P-ISSN: 1693-1246
E-ISSN: 2355-3812
June 2023

Jurnal Pendidikan Fisika Indonesia 19 (1) (2023) 1-15
DOI: 10.15294/jpfi.v19i1.35912

http://journal.unnes.ac.id/nju/index.php/jpfi

Identifying Middle School Students' Perceptions of STEAM Careers

G. Ozkan*, U. U. Topsakal

Yildiz Technical University, Turkey
*Corresponding author: gozkan@yildiz.edu.tr

Received: 04 April 2022. Accepted: 22 March 2023. Published: 10 June 2023

Abstract

The aim of this study was to identify the students' perceptions of STEAM careers. The effect of the STEAM intervention on students' perceptions was evaluated using one group pretest - posttest experimental design with career questionnaire. The sampling of the study consists of 37 seventh grade middle school students. In the study, STEAM activities were used in the teaching of the Force and Energy unit. First of all, the students were asked about their career choices and their responses were evaluated quantitatively. There was statistically significant difference between the distributions of changes in the number of students choosing STEAM careers. Content analysis also was performed on the findings obtained from the questionnaire. As a result of the study, it was determined that the students increased the percentage of choosing careers in the STEAM career fields such as scientists and engineering. Looking at the interest of students in STEAM fields, one of the biggest changes was in the field of science. One of the important findings of the research was that after the implementation, the majority of the students thought that gender was not important in the success of STEAM career fields. The results of the research revealed that the STEAM education approach can be used a lot to evaluate and improve the academic career choices of middle school students.

Keywords: Career perceptions, Career development, Middle school, STEAM, STEM

INTRODUCTION

For the last ten years, science, technology, engineering, and mathematics fields have been in the foreground under the name STEM as a new perspective (Gracin, Babarovic, Devic & Burusic, 2018). Deciding a career is one of the most important choices in people's lives. It is seen as important to encourage people to have a career in STEM fields to fulfill both global and local needs of humanity in recent years (Yamada, 2018).

Students' interest in STEM-related issues effects decisions to choose careers related to STEM. Thanks to the potential provided by STEM education, individuals can have experiences and learn career-related information that they can consider when making career decisions (Luo, So, Wan & Li, 2021). Although the studies about increasing knowledge on STEM career fields do not attract much attention in the literature, they are important in terms of making STEM education more functional (Cantrell & Ewing-Taylor, 2009) and we need to consider them constantly as they are efficient in making STEM education more functional (Drymiotou, Constantinou & Avraamidou, 2021).

Ritz & Fan (2015) stated that STEM education reform had two important objectives. Based on the purpose of the emergence of STEM education, first one is to increase the number of individuals who will choose a career within the scope of STEM fields at university level; and the second one of the objectives is to ensure that students find creative solutions to the situations and problems which are about STEM disciplines, which they encounter in their everyday lives, by improving their knowledge on these fields. In this way, using one or all of the STEM fields in combination with their daily lives will make people's lives easier.

As one of the aims of STEM education is to guide students to STEM fields in career choices, in

this study, it has been investigated how STEAM (science, technology, engineering, art, and mathematics) education given to students by adding art to STEM fields affects students' career perceptions.

The middle school years are widely considered a critical time to focus on career exploration and development (Grant, Springer, Tuttle & Reno, 2021). However, as students do not have enough information at these ages about professions, they cannot orient their choices correctly. Middle school students' interest changes have the most long-lasting effects than any other time in life (Babarovic, 2021).

When the literature is examined, many studies investigating students' career choices and STEM career expectations have been found. Students' career choices are determined by both external (science capital, socio-economic status, learning opportunities, school-related factors) and internal (attitudes towards science, interest related to self-efficacy issues, gender, social expectations) (Drymiotou *et al.,* 2021). Tsakissiris & Grant-Smith (2021) indicated that personal interests are a way of expressing oneself, and these interests and self-interest work together to shape career decisions. Hoang & Huy (2021) stated that the career choice of individuals is based on many dimensions. They stated that the center of career choice is individual and career choice was based on self-awareness, including knowledge, skills, work experience, personality, psychological needs. Researchers added that in addition to these, external factors are also effective in career choice. Hazari, Sadler & Shanahan (2010) also reported that self-perceptions and identities of students had a role in their career choices. Sevilla & Rangel (2022), stated that parents and teaching support play a critical role on individuals' self-efficacy and STEM career expectations. According to Lv, Wang, Zheng, Peng & Ping (2022), one of the factors affecting the expectation of STEM career is gender.

STEAM, which first appeared as STEM, has become the main point in many developed countries (Taljaard, 2016). If initiatives such as STEM education have been adopted, art should be an indispensable part of this initiative. For this reason, art should be included under the name of STEAM education (Steele & Ashworth, 2018).

As is clear from its acronym, STEAM is an extension of STEM by including the art component (Liliawati, Rusnayati, Purwanto & Aristantia, 2017). Combining STEM with art and validating emotion as a necessary component of the learning process with both cognitive and affective aspects makes it a way forward to provide meaningful and unique learning opportunities for future students (Steele & Ashworth, 2018). STEAM education is also supported to emphasize students' ability to understand science content as well as imagination and artistic feelings (Jho, Hong & Song, 2016). As students begin to increase their understanding and interest in mathematics and science, STEAM education is accepted as one of the educational methods that students can use to develop their creativity through convergence and to realize the purpose of creativity and character education (Kim & Kim, 2016). In the studies of scientists and artists, strong relationships were found between creativity, imagination and the necessary work of scientists (van der Veen, 2012). Therefore, by integrating the field of art into teaching, it is necessary to determine the effectiveness of students in career choices.

Career education provided by schools is mainly based on the dissemination of knowledge and giving direct/indirect experience to the students. It is difficult to wait for effective career education unless the students design their careers and develop the necessary skills for the profession (Steele & Ashworth, 2018). Students can be assisted in planning their careers, including art in an affective sense in STEM during teaching, and in deciding on career choices by providing both cognitive and affective skills in teaching.

When the literature is analyzed, although many studies were found dealing with students' STEM careers (e.g., Hiğde & Aktamış, 2022; Sahin, Gulacar & Stuessy, 2015; Lv, et al., 2022; Sevilla & Rangel 2022; there were few studies on STEAM careers (Bass, Dahl & Panahandeh, 2016; Park, 2014). For this reason, it is thought that this study will contribute to the literature in the field of STEAM. While many studies were conducted on the impact of STEM education focused on upper secondary

grades and college students, those for the younger grades appear to be limited (English & King, 2015).

There are studies in the literature that show that STEM or STEAM education has an effect on students' career choices. STEM activities based on realistic life problems, prepared with an understanding based on research and inquiry, increased students' interest and views on STEM fields and careers in the study which was carried out by Hiğde & Aktamış (2022). In this way, it was provided for them to have ideas about how to make and direct their career preferences and to understand STEM fields. At the end of the eighth week, it was determined that female participants were more determined than males when making decisions about their careers; and senior students had a better understanding than others about the content of STEM.

The study analyzing the effect of STEAM education on students' careers was carried out by Bass *et al.,* (2016). They developed a STEAM After School Program. This program provided underrepresented young people in digital media production to prepare them to pursue higher education and technology careers. In another study, Park (2014) developed STEAM Career Education Program on Virtual Reality. This study was carried out with 3rd and 4th-year students. The STEAM career education program on the virtual reality proposed in this paper transforms students' awareness of information technology-related affairs into a positive one, and encourages future-oriented skills based on education for future professions rather than existing professions.

These studies didn't specifically ask students about their perceptions of STEAM occupations. Studies on STEAM careers in the literature are still insufficient to fully understand students' perceptions.

This study was carried out with middle school students. After participating in some intervention, significant changes are possible in middle school students' awareness of career opportunities and their confidence in their ability to explore and plan their future careers (Mahat, Dollinger, D'Angelo, Naylor & Harvey, 2022). Students at this age may not have opportunities to have information about STEM career; and for this reason, they cannot think correctly about their career choices without having proper information (Wyss, Heulskamp & Siebert, 2012). For this reason, if they have proper information about professions, they can lead their choices to the professions which are suitable for them.

If students do not have accurate perceptions about STEM professions or if they have inclinations towards these professions, their career choices may be affected negatively (Watson, Williams-Duncan & Peters, 2022). In order to increase studies about STEM and the number of students who will pursue their careers in STEM fields, it is necessary to raise awareness of students about having careers in various STEM fields (Heise, Hall, Ivie, Meyer & Clapp, 2020). It is thought that the students who take such information at school can make more conscious decisions about their interests in STEM; and can prepare themselves in a better way for these professions. The purpose of this study is to present STEM fields to the students by integrating art. As one of the most important objectives of STEM education is to lead indivuduals to the STEM fields and to ensure the improvement of professions in these fields (John, Chen, Navaee & Gao, 2018), to what extent STEM education realized this objective will also be determined with this study.

This study was planned because of the reasons mentioned above and to fill the gap in the literature. The aim of this study was to determine the students' perceptions of STEAM careers. In this study, qualitatively collected data were quantitatively converted into frequency tables. Thus, it was aimed to present the results in concrete form. It is thought that this study will contribute to the literature in terms of proving that STEAM education has an effect on students' career perceptions.

METHOD

The study was carried out through teaching science lessons with 7th grade middle school students. The effect of the STEAM intervention was evaluated using one group pretest - posttest

experimental design with career questionnaire. True experimental design could not be made because it was impossible to assign random sampling (Oborah, 2022). With this questionnaire, first of all, the students were asked about their career choices and their responses were evaluated quantitatively. The data obtained from other open-ended questions were analyzed by content and qualitative findings were converted into frequency tables. Qualitative analysis was preferred for in depth-examination of the subject in the research. Within this context, students' perceptions were described.

This study was carried out in two 7th grade middle school classes located in Istanbul, Turkey. The students' ages ranged from 13 to 14 years. The participants of this research were selected according to the convenient sampling methods. None of the students were individuals who had not received STEAM education before. A total of 37 students (16 girls and 21 boys) were included in the research. Since it was planned to examine the thoughts of the students in depth, the number of participants was limited.

In this study, nine activities about physics topic were developed for outcomes stated in the teaching program. In the study, STEAM activities were used in the teaching of the Force and Energy unit. According to learning outcomes, these nine activities have the following learning areas: gravitational force, mass-weight, pressure in solids, pressure in liquids, gas pressure, force-work, energy-work, energy transformation, frictional force.

Worksheets were created to guide the activities. These papers were first presented to the experts. Before doing these activities, a pilot study was conducted. Every activity was tried first with a parallel group. During the pilot study, students were asked whether there was something that they did not understand. One of the sample worksheets used in this study was published by Ozkan and Umdu Topsakal in 2020.

The steps used by Oh, Lee & Kim (2013) in designing STEAM activities were taken into consideration. In developing these steps, creative design steps mentioned by the Korea Foundation for Advancement of Science and Creativity were used. Creative design steps presented by the Korean Foundation for Science and Creativity were; goal-setting, planning, and design, analysis of design, making, testing, and evaluation. These steps are specified as the characteristics of STEAM education. New STEAM education program steps created by Oh *et al.,* (2013) were; experiencing priming water for an idea, coming up with an idea, planning and design fusion, making or synthesizing, testing, and evaluation. In Oh *et al.,* (2013)'s study that was conducted by using the mathematical-based educational software called Scratch, hands-on activities were not performed. The activities performed in this research were planned and adapted according to these steps. The participants were given a scenario to use as a problem circumstance that they created in the first step. The second step required the pupils to come up with several solutions to the issue. The students developed a design strategy for their answer and sketched out their ideas in the third step. They were urged to work as scientists, engineers, artists, mathematicians, or technology experts in the fourth step as they developed their creations. The designs were put to the test in groups in the fifth step, and any found to be unsuitable were changed. The sixth and final step required the students to assess the output from the other groups' projects.

In order to improve students' engineering skills, they designed the products in all activities. In the developing idea step of the activities, they searched by using tablet computers. The students used mathematics to make the necessary calculations to design their products. All the materials required for the students were given in many colors, varieties, and sizes. They were freed in their designs in order to improve their art and aesthetic sense.

First of all, the students were divided into nine groups. Each group consisted of four students and one group consisted of five students. After the pretest was applied, the worksheet of the first activity was distributed. Tools and instruments used in the activities can easily be found and used. While doing the activities, classroom discussions were conducted to increase students' contribution to the activities. It was perceived that the contribution of

students to the lesson was high. The teacher only guided the students.

The data of this study were collected with STEAM Career Perceptions Questionnaire. The questionnaire was developed by the researchers in order to determine students' career choices, their knowledge of STEAM fields, occupational descriptions, and gender perceptions of these occupations.

The STEAM Career Perceptions Questionnaire was a qualitative measurement tool composed of open-ended questions designed to examine students' opinions in-depth and to determine the causes of their opinions. After the items of the questionnaire were prepared, they were checked by four faculty members in science education and two specialized science teachers.

The questions included in the Questionnaire are given below:

1. What profession do you want to choose in your future life? Why is that?
2. Which of the fields of science, technology, engineering, mathematics and art are you most interested in? Why is that?
3. Explain the profession of people working in the fields given below: a) Scientist, b) Technologist, c) Engineer, d) Mathematician, e) Artist.
4. In your opinion, in which of the fields of science, technology, engineering, mathematics and art, women and men are more successful? Why is that?

With this questionnaire, first of all, the students were asked about their career choices and their responses were evaluated quantitatively. The responses provided for the open-ended STEAM Career Perceptions Questionnaire also were analyzed by the researchers by using content analysis to determine the perceptions of students about STEAM careers in a detailed way. Many codes were created during data analysis. The codes created were first transformed into categories and were then combined with themes. The themes and categories created from the responses were reviewed by the two researchers together and then tables were created. The qualitative data was converted to quantitative data by calculating percentages.

Students' responses were coded independently by researchers according to the resulting inter-rater agreement (kappa) was 0.90.

RESULT AND DISCUSSION

Findings on students' opinions on STEAM careers were presented in this section. The themes obtained as a result of the data analysis were given in tables. Examples from student responses were also presented.

An open-ended response to item 1 was examined to answer the question of the career choices of the students. Table 1 gives the career choices of the students before and after the instruction.

Table 1. Career choices of the students before and after the instruction

Career Choices	Pre-test f(%)	Post-test f(%)
Doctor	13.5	16.2
Sportsman	8.1	0.0
Engineer	2.7	13.5
Police	8.1	2.7
Teacher	13.5	18.9
Psychologist	2.7	8.1
Architect	5.4	8.1
Scientist	2.7	13.5
Pilot	5.4	2.7
Artist (Singer, Painter)	2.7	8.1
Lawyer	2.7	0.0
Veterinarian	5.4	8.1
Astronaut	2.7	2.7

Career Choices	Pre-test f(%)	Post-test f(%)
Stilist	2.7	0.0
Youtuber	5.4	0.0
Not sure	10.8	2.7

Table 1 shows the professions that seventh-grade students wanted to be in their future life. It was observed that the students mostly chose to be doctors and teachers before the instruction. Looking at the answers of the students, there were also new occupational groups brought about by our time like being a YouTuber. Looking at the post-test percentages of student responses, the biggest difference was the percentage of students who chose scientists and engineering professions. Looking at this framework, the seventh-grade students were influenced by the STEAM activities in terms of career choices.

O*NET (Occupational Information Network) stated that the categorization of STEM professions which is accepted internationally. A consensus has been reached about the fact that STEM fields are the ones requiring to use science, technology, engineering, and mathematics knowledge. The occupations in the students' responses were compared with these STEM occupations. STEM professions in the student responses were engineer, teacher (some of the branches), doctor (some of the branches), psychologist, architect, scientist, and veterinarian. In order to determine whether the changes in the number of students choosing STEAM careers and not choosing STEAM careers differed or not, the chi-squared test was applied. According to the chi-squared test, there was statistically significant difference between the distributions of changes in the number of students choosing STEAM careers ($\chi^2 = 6.030$, $p < .05$).

Table 2 shows the students' reasons for their choices.

Table 2. Reasons for career choices of the students before and after the instruction

Reason	Pre-test f(%)	Post-test f(%)
Personal interest	43.2	48.6
Social factors (family, teacher etc.)	16.2	5.4
Trend	5.4	2.7
Self-perceptions	18.9	29,7
High income	8.1	5.4
Ability	5.4	8.1
Prestige	8.1	2.7

Table 3 shows that from before implementation to after implementation, personal interest, self-perceptions and ability percentages increased. Evidence showing how students may have operationalized some of their career choices and reasons is shown by representative student comments below. The students were given a number instead of their names. The gender of students was shown in parentheses at the end of each quote.

"I want to be a lawyer because I like to listen to people and solve their problems. I want to do a career in science" (Student 12, girl, pre-test)

"I want to do a career in science. I want to be a scientist because I like to think like scientists in experiments we did." (Student 12, girl, post-test)

The categories formed under the theme of interest to students' STEAM fields are given in Table 3.

Table 3. Interest to STEAM fields of the students before and after the instruction

Fields	Reason of Interest	Pre-test f(%)	Post-test f(%)
Science	Not like to do an experiment	10.8	27.0
	Like to do research	5.4	18.9
	Curiosity to discover new things	10.8	18.9
	Providing people with a comfortable life	5.4	18.9
	Wanting to discover new things	5.4	8.1
	Wanting to follow new developments	8.1	10.8
Technology	Wondering to technology	13.5	13.5
	Interest in technology	10.8	13.5
	Feeling self-confident about technology	8.1	10.8
	Providing easy access to information	10.8	21.6
	Being technologically in all areas of life	5.4	21.6
Engineering	Wondering about engineering	8.1	29.7
	Engineers to be able to work in every area	8.1	27.0
	Engineers know everything	5.4	16.2
Mathematics	Wondering about mathematics	16.2	16.2
	Like to work with numbers	10.8	16.2
	Like to solve a question	16.2	16.2
	Success in mathematics lessons	18.9	24.3
Art	Having the ability	8.1	13.5
	Having an interest in the art field	13.5	32.4
	Like to listen to music	13.5	13.5

According to Table 3, one of the biggest differences was in the science field. Evidence showing how students may have operationalized some of their interest in STEAM fields is shown by representative student comments below.

"I do not think I'm very successful in science. I am not interested in for this reason." (Student 12, girl, pre-test)

"I liked to try to discover new things." (Student 12, girl, post-test)

In the field of technology, there were changes in the percentages of student opinions before and after the instruction in terms of providing easy access to information and being technologically in all areas of life.

"Technology is the least interesting in these areas." (Student 33, girl, pre-test)

"I'm interested in technology because in the world there is everything like X-ray machines thanks to technology. I can see all of my body. This is very interesting." (Student 33, girl, post-test)

The engineering field was the least interested one among the other fields before the implementation. It is seen in the following theme of the students' answers that students do not have enough information about the engineering discipline. However, it can be said that the interest in the engineering field increased as students were asked to think exactly like an engineer with STEM activities.

"I have not got much interest in engineering, because I don't know what the engineer does." (Student 18, girl, pre-test)

"I am interested in engineering because an engineer combines what is dreamt with reality and designs." (Student 18, girl, post-test)

When we look at students' interest in the mathematics field, it is seen that the changes occurred less in students when compared to other fields.

"I don't like mathematics because it is complicated." (Student 3, girl, pre-test)

"Actually, I don't like mathematics but now I am not afraid of this. I like working with numbers". (Student 3, girl, post-test)

In the art field, different percentages were observed before and after the implementation.

"I am not interested in art as I do not have a talent". (Student 24, girl, pre-test)

"It is very good to express ourselves freely. That is why I have an interest in art". (Student 24, girl, post-test)

Students were asked to define some professions. The categories obtained from the students' responses are given in Table 4. The definitions of the professions made by students and percentages of the replies are given in groups in this table.

Table 4. The definitions of students about professions before and after implementation

Profession	Definition	Pre-test f(%)	Post-test f(%)
Scientist	Is someone who invents	27.0	32.4
	Establishes a theory	13.5	24.3
	Does experiment	27.0	54.0
	Is knowledgeable, wise.	16.2	43.2
	Makes an invention	21.6	40.5
	Has a rank in science	2.7	13.5
	Works for the sake of humanity.	10.8	27.0
	Informs people.	2.7	16.2
	Studies in nature.	10.8	37.8
	Learns what we do not know.	10.8	54.0
	Is patient and ambitious.	8.1	32.4
	Spends of most of his/her time in the lab.	5.4	13.5
	Observes and thinks	10.8	56.7
Expert in Computer technologies	Knows how to use computers very well	16.2	10.8
	Can fixes computers	27.0	10.8
	Interested in computers.	13.5	16.2
	Knows technology very well	10.8	18.9
	Flows the innovations.	2.7	16.2
Engineer	Constructs buildings	10.8	40.5
	Does machines	5.4	43.2
	Implements technological advancements in computers and software.	5.4	10.8
	Fixes computers	13.5	5.4
	Makes cars or mends its pieces.	5.4	5.4
	Draws.	8.1	24.3
	A profession that has many branches.	8.1	43.2
	Designs.	8.1	54.0
	Works in construction sites.	10.8	18.9
Expert in Mathematics	Solves mathematics problems	13.5	16.2
	Has a good command in mathematics operations	16.2	13.5
	They are mathematics teachers	27.0	0.0
	Sees everything as mathematics.	2.7	0.0
	Uses mathematics in everyday life	2.7	29.7
	Understands the nature of mathematics	5.7	16.2
Artist	Is a singer	56.7	21.6
	Is a painter.	29.7	16.2
	Writes lyrics for songs.	5.4	0.0
	Is a dancer.	2.7	0.0
	Is a fashion designer	2.7	0.0
	Expresses himself/herself with music or art	13.5	54.0
	Is a sculpture.	0.0	0.0
	Make tiles.	0.0	0.0
	Colors the world.	8.1	13.5
	Relaxes other people	0.0	0.0
	Has a talent.	21.6	18.9
	Is a famous person.	29.7	5.4

Profession	Definition	Pre-test f(%)	Post-test f(%)
	Is a craftsman	2.7	0.0
	Does whatever s/he wants.	8.1	56.7

It is seen that frequency percentages of some definitions in some categories displayed an increase from the beginning till the end of the implementation. The highest diversity in students' answers about the STEAM fields was about scientists.

The students' definitions of scientists showed diversity. In other words, we can see many different categories of scientists. Students' frequency percentages were in the following categories; does experiments, knowledgeable and wise, innovates, works for the sake of humanity, informs people, do observations, thinks, learns the things that we do not know, is patient and ambitious and studies nature; which changed amply from the beginning till the end of the implementation. The increase in the percentages of the answers displayed that the perception of the students about scientists widened.

"A scientist does experiments." (Student 7, girl, pre-test)

"A scientist discovers by doing experiments, that is s/he is curious about finding new things." (Student 7, girl, post-test)

When we look at the definitions for experts in the technology field who are chosen to represent the technology field, it is seen that there are a small number of categories. The frequency percentages of the definitions in the category of "someone who fixes computers" decreased after the implementation. This sample shows that students grasp the fact that experts have duties other than fixing the computers.

"Experts in computer technologies know using computers very well." (Student 4, boy, pre-test)

"Experts in computer technologies are interested in technology, follow the developments and know the structure of the computers." (Student 4, boy, post-test)

When we look at the answers coming from the students, it is seen that they provided various definitions for engineering. Most of the students had difficulties in defining the profession of an engineer during pre-test and they did not give any answers. The percentages of the students' answers like "constructs buildings, constructs machines, designs, a profession which has various types and draws" increased from pre-test till post-test.

"I do not know the exact definition of engineering, but there are various types of engineering. Like for example, Computer engineering, civil engineering, and mechanical engineering." (Student 23, girl, pre-test)

"An engineer is someone who produces something by designing." (Student 23, girl, post-test)

It is seen that there is limited number of categories regarding the definitions of students about professions occupied by mathematics experts representing the mathematics field. For students in pre-test, the people who are experts in mathematics are mathematics teachers. An increase was observed in the categories stated as a person who uses mathematics in everyday life and someone who understands the nature of mathematics.

"Experts in mathematics are mathematics teachers." (Student 37, boy, pre-test)

"Experts in mathematics are people who understand the nature of mathematics and know-how to employ it." (Student 37, boy, post-test)

There are various definitions of students for artists. There were ample changes in the frequency percentages about the categories stated as "someone who expresses himself/herself through music" and "someone who does whatever s/he wants" from the beginning of the implementation. After the implementation, students started to perceive the concept of artist from an in-depth perspective instead of explaining it through artificial definitions like "the artist is a singer".

"An artist draws, sings, sculptures, and lays the tiles." (Student 11, boy, pre-test)

"An artist reflects his/her inner world through drawing and externalizes his/her feelings

by painting. S/he is the only one who really knows what his/her painting includes and what s/he feels what doing this painting." (Student 11, boy, post-test)

The students were asked which fields women and men were more successful in order to determine their gender perceptions regarding STEM professions. The categories created for determining the students' perceptions regarding professions are given in Table 5.

Table 5. The gender perceptions of students about the fields of professions before and implementation

Gender	The field which s/he is successful in	Pre-test f(%)	Post-test f(%)
Female	Science	40.5	5.4
	Technology	21.6	5.4
	Engineering	8.1	5.4
	Art	59.4	13.5
	Mathematics	27.0	5.4
Male	Science	56.7	8.1
	Technology	27.0	8.1
	Engineering	64.9	13.5
	Art	5.4	5.4
	Mathematics	29.7	8.1
The gender has no importance		29.7	67.6

When looking at Table 5, it is seen that students think that females are more successful in art and mathematics and males are more successful in engineering, science and technology. After the implementation, it was concluded that most of the students thought gender had no importance at all.

"Males are more successful in engineering and mathematics because they are better at calculating and operations. I have never seen a female engineer." (Student 2, boy, pre-test)

"There are males and females who are successful in every field. I discriminated before, but I now realized that I should not have done it. If one person works hard and wants to be successful in any field, he or she can do it." (Student 2, boy, post-test)

In the study, firstly the career choices of the students were asked before and after the implementation. According to O*NET (Occupational Information Network) categorization of STEM professions, it was concluded that the percentage of choosing occupations in STEM areas increased significantly. Although the artist is not in the STEM professions category, the number of students interested in to be artist increased. The number of students, who were not sure, decreased. When we look from this perspective, it can be said that STEAM education has an effect on seventh-grade students about their career choices.

Since the students are at the trial period according to vocational development theory (Ginzberg, Ginsburg, Axelrad & Herma, 1951), very big differences might not have occurred from the beginning of the implementation until the end. However, the important point here is that STEAM activities create differences in the students' career choices.

Similar results were found in Kong, Dabney & Tai's (2014) studies which were carried out with middle school students. The purpose of their study was to determine the correlation between career choice possibilities of students who are attending science and engineering summer camps. As a result of the study, it was found out that students who attended summer camps were more inclined to choose a career in science and engineering than students who did not.

When looked at the students' reasons for career choices, seven categories (personal interest, social factors, trend, self-perceptions, high income, ability, and prestige) were found. Sahin et al., (2015) found the categories were science teachers, personal interest, parents, science fairs and

Olympiads, internships, and job availability. Drymiotou Constantinou & Avraamidou (2021) also said that personal features like personal interests, self-efficacy expectations, and stable tendencies affected students' choices. The categories presented in this study were similar to the literature. In this study, most of the students preferred careers because of their personal interests. Mostly, the impact of social factors decreased. At the end of the implementation, these students moved away from external influences and turned into personal interests. This finding supports STEAM education as being effective in choosing a career.

When we look at the students' interests in STEAM fields from the beginning till the end of implementation, it was concluded that the number of students who had an interest in the science field before the implementation was less compared to after the implementation. STEM education where students are actively involved offers the potential to positively affect students' interests in science (Barakat, 2022). In technology field, big differences did not occur in the percentages of the students' responses before and after the implementation. The reason for this can be the fact that the field of technology did not stand out in the activities carried out during the implementation. The field of engineering was the one that took the least attention. It is seen in the following theme of the students' responses that students did not have enough information about the engineering discipline. However, since students were asked to act like an engineer in the group, it can be said that the interest in the engineering field increased. The reason of this can be interpreted through the fact that students understood the definition of engineering profession with the tasks and scenarios given. Moreover, when we looked at the definitions of the professions, the percentage related to the definition of the engineering profession increased. When we analyzed the students' interest in mathematics, there were little changes before and after the implementation when compared to other fields. The reason of this can be presented as using more materials during the implementation instead of dealing with nature of mathematics. Changes were observed in art field from the beginning to the end of the implementation. The reason can be the fact that students were allowed to be free through the art component added to the STEM.

In the categories where students were asked to define professions, the frequency of some definitions in some categories increased after the implementation. The responses of the students showed the most variety in the scientist category among professions included in STEAM fields. The reason of this can be the fact that students were encouraged to act like a scientist during the given tasks. As research has shown that, middle school is the most critical period in which children shape their opinions about the professions (Grant *et al.*, 2021). For this reason, the positive effect of the implementation on the views of secondary school students on science reveals the importance of STEAM education. When we looked at the definitions provided for the experts representing the field of technology, it is seen that few categories were obtained in students. The reason of the less change in the technology field can be the fact that technology dimension in STEAM activities is less dominant.

In gender perceptions in STEAM professions, it is seen that students thought that females are more successful in art and mathematics fields and males are more successful in science and technology fields in pre-testing. After the implementation, most of the students thought that gender had no importance at all. The reason of this can be the fact that students were able to complete the tasks in STEAM implementations without considering the gender. When we looked at the findings of the study, it can be said that STEAM education affected the gender perceptions of the students. Sullivan and Bers (2019) stated that women generally worked less than men in STEM fields. For this reason, students might think before the implementation that men are more successful in engineering, science, and technology. Although women are found to be more successful in some skills, as in the study of Darmaji, Astalini, Kurniawan & Putri (2022), the most widely known stereotype in the literature about STEM fields is that men are better than women in these areas (Jimenez, Cribbs & Gill 2018). Although the students thought

differently at the beginning, they stated that at the end of the application, men and women would be equally successful in every field.

In summary, the study's findings showed that students were more likely to choose occupations in STEAM disciplines like science and engineering. When looked at the students' reasons for career choices, seven categories (personal interest, social factors, trend, self-perceptions, high income, ability, and prestige) were found. The students who had an interest in the science field before the implementation was lower than after the implementation, according to research on students' interests in STEAM subjects from the beginning to the end of implementation. In the categories where students were asked to define professions, the frequency of some definitions in some categories increased after the implementation. In gender perceptions in STEAM professions, it is seen that students thought that females are more successful in art and mathematics fields and males are more successful in science and technology fields in pre-testing. After the implementation, most of the students thought that gender had no importance at all.

CONCLUSION

The study's findings may lead one to the conclusion that additional research is necessary to fully understand the effects and structure of STEAM education. Making STEAM a standard practice at various grade levels is believed to guarantee that students from preschool to university would be knowledgeable about STEAM topics. Within the parameters of this study, it will be beneficial to engage students in STEAM activities to expose them to careers if they are undecided about their career choices. Because students will choose their careers at this stage, it is crucial to understand how they view STEAM disciplines not just in middle school but also in high school. Students may have the opportunity to experience careers that result from STEAM activities. In this study, STEAM activities were carried out with simple materials that are easily found. If teachers have sufficient awareness of STEAM education, they can easily make their students do STEAM activities in the classroom environment. In this way, educators can create professional awareness in students with STEAM education. It is advised to do a comparable study at the high school level due to this.

REFERENCES

Babarovic, T. (2021). Development of STEM vocational interests during elementary and middle school: a cohort-sequential longitudinal study. *Journal of Career Development*,49(6), 1230-1250. https://doi.org/10.1177/089484532110369 86

Barakat, R. (2022). Science and representation: examining the role of supplementary STEM education in elementary school student science identity. *SN Social Sciences*, *2*(3), 1-19.

Bass, K. M., Dahl, I. H., & Panahandeh, S. (2016). Designing the Game: How a Project-Based Media Production Program Approaches STEAM Career Readiness for Underrepresented Young Adults. *Journal of Science Education and Technology*, *25*(6), 1009-1024.

Cantrell, P., & Ewing-Taylor, J. (2009). Exploring STEM career options through collaborative high school seminars. *Journal of Engineering Education*, *98*(3), 295-303.

Darmaji, D., Astalini, A., Kurniawan, D. A., & Putri, W. A. (2022). Science process skills and critical thinking ability assessed from students' gender. *Jurnal Pendidikan Fisika Indonesia*, *18*(1), 83-95.

Drymiotou, I., Constantinou, C. P., & Avraamidou, L. (2021). Enhancing students' interest in science and understandings of STEM careers: the role of career-based scenarios. *International Journal of Science Education*, *43*(5), 717-736.

English, L. D., & King, D. T. (2015). STEM learning through engineering design: Fourth-grade students' investigations in

aerospace. *International Journal of STEM Education*, *2*(14), 1-18.

Ginzberg, E., Ginsburg, S.W., Axelrad, S., & Herma, J.L. (1951). *Occupational Choice.* New York: Columbia University.

Gracin, D.G., Babarovic, T., Devic, I., & Burusic, J. (2018). Development and validation of new objective school achievement tests in the STEM field for primary school students. *Croatian Journal of Education, 20*(3), 789-824.

Grant, K. L., Springer, S. I., Tuttle, M., & Reno, M. (2021). Small-group counseling intervention to support career exploration of rural middle school students. *The Journal for Specialists in Group Work*, *46*(1), 108-127.

Hazari, Z., Sonnert, G., Sadler, P., & Shanahan, M.C. (2010). Connecting high school physics experiences, outcome expectations, physics identity, and physics career choice: A gender study. *Journal of Research in Science Teaching, 47*(8), 978-1003.

Heise, N., Hall, H. A., Ivie, K. R., Meyer, C. A., & Clapp, T. R. (2020). Engaging high school students in a university-led summer anatomy camp to promote STEM majors and careers. *Journal of STEM Outreach*, *3*(1), 1-7.

Hiğde, E., & Aktamış, H. (2022). The effects of STEM activities on students' STEM career interests, motivation, science process skills, science achievement and views. *Thinking Skills and Creativity*, *43*, 101000.

Hoang, N. T., & Huy, D. T. N. (2021). Determining factors for educating students for choosing to work for foreign units: Absence of self-efficacy. *JETT*, *12*(2), 11-19.

Jho, H., Hong, O., & Song, J. (2016). An analysis of STEM/STEAM teacher education in Korea with a case study of two schools from a community of practice perspective. *Eurasia Journal of Mathematics, Science and Technology Education*, *12*(7), 1843-1862.

Jimenez, K., Cribbs, J., & Gill, N. (2018). College students' perceptions of gender stereotypes: making connections to the underrepresentation of women in STEM fields. *International Journal of Science Education*, *40*(12), 1432-1454.

John, D. D., Chen, Y., Navaee, S., & Gao, W. (2018). Board 57: STEM Education from the Industry Practitioners' Perspective. In *2018 ASEE Annual Conference & Exposition*.

Kim, B. H., & Kim, J. (2016). Development and validation of evaluation indicators for teaching competency in STEAM education in Korea. *Eurasia Journal of Mathematics, Science and Technology Education*, *12*(7), 1909-1924.

Kong, X., Dabney, K.P., & Tai, R.H. (2014). The association between science summer camps and career interest in science and engineering, *International Journal of Science Education, 4*(1), 54-65.

Liliawati, W., Rusnayati, H., Purwanto, & Aristantia, G. (2017). Implementation of STEAM Education to Improve Mastery Concept. *IOP Conference Series: Materials Science and Engineering*, *288*(1), 1–5.

Luo, T., So, W. W. M., Wan, Z. H., & Li, W. C. (2021). STEM stereotypes predict students' STEM career interest via self-efficacy and outcome expectations. *International Journal of STEM Education*, *8*(1), 1-13.

Lv, B., Wang, J., Zheng, Y., Peng, X., & Ping, X. (2022). Gender differences in high school students' STEM career expectations: An analysis based on multi-group structural equation model. *Journal of Research in Science Teaching*. https://doi.org/10.1002/tea.21772

Mahat, M., Dollinger, M., D'Angelo, B., Naylor, R., & Harvey, A. (2022). Co-designing a curriculum model for career education: perspectives from regional communities in Australia. The Australian Educational Researcher, 1-23. https://doi.org/10.1007/s13384-021-00505-0

MEB, (2013). *Secondary School Science Course Curriculum*, Ankara: Ministry of National Education.

Moore, T. J., Stohlmann, M. S., Wang, H. H., Tank, K. M., & Roehrig, G. H. (2014). Implementation and Integration of Engineering in K-12 STEM Education. In *Engineering in Precollege Settings: Research into Practice,* edited by J. Strobel, S. Purzer, and M. Cardella, 35–60. Rotterdam: Sense Publishers.

O*NET (2019). Occupational Information Network. Retrieved from www.onetonline.org. U.S: National O*NET Consortium.

Oborah, J. O. (2022). Effectiveness of the infusion teaching approach for the development of general ICT skills in Nigerian tertiary education. *Journal of Research in Innovative Teaching & Learning*, (ahead-of-print). https://doi.org/10.1108/JRIT-11-2021-0076

Oh, J., Lee, J., & Kim, J. (2013). Development and Application of STEAM Based Education Program Using Scratch: Focus on 6th Graders' Science in Elementary School. In *Multimedia and Ubiquitous Engineering, Lecture Notes in Electrical Engineering*, edited by J. Park, et al., 493-501. Dordrecht: Springer.

Ozkan, G., & Topsakal, U. (2020). A STEAM activity that can be used in science education. *Ulakbilge Dergisi*, *8*(45), 185-199.

Park, N. (2014). The development of STEAM career education program using virtual reality technology. *Life Science Journal*, *11*(7), 676-679.

Ritz, J. M., & Fan, S. C. (2015). STEM and technology education: International state-of-the-art. *International Journal of Technology and Design Education*, *25*, 429-451.

Sahin, A., Gulacar, O., & Stuessy, C. (2015). High school students' perceptions of the effects of international science Olympiad on their STEM career aspirations and twenty-first century skill development. *Research in Science Education*, *45*(6), 785-805.

Sevilla, M. P., & Rangel, V. S. (2022). Gender differences in STEM career development in postsecondary vocational-technical education. A social cognitive career theory Test. *Journal of Career Development*, 1-18. https://doi.org/10.1177/089484532210869 79

Steele, A., & Ashworth, E. L. (2018). Emotionality and STEAM integrations in teacher education. *Journal of Teaching and Learning*, *11*(2), 11-25.

Sullivan, A., & Bers, M. U. (2019). Investigating the use of robotics to increase girls' interest in engineering during early elementary school. *International Journal of Technology and Design Education*, *29*(5), 1033-1051.

Taljaard, J. (2016). A review of multi-sensory technologies in a science, technology, engineering, arts and mathematics (STEAM) classroom. *Journal of Learning Design*, *9*(2), 46-55.

Tsakissiris, J., & Grant-Smith, D. (2021). The influence of professional identity and self-interest in shaping career choices in the emerging ICT workforce. *International Journal of Work-Integrated Learning*, *22*(1), 1-15.

Veen, V.D.J. (2012). Draw your physics homework? Art as a path to understanding teaching in physics. *American Educational Research Journal, 49*(2), 356–407.

Watson, S., Williams-Duncan, O. M., & Peters, M. L. (2022). School administrators' awareness of parental STEM knowledge, strategies to promote STEM knowledge, and student STEM preparation. *Research in Science & Technological Education*, *40*(1), 1-20.

Wyss, V. L., Heulskamp, D., & Siebert, C. J. (2012). Increasing middle school student interest in STEM careers with videos of scientists. *International Journal of Environmental and Science Education*, *7*(4), 501-522.

Yamada, A. (2018). Developing global competencies through interdisciplinary studies: why collaboration is important between STEM and Non-STEM students. *New Directions of STEM Research and Learning in the World Ranking Movement: A Comparative Perspective*, 79-96.