Analyzing Nationwide Enrollment and Graduation Trends in Undergraduate STEM Majors in Türkiye from 2013 to 2023

RESEARCH ARTICLE

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Abstract

This study explored nationwide trends in STEM enrollments and graduations in Turkish higher education institutions from 2013 to 2023 by examining the official dataset provided by the Council of Higher Education. The findings highlighted an enduring demand for STEM areas, with more than half of high school graduates choosing STEM majors during this eleven-year period, while there were some fluctuations that could be related to a number of policy changes in the university entrance system. Gender differences were also analyzed. In the earlier years, males were overrepresented in STEM fields. However, the gender gap has recently narrowed, with growing female participation in areas such as biological sciences. Despite an increasing trend in overall female enrollments in STEM majors, significant disparities still remain in particular subfields such as engineering, where male enrollment and graduation rates have been substantially higher. The findings suggest that Türkiye's nationwide STEM pipeline appears relatively robust at the macro level; however, targeted evidence-based interventions and policy reforms are needed to promote more equitable participation in various STEM career pathways and address persistent gender disparities. This study provides the first comprehensive national analysis of the STEM pipeline in Türkiye and offers valuable insights for policymakers, educators, and other stakeholders.

Keywords: *higher education in Türkiye, STEM enrollment trends, STEM graduation trends, STEM pipeline, STEM classification, undergraduate STEM programs*

Türkiye Genelinde Lisans Düzeyindeki STEM Bölümlerine Ait 2013-2023 Yılları Arasındaki Kayıt ve Mezuniyet Eğilimlerinin Analizi

ARAŞTIRMA MAKALESİ

Öz

Bu çalışma, Yükseköğretim Kurulu tarafından sağlanan resmî verileri inceleyerek Türkiye'deki yükseköğretim kurumlarında 2013-2023 yılları arasında STEM (Fen, Teknoloji, Mühendislik ve Matematik) alanlarındaki kayıt ve mezuniyetlere ilişkin ülke genelindeki eğilimleri incelemiştir. Araştırmanın bulguları, bu on bir yıllık dönemde lise mezunlarının yarısından fazlasının STEM bölümlerini tercih etmesiyle birlikte, STEM alanlarına yönelik kalıcı bir talebin olduğunu ortaya koymuştur. Bununla birlikte üniversite giriş sistemindeki bazı politika değişikliklerine bağlı olabilecek birtakım dalgalanmalar da gözlemlenmiştir. Çalışmada ayrıca cinsiyete dayalı farklılıklar da analiz edilmiştir. İncelenen dönemin ilk yıllarında STEM alanlarında erkek öğrencilerin oranının belirgin biçimde yüksek olduğu görülürken son dönemde özellikle biyolojik bilimler gibi bazı alanlarda kadın öğrencilerin katılımının artmasıyla bu cinsiyet farkının daralmaya başladığı tespit edilmiştir. Her ne kadar STEM bölümlerinde genel anlamda kadın öğrenci kayıtlarında artış eğilimi olsa da, mühendislik gibi belirli alt alanlarda erkek öğrenci kayıt ve mezuniyet oranlarının hâlen önemli ölçüde yüksek olması nedeniyle ciddi farklılıklar görülmeye devam etmektedir. Bulgular, Türkiye genelinde STEM alanına yönelik ilginin makro düzeyde nispeten güçlü olduğunu ortaya koymakla birlikte, çeşitli STEM kariyer yollarına daha eşitlikçi katılımı teşvik etmek ve kalıcı cinsiyet eşitsizliklerini gidermek amacıyla hedeflenmiş, kanıta dayalı müdahale programları ve eğitim politikası reformlarına ihtiyaç olduğunu göstermektedir. Bu çalışma, Türkiye'deki STEM alanına yönelik ülke çapındaki ilk kapsamlı analizi sunmakta ve politika yapıcılar, eğitimciler ve diğer paydaşlar için değerli bilgiler sağlamaktadır.

Anahtar Kelimeler: *Türkiye'de yükseköğretim, STEM kayıt eğilimleri, STEM mezuniyet eğilimleri, STEM kariyer hattı, STEM alan sınıflandırması, STEM lisans programları*

Introduction

The rapid developments in various scientific and technological areas over the past decades have necessitated a workforce knowledgeable in science, technology, engineering, and mathematics (STEM) fields to bring innovation and address multi-faceted global challenges. Both developed and developing countries around the world have been promoting STEM-related studies in their education systems to ensure that an increasing number of students enter the STEM pipeline, equipping them with the knowledge and skills required to meet the demands of a rapidly changing global economy (English, 2016; National Science Board [NSB], 2024; Ma, 2021). For example, the workforce employed in STEM occupations

increased by 20% between 2011 and 2021 in the United States (National Center for Science and Engineering Statistics [NCSES], 2023), and seven million new jobs in STEM fields were projected to be available in Europe alone by 2025 (Women in Aerospace [WIA] Europe, 2021). While the global demand for skilled labour in STEM-related areas has been gradually increasing, recent studies highlighted an overall declining trend in students' interest and preference in STEM subjects at the secondary and higher education levels in several developed and developing countries (Jaremus et al., 2019; Kao & Shimizu, 2020). In addition, the related literature indicated that female students lag behind males in terms of entering and completing STEM majors in many countries, including the U.S., Japan, Germany, Kazakhstan, and Nigeria (Almukhambetova et al., 2023; Froehlich et al., 2022; Isma'il et al., 2023; Mau, 2016). As a result, women have been significantly underrepresented in the STEM workforce worldwide. Similarly, according to the latest figures from the Organisation for Economic Co-operation and Development [OECD] (OECD, 2024), although women's participation is, on average, higher in tertiary education enrollments across OECD countries, they remain significantly underrepresented in STEM fields, with only 15% of women entering higher education choosing STEM-related programs, compared to 41% of male students.

As an emerging economy, Türkiye also requires an increasing share of a qualified workforce in STEM to stay competitive on the global stage. For example, university graduates in Türkiye in the fields of natural science, engineering, and information technologies constituted less than 20% of all graduates nationwide in 2015, which was below the average for OECD countries (OECD, 2017). According to a report published by PricewaterhouseCoopers (PwC) and Turkish Industry and Business Association **(**TÜSİAD, 2017), which officially represents the business sector in Türkiye, about one million STEM jobs were projected to be available in 2023; however, around 31% were predicted to remain unfilled due to a shortage of STEM graduates. To mitigate this anticipated workforce shortage and develop policies that emphasize STEM participation and retention, it is important to analyse trends in Turkish high school graduates' STEM major selection patterns in higher education institutions and academic persistence in their studies. While large-scale studies on the STEM pipeline have been available for a number of countries in the literature (Hu & Ortagus, 2019; Koch et al., 2022; Lee et al., 2024; Mau, 2016), similar comprehensive analyses specifically

targeting the student population in Türkiye are rare, if they exist at all. This points to the need for such studies to compare trends in Türkiye with those in other countries and formulate evidence-based policies for promoting STEM-related academic fields at higher education institutions. The present study aims to fill this gap in the literature by systematically analysing the official nationwide data for the eleven-year period (2013 to 2023) provided by the Council of Higher Education in Türkiye (abbreviated as YÖK in Turkish) on the entire population of Turkish high school graduates' preferences in selecting majors for their undergraduate studies as well as the graduation patterns of the university student population.

The widely used 'STEM pipeline' metaphor (Allen-Ramdial & Campbell, 2014; Ball et al., 2017; Cannady et al., 2014; van den Hurk et al., 2019) was adopted as an analytical lens in this study to examine students' progressions from primary school through earning a STEM-related degree to entering the workforce. The researchers often illustrated the STEM pipeline as gradually narrowing by depicting the flow of students from first grade toward higher grade levels in the educational system. Along the way, students pass through several critical junctions representing important milestones toward attaining a STEM career, such as graduating from secondary school, entering college, pursuing a STEM degree, and persisting to graduate with a STEM-related qualification (Ball et al., 2017; Cannady et al., 2014). Studies in various countries have shown that the total number of students decreases significantly at each subsequent junction, resulting in far fewer individuals ultimately ending up in STEM careers than those who originally entered the pipeline (Doerschuk et al., 2016; Hinton et al., 2020). Therefore, researchers frequently depicted the STEM pipeline as 'leaky' to highlight the substantial attrition that occurs from K-12 through college, which ultimately limits the number of students who attain STEM careers. As such, the STEM pipeline metaphor serves as a useful analytical lens for inquiring about who leaves the pipeline and who persists (e.g., by gender, race), the junctions at which attrition is most pronounced and acute (e.g., dropping out of STEM majors), the factors contributing to these losses (e.g., cultural stereotypes, educational policies), and evidence-based strategies for addressing them in a sustainable manner (Hinton et al., 2020; Stefani et al., 2024).

In the context of the present study, the STEM pipeline metaphor was used to structure both the analysis and the interpretation of emerging trends in national enrollment in and graduation from STEM majors in Türkiye. Specifically, the

pipeline's 'critical junctions' (e.g., entry into undergraduate programs, choosing to pursue a STEM degree, and graduation) align directly with the variables analyzed in the national dataset, which allowed a systematic identification of nationwide interest, persistence, and attrition in STEM majors among the student population during the 2013-2023 period in Turkish universities. In addition, the STEM pipeline metaphor also informed the discussion of the findings by linking the observed trends to broader factors such as cultural norms and expectations along with the recent policy reforms in higher education to highlight where targeted interventions could most effectively improve STEM equity and retention in Türkiye.

Literature Review

There appears to be no commonly accepted definition of STEM in the literature (Breiner et al., 2012) and how scholars conceptualize the nature of STEM may also differ (DeCoito et al., 2024). For instance, Breiner et al. (2012) studied faculty members in the U.S. regarding how they defined STEM. The findings illustrated that although most participants correctly stated what STEM stands for, no shared definition emerged. Specifically, some of the participants considered medicine to be a STEM field, while around 27% were unable to provide what they understood from STEM. Some institutions, such as the American College Testing (ACT; 2020) and the U.S. Department of Labor, took medicine and teacher training programs related to mathematics and science as STEM fields (NSB, 2015), while the National Science Foundation (NSF; 2019) did not consider medicine as STEM. Adler et al. (2024) investigated how American college students contemplated STEM. The researchers found that most participants correctly stated what STEM entailed, and among 15 career choices, participants tended to classify medical careers as non-STEM compared to traditional STEM careers. Green (2007) emphasized the NSF's broad inclusion of the social-behavioural sciences in STEM, such as economics, psychology, sociology, and politics. Marshall and Underwood (2022) made a distinction between STEM-eligible economics degrees and traditional economics degrees by identifying that the former require advanced mathematics courses, such as calculus, at high proportions compared to the latter. Similarly, Grinis (2019) emphasized the difficulty of identifying professions as either STEM or non-STEM since various non-STEM professions (e.g., business analysts) require significant expertise in a STEM area.

The classification of medicine, dentistry, and STEM-related programs in social sciences as STEM is still under debate. Therefore, it would be meaningful to use the most comprehensive STEM list by extending the U.S. Department of Homeland Security's (DHS) list, which is among the most extensive in the existing literature, to include medicine and dentistry programs, and then present it to readers by dividing it into subfields. In this study, the DHS's (2024) STEM Designated Degree Program List was primarily used to classify bachelor's degree programs in Turkish universities as either STEM or non-STEM to explore the nationwide STEM enrollment and graduation trends. DHS in the U.S. provided a detailed list of STEM fields, which included four main areas: Engineering, Biological and Biomedical Sciences, Mathematics and Statistics, and Physical Sciences. Apart from these areas, 18 related fields were included in the STEM list (DHS, 2024). These 18 relevant fields include programs that combine aspects of social sciences and STEM disciplines, such as cognitive psychology, social psychology, and business and management. All undergraduate programs matching the DHS's list were categorized as STEM. The list was then examined in six subfields, enabling readers to observe these controversial areas' impact and gain insight into a more detailed analysis. The Methods section provides an explanation of how the DHS's list was adapted for the current study.

Global Trends and Gender Disparities in STEM Education

Previous research consistently pointed to gender disparity regarding interest in STEM fields in high school levels (e.g., Adler et al., 2024; Bergeron & Gordon, 2017; Marginson et al., 2013), choosing STEM majors in higher education (e.g., Appiah-Castel et al., 2020; Marginson et al., 2013; Mau, 2016), working in the STEM workforce (Jenkins & Mitchell, 2012; OECD, 2024), by revealing country-wise trends and emphasizing economic, social, and cultural differences among countries (Lee et al., 2024). For example, in a large-scale study, Bergeron and Gordon (2017) used the data from the International Baccalaureate (IB) internal database to examine the patterns in female and male enrollments in secondary STEM courses. The data included the total student population taking the IB Diploma Programme examinations from 2005 to 2010 worldwide (N=355,688). The researchers found that compared to males, females less frequently chose STEM courses. However, the academic success of females and males in STEM courses did not significantly differ.

In addition, the report from OECD (2024) also revealed that among the OECD countries, female college students and graduates were the majority compared to males in the fields of health, while males dominated the fields of science, technology, engineering, and mathematics. Specifically, the percentage of female new entrants to health and welfare areas was 18% in 2015 and 20% in 2022, while the percentage of male new entrants was 7% and 8%, respectively. Specifically, considering STEM enrollment trends in Australia between 2002 and 2010, there was a major increase in the number of students (approximately 15,000 more from 2002 to 2010) enrolled in health sciences (Marginson et al., 2013). However, the number of enrolled students in engineering, agriculture, and environmental sciences did not change much over the years, and there was a decline in the number of students in information technology departments (Marginson et al., 2013). Regarding the percentage of gender differences in STEM enrollments, although the percentages of females and males were close to each other between 2002 and 2004, with a slightly higher percentage of males, the gap increased in favour of females from 2004 to 2010. Additionally, in Arkansas in the U.S., male and female STEM enrollment percentages remained stable at around 64% and 35%, respectively, from 2007 to 2011. This further illustrates that males were outnumbering females in higher education STEM programs in many countries (Jenkins & Mitchell, 2012).

Another study from Ghana exploring the trends in STEM enrollments by gender at one university between 2003 and 2018 showed a gradual increase in female enrollment in STEM fields from 2003 to 2015 (Appiah-Castel et al., 2020). In 2015, the university intentionally increased female admissions. However, the proportions of female students compared to that of males in engineering and physical sciences were still low, while female enrollments were higher in health sciences. Likewise, in Nigeria, while the percentage of male enrollment in STEM courses always stayed at high levels compared to that of females from 2014 to 2020 in one university, female enrollment in STEM courses indicated an increase from 23% to 31.4% (Isma'il et al., 2023). There was also a decrease in the percentage of male enrollments from 77% to 68.6% during the same period (Isma'il et al., 2023). Throughout six academic years, 50%, 49%, and 39% of female students were enrolled in courses in plant science and biotechnology, microbiology, and biochemistry, respectively. However, above 65% of male students enrolled in physics, chemistry, computer science, and mathematics between 2014 and 2020 (Isma'il et al., 2023).

A large-scale study with 102 countries illustrated the gender disparity in graduations from STEM fields between 1998 and 2018 (Lee et al., 2024). Firstly, although fluctuations existed in the percentages of males graduating from STEM fields, for each year, the percentages were above 20% for all regions of the world. While the percentages of male graduates were always higher than female graduates, only between 1998 and 2002 in the Asia region and between 2012 and 2018, in the Middle East and North Africa region, the percentages of female STEM graduates were above 20%. Regarding the difference in economic developments, it was reported that between 1998 and 2018, percentages of male graduates from STEM fields were above 35% in high-income countries, followed by upper-middle income, lower-middle income, and low-income countries. While the percentage of female graduates increased in upper-middle-income countries from around 12.5% to 15.5% between 1998 and 2018, it decreased in lower-middle-income countries from around 14% to 12% (Lee et al., 2024). Even though in high-income countries, the percentage of female graduates increased, it did not exceed the percentages in upper-middle-income countries. Surprisingly, in low-income countries, although there was a decline in the percentage of female graduates from 12% to 11% between 1998 and 2008, after that period, the percentage of female graduates increased from 11% to 16% between 2008 and 2018, reaching the highest percentage in all levels of economic development (Lee et al., 2024).

STEM Interest and Preferences in Türkiye

A substantial body of research has been dedicated to examining Turkish secondary students' interests and preferences in STEM fields (e.g., Herdem & Ünal, 2019; Kırıktaş & Şahin, 2019; Korkut Owen & Eraslan Çapan, 2020). In general, Turkish students appeared to demonstrate positive attitudes towards STEM-related careers (e.g., Herdem & Ünal, 2019; Kırıktaş & Şahin, 2019; Yerdelen et al., 2016). Interest and creativity were found to be the factors influencing secondary students' preferences for STEM jobs (Herdem & Ünal, 2019). Compared to males, females had higher career interest in STEM jobs, and also there was a considerably higher tendency of female students towards mathematics and engineering regarding career interest; however, interestingly, there was a decrease in females' interest as their success in STEM courses increased (Kırıktaş & Şahin, 2019). Korkut Owen and Eraslan Çapan (2020) revealed that among 216 Turkish high school students, the tendency to choose

fields of study related to the natural sciences did not lead to a difference with regard to gender. However, the differences in math and science scores yielded varying trends, as students with high math and science scores were evenly distributed across the three categories: choosing physical and natural sciences, not choosing physical and natural sciences, and being indecisive. Also, males were more likely to choose engineering majors.

Although there is a considerable effort to encourage and support females to attend and work in STEM areas (Hill et al., 2010), the United Nations Development Programme's (UNDP) report for indicators of sustainable development emphasizes that in the ten-year period (2008-2018), the percentage of female graduates from STEM fields in Türkiye was 34.7% (UNDP, 2019) which shows a low representation of females in STEM fields. Moreover, a report prepared by the PwC and TÜSİAD (2017) showed that when proportions of female graduates and postgraduates to total graduates and to the total workforce in 2014 were compared with other countries such as Germany, U.S., and Australia, the results indicated that Türkiye was the 9th among ten countries regarding the ratios of female graduates and postgraduates to total graduates (16%) and the 8th country for ratios of female graduates and postgraduates to the total workforce (27%). Mutlu Çaykuş and Korkut Owen (2017) found that societal stereotypes and family opinions are the key factors when females are at the stage of department and university choices in Türkiye. The participants of the study demonstrated that the majority of the families insist on the idea that teaching is a profession suitable for women (Mutlu Çaykuş & Korkut Owen, 2017). As such, females were not supported in their choice of engineering departments. Regarding their experience in university and work settings, the participants also stated that there exists a preconception among the Turkish people in STEM fields about females' inability to understand technical issues. Consequently, it can be deduced that the stereotypical and negative perceptions held by families and male professionals in the STEM fields regarding women's presence in STEM are manifestations of cultural issues inherent in the country (Mutlu Çaykuş & Korkut Owen, 2017).

The graduation percentages might also be related to university entrance percentages. Akgündüz (2016) explored the data regarding the STEM preferences of students who ranked among the top thousand according to the results of the university entrance examinations between 2000 and 2014. During these years, the percentage of students who ranked among the top thousand choosing STEM

fields decreased from 85.63% to 38.23%. Moreover, regarding gender differences, there was a large gap between male and female preferences. Excluding the faculty of medicine, approximately 81.39% of male students chose STEM fields, whereas around 18.61% of female students chose a STEM field. When medicine is included as STEM, there is a large gap between the percentages of males and females choosing STEM fields. Using the same dataset, Akgündüz (2016) reported and expanded on the above-mentioned findings, addressing enrollment trends in STEM fields, medicine, and non-STEM fields. The students tended to choose engineering departments and medicine mostly, while the enrollments in faculties of fundamental sciences, education, and others were relatively low. Specifically, the highest percentage of total enrollment in the faculties of engineering and architecture was obtained in 2000 with 82.73% and the lowest percentage of total enrollment in the faculties of medicine was reported in 2000 with 6.29%. Although there were fluctuations between 2000 and 2014 regarding enrollments in the faculties of engineering and architecture and the faculties of medicine, the enrollment percentages in the faculties of engineering and architecture decreased to 37.54%, and the enrollment percentages in the faculties of medicine increased to 59.93%.

Overall, the aforementioned studies provided various conceptualizations of STEM and highlighted different findings related to STEM preferences among countries and different regions of the world. First of all, it is essential to emphasize that by acknowledging and embracing different conceptualizations of STEM, such as including medicine in STEM areas, we adapted a broader conceptualization as suggested by the DHS (2024). Specifically, we considered health sciences and several social science areas, such as the economy as STEM disciplines. In this way, we aimed to provide a detailed picture related to the preferences of STEM disciplines among the Turkish university student population between 2013 and 2023. According to the findings of previous research, it can be concluded that gender disparities existed in enrollment and graduation trends in STEM fields, mostly in favor of males in Türkiye and other countries (e.g., Akgündüz, 2016; Jenkins & Mitchell, 2012; Lee et al., 2024). Although there seems to be an increase in females' tendency to choose a STEM area in Türkiye in recent years, mostly in engineering departments, the number of male students seems to constitute a high percentage compared to female students (Akgündüz, 2016). However, if the health sciences are included in STEM areas, the percentages of female entrants

and graduates show an increase (e.g., Akgündüz, 2016; Isma'il et al., 2023). It is possible that such gender disparity may also be related to cultural stereotypes, as there is a preconception in Türkiye that females are unable to understand technical issues in engineering (Mutlu Çaykuş & Korkut Owen, 2017). Another source for gender disparity might be related to the welfare of the countries. In high-income countries, it seems that overall percentages of entrance and graduation from STEM fields are high compared to low-income countries (Lee et al., 2024; PwC & TÜSİAD, 2017). Furthermore, percentages of female entrants and graduates are also high in high-income countries (Lee et al., 2024). Although there is a tendency to increase female entrants to STEM fields by intentionally increasing female admissions in low-income countries (e.g., Appiah-Castel et al., 2020), it appeared to provide only a temporary solution to the participation of females in STEM majors and careers. Therefore, studies commonly pointed to the issue of encouraging and supporting female students' tendency towards STEM fields (Appiah-Castel et al., 2020; Hill et al., 2010). In this regard, examining trends in STEM enrollment and graduation is an important initial step. These trends have the potential to contribute to the development of quality STEM programs at the university level, raise awareness of STEM jobs, and increase STEM workforce opportunities for both males and females. Furthermore, such trend analysis studies might be beneficial in informing evidence-based policy formulations in STEM-related areas. In this respect, the current study has the potential to extend limited studies in the extant literature (e.g., Akgündüz, 2016) by providing a continuum for the analysis of the trends between the years 2013-2023 considering all STEM and non-STEM majors in both public and private universities in Türkiye.

The Purpose of the Study

The goal of the present study was twofold. First, it aimed to explore trends in the preferences of high school graduates for STEM-related majors at public and private universities by exploring the official data on university enrollments and graduations in Türkiye from 2013 to 2023. Secondly, by utilizing the same dataset, the present study intended to investigate graduation patterns from STEM-related majors in Turkish universities. Specifically, this study was designed to answer the following research questions:

1. What are the trends in the preferences of high school graduates in Türkiye for enrolling in undergraduate STEM majors from 2013 to 2023?

    1.1. How do male and female high school graduates' enrollment patterns in undergraduate STEM majors compare over the years?

    1.2. How do male and female high school graduates' enrollment patterns in the main subfields of STEM compare over the years?

2. What are the trends in the graduation of undergraduate students from STEM majors in Türkiye from 2013 to 2023?

    2.1 How do male and female undergraduate students' graduation patterns from STEM majors compare over the years?

    2.2 How do male and female undergraduate students' graduation patterns from the main subfields of STEM compare over the years?

Methodology

Context

In Türkiye, students must take a nationwide, centrally administered exam after graduating from high school to be eligible to enrol in a university. In 2023, 2,447,707 undergraduate program students were in formal education in all higher education institutions. 1,979,533 of these students were studying in public universities and 468,174 in private ones (Yükseköğretim Bilgi Yönetim Sistemi [YBYS], 2024). In 2013, a total of 1,924,547 candidates applied to associate and undergraduate degree programs, and 877,787 of them were enrolled in universities. In 2023, the total number of applicants had grown to 3,527,443, of whom 1,063,807 were enrolled (YBYS, 2024). While the total number of applications almost doubled during this period, the increase in the number of enrolled students is considerably smaller in comparison.

Population

The population of the study includes all bachelor's degree students who enrolled in or graduated from higher education institutions in Türkiye between 2013 and 2023. Two-year associate degree programs were excluded. Therefore, the term 'undergraduate program' in this study refers to programs planned for at least four years. Pharmacy, dentistry, and veterinary medicine are 5-year programs, and medicine is a 6-year program. Students graduating from these four

fields are considered to have obtained qualifications for integrated bachelor's and master's degrees. Appendix A shows the participants' gender information across the years.

Data Sources

The data in this study were obtained from the Higher Education Information Management System (YBYS), which is a platform that shares open-access data belonging to all higher education institutions across the country by YÖK (YBYS, 2024). The data for the years between 2013 and 2023 were downloaded from the YBYS website (YBYS, 2024). Details of undergraduate programs in the classification of the fields of education and training are shared by YÖK (n.d.). The document is organized in alignment with the International Standard Classification of Education 2013 ([ISCED – F 2013], UNESCO Institute for Statistics, 2015) to classify all bachelor's degree programs under broader clusters (2015).

Data Analysis

The undergraduate programs in the dataset shared by YÖK were classified as STEM or non-STEM by employing the 'STEM Designated Degree Program List' published by DHS (2024), which provides one of the most comprehensive lists of STEM fields in higher education and is widely adopted in the literature (e.g., Corral & Rahim, 2024; Marshall & Underwood, 2020). All undergraduate programs matching the list were considered STEM programs; the rest were coded as non-STEM, except for medicine and dentistry. Whether medicine and dentistry should be regarded as STEM programs is still controversial. ACT (2020) and the U.S. Department of Labor consider these programs to be STEM areas (NSB, 2015), NSF (2019) did not classify them as STEM fields. To keep the list as relevant as possible, the researchers decided to include medicine and dentistry departments as STEM departments. Thanks to the document published by YÖK (n.d.), Turkish undergraduate programs' classification of fields of education and training in the dataset was investigated and classified as STEM (see Appendix B), non-STEM (see Appendix C), or mixed. By extracting STEM undergraduate programs under mixed categories, the mixed categories were also divided into STEM or non-STEM categories based on the DHS's STEM classification list. Computer and Educational Technologies program in the Training for Teachers with Subject Specialization category, the Archaeology program in the

Archaeology and History category, the Geography program in the Sociology and Cultural Studies category, and the Media and Communication programs in the Journalism and Reporting category were extracted and coded as STEM fields. After subtracting STEM programs, the remainder of these four mixed categories were coded as non-STEM categories. The data provided by the YÖK did not include the number of male and female students enrolled in these four programs for 2013 and 2014, which made the separation of the categories impossible. The total number of students enrolled in these programs was obtained from the placement result report published by ÖSYM (2013, 2014). Then, the k-Nearest Neighbors data imputation method was applied to predict the number of male and female students in these programs in 2013 and 2014. The data imputation was conducted with the MultiUS package (Aleš et al., 2023) in the R-Studio program by selecting the nearest three years' means.

The subfields for STEM departments categorized in the study are Engineering, Biological and Biomedical Sciences, Physical Sciences, Social Sciences, Mathematics and Statistics, and Others. These categories are aligned with the sub-fields identified by DHS (2024). Three researchers categorized each undergraduate major in the dataset shared by YÖK based on these six main STEM subfields individually and separately. Then, they compared three lists, and a complete consensus was achieved by comparing and debating the disagreements (see Appendix D).

The data were then categorized into male, female, STEM, and non-STEM groups. The percentage and the number of students in STEM and non-STEM programs were calculated to investigate the students' enrollment and graduation trends in eleven years for questions 1 and 2. The researchers calculated the percentage of males and females enrolled in and graduated from STEM programs for research questions 1.1 and 2.1. In addition, the chi-square test of independence was used to determine whether enrollment in STEM programs was significantly different according to gender to answer research questions 1.1 and 2.1. The researchers calculated the percentage of males and females enrolled in and graduated from each STEM subfield during the eleven-year period to track the male and female trends in the subfields for research questions 1.2 and 2.2.

Findings

STEM Enrollment Trends

Figure 1 illustrates the total number of high school graduates entering undergraduate programs at higher education institutions in Türkiye between 2013 and 2023. Figure 1 also shows the proportions of students who enrolled in STEM versus non-STEM majors each year. During this period, the total number of students entering a four-year major in Türkiye ranged from 667,891 (2013) to 844,812 (2022). There is a fluctuating trend regarding the total enrollments across the years. Examining the percentage of students selecting STEM versus non-STEM majors, slightly more than half of the graduates enrolled consistently in a STEM major, with the proportion ranging from 50.9% to 56.5%, except during the period from 2016 to 2018. Both the lowest number and the lowest proportion of STEM enrollments occurred in 2018, signifying a notable exception to the general trend.

Figure 2 shows a yearly comparison of the total number of students enrolling in STEM versus non-STEM majors, presenting this data as a line graph to delineate the trends over time. Although overall enrollments in STEM fields mostly remained higher than non-STEM enrollments throughout this period (2013-2023), Figure 2 shows some variability in both categories. Particularly, STEM enrollments experienced quite a sharp decline between 2016 and 2018, reaching their lowest point in 2018. On the other hand, non-STEM enrollments remained relatively stable during this period, even surpassing STEM enrollments briefly. However, after 2018, the total enrollments in STEM majors rebounded significantly and stayed consistently above non-STEM enrollments in the following years. Overall, these trends reveal a substantial demand for STEM undergraduate programs by high school graduates in Türkiye, with over half of the student population choosing to enrol in STEM majors in most years except for a brief period of considerable decline from 2016 to 2018, which was followed by a strong recovery and consolidation.

Figure 1

Total Number of Enrollments in STEM and non-STEM Majors from 2013 to 2023

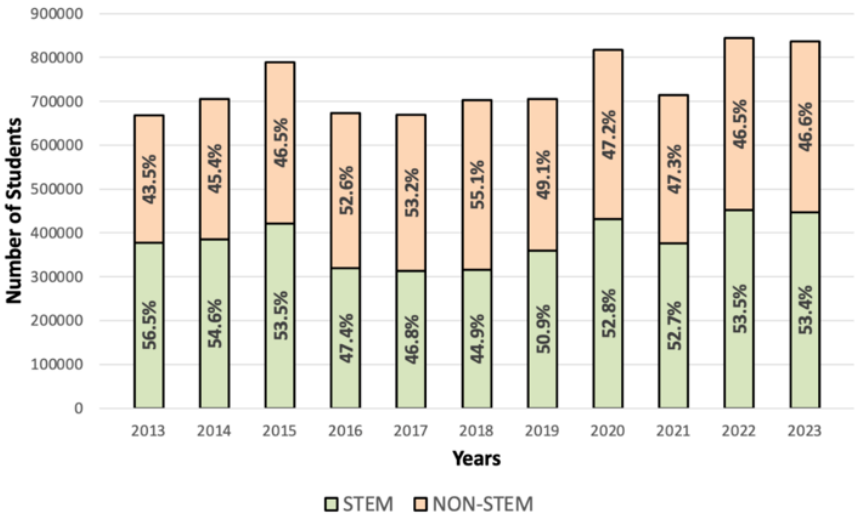


Figure 2

Trends in the Total Number of Enrollments in STEM and non-STEM Majors from 2013 to 2023

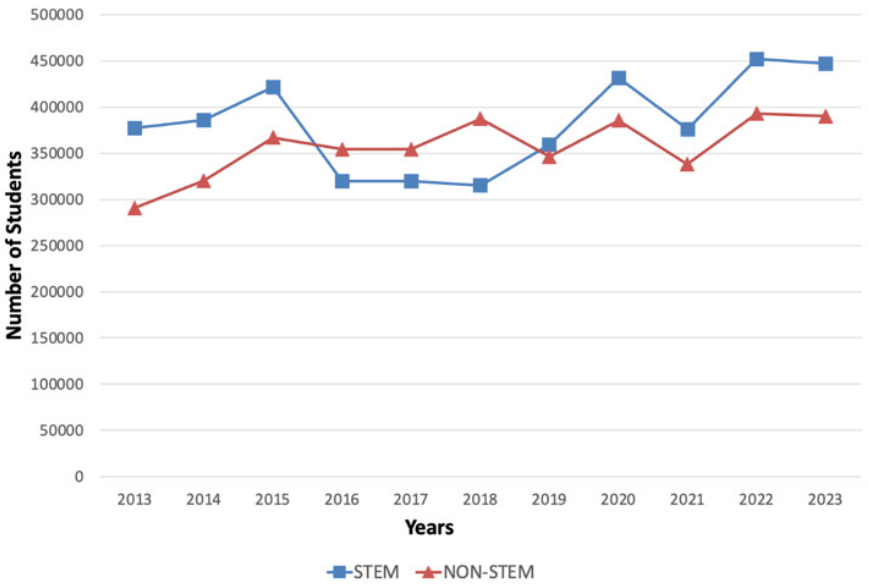


Figure 3 presents the total number of enrollments in STEM and non-STEM majors by gender between 2013 and 2023 in Türkiye. Additionally, Figure 4 highlights the trends in the proportions of male and female students choosing to study STEM majors across the years. Firstly, Figure 3 shows that while the total number of male high school graduates enrolling in a four-year degree program did not significantly change during this period (i.e., fluctuating around 350,000), there seems to be a steadily increasing trend in the number of female students going into undergraduate programs, with the highest number shown in 2023. Starting in 2018, the total number of female students entering all undergraduate programs consistently exceeded their male counterparts. Besides, between 2013 and 2019, more males than females chose STEM majors in terms of actual numbers and proportions within groups. However, this pattern appeared to start changing in 2020 and later when slightly higher numbers of female graduates entered STEM programs, even though in terms of proportions within the groups, females were still consistently behind males when it comes to enrollments in STEM majors across the years. In other words, more of the male entrants into undergraduate programs persistently chose STEM fields compared to the proportions of female entrants during 2013 and 2023, as highlighted in Figure 4. Moreover, Figure 4 shows that the gap between the proportions of male and female entrants into STEM programs began to narrow in 2019 and continued to do so in the following years, reaching less than 10% in 2023.

Figure 3

Male and Female Enrollments in STEM and non-STEM Majors from 2013 to 2023

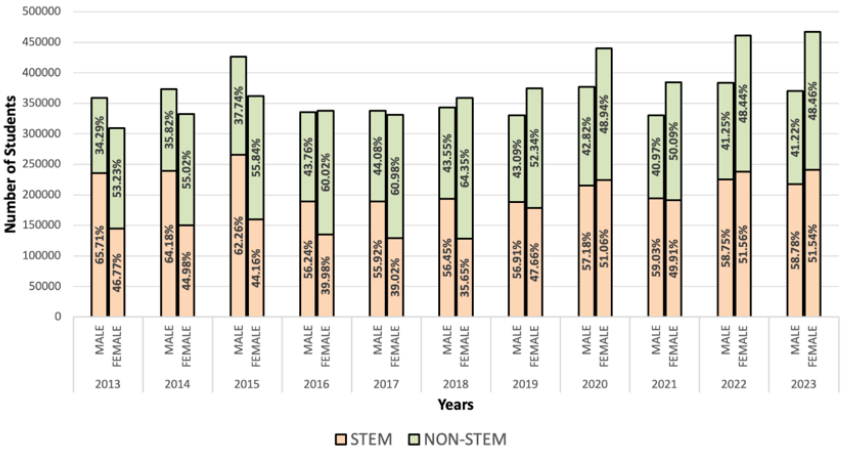
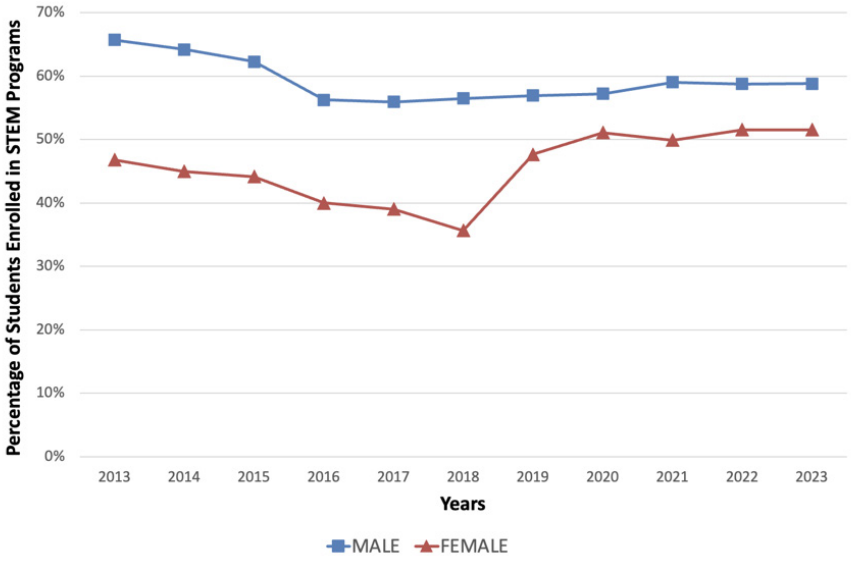


Figure 4

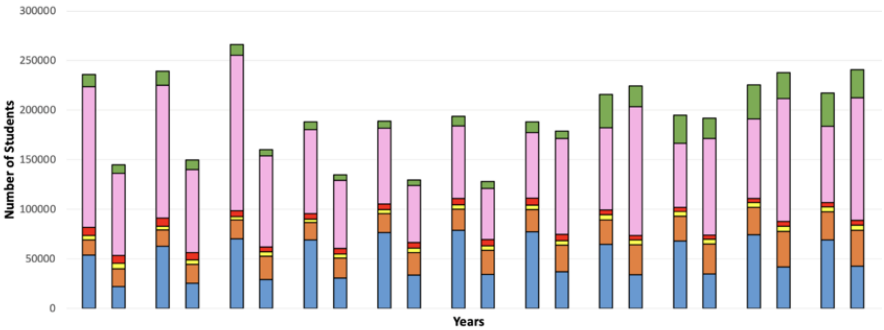
Trends in Proportions of Male and Female Enrollments in STEM Majors from 2013 to 2023



The results of the chi-square analyses shown in Table 1 indicate a statistically significant relationship between gender and STEM versus non-STEM enrollments for all the years between 2013 and 2023 ($p < .001$). Cramer's V values suggest small effect sizes (Moraine et al., 2021), with the highest effect size observed in 2018 (Cramer's $V = .208$). These results corroborate the observed trends in Figures 3 and 4, pointing out that male high school graduates in Türkiye were consistently more likely to choose STEM majors in proportion to their total enrollments, while females were increasingly entering STEM fields, particularly after 2018. Nevertheless, the results of the chi-square analyses suggest that gender differences in the preference for seeking STEM versus non-STEM degree programs remain statistically significant throughout this entire period.

Figure 5

Male and Female Enrollments in STEM Subfields from 2013 to 2023



	2013		2014		2015		2016		2017		2018		2019		2020		2021		2022		2023	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Engineering	5.3%	6.0%	6.0%	6.5%	4.0%	4.0%	4.2%	4.3%	3.8%	4.1%	5.0%	5.4%	5.7%	4.2%	15.5%	9.5%	14.4%	10.7%	15.3%	11.0%	15.6%	11.8%
Biological and Biomedical Sciences	61.1%	58.8%	56.9%	57.0%	59.9%	58.4%	46.1%	52.0%	41.5%	45.7%	38.6%	41.6%	36.1%	54.8%	39.6%	58.7%	34.4%	52.0%	36.2%	53.1%	36.2%	52.1%
Mathematics and Statistics	3.1%	4.9%	3.1%	4.7%	1.9%	2.7%	2.6%	3.5%	2.8%	4.0%	3.0%	4.3%	3.5%	3.3%	1.6%	1.5%	1.6%	1.6%	1.5%	1.5%	1.5%	1.6%
Physical Sciences	1.2%	2.9%	1.0%	2.1%	0.8%	2.0%	1.3%	2.5%	1.4%	2.7%	1.7%	2.8%	1.8%	2.1%	1.9%	1.7%	1.9%	1.8%	1.9%	1.8%	1.9%	1.8%
Social Sciences	6.5%	12.3%	6.8%	12.9%	7.1%	14.7%	9.2%	15.2%	10.1%	17.5%	11.1%	19.0%	11.8%	15.0%	11.5%	13.6%	12.8%	15.8%	12.2%	15.1%	13.0%	15.1%
Others	22.8%	15.1%	26.2%	16.8%	26.4%	18.2%	36.7%	22.5%	40.5%	25.9%	40.6%	26.8%	41.2%	20.6%	29.9%	15.1%	34.8%	18.1%	32.9%	17.6%	31.7%	17.6%

Enrollments in the main STEM subfields were depicted in Figure 5. Firstly, a holistic look at Figure 5 reveals a persistent pattern of substantially higher numbers and percentages of male high school graduates entering undergraduate engineering programs compared to female graduates. The proportion of male students choosing Engineering degrees varied from 22.8% (2013) to 41.2% (2019), whereas it was between 15.1% (2013) and 26.8% (2018) for females. Additionally, a higher proportion of females appeared to select Biological and Biomedical Sciences compared to males during this eleven-year period. Moreover, there appears to be a steadily declining trend in entering STEM-related Social Science fields among males, whereas more females, compared to males, chose Social Sciences starting in 2019. Also, enrollments in Physical Sciences remained consistently low (i.e., less than 5%) among both groups, and there seems to be a decreasing trend in entering Physical Science majors for both males and females across the years. Regarding majors related to the field of Mathematics and Statistics, females had a higher representation than males until 2019, after which the enrollment proportions between the two groups became almost equal.

Table 1

The Results of Chi-Square Tests of the Enrolled Students' Gender in STEM and non-STEM Majors

Year	Gender	STEM	Non-STEM	Total	$\chi 2$ (1)	df	Cramer's V
	Male	235729 (66%)	122993 (34%)	358722			
2013	Female	144612 (47%)	164555 (53%)	309167	24293*	1	.191
	Total	380341	287548	667889			
	Male	239400 (64%)	133624 (36%)	373024			
2014	Female	149751 (45%)	183211 (55%)	332962	26225*	1	.193
	Total	389151	316835	705986			
	Male	265589 (62%)	160999 (38%)	426588			
2015	Female	159787 (44%)	202067 (56%)	361854	25820*	1	.181
	Total	425376	363066	788442			
	Male	188781 (56%)	146875 (44%)	335656			
2016	Female	135184 (40%)	202958 (60%)	338142	17849*	1	.163
	Total	323965	349833	673798			
	Male	188984 (56%)	148979 (44%)	337963			
2017	Female	129330 (39%)	202074 (61%)	331404	28546*	1	.206
	Total	318314	351053	669367			
	Male	193845 (56%)	149553 (44%)	343398			
2018	Female	128001 (36%)	231055 (64%)	359056	30589*	1	.208
	Total	321846	380608	702454			
	Male	188038 (57%)	142385 (43%)	330423			
2019	Female	178730 (48%)	196256 (52%)	374986	6014*	1	.092
	Total	366768	338641	705409			
	Male	215593 (57%)	161449 (43%)	377042			
2020	Female	224515 (51%)	215190 (49%)	439705	3059*	1	.061
	Total	440108	376639	816747			
	Male	194775 (59%)	135212 (41%)	329987			
2021	Female	191759 (50%)	192421 (50%)	384180	5934*	1	.091
	Total	386534	327633	714167			

Year	Gender	STEM	Non-STEM	Total	χ2 (1)	df	Cramer's V
	Male	225517 (59%)	158346 (41%)	383863			
2022	Female	237660 (52%)	223289 (48%)	460949	4372*	1	.072
	Total	463177	381635	844812			
	Male	217418 (59%)	152468 (41%)	369886			
2023	Female	240830 (51%)	226458 (49%)	467288	4370*	1	.072
	Total	458248	378926	837174			

*$p < .001$

STEM Graduation Trends

Figure 6 provides the total number and proportion of university students who graduated from STEM and non-STEM undergraduate programs in Türkiye from 2013 to 2023. The total number of students who graduated from undergraduate programs during this period ranged from 399,047 (2014) to 575,654 (2021). The highest number of students graduated in 2021. In addition, there is a decreasing trend in the proportion of students graduating from STEM fields until 2019, after which the number of STEM graduates increased in terms of both numbers and proportions. Overall, during this eleven-year period, more students consistently graduated from STEM majors than non-STEM majors. Similar to the data presented in Figure 6, Figure 7 shows the total number of graduates from STEM versus non-STEM majors to highlight trends over the years. It is evident from Figure 7 that there was a significant gap between STEM and non-STEM graduates during 2013 and 2014, which narrowed afterward.

Figure 6

Total Number of Graduations from STEM and non-STEM Majors from 2013 to 2023

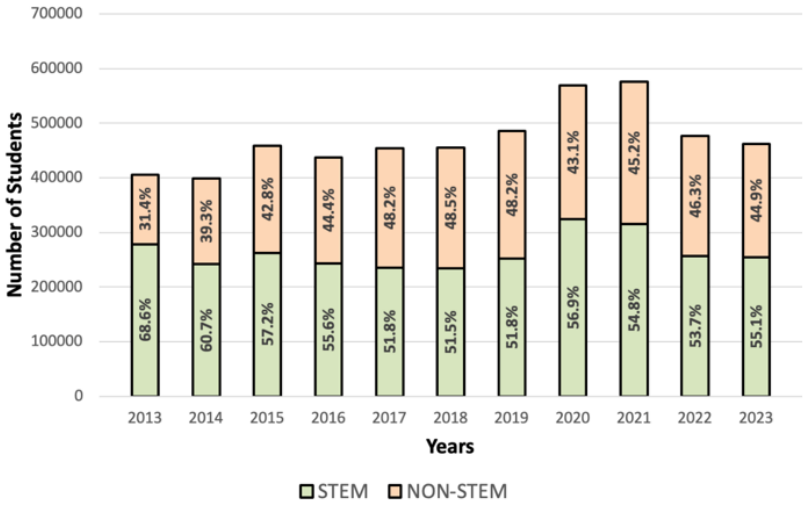


Figure 7

Trends in the Number of Graduations from STEM and non-STEM Majors from 2013 to 2023

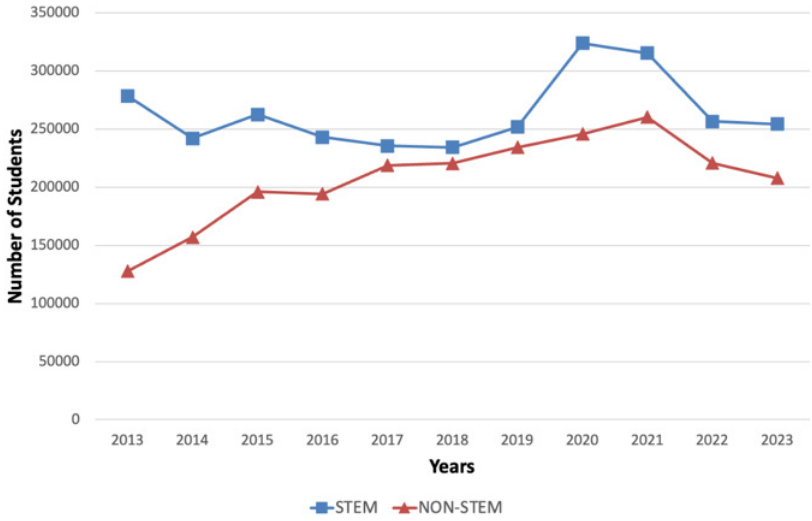


Figure 8 illustrates the total number of university graduates from STEM and non-STEM majors by gender. Additionally, Figure 9 is provided to delineate the trends in the proportion of male and female graduates from STEM majors during this period. Figure 8 reveals that from 2013 to 2016, the total numbers of male and female graduates from four-year degree programs were relatively similar. However, starting in 2017, the total number of female graduates consistently exceeded that of male graduates, with the largest gap in the last two years. Furthermore, more males, in terms of both absolute numbers and proportions, graduated from STEM majors compared to females during the period from 2013 to 2021. After 2021, this trend partially reversed, with a marginally higher number of females earning STEM degrees compared to males, even though males still constitute a higher proportion of STEM graduates. Finally, Figure 9 indicates that the proportion of STEM graduates declined for both males and females between 2013 and 2017. From 2017 onward, the proportions of male STEM graduates remained mostly stable until 2023, whereas the female proportion experienced a slight increase.

Figure 8

Male and Female Graduations from STEM and non-STEM Majors from 2013 to 2023

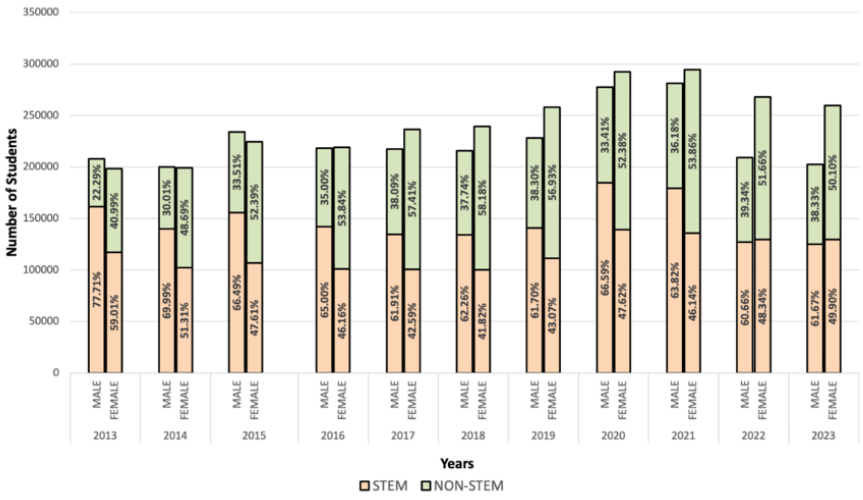
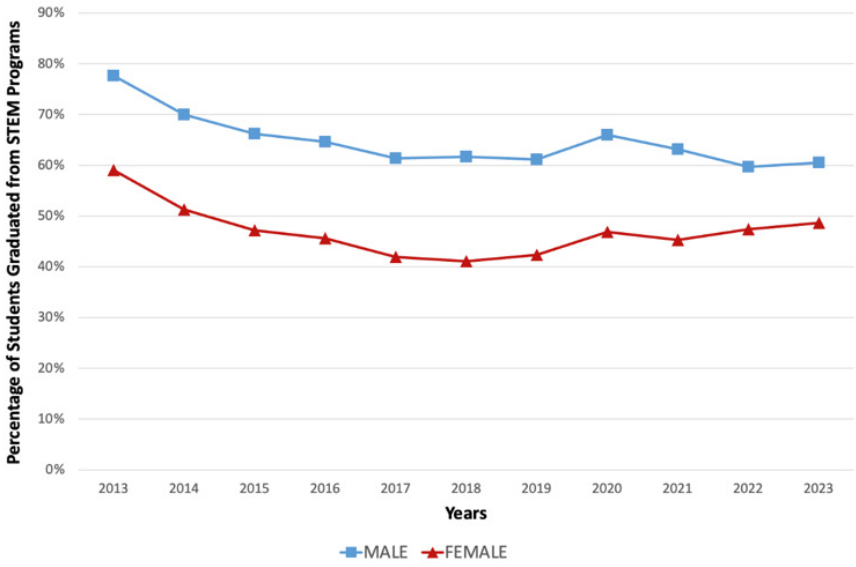


Figure 9

Trends in Proportions Within Groups of Male and Female Graduations from STEM Majors from 2013 to 2023



The results of chi-square analyses given in Table 2 indicate a statistically significant relationship between gender and the likelihood of graduating with a STEM versus a non-STEM degree for each year between 2013 and 2023 (all $p < .001$). For example, in 2023, the chi-square test of independence yielded χ^2 (1, N = 462139) = 6470, with Cramer's V = .118. However, the strength of this overall association was mostly weak (Moraine et al., 2021), with Cramer's V values ranging from .118 to .206, suggesting that while gender is significantly associated with graduation outcomes (STEM versus non-STEM), it accounts for only a small portion of the observed variability.

Regarding the graduation patterns from STEM subfields by gender, Figure 10 reveals similar patterns to those shown in Figure 5 for STEM enrollments. Firstly, considerably more males, in absolute numbers and proportions, graduated from Engineering majors compared to females across the years. Secondly, a relatively higher proportion of females graduated from majors in Biological and Biomedical Sciences as well as Mathematics and Statistics each year during this

eleven-year period compared to males, although the gap narrowed in 2022 and 2023. Additionally, there appears to be a declining trend in graduation from majors in Physical Sciences for both males and females, with less than 2% of students in each group graduating from these majors in 2023. Figure 10 also shows that, in 2017 and onwards, a consistently higher proportion of females graduated from Social Sciences. Although in some years the difference was only marginal (e.g., 2018), the gender gap favouring females remains clear for the Social Sciences. Additionally, while both males and females experienced minor fluctuations over the years, the percentages of female graduates from Social Sciences experienced a slight upward trend in recent years, indicating the growing participation of women in this field.

Table 2

The Results of Chi-Square Tests for the Graduated Students' Gender in STEM and non-STEM Majors

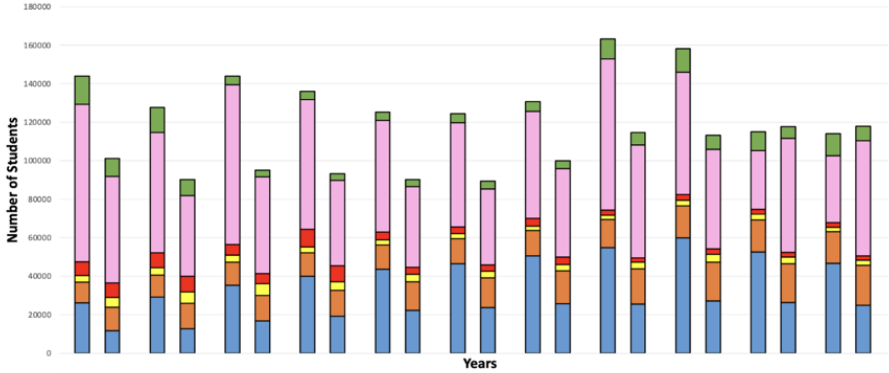
Year	Gender	STEM	Non-STEM	Total	$\chi 2$ (1)	df	Cramer's V
2013	Male	161598 (78%)	46359 (22%)	207957	16464*	1	.201
	Female	116990 (60%)	81260 (40%)	198250			
	Total	278588	127619	406207			
2014	Male	139886 (70%)	59968 (30%)	199854	14588*	1	.191
	Female	102214 (51%)	96979 (49%)	199193			
	Total	242100	156947	399047			
2015	Male	154967 (66%)	79178 (34%)	234145	16898*	1	.192
	Female	105849 (47%)	118570 (53%)	224419			
	Total	260816	197748	458564			
2016	Male	141097 (65%)	77298 (35%)	218395	15999*	1	.191
	Female	99845 (46%)	119206 (54%)	219051			
	Total	240942	196504	437446			
2017	Male	133661 (61%)	83949 (39%)	217610	17200*	1	.195
	Female	99257 (42%)	137340 (58%)	236597			
	Total	232918	221289	454207			

Year	Gender	STEM	Non-STEM	Total	$\chi 2$ (1)	df	Cramer's V
2018	Male	133030 (62%)	82556 (38%)	215586	19321*	1	.206
	Female	98335 (41%)	141074 (59%)	239409			
	Total	231365	223630	454995			
2019	Male	139493 (61%)	88536 (39%)	228029	17219*	1	.188
	Female	109266 (42%)	148905 (58%)	258171			
	Total	248759	237441	486200			
2020	Male	183128 (66%)	94226 (34%)	277354	21307*	1	.193
	Female	136903 (47%)	155445 (53%)	292348			
	Total	320031	249671	569702			
2021	Male	177741 (63%)	103524 (37%)	281265	18492*	1	.179
	Female	133430 (45%)	160959 (55%)	294389			
	Total	311171	264483	575654			
2022	Male	124913 (59%)	84287 (41%)	209200	7192*	1	.123
	Female	126944 (47%)	141109 (53%)	268053			
	Total	251857	225396	477253			
2023	Male	122607 (61%)	80028 (39%)	202635	6470*	1	.118
	Female	126165 (49%)	133339 (52%)	259504			
	Total	248772	213367	462139			

*$p < .001$

Figure 10

Male and Female Graduations from STEM Subfields from 2013 to 2023



	2013		2014		2015		2016		2017		2018		2019		2020		2021		2022		2023	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Engineering	10.2%	9.2%	10.2%	9.2%	3.1%	3.7%	3.1%	3.7%	3.5%	4.1%	3.9%	4.4%	4.0%	4.0%	6.4%	5.7%	7.7%	6.3%	8.5%	5.3%	10.0%	6.4%
Biological and Biomedical Sciences	56.9%	55.1%	49.5%	46.9%	58.1%	53.2%	49.9%	48.1%	46.9%	47.1%	44.0%	44.9%	43.0%	46.9%	48.4%	51.4%	40.7%	46.2%	27.7%	50.6%	31.7%	51.6%
Mathematics and Statistics	4.9%	7.5%	6.1%	9.0%	3.8%	5.5%	6.7%	8.9%	3.2%	3.9%	2.8%	3.4%	3.1%	3.4%	1.6%	1.9%	1.9%	2.5%	1.9%	2.0%	1.7%	1.7%
Physical Sciences	2.1%	4.6%	2.3%	6.1%	2.2%	6.0%	1.8%	4.4%	1.5%	3.8%	1.4%	3.4%	1.2%	2.8%	1.0%	2.7%	1.3%	3.2%	1.6%	2.7%	1.2%	1.5%
Social Sciences	7.5%	12.1%	9.0%	14.8%	8.3%	13.9%	9.0%	14.3%	10.1%	16.3%	10.5%	17.4%	10.2%	17.1%	9.0%	16.0%	10.5%	17.8%	14.6%	17.1%	14.4%	17.6%
Others	18.4%	11.5%	22.9%	14.0%	24.5%	17.6%	29.4%	20.6%	34.8%	24.8%	37.4%	26.5%	38.6%	25.8%	33.6%	22.3%	37.9%	24.0%	45.7%	22.3%	41.0%	21.1%

Discussions

The present study utilized the nationwide official data to comprehensively analyze both enrollment and graduation patterns for STEM majors at public and private postsecondary institutions in Türkiye. The findings not only provide valuable insights into the nationwide demand for STEM majors in both public and private universities but also reflect on the current state of the STEM pipeline in the Turkish context. The results of this study revealed several important trends in STEM enrollments and graduations, particularly the sustained preference for STEM majors over the years and the ongoing gender imbalance in the STEM pipeline in Türkiye.

First, the results indicate a consistently moderate level of demand for STEM majors among high school graduates. Except for the period from 2016 to 2018, slightly more than half of the total student population in Türkiye who enrolled in undergraduate programs chose a STEM major. This demonstrates that, despite minor fluctuations across the years, there remains an enduring preference for tertiary-level STEM fields among high school graduates. However, according to a recent report from the OECD (2024), Türkiye still lags

behind many developed countries regarding the proportion of new entrants into STEM degree programs. Notably, the OECD (2024) employed a much narrower classification of STEM fields than the DHS (2024) framework utilized in this study. Particularly, the OECD's classification of STEM consisted of three broad categories, which are (1) "natural sciences, mathematics and statistics", (2) "information and communication technologies", and (3) "engineering, manufacturing and construction" (p. 15). As such, despite the broader inclusion criteria for STEM in Türkiye's college enrollment data analyzed in the present study, the OECD average for new STEM entrants in 2022 (56%) still slightly exceeded Türkiye's share (53.5%) in the same year, highlighting the disparity in overall STEM participation in Turkish higher education compared to the other developed nations (OECD, 2024). For instance, in Austria and Israel, the proportion of total STEM entrants in 2022 was 66% and 68%, respectively. To meet the growing demand for the STEM workforce in the industrial landscape and compete with other nations in an increasingly globalized economy, policymakers in Türkiye should prioritize reforms in the K-16 education system in order to boost STEM enrollments.

The findings also revealed a relatively sharp decline in STEM enrollments in Türkiye from 2016 through 2018. This decline might be linked to several significant policy changes in the student selection and placement system into higher education institutions through the centralized university examinations, which were introduced by YÖK starting in 2015. These new changes affected how high school graduates were placed into specific fields of study in higher education with respect to their achievement rankings in university entrance examinations. Firstly, in 2015, YÖK announced the achievement ranking policy for admission to medicine and law programs (YÖK, 2015). Specifically, based on the university examination results, candidates ranked below 40,000th for medicine and below 150,000th for law would be ineligible to apply to these degree programs. In 2016, YÖK expanded this policy to include engineering and architecture programs, setting minimum achievement rankings at 240,000th and 200,000th, respectively (YÖK, 2016). In 2017, teacher training degree programs were also included in this policy, with a threshold of 240,000th (YÖK, 2017). These new requirements obviously limited the number of students choosing STEM as their field of study, especially among those who did not meet the minimum achievement levels in the university examinations. By introducing these changes, the policymakers

likely aimed to boost the quality and competitiveness of certain degree programs, including the STEM fields, by attracting more high-achieving students. However, these measures might also have inadvertently discouraged or prevented some otherwise capable candidates from pursuing STEM degrees. That being said, the results also showed that although there was a decline in the number and proportion of new entrants into STEM undergraduate programs between 2016 and 2018, the share of total STEM enrollments increased gradually in the subsequent years. This indicates that the policy changes, while temporarily reducing STEM enrollment numbers, did not have a long-lasting negative effect and resulted in attracting higher-achieving students to these programs.

STEM enrollments in Türkiye were largely dominated by males between 2013 and 2018, both in absolute numbers and as a proportion of their respective gender groups. However, in 2019, there was a sharp rise in females choosing STEM majors, which is a trend that continued in the subsequent years. Nevertheless, despite women constituting a larger share of new entrants to undergraduate programs after 2017, the percentage of male students entering STEM consistently remained higher throughout this eleven-year period. In other words, although more women appeared to be enrolled in undergraduate programs, they were underrepresented in STEM fields relative to their total share when compared to males. This gender disparity in STEM enrollments in Türkiye was also observed in a number of other developed and developing countries in the literature (Appiah-Castel et al., 2020; Jenkins & Mitchell, 2012; Mau, 2016; OECD, 2024; Ramirez & Kwak, 2015). For instance, in Arkansas in the U.S., while the overall STEM enrollments in higher education increased by 19.1% from 2007 to 2011, males significantly outnumbered females each year, with the gap between the genders ranging from 28.2% (2007) to 31% (2009) (Jenkins & Mitchell, 2012). Furthermore, according to the most recent OECD report, the OECD average for the proportion of new female entrants into tertiary STEM fields was 15%, which was considerably below the male proportion (41%) entering STEM (OECD, 2024). Overall, the findings of this study are promising by showing that the gender disparity in STEM enrollments in Türkiye is not as severe as in some other countries. Particularly, the upward trend identified over the last four years (2019–2023) indicated a positive shift, with more females choosing STEM majors and the gender gap getting narrower. While this observed trend is definitely encouraging, it also underlines the urgency for initiatives to encourage more women to pursue STEM careers.

Although women were generally underrepresented in STEM enrollments from 2013 to 2023 relative to their overall share, their enrollment rates varied considerably across specific STEM subfields. The results revealed that males consistently outnumbered females in Engineering enrollments, with the male proportion in some years being as high as double that of females (e.g., 2019). On the other hand, an opposite trend existed for the field of Biological and Biomedical Sciences, where female entrants comprised the majority each year, although the gap was smaller than that in Engineering. Notably, similar findings have also been reported in the literature from several other countries (Aziz et al., 2024; Marginson et al., 2013; OECD, 2024). For example, in Australia, 14.3% of male higher education students were enrolled in an engineering and related technologies field in 2010, compared to just 2.3% of female students, despite females significantly outnumbering males in overall higher education enrollment (Marginson et al., 2013). Conversely, the proportion of female students enrolled in a health-related field was 19.1%, compared to 9.3% of males (Marginson et al., 2013). In addition, according to the OECD report, out of 41 countries examined in 2022, none of them had "a greater share of men than women choosing to study health or medicine" (OECD, 2024, p. 230). In conclusion, the substantially lower number and percentage of females choosing engineering degrees in Türkiye is particularly troubling news, and some significant measures might be introduced to encourage more women to consider a career in engineering. In a large-scale study conducted with first-year students (N=1635) enrolled in various engineering majors from 21 different universities in Türkiye, Cavas et al. (2011) explored the factors influencing engineering students' career choices. Their findings revealed that students generally tended to determine their career pathways during the last year in high school or later, and the top three factors influencing their career-related decisions included their personal interest in jobs, securing a job quickly after graduation, and being able to use their talents, respectively (Cavas et al., 2011). Drawing on the findings of Cavas et al. (2011), school-based interventions during the final year of high school could be designed to increase female interest in engineering fields. For example, schools might offer exploratory sessions inviting successful women engineers who would showcase their occupations and ignite career interest among female students.

It might be assumed that STEM graduation patterns as a whole and by gender would mirror respective enrollment patterns to a large extent, considering

that students entering undergraduate programs are expected to graduate at some point. However, it is important to note that not all students may persist in their university majors due to attrition due to academic and personal challenges, changing interests and life expectations, or other factors that may lead to differences between overall enrollments and graduations. Thus, the key question is whether substantial discrepancies exist between STEM enrollment and graduation patterns over the eleven-year period (2013–2023), which may consequently indicate a leaky STEM pipeline. The findings indicated that despite a certain degree of annual attrition, there were no substantial discrepancies between enrollments and graduations over the eleven-year period. Notably, although the numbers fluctuated from year to year, more than half of all graduations consistently came from STEM majors. This suggests that most students enrolling in STEM fields were able to eventually graduate, pointing to a healthy STEM pipeline at the macro level. However, to fully evaluate the STEM pipeline's health in Türkiye, it is also essential to holistically examine potential gender disparities pertaining to STEM enrollments and graduations. Comparing the findings (Figures 3, 8), it is evident that the trends identified at STEM enrollments and graduations for males and females appeared to overlap to some extent. From 2013 to 2021, both a higher number and percentage of males graduated from STEM areas, which is similar to the trend that existed for STEM enrollments until 2019. In recent years, however, females outnumbered males regarding enrolling in and graduating from STEM programs, although women's representation in STEM enrollments and graduations is still consistently lower than males relative to their total shares. For instance, in 2022 and 2023, a higher number of females entered and graduated from STEM majors, while the gap continued to be in favour of males, with around 7% in enrollments (Figure 3) and around 12% in graduations (Figure 8). In summary, Türkiye's overall STEM pipeline appears relatively robust, while the persistent gender gap, despite recent increases in female STEM enrollments and graduations, underscores the urgency for nationwide targeted strategies to promote a more equitable representation in higher education STEM areas.

Conclusions and Implications

Employing the official dataset pertaining to the national enrollment and graduation numbers for undergraduate programs in Türkiye from 2013 to 2023, the findings of this study can potentially shed light on the evolution and the current state of the STEM pipeline in an emerging Eurasian country and provide valuable

insights for researchers, policymakers, and other stakeholders to address ongoing challenges concerning STEM career pathways. Since, to the best of the authors' knowledge, no previous study on this scale existed in the literature, and the present study constitutes the first comprehensive analysis of Türkiye's STEM pipeline at the national level, which laid a foundational groundwork for future research and evidence-based policy interventions to overcome persistent challenges in equitable STEM education and workforce development. The overall findings revealed that a relatively robust demand existed for STEM degree programs among high school graduates over the years, although the total STEM enrollment rates still lag behind some other developed nations, which calls for further research in exploring the factors limiting students' career decisions in STEM fields as well as developing targeted policies and school-based interventions to promote STEM career pathways among secondary students. Particularly, many studies have been conducted in K-12 settings, which explored Turkish middle and secondary school students' STEM attitudes, interests, and career aspirations (e.g., Herdem & Ünal, 2019; Yerdelen et al., 2016). However, research examining the reasoning behind Turkish high school graduates' major choices is scarce (e.g., Cavas et al., 2011; Karaarslan & Özbakır, 2017). To address this gap in the literature, future studies can employ qualitative or mixed-methods research designs to further investigate why high school graduates choose STEM majors in higher education and what common factors influence their career decision-making processes. Moreover, the findings of the present study pointed to the existence of gender imbalance, favouring males, in STEM enrollments and graduations, mirroring the trends reported in numerous previous studies. As such, policymakers should formulate evidence-based measures to address these gender disparities in STEM and boost overall STEM enrollments by designing targeted outreach programs and initiatives that would aim to foster equitable participation and a long-term upward trend in STEM enrollments in Türkiye.

A limitation of this study includes exploring the data only on four-year bachelor's degree enrollments and graduations. There are also two-year vocational programs in the Turkish higher education system in which students can earn an associate degree. While the official data at the national level on enrollments and graduations for the two-year degree programs is also publicly available by YÖK, the researchers of the present study chose to focus on four-year degree programs due to the scope of the study. As such, future research can explore the enrollment

and graduation patterns for two-year postsecondary programs in Türkiye by employing the official data provided by YÖK. Another limitation was that YÖK does not provide any enrollment and graduation statistics separately for public and private universities. Therefore, analysing trends separately for public and private universities was not possible in this study. Future research may examine whether different trends exist in public and private higher education institutions in terms of STEM enrollments and graduations.

Genişletilmiş Özet

Giriş

Son yıllarda bilim ve teknolojideki hızlı gelişmeler, STEM (Fen, Teknoloji, Mühendislik ve Matematik) alanlarında yetişmiş iş gücüne olan talebi dünya genelinde önemli ölçüde artırmıştır. Gelişmiş ve gelişmekte olan ülkeler, ekonomik kalkınmalarını sürdürebilmek için STEM eğitimini teşvik etmekte ve bu alanlara yönelik ilgiyi artırmak amacıyla çeşitli eğitim politikaları uygulamaktadırlar (English, 2016; Ma, 2021; NSB, 2024). Örneğin, Amerika Birleşik Devletleri'nde 2011-2021 yılları arasında STEM mesleklerinde çalışan iş gücü %20 artış göstermiştir (NCSES, 2023). Benzer şekilde, Avrupa'da 2025 yılına kadar yalnızca STEM alanlarında yedi milyon yeni iş imkânının ortaya çıkması beklenmektedir (WIA Europe, 2021). Ancak, küresel ölçekte STEM alanlarına olan talebin artmasına rağmen, özellikle gelişmiş ve gelişmekte olan ülkelerde ortaöğretim ve yükseköğretim düzeyinde öğrencilerin STEM alanlarına olan ilgisinde genel bir düşüş gözlemlenmektedir (Jaremus vd., 2019; Kao & Shimizu, 2020).

Türkiye gibi gelişmekte olan bir ülkenin, küresel rekabette öne çıkabilmesi için STEM alanlarında kalifiye insan gücüne ihtiyacı bulunmaktadır. OECD verilerine göre Türkiye'de 2015 yılında doğa bilimleri, mühendislik ve bilişim teknolojileri alanlarından mezun olan öğrencilerin oranı %20'nin altında kalmış ve bu oran OECD ortalamasının gerisinde yer almıştır (OECD, 2017). PwC ve TÜSİAD tarafından hazırlanan bir rapora göre 2023 yılında Türkiye'de STEM alanında bir milyon işin ortaya çıkması beklenirken bu işlerin yaklaşık %31'inin nitelikli mezun eksikliği nedeniyle doldurulamayacağı öngörülmüştür (PwC & TÜSİAD, 2017). Bu nedenle Türkiye'de yükseköğretim kurumlarında lisans düzeyindeki STEM alanlarına yönelik kayıt ve mezuniyet eğilimlerinin ülke genelinde kapsamlı bir şekilde incelenmesi özellikle önem arz etmektedir.

Bu çalışma, özellikle 2013-2023 yılları arasında Türkiye'deki STEM alanlarındaki kayıt ve mezuniyet oranlarındaki değişimlerin detaylı olarak analiz edilmesini amaçlamaktadır. Araştırma, Yükseköğretim Kurulu (YÖK) tarafından sağlanan resmî verileri kullanarak lisans eğitimi düzeyinde STEM alanlarına yönelik talebin zaman içindeki seyrini ve eğilimleri ortaya koymayı hedeflemektedir. Ayrıca varsa cinsiyet bazlı farklılıkların ortaya konulması ve kadınların STEM alanlarına katılımlarını artıracak politika önerilerinin geliştirilmesi hedeflenmiştir.

Yöntem

Araştırmada nicel araştırma yöntemlerinden betimsel analiz yöntemi benimsenmiştir. Kullanılan veriler, Yükseköğretim Kurulu (YÖK) tarafından paylaşılan Yükseköğretim Bilgi Yönetim Sistemi (YBYS, 2024) veri tabanından elde edilmiştir. Bu veri tabanı, Türkiye genelindeki tüm yükseköğretim kurumlarına ilişkin 2013-2023 yıllarına ait lisans programlarındaki kayıtlı ve mezun öğrenci sayılarını içermektedir. Veriler, STEM ve STEM-dışı programlar olarak sınıflandırılmış ve cinsiyet bazında analiz edilmiştir. STEM ve STEM-dışı programların sınıflandırılması için ABD İç Güvenlik Bakanlığı (Department of Homeland Security [DHS], 2024) tarafından oluşturulmuş kapsamlı bir STEM programları listesi kullanılmıştır. Bu liste; mühendislik, biyoloji ve biyomedikal bilimler, fiziki bilimleri, sosyal bilimler, matematik ve istatistik gibi alt kategorileri içermektedir. Ayrıca, tıp ve diş hekimliği gibi bazı alanlar da bu çalışma kapsamında STEM olarak sınıflandırılmıştır. Veri analizinde, öğrenci kayıt ve mezuniyet oranları yıllara göre karşılaştırılmış ve cinsiyet bazındaki farklılıklar ki-kare bağımsızlık testleri ile incelenmiştir. Analizler, R-Studio programı kullanılarak gerçekleştirilmiş ve sonuçlar grafik ve tablolarla desteklenerek sunulmuştur.

Bulgular

Araştırmanın bulguları, incelenen on bir yıllık dönemde lise mezunlarının genellikle yarıdan fazlasının STEM bölümlerini tercih ettiğini göstermektedir. Bununla birlikte bu eğilimde 2016-2018 yılları arasında geçici ancak belirgin bir düşüş yaşanmıştır. Bu düşüş, YÖK tarafından getirilen üniversite giriş sistemindeki minimum başarı sıralaması politikalarıyla ilişkilendirilmiştir. Özellikle 2016 yılında mühendislik ve mimarlık programları için getirilen başarı sıralaması şartı, bu alanlara olan talebi geçici olarak azaltmış olabilir. Ancak 2019

yılından itibaren STEM bölümlerine olan talep yeniden yükselişe geçmiş ve 2023 yılında %53,4'e ulaşmıştır.

Cinsiyet bazında bakıldığında erkek öğrenciler STEM bölümlerinde sayı ve oran bakımından kadın öğrencilere göre daha yüksek temsile sahiptir. Ancak kadın öğrencilerin STEM alanlarına olan ilgisi, özellikle 2020 yılından itibaren dikkate değer şekilde artmıştır. Biyoloji ve biyomedikal bilimlerde kadın öğrenci sayısı erkek öğrencileri aşmış durumdayken mühendislik bölümlerinde erkek öğrenci oranı kadınlardan çok daha yüksektir. Ayrıca fiziki bilimler gibi bazı alt alanlarda genel bir düşüş gözlemlenmiş, matematik ve istatistik bölümlerinde ise kadın öğrenci oranları artış göstermiştir.

Mezuniyet oranları da kayıt eğilimlerine paralel bir seyir izlemiştir. STEM alanlarından mezun olan öğrenci oranları, genelde kayıt oranlarıyla tutarlıdır ve sürekli olarak yüksek seviyelerde kalmıştır. Erkek öğrenciler, STEM alanlarından mezuniyet oranları açısından kadın öğrencilere kıyasla daha yüksek bir temsil oranına sahiptir. Ancak son dönemde özellikle sosyal bilimler ile matematik ve istatistik alanlarında kadın mezunların oranlarında belirgin bir artış olduğu göze çarpmaktadır.

Tartışma

Elde edilen bulgular, Türkiye'de STEM alanlarına yönelik talebin 2013-2023 döneminde genel olarak istikrarlı bir seyir izlediğini, ancak 2016-2018 yılları arasında belirgin bir düşüş yaşandığını göstermektedir. Bu düşüşün arkasındaki temel nedenin YÖK tarafından bu dönemde uygulamaya konulan üniversite giriş sistemindeki köklü değişiklikler olduğu düşünülmektedir. Özellikle tıp ve hukuk programlarında 2015 yılında başlatılan başarı sıralaması uygulamasının 2016'da mühendislik ve mimarlık, 2017'de ise öğretmenlik programlarına genişletilmesi, bu alanlara olan talebin geçici olarak bir miktar azalmasına neden olmuş olabilir. Bu politika değişikliklerinin başarılı öğrencileri STEM alanlarına yönlendirme amacı taşıdığı açıktır. Ancak bu değişiklikler aynı zamanda orta düzeyde başarı gösteren ve potansiyeli yüksek olan öğrencilerin bu alanlardan uzaklaşmasına da neden olmuş olabilir.

OECD verileriyle yapılan karşılaştırmalar, Türkiye'nin STEM alanlarındaki kayıt oranlarının henüz birçok gelişmiş ülkenin gerisinde kaldığını göstermektedir. Örneğin, 2022 yılında Avusturya ve İsrail'de yükseköğretime

yeni başlayan öğrenciler sırasıyla %66 ve %68'i STEM alanlarını tercih ederken Türkiye'de bu oran %53,5 olarak gerçekleşmiştir (OECD, 2024). Bu durum, Türkiye'nin STEM alanlarındaki insan kaynağı ihtiyacını karşılamak için daha fazla çaba göstermesi gerektiğine işaret etmektedir. Özellikle ilköğretim ve ortaöğretim düzeyindeki eğitim sisteminde STEM farkındalığını artıracak ve öğrencilerin bu alanlara yönelik ilgisini teşvik edecek programların yaygınlaştırılması kritik önem taşımaktadır.

Çalışmanın en çarpıcı bulgularından biri, STEM alanlarındaki cinsiyet eşitsizliğinin sürmesiyle birlikte son yıllarda daralma eğilimi göstermesidir. 2013-2018 döneminde erkek öğrenciler hem mutlak sayı hem de oransal olarak STEM alanlarında kadın öğrencilere göre belirgin bir üstünlük sergilerken 2019 sonrasında kadın öğrencilerin STEM alanlarına yönelik ilgisinde önemli bir artış gözlemlenmiştir. Bununla birlikte kadın öğrencilerin STEM alanlarına katılım oranları hâlâ erkeklerin gerisinde kalmaktadır. Bu durum, küresel ölçekte de benzerlik gösteren bir eğilimdir. Örneğin OECD'nin 2024 raporuna göre, OECD ülkelerinde yükseköğretime başlayan kadın öğrencilerin yalnızca %15'i STEM alanlarını seçerken bu oran erkek öğrencilerde %41'e ulaşmaktadır (OECD, 2024).

STEM alt alanlarına bakıldığında cinsiyet temsiliyetindeki dengesizliğin daha da belirginleştiği görülmektedir. Mühendislik gibi geleneksel olarak erkek egemen olarak algılanan alanlarda kadın temsiliyeti son derece düşük seviyelerde seyrederken biyoloji ve biyomedikal bilimler gibi alanlarda kadın öğrencilerin oranı erkekleri geçmektedir. Bu durum, toplumsal cinsiyet kalıplarının ve ön yargıların eğitim ve kariyer tercihleri üzerindeki güçlü etkisini yansıtmaktadır. Mutlu Çaykuş ve Korkut Owen (2017) tarafından yapılan bir çalışma, Türkiye'de ailelerin kız çocuklarını öğretmenlik gibi geleneksel olarak "kadına uygun" görülen mesleklere yönlendirme eğiliminde olduğunu ortaya koymuştur. Benzer şekilde, STEM alanlarında çalışan kadınların teknik konuları anlamakta zorlanacağına dair ön yargıların yaygınlığı da kadınların bu alanlardan uzaklaşmasına neden olabilmektedir.

Çalışmanın bir diğer önemli bulgusu, STEM alanlarına kayıt yaptıran öğrencilerin büyük çoğunluğunun bu programlardan mezun olmayı başarmasıdır. Bu durum, Türkiye'deki yükseköğretim kurumlarının STEM programlarında öğrenci devamlılığını sağlamada nispeten başarılı olduğunu göstermektedir. Bu çalışmanın bulguları, Türkiye'nin STEM alanlarındaki insan kaynağı ihtiyacını

karşılamak için atılması gereken adımlara ışık tutmaktadır. Öncelikle ortaöğretim düzeyinde STEM farkındalığını artıracak ve öğrencilerin bu alanlara yönelik ilgisini teşvik edecek programların yaygınlaştırılması gerekmektedir. İkinci olarak kadınların STEM alanlarına, özellikle de mühendislik gibi geleneksel olarak erkek egemen alanlara katılımını artırmak için hedefli müdahale programları geliştirilmelidir.

Sonuç ve Öneriler

Sonuç olarak Türkiye'de STEM alanlarına yönelik genel öğrenci talebinin 2013 ile 2023 arasındaki yıllarda görece olarak güçlü olduğu görülmüştür, ancak uluslararası kıyaslamalara göre geliştirilmesi gereken noktalar bulunmaktadır. Özellikle mühendislik gibi bazı alt STEM alanlarında kadın öğrenci oranlarının artırılması için girişimlere ve müdahale programlarına ihtiyaç duyulmaktadır. Lise eğitiminde özellikle son sınıflarda yapılacak kariyer bilgilendirme çalışmaları ve STEM alanlarında başarılı Türk kadın rol modellerinin tanıtılması, cinsiyet eşitliğinin sağlanmasına belli ölçüde katkı sağlayabilir.

Bu araştırma, Türkiye'de STEM alanlarına yönelik kayıt ve mezuniyet eğilimlerini kapsamlı bir şekilde inceleyen ilk çalışma olması açısından önemlidir ve elde edilen bulguların eğitim politikalarının şekillenmesine katkı sağlaması beklenmektedir. Gelecek araştırmalar, iki yıllık ön lisans programlarında STEM alanlarına yönelik eğilimleri inceleyebilir ve kamu üniversiteleri ile özel üniversiteler bağlamında STEM alanlarına yönelik farklı eğilimlerin olup olmadığını analiz edebilir. Ayrıca öğrencilerin STEM tercihlerinin altında yatan motivasyonların nitel yöntemlerle daha detaylı incelenmesi, politika oluşturma süreçlerine önemli katkılar sağlayacaktır.

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Appendix A

Demographic Information of the Participants

	Enrolled students			Graduated students		
Year	Total	Female	Male	Total	Female	Male
2013	668218	309324	358894	406215	198253	207962
2014	707222	333607	373615	399049	199193	199856
2015	789726	362398	427328	458564	224419	234145
2016	673327	337934	335393	437446	219051	218395
2017	669367	331404	337963	454207	236597	217610
2018	702454	359056	343398	454995	239409	215586
2019	705409	374986	330423	486200	258171	228029
2020	816747	439705	377042	569702	292348	277354
2021	714167	384180	329987	575654	294389	281265
2022	844812	460949	383863	477253	268053	209200
2023	837174	467288	369886	462139	259504	202635

Appendix B

STEM Fields Designated from the Categories Prepared by YÖK according to ISCED-F 2013

STEM FIELDS
Archaeology
Architecture and Town Planning
Architecture and Construction not Further Defined
Audio-Visual Techniques and Media Production
Biochemistry
Biology
Biology and Biochemistry
Building and Civil Engineering
Chemical Engineering and Processes
Chemical Process
Chemistry
Child Care and Youth Services
Computer and Educational Technologies Teaching
Computer Science
Computer Use
Crop and Livestock Production
Database and Network Design and Administration
Dental Studies
Design
Earth Science
Economics
Electricity and Energy
Electronics and Automation
Engineering and Engineering Trades
Engineering and Engineering Trades not Elsewhere Classified
Environmental Protection Technology
Environmental Science
Fashion, Interior and Industrial Design
Fisheries
Food Processing
forestry

STEM FIELDS
Geography
Health
Horticulture
Interdisciplinary Programs and Qualifications Involving Agriculture, forestry, Fisheries and Veterinary
Interdisciplinary Programs and Qualifications Involving Engineering, Manufacturing and Construction
Interdisciplinary Programs and Qualifications Involving Health and Welfare
Interdisciplinary Programs and Qualifications Involving Information and Communication Technologies
Management and Administrations
Manufacturing and Processing
Manufacturing and Processing (Extended Programs)
Manufacturing and Processing not Elsewhere Classified
Materials (Wood, Paper, Plastic, Glass)
Mathematics
Mathematics and Statistics
Mechanics and Metal Work/Trades
Media and Communication
Medical Diagnostics and Treatment Technology
Medicine
Mining and Extraction
Motor Vehicles, Ships and Aircraft
Natural Environment and Wildlife
Occupational Health and Safety
Pharmacy
Physics
Psychology
Social and Behavioral Science
Software and Applications Development and Analysis
Statistics
Textiles (Clothes, Footwear and Leather)
Training for Teacher of Vocational Subjects
Transport Services
Veterinary

Appendix C

Non-STEM Fields Designated from the Categories Prepared by YÖK according to ISCED-F 2013

Non-STEM FIELDS
Accounting and Taxation
Art
Art (Extended Programs)
Domestic Services
Education Science
Finance, Banking and Insurance
Fine Arts
foreign Languages
Handicrafts
History
Hotel, Restaurants and Catering
Interdisciplinary Programs and Qualifications Involving Arts and Humanities
Interdisciplinary Programs and Qualifications Involving Business, Administration and Law
Interdisciplinary Programs and Qualifications Involving Education
Interdisciplinary Programs and Qualifications Involving Social Sciences
Journalism and Reporting without Media and Communication
Language Acquisition
Languages not Elsewhere Classified
Law
Library, Information and Archival Studies
Literature and Linguistics
Marketing and Advertising
Mother Tongue
Music and Performing Arts
Nursing and Caring
Nursing and Midwifery
Philosophy and Ethics
Political Science and Citizenship

Non-STEM FIELDS
Political Sciences and Civics
Protection of Persons and Property
Religion
Religion and Theology
Social Work and Counselling
Sociology and Cultural Studies without Geography
Sports
Teacher Training and Education Science
Teacher Training with Subject Specialization without Computer and Educational Technologies
Teacher Training without Subject Specialization
Therapy and Rehabilitation
Training for Pre-School Teachers
Training of Teachers at Basic Levels
Travel, Tourism and Leisure
Wholesale and Retail Sales
Work Skills
Working Life

Appendix D

Sub-Fields Designated from the Categories Prepared by YÖK according to ISCED-F 2013

STEM Fields	Sub-Fields
Archaeology	Social Sciences
Horticulture	Biological and Biomedical Sciences
Fisheries	Biological and Biomedical Sciences
Computer Science	Engineering
Computer Use	Others
Computer and Educational Technologies Teaching	Others
Interdisciplinary Programs and Qualifications Involving Information and Communication Technologies	Others
Building and Civil Engineering	Engineering
Crop and Livestock Production	Biological and Biomedical Sciences
Biochemistry	Biochemistry
Biology	Biological and Biomedical Sciences
Biology and Biochemistry	Biological and Biomedical Sciences
Environmental Science	Physical Sciences
Environmental Protection Technology	Engineering
Child Care and Youth Services	Social Sciences
Geography	Social Sciences
Dental Studies	Biological and Biomedical Sciences
Natural Environments and Wildlife	Biological and Biomedical Sciences
Pharmacy	Biological and Biomedical Sciences
Economics	Social Sciences
Electricity and Energy	Engineering

STEM Fields	Sub-Fields
Electronics and Automation	Engineering
Physics	Physical Sciences
Food Processing	Biological and Biomedical Sciences
Audio-Visual Techniques and Media Production	Others
Manufacturing and Processing	Engineering
Manufacturing and Processing (Extended Programs)	Engineering
Manufacturing and Processing Not Elsewhere Classified	Engineering
Building and Civil Engineering	Engineering
Occupational Health and Safety	Others
Audio-Visual Techniques and Media Production	Others
Statistics	Mathematics and Statistics
Chemistry	Physical Sciences
Chemical Engineering and Processes	Engineering
Chemical Process	Physical Sciences
Mining and Extraction	Engineering
Materials (Glass, Paper, Plastic and Wood)	Engineering
Mathematics	Mathematics and Statistics
Mathematics and Statistics	Mathematics and Statistics
Materials (Wood, Paper, Plastic, Glass)	Engineering
Media and Communication	Others
Mechanics and Metal Trades	Engineering
Mechanics and Metal Work	Engineering
Training for Teacher of Vocational Subjects	Others
Architecture and Construction Not Further Defined	Engineering
Architecture and Town Planning	Engineering
Fashion, Interior and Industrial Design	Engineering
Motor Vehicles, Ships and Aircraft	Engineering
Engineering and Engineering Trades	Engineering
Engineering and Engineering Trades Not Elsewhere Classified	Engineering

STEM Fields	Sub-Fields
Interdisciplinary Programs and Qualifications Involving Engineering, Manufacturing and Construction	Engineering
forestry	Biological and Biomedical Sciences
Psychology	Social Sciences
Health	Biological and Biomedical Sciences
Interdisciplinary Programs and Qualifications Involving Health and Welfare	Biological and Biomedical Sciences
Social and Behavioral Science	Social Sciences
Interdisciplinary Programs and Qualifications Involving Agriculture, forestry, Fisheries and Veterinary	Biological and Biomedical Sciences
Design	Engineering
Textiles (Clothes, Footwear and Leather)	Engineering
Medical Diagnostics and Treatment Technology	Biological and Biomedical Sciences
Medicine	Biological and Biomedical Sciences
Transport Services	Others
Database and Network Design and Administration	Others
Veterinary	Biological and Biomedical Sciences
Software and Applications Development and Analysis	Engineering
Earth Sciences	Physical Sciences
Management and Administration	Social Sciences