

Investigation of students' career choices in stem fields

Abstract

The main purpose of this study is to reveal the reason that although STEM professions are very important for the development of countries, why the rate of students choosing these professions is low compared to other professions. Therefore, in the scope of this research, many articles on the factors that affect students' career choices in STEM fields have been reviewed. As a result of the literature review, it was found that factors such as gender, race, socio-economic status, family, interest, attitude, and self-efficacy affect students' career choices in STEM fields. Moreover, within the scope of the study, considerations that prevent and support students from choosing a career in STEM were mentioned and some suggestions were presented for increasing the number of students who choose a profession in STEM.

Keywords: STEM, STEM careers, Gender, Race, Family, Socio-Economic Status, Attitude and Self-Efficacy.

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Nurevşah Kaya, Sefa Bulut

Department of Counseling Psychology, Ibn Haldun University, Turkey

Correspondence: Sefa Bulut, Department of Counseling Psychology, Ibn Haldun University, Turkey, Email sefabulut22@gmail.com

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Introduction

In the 21st century, when globalization has reached its peak, economic and technological developments are of great importance in determining the development levels of countries. World countries that want to increase their economic and technological development levels in the global world and thus have an international status, attach great importance to scientific studies.¹ If significant developments occur in science and technology in a country, the country leaves behind rival countries in the field of economy and labor and takes place as an internationally developed country in the world. Before the 21st century, countries tried to increase their development and economic levels with the labor market dependent on manpower but, today, the level of development of a country is trying to be increased by combining the business market with scientific and technological power. For this reason, countries try to find various ways in which technology and science can develop in their countries and be integrated into the job market.

The importance of the integration of science and technology with the business world has led to some changes in traditional business perception. As a result of this change, the business world has been separated from a traditional, raw information-oriented structure that needs manual power and has turned into a technology-oriented structure that keeps pace with scientific developments. This radical change in the business world has created some differences in the demands of the labor market and led to the emergence of a new field called 21st-century job skills.¹ In order for a country to develop in the scientific field and to develop the economy thanks to its labor force, it has started to be seen as a necessity for the individuals working in that country to have 21st-century job skills. According to these skills, individuals who want to exist in the labor market should think critically and creatively, know the ways to access information, be compatible with teamwork, be open to innovations, know their responsibilities, and focus on problem-solving and production.² Countries that want individuals with all these characteristics to play an active role in the business field and support the development of the country by turning to science and technology have made some changes in education in order to raise individuals with these skills. In particular, countries such as America, Japan, and South Korea, which want to be dominant in the international arena, made some changes in their education programs

and plans for this purpose and enriched their school curricula with science and technology-based courses.¹ America that doesn't want to leave the world leadership to countries such as Japan, Russia, and China in the areas of science and technology, started an application called STEM as an education reform.³ STEM refers to the initials of science, technology, engineering, and mathematics. On the basis of STEM education is the teaching of course contents associated with real-life by integrating them with fields such as science, mathematics, technology, and engineering.⁴ STEM education removes the difference between mathematics, science, and engineering disciplines and provides complete integration between these fields. Furthermore, this educational approach aims to raise students from primary school to university as questioner, curious, scientific, critical thinker individuals and directs them to fields such as science, mathematics, and engineering in their university choices.

Individuals who continue their university education in these areas both have the job skills required by the 21st century and contribute to the development of the country at the highest level. Besides, in the 21st century, STEM education has become compulsory for all countries of the world because it is much more important to improve the mental thinking processes and project planning skills of individuals in the business field rather than their labor and muscle power. The importance of STEM education in today's world has made it inevitable for countries to support students in choosing a profession in these fields. Many countries want the majority of the working workforce to take part in fields such as science, mathematics, and engineering due to the importance of technology and science in the development of the country. However, many factors play a role in students' career choices. Although STEM education is applied in many countries, not every student chooses a career in fields such as mathematics, engineering, or technology. In particular, although America supports students to choose a career in STEM fields at the national level, the number of students who choose and graduate from STEM-related programs in higher education institutions is very low.⁵ According to Cataldi and et al.,⁶ the number of individuals working in STEM-related professions in America is 16% of the students.⁶

Students consider many factors while choosing their profession. They make their professional choices by considering the role of gender, religion, family expectations, social class, and culture. This

paper will focus on the factors that influence students' career choices in STEM fields by taking into consideration gender, race/ethnicity, socio-economic status, family, attitude in STEM, and students' self-efficacy perceptions.

Literature review

Gender

The gender role that society imposes on the individual manifests itself from the moment the individual is born. It determines the expectations, values, images, beliefs, and behaviors of women and men in society. Men and women who act according to the roles determined by society make many choices and practices according to these roles. As a result of these choices from childhood, men and women develop a gender self schema. Gender self-schema is described as cognitive structures that are developed over time and include sex-typed generalizations about the self.⁷ Individuals define themselves as masculine or feminine and determine everything from their hobbies, behaviors, personality characteristics, beliefs to career choices, according to their gender self-schema. Gender-self schema, which has a very important place in individuals' choice of profession, gives us significant information about the distribution of career choices of female and male students in STEM fields. According to the understanding existing in many societies, women are deemed suitable for professions such as teaching, counseling, and nursing in order to spend time with their families and use their social skills, while men are considered suitable for technology, science, and engineering-oriented professions. This understanding has also affected the distribution of female and male students to pursue a career in STEM fields, and many studies have been conducted to reveal this distribution. Students consider the gender role imposed by society while making their career choices. Therefore, female students, who do not want to contradict the understanding of society, have a significantly lower rate of pursuing a career in STEM areas compared to male students. For example, the proportion of women pursuing a career in engineering in different countries is as follows: Latvia 30%, Bulgaria 29.3%, Turkey 21%, Italy 19.5%, Ireland 14.3%, Austria 10%, and the UK 8.7%.⁸ These rates are very low considering the importance of STEM careers. There are many reasons why female students do not choose a profession in the STEM field. For example, the perspective of society and family towards a career choice that is suitable for gender roles, teachers' negative attitudes towards gender, and women's home and child responsibilities are some of these reasons.⁹

In a study by Azgın and Şenler¹⁰ measuring the interest of primary school 3rd and 4th-grade female and male students in careers in STEM fields, it was found that male students had a much higher average score than female students.¹⁰ Besides, in another study by Edwards, Coddington, and Caterina¹¹ it was revealed that male students are much more advanced in science, mathematics, and technology than female students in terms of attitude, knowledge, and skills.¹¹ Furthermore, according to a study by Brotman and Moore,¹² it was found that while female students' interest in STEM fields decreased during their high school years, male students' interests increased.¹² Also Lent et al.,¹³ while examining middle school and high school students' career perceptions towards STEM, stated that female students do not see science and technology as their future career.¹³ Moreover, Ünlü and Dökme¹⁴ in a study they conducted with 851 middle school students, found that boys' interest in STEM careers are higher than girls.¹⁴ According to almost all research results in this field examined in the literature review, female students have a much lower rate of choosing a career in STEM compared to male students. One of the most important reasons for this situation is that female students

feel obliged to comply with the gender stereotypes determined by society, therefore they tend to focus on fields such as teaching and consultancy instead of engineering and science.

Race/Ethnicity

The race of individuals is of great importance in choosing a profession. Throughout history, some ethnicities have been deemed suitable for high prestige professions such as engineering and medicine, while some ethnicities have been deemed suitable for low prestige professions such as the service sector. The mental caste systems that society uses to distinguish individuals according to their races caused discrimination that has become a bleeding wound of society. Today, different races, who have to live together due to some reasons such as globalization and migration, feel discrimination in almost every field from the rights that they have to their choice of a profession. Therefore, the discrimination that students experience due to their race may affect their career choices. Students who are exposed to discrimination and deemed worthless by society because of their race either do not continue their education or choose a profession in the service sector. On the other hand, the races that create the majority in society and are perceived as noble, choose highly prestigious professions such as science, technology, and engineering. The research which is conducted by the National Science Foundation¹⁵ revealed that throughout history, African- Americans and Hispanics are under-represented in STEM fields compared to the other races.¹⁵ Also, in contrast, according to the study that is conducted by Beede et al.,¹⁶ Caucasians and Asians are over-represented in STEM fields compared to the other races in the US.¹⁶ Furthermore, Andersen and Ward¹⁷ found that while Caucasian students have more interest in pursuing STEM career fields, African-American and Hispanic students have lower interest and motivation for pursuing STEM career fields.¹⁷ As a result, when students make a career choice, they consider racial discrimination that prevents them from choosing a career in STEM. Even if these students want to pursue a career in STEM fields, they tend to pursue careers in different fields due to the discrimination they will face.

Socio Economic Status

The economic class of students plays an active role in choosing a career in STEM fields. Choosing a career in STEM fields requires intensive study because having a career in these fields is not something that can be easily accomplished. Students who want to have a profession in STEM fields take lessons from private teachers, go to private teaching institutions, buy many books in order to study and prepare for the university exam. In addition, with the widespread use of the internet, today, many students can easily learn a lot of information and watch videos from the internet. However, it requires a certain economic level to have all these opportunities. On the other hand, students who come from a low socio-economic level cannot go to private teaching institutions and cannot buy books to study. Also, generally, they don't have an internet connection at home to listen to videos and search for information. Some students, who cannot have these opportunities due to financial difficulties, cannot choose a profession from STEM fields that require high scores from the university exam. Azgın and Şenler¹⁰ revealed in a study that students who do not come from low economic status and have an internet connection at home choose more careers in STEM fields than students who do not have an internet connection at home.¹⁰ Furthermore, Mutlu and Korkut-Owen⁹ stated that the most important factor negatively affecting the career development of students in STEM fields is socio-economic conditions with their research.⁹ Besides, Brown et al.,¹⁸ points out that students with low socio-economic levels are more

likely to get less financial support for lower quality education rather than for STEM education.¹⁸ Therefore, countries that want students to make more career choices in STEM fields should support students economically and eliminate financial problems that prevent them from studying.

Family

Families have a determining role in students' choice of profession. Students are significantly influenced by their families' attitudes, behaviors, beliefs, and expectations while making their career choices. Some families have a dominant structure over their children and direct them to follow a certain profession. This certain occupation is usually one that parents could not have due to some obstacles in their time. In this way, families want to realize their dreams through their children. On the other hand, some families leave the decision about their choice of profession to their children and support them whatever they decide. However, today most parents want their children to have a high prestigious profession. Especially educated parents want their children to be successful in fields such as science, technology, and engineering. The study which is conducted by Azgın and Şenler¹⁰ showed that as the education level of parents increases, students' attitudes towards STEM fields also increase.¹⁰ Furthermore, Bacanlı and Sürücü¹⁹ revealed a positive relationship between the education level of families and students' career choices in STEM fields.¹⁹ Parents with a high level of education know the importance of STEM careers for their children and country and support their children in this direction. In addition to the education level of the families, the thinking system they have about the gender role is also effective in students' choice of profession. According to Chhin, Bleeker, and Jacobs,²⁰ if families stay away from gender stereotypes and encourage their children to choose professions that fit their expectations and abilities, children tend to focus more on STEM fields.²⁰ For example, if a girl who is not considered suitable for the engineering profession just because she is a girl is supported by her family, this person contributes to the number of individuals working in the STEM field and ensures the development of the country. Moreover, the study which is conducted by Mutlu and Korkut-Owen⁹ found that the first thing that girls who choose a profession in STEM fields receive support is their families.⁹ Therefore, families' thinking systems that are away from gender expectations are very important for the development of STEM fields.

Attitude and Interest in STEM

One of the most significant factors in students' career choice is their attitude and interest in that profession. Students make their career choices based on the subjects of their greatest interest during their school years. For example, students who are interested in English lessons during their school years and like to watch foreign movies make their career choices in this direction and choose a career in areas such as English teaching and translator. Students' attitudes and interests towards subjects such as science, mathematics, physics, chemistry, and biology play a determining role in making a career choice in STEM fields. Altan, Üçüncüoğlu, and Zileli²¹ stated the views of students who are interested in STEM professions in the "Interest Scale for STEM Professions" which they applied to 92 students in 8th grade as follows; "Since my interest in my science lesson is very high, I turned to this profession. I love science, I am also interested in the sky, balance in space, observation with a telescope are things I love"; "I like dealing with computers. I am good with technology. I like making graphics or designing programs on the computer".²¹ As can be seen in these examples, the important factor in making a career choice in STEM fields is the attitude and interest in this field. If students are interested in fields such as mathematics and science, they

are more likely to pursue a career in these areas than those who are not interested in these fields.

Students Self-Efficacy in STEM Fields

Hackett and Betz²² express the most important factor that individuals consider when choosing a profession as the individual's self-efficacy perception.²² Adapting the concept of self-efficacy from Albert Bandura's social cognitive theory, Hackett and Betz form the social cognitive career theory.²³ According to this theory, if individuals consider their abilities and skills sufficient for a profession, they do not hesitate to choose that profession. For example, if a person thinks that he/she has sufficient knowledge and skills in computers, he/she may choose computer engineering as a profession. Just like in this example, students tend to choose professions that take part in the courses they are successful in. Therefore, the professions in STEM fields are generally chosen by students who are successful in courses such as science, mathematics, physics, chemistry, and biology. In their study, Altan, Üçüoğlu, and Zileli²¹ stated that students who chose a career in the STEM fields gave the following answers based on their perception of self-efficacy in the STEM Career Interest Scale; "I think that I can become a doctor because I am successful in science class" and "I am successful in mathematics class. I think I can be a good math researcher in the future".²¹ It is very important for students to choose a career in a field that they consider themselves successful and competent because only in this way the individual uses his / her maximum capacity and becomes happy in his/her job.

Conclusion

As a result, the 21st century has brought some changes in traditional job understanding due to globalization and technological developments. This change, which appears as 21st-century job skills, emphasizes the importance of individuals in the business field to have certain talents such as productivity, curiosity, and scientificness. For this reason, countries that want to follow the age have made some regulations in the field of education so that individuals who contribute to the workforce of the country can have sufficient knowledge and experience in the fields of technology and science. The most important of these regulations is the STEM education concept, which expresses the integration of fields such as science, technology, engineering, and mathematics into other courses. However, although countries place too much emphasis on the implementation of STEM education in schools, students are not too keen on choosing a career in these fields. For this reason, this essay tried to find out why students are reluctant to choose a career in STEM by trying to reveal the factors that affect students' choice of a career in the STEM field. As a result of the research, it was revealed that factors such as gender, race, socio-economic class, family, attitude, and self-efficacy perception were effective in students' choice of a career in STEM fields.

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Conflict interest

The authors declared no have conflict interest for the study.

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