried out. The findings are presented in Table 2.

Table 2. Descriptive statistics for students' 21st century skills and STEM career interest

Variables	N	$\bar{X}$	sd	Skewness	Kurtosis
Cognitive	282	48.52	6.59	-.67	.85
Affective	282	42.71	6.02	-1.2	2.4
Sociocultural	282	40.53	6.06	-.79	.61
21st century skills	282	131.76	16.75	-.89	1.46
STEM careers	282	155.11	20.53	-.51	.03

As seen in Table 2, the skewness and kurtosis values of all variables are between +3 and-3, the range required to meet the criteria for normal distribution (Bentler, 2006). Pearson Correlation Analysis was carried out after it was seen that the criteria for normal distribution was met. The findings of this analysis are presented in Table 3.

Table 3. The relationship between students' 21st century skills and their STEM career interest

Variables	N	Interest in STEM careers	*p*
Cogntive	282	.59**	.00
Affective	282	.52**	.00
Sociocultural	282	.57**	.00
21st century skills (total)	282	.63**	.00

Table 3 shows a significant and positive relationship between students' cognitive skills (r = .59, p <.01), affective skills (r = .52, p < .01), and sociocultural skills (r = .57, p < .01) and their STEM career interest. Furthermore, the level of the relationship between the total score of 21st century skills and the students' STEM career interest was found to be 0.63. A correlation coefficient between 0.00 and 0.30 shows a low-level relationship, between 0.30 and 0.70 a mid-level, and between 0.70 and 1.00 a high-level relationship between two variables (Büyüköztürk, 2003). Therefore, a mid-level relationship was found between cognitive, affective, and sociocultural skills — and the total 21st century skills—and the students' STEM career interest. Moreover, these findings might be interpreted to indicate that students' STEM career interest may increase as their 21st century skills increase.

Gender Differences in Middle School Students' STEM Career Interest

First, the assumption of normal distribution was checked. These results were used to choose an analysis method to determine whether there is a significant difference between female and male students' STEM career interest. The findings are given in Table 4.

Table 4. Descriptive statistics for girls' and boys' STEM career interest

Variables	N	$\bar{X}$	sd	Skewness	Kurtosis
Girl	174	155.06	20.44	-.39	-.42
Boy	108	155.20	20.76	-.69	.80

As seen in Table 4, the data for female and male students' STEM career interest show normal distribution. In addition, since the p-value of Levene's test was greater than .05 (p =.63), the hypothesis that there was no significant difference between the variances of the groups was accepted. Therefore, the significant difference between the female and male students' STEM career interest was analyzed by an independent-samples t-test. The findings of this t-test are given in Table 5.

Table 5. t-test results of the difference between girls' and boys' STEM career interest

Group	N	$\bar{X}$	sd	*df*	*t*	*p*
Girl	174	155.06	20.44	280	-.06	.95
Boy	108	155.20	20.76			

As seen in Table 5, there was not a statistically significant difference between the female students' mean scores and the male students' mean scores (t = -.06, p > 0.05). Thus, it can be said that gender made no significant impact on the participants' STEM career interest.

Gender Differences in Middle School Students' 21st Century Skills

First, we checked the assumption of normal distribution in order to choose an analytical method to determine the differences between the 21st century skills of male and female students. The findings are given in Table 6.

Table 6. Descriptive statistics for girls' and boys' 21st skills

	Variables	N	$\bar{X}$	sd	Skewness	Kurtosis
Girl	Cognitive	174	49.1	6.09	-.36	-.45
	Affective	174	43.67	5.42	-1.29	2.24
	Sociocultural	174	40.74	5.91	-.71	.35
	21st century skills	174	133.50	15.30	-.63	-.03
Boy	Cognitive	108	47.59	7.26	-.86	1.46
	Affective	108	41.18	6.63	-1.02	2.06
	Sociocultural	108	40.18	6.32	-.90	.91
	21st century skills	108	128.96	18.57	-1.02	2.06

As can be seen in Table 6, the data on female and male students' 21st century skills show normal distribution. After the assumption of normality was met, the significant difference between the female and male students' 21st century skills was analyzed by an independent-samples t-test. The findings of this t-test are presented in Table 7.

Table 7. t-test results of the difference between girls' and boys' 21st century skills

		N	X̄	sd	*df*	*t*	*p*
Cognitive	Girl	174	49.1	6.09	280	1.87	.062
	Boy	108	47.59	7.26			
Affective	Girl	174	43.66	5.42	193.73	3.28	.001
	Boy	108	41.17	6.62			
Sociocultural	Girl	174	40.73	5.90	280	.74	.46
	Boy	108	40.18	6.31			
21st century skills	Girl	174	133.5	15.3	194.73	2.13	.03
	Boy	108	128.9	18.5			

As seen in Table 7, there was not a statistically significant difference between the female and male participants' mean scores in the cognitive and sociocultural dimensions ($t = 1.87$, $p > 0.05$; $t = .74$, $p > 0.05$). However, a significant difference was found between the female and male participants' mean scores in terms of affective skills and 21st century skills ($t = 3.28$, $p < 0.05$; $t = 2.13$, $p < 0.05$). This finding shows that gender made no significant difference on cognitive and sociocultural skills, while it made a significant difference on affective and 21st century skills, with female students scoring higher than their male counterparts on average in those areas.

Discussion and Implications

This section presents the discussions and implications for each sub-problem.

The Relationship between 21st Century Skills and STEM Career Interest

The first aim of this study was to investigate the presence and level of the relationship between the 21st century skills of middle school students and their STEM career interest. The findings showed that there was a statistically significant relationship between total 21st century skills—as well as the cognitive, affective, and sociocultural sub-dimensions—and STEM career interest. This finding indicated that as students' 21st century skills increase, their STEM career interest will increase. Or, as students' 21st century skills decrease, their STEM career interest will decrease. There are no studies in the literature investigating the relationship between students' 21st century skills and their STEM career interest. Similar to the present study, findings from Zorlu and Zorlu (2017), Cooper and Haeverlo (2013), and Arevalo and Ignaco (2018) showed a significant and positive relationship between middle school students' problem solving skills, digital age literacy, and creative thinking and their STEM career interest. Our finding is thus supported by the literature, which is not surprising considering that individuals working in STEM careers should have 21st century skills, and that individuals tend to choose careers suitable to their skills (Savickas, 1991).

The skills needed for STEM-related tasks are defined as STEM skills and they include cognitive skills (e.g., critical, analytical thinking, and problem solving skills), manipulative technological skills (e.g., using technical equipment), and collaboration and communication skills (e.g., teamwork and cooperation) (United Nations Educational, Scientific and Cultural Organization, 2019). As described above, these are also 21st century skills. Therefore it is possible for individuals with 21st century skills to choose STEM careers and to be successful in these fields (Baran et al., 2015), as it is likely that people show interest in subjects they believe they have a suitable aptitude for performing (Lent et al., 2002). As a result, improving students' 21st century skills might be accepted pedagogically as a way of developing student's STEM career interest in educational settings.

Another finding is a significant relationship between STEM career interest and affective dimension skills, including self-efficacy, self-esteem, and self-responsibility. Similarly, Halim et al. (2018) found a positive and significant relationship between students' STEM self-efficacy and their STEM career interest. In addition, McCormick (2019) found a relationship between middle school students' self-efficacy and STEM career interest; this result is also consistent with the present study results. In fact, there are many studies with results supporting the present study's result. For example, Milner et al. (2014) found that college students with a high level of interest in STEM professions also showed a high level of self-efficacy. Blotnicky et al. (2018) found that students with mathematics self-efficacy were more likely to choose a STEM career. Roue (2007) researched the math and science interest of 2,800 young girls and found that self-esteem was the greatest predictor of interest (36.4%) and self-efficacy was the second highest predictor, with 26.5% of the variability. Barth et al. (2018) found that self-efficacy is the best predictor of STEM career interest across gender and grade level. Each

of these studies supports the present study's results.

In addition, the theoretical framework that this study is based on explains that self-efficacy causes an increase in interest, and interest supports career choices and goals (Lent et al., 1994). This framework also states that if self-efficacy is weak in a field, it is difficult to develop an interest in that field. Therefore, it is likely that people will be interested in areas where they have strong self-efficacy beliefs and will perform better (Lent et al., 2002). Self-esteem is also among the known factors that affect interests, including career interests. An increase in self-efficacy in a subject supports the increase in value and interest given to a subject (Eccles & Wigfield, 1995); meanwhile, individuals with advanced self-esteem can set realistic goals in terms of career choices. They are likely to pursue these goals and see this effort as valuable (Gök & Tekin, 2015). Therefore, in the present study, the students' self-esteem and self-efficacy might be a cause of the meaningful relationship between STEM career interest and affective skills. With this knowledge, learning environments can be designed to support students' affective skills, like self-efficacy and self-esteem, in order to lead them to STEM careers.

The study results also revealed that there was a significant relationship between sociocultural skills (e.g., social values and global citizenship) and a STEM career interest. Similar to the present study, Agarwala (2008) and Wang and Degol (2013) expressed that career choices are influenced by values. Therefore, values are part of the career decision-making process (Foskett & Hemsley-Brown, 1999). This study result is not surprising; people's perceptions about careers may be determined by their cultural values (Majid et al., 2014) and cultural values are widely considered important in career choice and development (Brown, 2002). Perhaps one reason that values affect the choice of career is that individuals want to live their values as well as their hopes and dreams in their professions (Theresa, 2015). In addition, global citizenship requires students and individuals to be aware of current developments worldwide and to follow these developments. Even at a young age, today's students can follow developments in every field via mobile phones and social media tools; this gives them a chance to realize the importance of STEM education and its value around the world. Increasing students' awareness of STEM studies may have supported their interest in these careers, and thus might have caused a significant relationship between sociocultural skills and STEM career interest.

In conclusion, a significant relationship was found between the cognitive, affective, and sociocultural dimensions of 21st century skills and STEM career interest. In addition, a significant and positive relationship was found between the total scores obtained from the scale on 21st century skills and the scores from the scale on interest in STEM careers. In line with our result, Kan and Murat (2018) found a moderate relationship between students' self-efficacy and perception of their 21st century skills and their attitudes towards STEM careers. The researchers explained their study results by claiming that individuals who think that they have 21st century skills developed positive attitudes toward STEM careers. Other studies found a relationship between problem solving and creative thinking—both 21st century skills—and STEM career interest, which also supports our results (Arevalo & Ignacio, 2018; Cooper & Haeverlo, 2013; Zorlu & Zorlu, 2017). Having 21st century skills arguably improves students' interest in and tendency to pursue STEM careers (Baran et al., 2015), which is logical because individuals' skills guide their career choices (Savickas, 1991) and skills are career path indicators (Al-Abri & Kooli, 2018). Agarwala's (2008) study result, showing that skills, competencies, and abilities are the most important factors influencing career choice, supports the present study result.

Gender Differences in STEM Career Interest

One of this study's findings was that male and female students were not significantly different from one another in terms of STEM career interest. This finding differs from study results in which female participants have a higher STEM career interest than male participants (Karakaya et al., 2018), or vice versa (Christensen & Knezek, 2017; Sadler et al., 2012; Su et al., 2009). Most studies in the literature have found that male participants' STEM career interest is relatively higher than female participants' (Sadler et al., 2012). One potential explanation is that a profession's stereotypes may influence whether girls and women choose those careers (Hill et al., 2010). According to the social role theory (Eagly & Wood, 2012), there are certain roles assigned to women and men in a community, and both genders are expected to fulfill their roles. In this study, the absence of a significant difference between male and female students' STEM career interest might be attributed to changes in social roles over time. The post-industrial period emphasizes equality between men and women: making decisions together and benefiting from political, professional, and/or educational opportunities equally (Rapoport & Rapoport, 1969). With these changes in social roles and modernization, women have started to benefit more from educational opportunities and are gaining gender equality in professional fields (Inglehart et al., 2003). These social changes shift roles by expecting women to take part in new education and employment fields (Eagly & Wood, 2012). The number of women pursuing an education has also increased

(Keskin & Ulusan, 2016). For example, in Turkey, the percentage of schooled female and male children of middle school age was 94.69% and 94.26%, respectively, as of the 2017-2018 teaching year (Ministry of National Education [MoNE], 2018). Similarly, the number of female students enrolled in mathematics and science courses has been increasing remarkably (Burrelli, 2008). Considering these values, we can argue that the schooling ratio is balanced in terms of gender in Turkey as women have increased access to education.

In parallel to the increasing number of female students in education settings, the number of working women has also increased. It has been proven that women capable of performing many jobs (Myrdal, & Klein, 1956). Furthermore, the roles of women and men have begun to change in Turkey and globally; women are working toward a career and men are participating more in home-care activities (Sekścińska et al., 2016). Women have begun to be more active participants in business and social settings (Güldü & Kart, 2009). For example, the Turkish Statistical Institute declared that women who have a university degree participated in the labor force at a rate of 71.3% in 2016. The increasing number of female students in educational settings—especially in science and mathematics—and in the labor force might have supported gender equality in many STEM fields. The change of gender roles over time is likely to impact the career choices of women (Callahan, 2015); educational and societal changes affect ability levels and this may support and increase the number of women succeeding in STEM fields (Wang & Degol, 2013). Supporting women who choose to work and further their education, especially those studying mathematics, science, or technology, would help increase their ability to begin and thrive in STEM careers.

Another reason male and female participants' STEM career interest did not significantly differ might be the increasing number of female role models in STEM fields. For example, Donna Strickland was awarded the Nobel Prize in Physics in 2018, Frances Arnold the Nobel Chemistry Prize, and Nabia Murad the Nobel Peace Prize. In other words, the fact that three female scientists received Nobel Prizes in 2018 alone is an example of women's success in scientific activities. Considering that role models have a positive effect on girls' perspectives (Astin & Sax, 1996), one explanation for the elimination of gender inequality in STEM fields might be the increase in the number of female role models. Quimby and Desantis (2006) confirm role models' influence on career choices; their study results show a significant variance for role models in career choice (Quimby & De Santis, 2006). BarNir et al. (2011) study results also showed that role models positively affect a person's belief that he or she has the skills necessary to succeed in entrepreneurial careers by increasing the knowledge, mastery, or general abilities required for the tasks associated with this career. Mishkin et al. (2016) found that women are more affected by other people with a rate of 43.2 to 22.7. Based on their study result, they recommend to educating young girls about role models in STEM fields to encourage girls to become interested in STEM careers. Introducing students to the stories of women who are successful in STEM fields may encourage girls to consider those careers.

Another factor affecting the elimination of gender differences in terms of STEM career interest might be the increase in research on STEM fields in recent years. For instance, in Turkey, there were 4 studies in 2014, 7 in 2015, and 18 in 2016 focused on STEM (Elmalı & Kıyıcı, 2017). The Ministry of National Education in Turkey supports in-service trainings and projects for STEM education, which might promote STEM awareness in educational settings and in general. In addition, changes have been made in science curriculums to include STEM activities in classrooms in Turkey. To achieve this goal, a STEM activity related to unit content has been added at the end of the every unit in secondary science books. These changes present opportunities for students to be aware of STEM fields, activities, and careers. In fact, this opportunity meets the recommendation to raise awareness about STEM fields in order to prevent failures and decreases in the number of graduates from these fields of study (Buyruk & Korkmaz, 2016). An increase in studies that explore the necessity, benefits, or importance of STEM—or projects that aim to increase women's interest in STEM fields—would support gender equality among the students who choose these professions. In addition, the increased amount of STEM activities in Turkish science books may have caused the disappearance of gender differences in terms of STEM career interest in this sample of participants.

Gender Differences in 21st Skills

In this study, the significance difference of 21st century skills of female and male students was also investigated. There was no significant difference between the female and male students' mean scores in the cognitive and sociocultural dimensions. When the affective dimension and 21stcentury skills were examined, a significant difference was found between the female and male students' mean scores, in favor of the female students. Based on these findings, it can be said that gender made a significant difference on affective dimension and 21st century skills, and it does not lead a significant difference in favor of female students in terms of the cognitive

and sociocultural skills.

The cognitive dimension consists of skills such as problem solving, questioning, critical thinking, and metacognition. Many studies have found that girls are not significantly different from boys in problem-solving skills (Fadli, 2019; Jena, 2014; Warren, 2000), scientific process skills (Böyük et al., 2011; Ekon & Eni, 2015), questioning skills (Duran, 2015), critical thinking skills (Salahshoor & Rafiee, 2016), metacognitive skills (Siswati & Corabima, 2017), or creative thinking skills (Vani, 2016); these studies support our results. The absence of a significant difference between the male and female students in terms of cognitive skills could be attributed to the MoNE in Turkey, which has adopted a research– and inquiry-based learning approach. In line with this approach, teachers and educators are instructed to carry out their lessons through problems, projects, discussions, and cooperative learning, in which students are active and teachers are facilitators (MoNE, 2013).These strategies and approaches are educational implementations that improve students' skills in inquiry, problem solving, critical thinking, structuring, and using their knowledge. This program might have supported male and female students' cognitive development equally since its implementation in 2013.

Another finding of this study was that female students' affective skills (e.g., self-regulation, self-esteem, self-efficacy, and responsibility) were significantly higher than the male students'. Similar to our results, other studies demonstrate that female participants' sense of responsibility (Beutel & Marini, 1995), self-regulation skills (Mahmoodi et al., 2014), self-esteem (Bhamani, Jami et al., 2014; Özkan, 1994), and self-efficacy (Willemse, 2008) are more advanced than that of their male counterparts, a difference which can be explained by the social roles that are traditionally attributed to the male and female genders. Self-regulation is the ability to control one's behavior, according to social cognitive theory. Features such as being strong-minded, postponing demands, and controlling feelings are included in self-regulation (Vohs & Baumeister, 2011). In addition, "sense of responsibility" refers to feelings of being in control of and accountable for our achievements or failures (Hinton, 2019). These values are expected from women in traditional societies. Women's behavior is given more attention, and women more frequently express their concerns about undesirable behaviors to their family members, teachers, or other individuals in their social environment (Kesici, 2018) in traditional societies. The Eastern Anatolia region, where the study was carried out, is a region where these social rules are highly dominant, which may increase the girls' sense of responsibility and self-regulation skills. Therefore, the fact that female participants had higher affective skills than male participants can be explained by the fact that the local social structure has higher expectations for girls and women in the affective context (Ersoy, 2009). Self-esteem can be defined as individuals' self-understanding and it is also affected by gender roles (Agam et al., 2015).

Though our results showed that female students have stronger affective skills than male students, many past studies have found that male students have higher self-esteem and self-efficacy (Kling et al., 1999, Nupur & Mahapatro, 2016; Rentzsch et al., 2016;). These studies justify their findings based on the roles assigned to women in society. For example, lower status, education, and income levels have been accepted as reasons for decreased self-esteem and self-efficacy in women and girls (Mcmullin & Cairney, 2004). However, nowadays, women can benefit from all kinds of educational opportunities; they can work in higher status jobs with higher incomes than men; and there are increasingly more female role models achieving success. These social changes might have increased female students' self-esteem and self-efficacy. In the province where the study was conducted, 96.25% of middle school–aged girls attended school during the 2015-2016 school years (Arslan, 2016) and many girls also have opportunities to visit different countries within European Union Projects. Each of these developments could improve female students' self-esteem and self-efficacy, which in turn might have resulted in higher affective skills.

Another finding of this study was that no significant difference was found between the male and female students' sociocultural skills, including sub-dimensions such as sense of community, respect for differences, social value system, and global citizenship. The literature supports our results, indicating that gender made no significant difference on an individual's level of global citizenship (Chui & Leung, 2014), sense of community (Wiseman et al., 2004), or respect for differences (Eren & Erkan, 2016). Global citizenship includes awareness of actual developments in global issues. In Turkey, almost every student studying middle school has a mobile phone; this helps them to be aware of the developments in the world and to follow current developments in education. Thus, mobile access may have supported both male and female students' global citizenship. In addition, living in the same society may have caused the development of similar social values, another sub-dimension of sociocultural skills. Therefore, cultural similarities in students' global citizenship and social values might have prevented a statistical difference between the male and female students.

The final finding from the present study was that the female students' total 21stcentury skills scores were significantly higher than the male students' scores. The study result is consistent with the study which found that

female students were better in acquiring 21st century skills than male students (Kanan, 2018). The scale used consists of three dimensions: cognitive, affective and sociocultural; we found that gender made no significant difference on the cognitive and sociocultural dimensions. However, there was a significant difference in the affective dimension in favor of female students, which was likely the cause of the discrepancy in scores. The reasons for the significant difference in affective dimension are discussed above. In addition, Zimmerman and Martinez-Pons' (1990) and Chyung' (2007) studies supports this conclusion. In their study, Zimmerman and Martinez-Pons'(1990) found that girls were better than boys in terms of self-regulated learning including self-monitoring, goal-setting, planning. In another study, Chyung (2007) also found that younger and female students improved their self-efficacy than boys at the end of different learning approaches. In this sense, an increase in girls' self-esteem as a consequence of provided equal opportunities, especially in education; the increase in female role models in business and social life; and the possibility of better-developed responsibility and self-regulation skills due to social expectations might be included among the reasons for the gender difference in 21st century skills evidenced in this study.

Suggestions

In this study, the relationship between 21st century skills and STEM career interest and between the cognitive, affective, and sociocultural dimensions of 21st century skills and STEM career interest was investigated. Only quantitative data were used in this study; similar research questions could be approached using mixed research supported by qualitative data. The results of the study showed that there is no significant difference between male and female students' STEM career interest, this result is different from most of the study results in the literature. Further studies might be carried out to explore why the gender gap in STEM fields appears to be disappearing in this context.

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Scientific Ethics Declaration

We, the authors, declare that the scientific ethical and legal responsibility of this article published in JESEH journal belongs to the authors.

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Author Information

NejlaAtabey
Mus Alparslan University
Muş, Turkey
Contact e-mail: *n.atabey@alparslan.edu.tr*
ORCID iD: 0000-0001-8710-3595

Mustafa Sami Topçu
Yıldız Technical University
Istanbul, Turkey
ORCID iD: 0000-0001-5068-8796