STEM Education

STEM Education, 5(1): 19–40
DOI: 10.3934/steme.2025002
Received: 31 July 2024
Revised: 07 October 2024
Accepted: 17 October 2024
Published: 05 November 2024

https://www.aimspress.com/journal/steme

Research article

Factors influencing the lower number of women in STEM compared to men: A case study from Kosovo

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Academic Editor: Suzieleez Syrene Abdul Rahim

Abstract: The gender gap in Science, Technology, Engineering, and Mathematics (STEM) is a global issue. Despite progress in recent years, significant barriers continue to hinder women's entry and persistence in STEM disciplines. This study examines the multifaceted barriers that prevent women from entering and continuing in STEM disciplines through interviews with high school schoolers. The findings highlight challenges such as gender stereotypes, the lack of role models, and insufficient encouragement from educational environments. The study proposes interventions to increase women's engagement in STEM, including mentoring programs, integration of STEM in early education, and increased institutional support. These recommendations aim to inspire a new generation of women to explore and succeed in STEM fields, thus contributing to a more balanced workforce.

Keywords: women, STEM, gender, disparities, education, stereotypes, workforce, bias, careers

1. Introduction

Science, Technology, Engineering, and Mathematics (STEM) educates individuals in the four named disciplines. This term refers to any topic and subject that contains these four disciplines (Rust, 2010). The admiration for these disciplines has existed since the oldest civilizations. STEM

educational programs around the world have designed their way of learning based on real-world applications. In other words, they are built to teach practical skills that can be applied in real life. Previous innovations have laid the foundations for today's science [1]. The term STEM was first introduced in 2001 by science administrators at the National Science Foundation (NSF) in the USA. Initially, the term SMET (i.e., science, mathematics, engineering, and technology) was used; however, in 2001, American biologist Judith Ramaley, who was an assistant director at NSF, reorganized the words to form the term STEM, which has since had a broad reach in many countries around the world [13]. STEM is one of the fastest-growing fields in the last decade, with a full 20% increase [24]. In 2024, women worldwide represent only 28% of the STEM workforce; moreover, in Europe, women only represent 17% of the STEM workforce [14]. Adding to the low representation of women entering STEM fields, women with STEM degrees are more likely to work in education or healthcare than in STEM fields [2]. Furthermore, despite efforts to encourage girls to pursue an education in STEM, there is a gender inequality in the representation of women in STEM careers. This gap is evident not only in the workforce but also in leadership positions within STEM-related industries and academia. A factor that contributes to the underrepresentation of women in STEM is the prevalence of gender stereotypes that portray STEM fields as more suitable for men [21]. These stereotypes begin early in childhood and can affect girls' perceptions of their abilities and interests in STEM subjects [19]. Moreover, the lack of visible female role models and mentors in STEM further reinforces these stereotypes and can discourage girls from pursuing STEM careers (PNAS, 2020).

2. Related to work

In recent decades, many things have improved from the past, including the increase in the number of women who are educated. However, the world still faces a phenomenon called the “learning crisis,” which means that even though women are educated, they still do not receive a quality education. Additionally, the small number of women who pursue a career in STEM is a concern. STEM educates individuals in four different disciplines: science, technology, engineering, and mathematics. Recent studies in the Balkans have indicated that women's participation in STEM fields remains disproportionately low. For example, women only hold 14% of STEM jobs in the Western Balkans, which is significantly lower than the European Union (EU) average (Friends of Europe, 2023). In 2021, women made up 32.8% of all STEM graduates across the EU. Romania and Poland led with higher percentages of women graduates in STEM, while Germany and Belgium fell below the EU average [8]. These trends indicate ongoing disparities that require regional and national efforts to address. In the Western Balkans, efforts such as the Women in STEM Network, launched by the United Nations Development Programme (UNDP) in collaboration with the Regional Cooperation Council (RCC), aims to reduce gender disparities through mentorship programs and skill-building initiatives. Events such as the 2023 Ulcinj capacity-building initiative further emphasized the need for regional cooperation to challenge societal stereotypes and improve recruitment and retention of women in STEM [23].

Nevertheless, the good news is that the number of women enrolling in STEM college courses increases by about 6% each year. Statistically, scientific data has proven that boys and girls are equally capable in STEM [13]. National math test results for lower grades have been the same for several years; in high school, girls progress in algebra at faster rates than boys. Additionally, in science, girls perform at the same level as boys and equally enroll in advanced science and math

courses as they move through high school. Therefore, from elementary and high school, the interest of both parties is found to be the same; however, with the continuation of higher studies, a smaller number of girls continue in STEM fields. The number of boys graduating in fields such as physics, computer science, and engineering is significantly higher, including only 20% of women graduating in these fields. Then, all these absences result in their absence in STEM workplaces, where women make up only 28% of the workforce in science, technology, engineering, and mathematics [24]. Moreover, regarding the percentage of women working in the STEM field who have degrees, 38% of those who graduated in computer science work in that field, while only 24% of those who graduated in engineering work in the field of engineering. Additionally, based on data from the United States, the annual earnings are $15,000 higher for men than for women (men $85,000 – women $60,828). It is important to note that women with a STEM degree tend to earn more than those without one, particularly when working in STEM-related jobs, compared to those in non-STEM fields. For comparison, the median income in the US was $68,703 in 2021, thus highlighting the gender wage disparity in STEM occupations [26].

In Europe, women working in STEM fields earn approximately 15% less than men. This gender pay gap persists despite efforts to promote gender equality in the workforce. For instance, in the EU, women's gross hourly earnings were on average 12.7% below those of men in 2022, with variations across countries [8]. In the Western Balkans, the gender pay gap can reach up to 21.3%, as observed in some regions (Foundation for European Progressive Studies, 2023).

According to a recent report, the STEM gender pay gap in Europe increased to 14% in 2024, thus demonstrating that challenges in addressing pay inequalities remain. In contrast, North America saw a reduction in the pay gap, with women earning 8% less than men in STEM fields (SRG Talent, 2024).

2.1. Growth in the STEM workforce between 2011 and 2021

In some regions, women represent approximately 35% of the STEM workforce. However, this figure varies significantly depending on the country and socio-economic factors. For instance, in the EU, the average participation rate of women in STEM fields is around 35% [8]. In comparison, in North America, women make up 28% of the STEM workforce [26]; alternatively, in Africa, the figure drops to about 18% (African Development Bank, 2021).

In Australia, women represent about 27% of the STEM workforce, though the percentage slightly increases in specific sectors such as healthcare and education [3]. However, women in Australia still face a significant gender pay gap in STEM fields, where men earn on average 13% more than women [3].

When analyzing this data, it is important to consider various factors such as the country's wealth, predominant religion, and cultural attitudes toward gender roles. Some examples are provided below.

Rich vs. Poor Countries: Wealthier countries such as the United States and Germany tend to have more resources dedicated to education, which has led to higher participation rates of women in STEM. However, even in these countries, a significant pay gap persists (SRG Talent, 2024).

Religious Influence: In some regions where conservative religious practices dominate, such as parts of the Middle East, cultural norms may restrict women's access to STEM education and jobs. Conversely, more secular countries such as Sweden and Finland have higher gender equality in STEM participation.

Educational Systems: Countries with robust STEM education policies such as Japan and South Korea see more gender parity in STEM fields. However, gender gaps remain more pronounced in other nations with smaller investments in STEM education.

Figure 1. The difference in the STEM workforce between 2011 and 2021.

2.2. Statistics in some countries of the world on women's participation in STEM

2.2.1. Research in the European Union

In the EU, about 41% of scientists and engineers are women [8]. However, when it comes to women working for themselves in science, engineering, and technology, this figure drops to just over 25% [9]. This demonstrates the need for more women in these fields [14]. Women's participation in entrepreneurship and STEM remains a significant challenge. Currently, only 19% of professionals in technology fields are women, and only one-third of graduates in this field are female [8].

Furthermore, only 15% of startups in Europe are led by women, thus showing the gender gap in leadership and founding roles (European Startup Monitor, 2021). In 2021, women graduates in STEM fields made up 32.8% of total STEM graduates, which is a slight increase from 2020 [8]. The highest percentages of female STEM graduates in tertiary education in 2021 were recorded in Romania (42.5%), Poland (41.5%), Greece (40.9%), and Italy (39.0%). At the other end of the spectrum, the lowest percentages were found in Belgium (27.4%), Spain and Germany (both 27.7%), and Austria (28.0%) [8].

2.2.2. Research in the United Kingdom

In a report given in January 2021 based on research conducted in the United Kingdom, 35% of STEM schoolers in higher education in 2017/18 were women (WISE, 2020).

Figure 2. Women's participation in STEM careers across Europe. The data represents the percentage of women working in STEM fields in various EU countries, based on data from the European Commission's She Figures 2021 report and Eurostat statistics.

From 2015 to 2019, the number of women who studied STEM increased from 22,020 to 24,075, reaching 26% of the total number. Although the number of women who studied STEM increased by almost 1000 per year, this has shown that the effort to encourage them to study STEM has been somewhat successful; however, the percentage remained the same due to the increase in the number of boys who chose to study these fields (Eurostat, 2024).

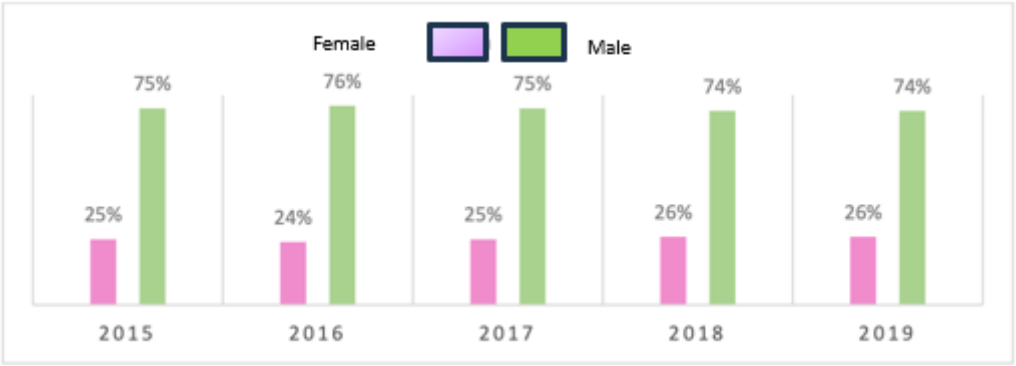

Figure 3. Change in the percentage of male and female schoolers in STEM fields between 2015 and 2019 in the European Union. The data reflects the trends in gender participation in STEM education across various European countries during this period.

This report showed that according to data from the Universities and Colleges Admissions Service (UCAS) provided by the Higher Education Statistics Agency (HESA), the percentage of women in the STEM workforce in the United Kingdom increased by 6.3% from 2017. Government data from 2019 showed that there were over one million women who worked in key STEM professions. This was the first time that the number of women employed in STEM surpassed one million, thereby representing 24% of the total STEM workforce. This increase was achieved by adding 216,552 women to the STEM workforce since 2016.

By analyzing data from the last decade (2009-2019), Women in Science and Engineering (WISE) predicted that the proportion of women in STEM will rise to 29% by 2030.

2.2.3. Women's participation in STEM in Australia

The STEM Equity Monitor is an Australian national source of information that provides a current overview of gender equity in STEM in Australia and tracks changes and current trends. Based on their 2021 report, women's participation in STEM has increased. The 2021 monitoring showed some real improvements in the representation and participation of girls and women in STEM education and careers. Data based on this report showed that the participation of women who worked in the STEM industry increased from 24% in 2016 to 28% in 2020. Additionally, there was an increase in the number of women who continued to study STEM, reaching 36% in 2019, thus achieving the highest percentage since 2015.

2015 - 34% (70,000 women)

2019 - 36% (more than 81,000 women)

Numerous activities were engaged by the Australian government, such as the following:

- Women in STEM Ambassador initiative
- The Girls in STEM Toolkit
- The Women in STEM and Entrepreneurship grants,

Over 100 million dollars have been invested to increase women's participation in STEM and entrepreneurship. These aforementioned improvements show that the efforts of the Australian government and various sectors for the advancement of women in STEM have begun to have an impact, although many changes are still needed to achieve the vision for gender equity in STEM in Australia by 2029 [2]. Reports from the Monitor will be published annually until 2029 to show the improvements and changes that will be achieved.

2.3. What has influenced the lower number of women in STEM compared to men

In recent years, especially during the last five years, many studies and discussions have been conducted on why women are underrepresented in STEM fields. In about 35 European countries, 1 in 5 STEM graduates are girls. Their interest in STEM subjects increases around the ages of 11-12; however, this interest begins to fade around the ages of 15-16, meaning they lose interest as they grow up. This implies that governments, parents, and teachers have only 4-5 years to encourage girls to pursue STEM subjects before they turn away from these subjects forever [17]. The reasons girls and women engage and participate at a lower rate than boys in STEM fields can be a multitude of social, cultural, and psychological reasons. The root of what hinders girls from pursuing a career in STEM has been equated to gender stereotypes, cultural norms, the social undervaluation of women in STEM careers, the lack of role models to inspire their interest, discrimination, gender biases, the lack of support from parents and teachers, girls undervaluing their scientific abilities, etc. To a greater or lesser extent, all these factors can be mentioned as the main reasons that push women away from continuing a career in STEM, thus making them grow up believing that STEM belongs to the male gender and that women's ability in this field is naturally smaller than that of boys [21]. This

can damage a girls' confidence, interest, and willingness to get involved in STEM subjects. Based on many reports, experiments, and research conducted so far, gender stereotypes are a fundamental problem for women's non-participation in STEM. In almost every report and writings that mentioned the texts and studies above, which showed what pushes girls away from continuing an education or career in STEM, the primary influences mentioned are gender stereotypes. When the term 'science' is heard, most people associate it with the concept of a 'male.' This might happen unconsciously, but this stereotype makes it harder for female scientists to receive the promotions they deserve. These stereotypes can lead women to question their ability in STEM fields, despite no evidence which suggests that their capabilities are inherently lower than those of men. Parents, teachers, and community members may not see the potential for young girls and women in STEM. These stereotypical classifications have an impact not only on career choices but also on retaining women in STEM fields, as they can damage their confidence, interest, and willingness to get involved in these fields (PNAS, 2020). According to a study conducted by Proceedings of the National Academy of Sciences (PNAS) with schoolers from the first grade to the twelfth grade, it is shown that children as young as 6 years old start to develop the idea that STEM is more suitable for boys than for girls. Efforts to challenge gender-stereotypical beliefs about STEM should focus on children at a young age. In this study, several experiments were conducted. In the first experiment, 51% of boys believed that girls were less interested than boys in computer science. In the second experiment, a smaller number of schoolers were involved. When these schoolers were told that boys were more interested in science and mathematics, only 35% of girls were likely to choose this activity, while this percentage increased to 65% when they were told that both boys and girls were equally interested in these fields. In an environment where there were stereotypical STEM objects, such as video game boxes or computer and electronics parts, females were less interested in computer science, even if everyone working in that environment was female. As much as these stereotypical objects seem harmless, they evoke a male stereotype that makes females feel like they don't belong in that environment. Unconscious gender biases against females affect their progress in STEM [24].

Moreover, the perception of how women think they will perform in STEM-related careers needs to change. In the Randstad study, which surveyed over 35,000 workers aged 18 to 67 across 34 markets, data were collected from individuals employed for at least 24 hours per week, including sole traders and unemployed individuals considering job opportunities (Randstad, 2023; Workmonitor, 2024). This comprehensive approach provided a solid foundation to understand workforce dynamics and perceptions regarding gender in STEM fields.

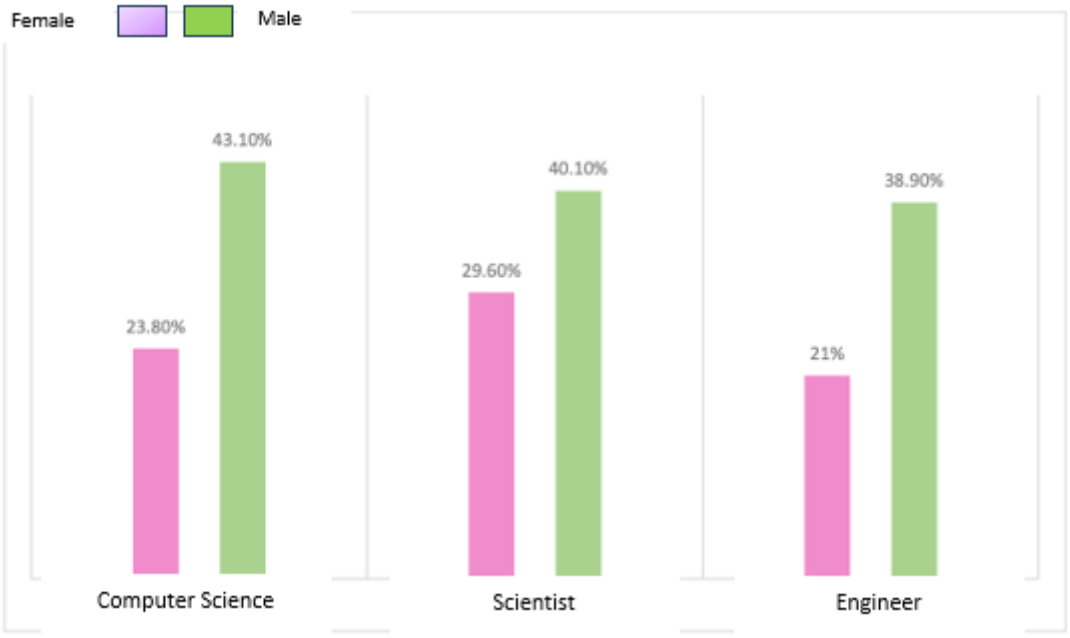

Figure 4. The difference between the two genders in their self-assessment in STEM.

Figure 4 depicts the self-assessment of abilities among male and female respondents in three STEM fields: Computer Science, Scientist, and Engineer. The percentages represent the respondents who rated their skills as "high" or "very high" in each field.

COMPUTER SCIENCE:

Male: 43.10%

Female: 23.80%

This substantial gap indicates that while a higher proportion of males feel confident in their abilities, significantly fewer females share this self-assessment. Research suggests that societal stereotypes surrounding gender roles in technology can negatively impact women's confidence in their skills [14].

SCIENTIST:

Male: 40.10%

Female: 29.60%

Again, a noticeable disparity exists, with more males favorably perceiving their abilities compared to females. This discrepancy can be linked to biases in educational environments that may lead to a lower confidence among female schoolers in STEM subjects [6].

ENGINEER:

Male: 38.90%

Female: 21%

The difference in engineering is particularly pronounced, thus highlighting significant barriers that women face in pursuing and feeling competent in engineering careers. The lack of female role models and persistent stereotypes contribute to this lower self-assessment among women in engineering [22].

3. Methodology

We conducted a study with high school schoolers, specifically twelfth graders, to understand the factors that influence the lower number of women in STEM in Kosovo and to compare how they and boys feel in certain STEM fields. The survey was anonymous to encourage honest responses and reduce bias, and only the gender information was collected.

Research Questions

1. Are there gender stereotypes about abilities in science and technology among schoolers?
2. How does gender perception influence schoolers' career choices in STEM fields?

The research questions of the study focused on evaluating gender stereotypes in science and technology among schoolers, as well as the impact of gender perception on their career choices in STEM fields. For the first question, the study aimed to discover whether there are gender stereotypes that influence the perception of abilities in science and technology among schoolers. This includes assessing the schoolers' perceptions of their personal abilities and gender-specific abilities in these fields. Through the analysis of the schoolers' responses, the goal was to identify dominant perceptions and explain whether they were related to gender stereotypes.

For the second question, the aim was to understand how gender perception influences the schoolers' career choices in STEM fields. This includes identifying the impact of gender stereotypes on the schoolers' preferences and decisions to choose a particular field of study or career in STEM. To understand this, the study analyzed the relationship between gender stereotypes, career choice preferences, and the factors that influence these choices, including the social context, education, and personal skills of the schoolers. Through these research questions, the goal was to contribute to a deep understanding of the role that gender stereotypes play in the schoolers' career choices in STEM fields and propose measures to address these concerns and promote gender diversity in these fields.

Participants

In the study, 73 participants were involved, consisting of 42 girls and 31 boys from a high school in Peja, Kosovo. Of the 42 girls and 31 boys that were initially contacted, only 39 girls and 21 boys completed the survey. The reduction was due to some participants either not responding to certain questions or choosing not to complete the survey.

The participants were selected from multiple schools, with all 12th-grade schoolers being invited to participate. Participation was voluntary, and the survey was distributed via online forms to ensure an ease of access.

Instruments

For this study, a comprehensive survey was designed to explore the perceptions, attitudes, and experiences of high school students regarding STEM fields. The survey instrument consisted of several key components:

1. **Structured Questionnaire**: The main instrument was a structured questionnaire comprised of multiple-choice and Likert-scale questions. This allowed for a quantitative measurement of the students' self-assessment in STEM subjects, their perceptions of their abilities, and their attitudes towards gender stereotypes.
    - **Example Questions**:
        - "I believe I am smart" (Response options: Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree)
        - "I think the field related to science/mathematics/computers is very difficult" (Response options: Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree)
2. **Demographic Information**: Additionally, the questionnaire collected demographic data, including age, gender, and the current field of study. This information was crucial to analyze trends and to understand the context of the students' responses.
3. **Open-Ended Questions**: To gain qualitative insights, the survey included open-ended questions that encouraged the respondents to elaborate on their experiences and challenges in STEM. This qualitative data provided depth and context to the quantitative findings.
4. **Pilot Testing**: The survey instrument underwent a pilot test with a small group of students to ensure clarity and relevance of the questions. Feedback from this pilot test was used to refine the questionnaire, thus enhancing its reliability and validity.
5. **Comparison with Existing Data**: Additionally, the study compared the collected survey data with existing national and regional statistics from sources such as Eurostat, HESA, and UCAS to contextualize the findings within broader trends in STEM education and gender disparities.

Data Collection

The survey consisted of multiple sections, each designed to assess different aspects of the students' skills, perceptions, and attitudes towards STEM fields. The questions were structured to gauge their self-assessment and beliefs about their abilities in mathematics, science, and technology.

Section 1: Self-Assessment of Skills in STEM

Survey Questions: The following statements were included in the survey to assess the students' self-perceptions in mathematics and STEM fields:

1. "I believe I am smart."
2. "I believe I can achieve any goal I set."
3. "I understand lessons related to technology easily."
4. "I like to deal with lessons related to technology."
5. "My school allows me to learn about science/mathematics/computers."

6. "I think the field related to science/mathematics/computers is interesting."
7. "I prefer to be good at mathematics rather than other subjects."
8. "Doing well in mathematics makes me feel good."
9. "I am talented in mathematics."

The respondents answered using the following scale: **Not at All, A Little, Moderately, Very Much**. The goal was to assess their mindset, interest, and skills in science, mathematics, and technology.

Section 2: Attitudes Towards STEM

In this section, the participants responded on a scale from **Strongly Disagree** to **Strongly Agree**. The questions aimed to evaluate the students' feelings about their experiences in STEM and the influence of external factors, such as family support and school environment. The statements included the following:

- "I think the field related to science/mathematics/computers is very difficult."
- "I don’t understand science/mathematics/computers."

Section 3: Gender Stereotypes in STEM

Again, the respondents used the scale from **Strongly Disagree** to **Strongly Agree** to express their beliefs about gender roles in STEM fields. The aim was to reflect on societal stereotypes and their impact on the perceptions of their abilities. Some example statements are as follows:

- "Boys work harder than girls."
- "Girls are more intelligent than boys."

Section 4: Perceptions of Abilities

In this section, the participants selected one of three options: **Boys, Girls, Both**. The questions were designed to evaluate perceptions of who is typically good at various STEM subjects. Some example questions are as follows:

- "Who do you think is usually good at science?"
- "Who do you think can be good at mathematics?"

Section 5: Career Aspirations in STEM

The responses in this section were provided on a scale from **Strongly Disagree** to **Strongly Agree**. These questions explored the students’ thoughts about choosing careers in mathematics, engineering, and computer sciences, as well as the perceived impact of social influences and gender stereotypes. Some example statements are as follows:

- "I think I would be highly successful if I chose to study engineering."
- "I would not like to work as an engineer because women cannot be successful in this field."

Assessment Technique

The results were analyzed and presented through percentages and graphs.

4. Results, critical discussion of achievements, and project evaluation

The first step of this paper was preparing the data for analysis. This involved reviewing the data to ensure that all necessary information was collected and that no further data collection was required. The text of each entry was copied into a separate document and later reviewed to confirm that all information was valid and accurate before beginning the analysis process.

4.1. Self-evaluation of skills and interest in STEM

4.1.1. I believe I am smart

- Females: A considerable portion of females (14 out of 39, or 36%) believe they are moderately intelligent. Moreover, 10 out of 39 (26%) females consider themselves very intelligent. On the other hand, 6 out of 39 (15%) females believe they are not intelligent at all. Overall, the majority of females (29 out of 39, or 74%) perceive themselves as intelligent to some extent.
- Males: Among males, the majority (13 out of 21, or 62%) perceive themselves as very intelligent. Furthermore, 5 out of 21 (24%) males consider themselves moderately intelligent. Only 2 out of 21 (10%) males believe they are not intelligent at all. Overall, a considerable portion of males (20 out of 21, or 95%) perceive themselves as intelligent to some extent.

These results show that both male and female participants generally perceive themselves as intelligent. However, there is a higher percentage of females who consider themselves moderately intelligent, while a higher percentage of males perceive themselves as very intelligent. Overall, most participants from both genders see themselves as intelligent to some extent.

4.1.2. I believe I can achieve any goal I set

Females: There was a wide range of responses among the female participants. Approximately 44% (17 out of 39) of females believe they can achieve any goal they set, while 33% (13 out of 39) express doubts about their ability to do so. Moreover, 23% (9 out of 39) of females are neutral on this belief. A neutral response indicates that these participants neither agree nor disagree with the statement, thus reflecting uncertainty or ambivalence about their potential to achieve goals. This uncertainty may stem from various factors, including either a lack of confidence or an insufficient experience in goal-setting.

Overall, there is a relatively balanced distribution of responses among the female participants.

Males: Among the male participants, a higher percentage (15 out of 21, or 71%) believe they can achieve any goal they set. Only 19% (4 out of 21) express doubts about their ability to do so, and the remaining 10% (2 out of 21) are neutral on this belief. Similar to the female participants, a neutral response here suggests that these males have mixed feelings about their confidence to achieve their goals, which may indicate uncertainties regarding their capabilities.

Overall, a considerable majority of the male participants have a strong confidence in their ability to achieve their goals.

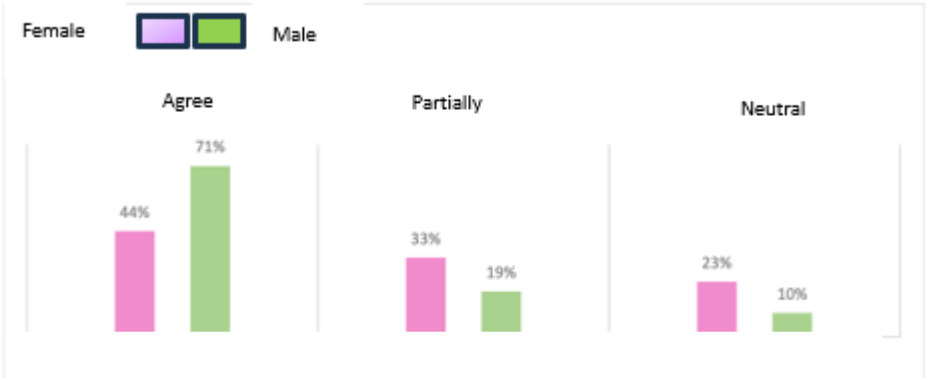

Figure 5. Responses from interviewees about achieving the goals they set.

4.1.3. I understand lessons related to technology easily

- Females: The responses from female participants significantly vary. Approximately 31% (12 out of 39) of females find it easy to understand lessons related to technology, while 41% (16 out of 39) do not find it easy. Additionally, 28% (11 out of 39) of females are neutral on this statement. Overall, there is a relatively balanced distribution of responses among the female participants.
- Males: Among the male participants, a considerable majority (17 out of 21, or 81%) find it easy to understand lessons related to technology. Only 10% (2 out of 21) of males do not find it easy, and the remaining 10% (2 out of 21) are neutral on this statement. Overall, a considerable majority of the male participants perceive lessons related to technology as easy to understand.

These results suggest that the male participants generally find it easier to understand lessons related to technology compared to the female participants. While there is a relatively balanced distribution of responses among the female participants, a considerable majority of the male participants perceive lessons related to technology as easy to understand.

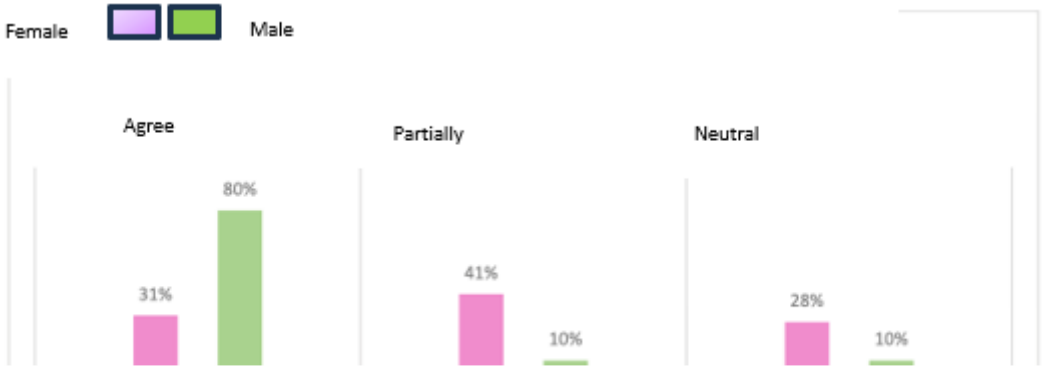

Figure 6. Responses from interviewees about the difficulty of lessons related to technology.

4.1.4. I like to deal with lessons related to technology

• Females: The responses from the female participants indicate a range of attitudes towards studying subjects related to technology. Approximately 36% (14 out of 39) of females enjoy studying such subjects, while 41% (16 out of 39) do not like them. Additionally, 23% (9 out of 39) of females are neutral on this statement. Overall, there is a relatively balanced distribution of responses among the female participants.

• Males: Among the male participants, a considerable majority (16 out of 21, or 76%) enjoy studying subjects related to technology. Only 14% (3 out of 21) of males do not enjoy them, and the remaining 10% (2 out of 21) are neutral on this statement. Overall, a considerable majority of the male participants express enjoyment in studying subjects related to technology.

These results suggest that the male participants generally enjoy studying subjects related to technology more than the female participants. While there is a relatively balanced distribution of responses among the female participants, a considerable majority of the male participants express enjoyment in studying subjects related to technology.

4.1.5. My school allows me to learn about science, technology, engineering, and mathematics

• Females: The responses from the female participants indicate different perceptions regarding the extent to which their schools provide opportunities to learn about STEM. Approximately 28% (11 out of 39) of females perceive their schools as providing such opportunities to some extent, while 33% (13 out of 39) do not perceive their schools as providing such opportunities. Additionally, 38% (15 out of 39) of females are neutral on this statement. Overall, there is a relatively balanced distribution of responses among the female participants.

• Males: Among the male participants, a considerable majority (17 out of 21, or 81%) perceive their schools as providing opportunities to learn about STEM. Only 19% (4 out of 21) of males do not perceive their schools as providing such opportunities, and there are no neutral responses. Overall, a considerable majority of male participants perceive their schools as providing opportunities to learn about STEM.

These results suggest that the male participants generally perceive their schools as providing more opportunities to learn about STEM compared to the female participants. While there is a relatively balanced distribution of responses among the female participants, a considerable majority of the male participants perceive their schools as providing numerous opportunities in these fields.

4.1.6. I think the field related to science/mathematics/computers is interesting

• Females: The responses from the female participants indicate a range of opinions regarding the level of interest in fields related to STEM. Approximately 28% (11 out of 39) of females find these fields somewhat interesting, while 31% (12 out of 39) do not find them interesting. Additionally, 41% (16 out of 39) of females are neutral on this statement. Overall, there is a relatively balanced distribution of responses among the female participants.

• Males: Among the male participants, a considerable majority (18 out of 21, or 86%) find fields related to STEM interesting. Only 10% (2 out of 21) of males do not find them interesting, and 5%

(1 out of 21) are neutral on this statement. Overall, a considerable majority of the male participants find these fields interesting.

These results suggest that the male participants generally find fields related to STEM more interesting compared to the female participants. While there is a relatively balanced distribution of responses among the female participants, a considerable majority of the male participants find these fields interesting.

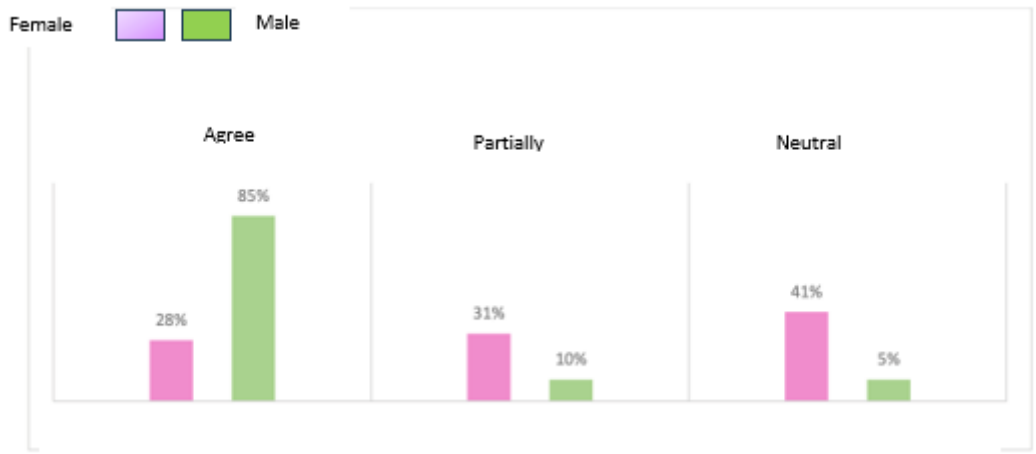

Figure 7. Responses from interviewees related to Science/Mathematics/Computers is interesting.

4.1.7. I prefer to be good at mathematics rather than other subjects

• Females: The responses from the female participants indicate a range of preferences regarding excelling in mathematics compared to other subjects. Approximately 38% (15 out of 39) of females strongly prefer to excel in mathematics, while 23% (9 out of 39) do not prefer it. Additionally, 38% (15 out of 39) of females are neutral on this statement. Overall, there is a relatively balanced distribution of responses among the female participants.

• Males: Among the male participants, a considerable majority (15 out of 21, or 71%) strongly prefer to excel in mathematics compared to other subjects. Only 19% (4 out of 21) of males do not prefer it, and 10% (2 out of 21) are neutral on this statement. Overall, a considerable majority of the male participants prefer to excel in mathematics.

These results suggest that the male participants generally prefer to excel in mathematics compared to other subjects more than the female participants. While there is a relatively balanced distribution of responses among the female participants, a considerable majority of the male participants express a strong preference for excelling in mathematics.

4.1.8. Performing well in mathematics makes me feel good

• Females: The responses from the female participants indicate a range of feelings regarding the correlation between performing well in mathematics and feeling good. Approximately 38% (15 out

of 39) of females strongly agree that performing well in mathematics makes them feel good, while 15% (6 out of 39) disagree. Additionally, 46% (18 out of 39) of females are neutral on this statement. Overall, there is a relatively balanced distribution of responses among the female participants.

- Males: Among the male participants, a majority (12 out of 21, or 57%) strongly agree that performing well in mathematics makes them feel good. Approximately 24% (5 out of 21) disagree, and 19% (4 out of 21) are neutral on this statement. Overall, a majority of the male participants agree with this statement.

These results suggest that there is a somewhat positive correlation between performing well in mathematics and feeling good for both the male and female participants. While a higher percentage of the female participants are neutral on this statement compared to males, the majority of both genders' express agreement with the notion that performing well in mathematics positively impacts their mood.

4.1.9. I am talented in mathematics

- Females: The responses from the female participants regarding their perceived talent in mathematics vary. Approximately 26% (10 out of 39) of females strongly agree that they are talented in mathematics, while approximately 26% (10 out of 39) disagree. Additionally, 48% (19 out of 39) of females are neutral on this statement, indicating uncertainty about their perceived talent in mathematics.

- Males: Among the male participants, a majority (57%, 12 out of 21) strongly agree that they are talented in mathematics. Approximately 19% (4 out of 21) disagree, and 24% (5 out of 21) are neutral on this statement.

These results suggest that while the majority of the male participants express confidence in their talent in mathematics, there is more uncertainty among the female participants. A considerable portion of females are neutral on this statement, indicating a lack of clear self-assessments regarding their mathematical abilities.

4.2. Perception of difficulties and support in STEM fields

4.2.1. I think the field related to science/mathematics/computers is very difficult

- Females: Among the female participants, opinions on the difficulty of fields related to Science/Mathematics/Computers vary. Approximately 29% (11 out of 38) partially agree, while 34% (13 out of 38) fully agree with the statement. Additionally, around 24% (9 out of 38) moderately agree, and approximately 13% (5 out of 38) disagree that these fields are very difficult.

- Males: The male participants have different opinions on the difficulty of these fields. Approximately 20% (5 out of 25) moderately agree, and 24% (6 out of 25) fully agree with the statement. Conversely, around 36% (9 out of 25) partially agree, and 20% (5 out of 25) disagree that these fields are very difficult. One male participant did not respond.

These results indicate that while a considerable portion of both the male and female participants perceive fields related to Science/Mathematics/Computers as very difficult, there are also significant

portions that disagree with this notion.

4.2.2. I don't understand science/mathematics/computers

- Females: Among the female participants, opinions on understanding science/mathematics/computers vary. Approximately 37% of females feel they do not understand these subjects well, while the remaining percentages reflect different levels of agreement with the statement.
- Males: Among the male participants, a considerable majority (57%) feel they understand these subjects well, while the remaining percentages reflect different levels of understanding.

These results suggest that the male participants generally have a stronger sense of understanding in science/mathematics/computers compared to the female participants.

4.2.3. I think science/mathematics/computers are boring

- Females: Among the female participants, approximately 36% strongly agree that these subjects are boring, while 28% moderately agree, and the remaining percentages reflect varying levels of interest.
- Males: Among the male participants, only 14% find these subjects boring, while the remaining percentages indicate varying levels of interest and engagement.

These results suggest that the male participants generally find science/mathematics/computers more interesting compared to the female participants.

4.2.4. My school does not allow me to learn about the sciences

- Females: Among the female participants, approximately 41% agree that their school does not provide enough opportunities to learn about sciences, while 28% are neutral, and the remaining percentages reflect varying levels of satisfaction with their school's offerings.
- Males: Among the male participants, a considerable majority (67%) feel their school provides ample opportunities to learn about sciences, while the remaining percentages indicate varying levels of satisfaction.

These results suggest that the male participants generally perceive their schools as providing more opportunities to learn about sciences compared to the female participants.

4.2.5. I think people who work in the field of science do a lot of work on their own and I don't want to do that

- Females: Among the female participants, approximately 36% agree that people in the field of science work mostly on their own and they do not want to do that, while 28% are neutral, and the remaining percentages reflect varying levels of interest in independent work.
- Males: Among the male participants, only 14% agree with this statement, while the remaining percentages indicate varying levels of interest in independent work.

These results suggest that the male participants generally have a more positive perception of independent work in science compared to the female participants.

4.2.6. I didn't have enough support at home or after school to do well in these classes

- Females: Among the female participants, approximately 37% agree that they did not receive enough support at home or after school, while the remaining percentages reflect varying levels of support.
- Males: Among the male participants, a considerable majority (62%) feel they received enough support, while the remaining percentages indicate varying levels of support.

These results suggest that the male participants generally feel they received more support either at home or after school compared to the female participants.

4.2.7. I felt that I didn't belong in science classes

- Females: Among the female participants, approximately 39% agree that they felt they did not belong in science classes, while the remaining percentages reflect varying levels of belonging.
- Males: Among the male participants, only 24% agree with this statement, while the remaining percentages indicate varying levels of belonging.

These results suggest that the male participants generally feel a stronger sense of belonging in science classes compared to the female participants.

4.3. Gender stereotypes in science and technology

4.3.1. There are gender stereotypes about abilities in science and technology among schoolers

- Females: Among the female participants, approximately 51% agree that there are gender stereotypes about the abilities in science and technology among schoolers, while the remaining percentages reflect varying levels of agreement.
- Males: Among the male participants, a considerable majority (62%) agree with this statement, while the remaining percentages indicate varying levels of agreement.

These results suggest that both the male and female participants recognize the presence of gender stereotypes about their abilities in science and technology among schoolers.

4.3.2. Perception of gender influences career choices in STEM fields

- Females: Among the female participants, approximately 44% agree that gender perception influences their career choices in STEM fields, while the remaining percentages reflect varying levels of agreement.
- Males: Among the male participants, a considerable majority (67%) agree with this statement, while the remaining percentages indicate varying levels of agreement.

These results suggest that both the male and female participants recognize that gender perception influences their career choices in STEM fields.

Limitations

While this study provided valuable insights, the sample size was limited to one school, which may not represent the broader population. Future research should aim to increase the number of respondents by including multiple schools and larger participant groups to enhance the credibility and generalizability of the findings. Expanding the scope of the study would allow for a more comprehensive understanding of the factors that influence gender disparities in STEM fields.

5. Conclusion and recommendations

The main goal of this study was to investigate the stereotypes women face in STEM and to determine if these contribute to their underrepresentation in the field. Based on the findings, when asked to express their perception regarding the difficulty of fields related to Science/Mathematics/Computers, most of the responses from females were negative. This indicated a need to further address this perception and encourage a more positive approach to these fields among females.

We encountered additional gender stereotypes when we evaluated the results of the questions on whether females would choose to work as programmers or engineers because they believed they couldn't be successful. This is because culture trained women to be feminine and to seek positions that are common for most women. When asked who is usually good at STEM, most votes were for boys rather than girls, although there were a majority of votes for both sides. These stereotypes likely play a significant role if women try to enter a male-dominated field.

Perhaps the stereotypes are high due to the low representation of women, which negatively reflects on the image of women currently in STEM. Therefore, it is important to promote inspiring female role models in these fields, as they can serve as important figures for their future. This should start from childhood to inspire them and help them understand that these disciplines are for everyone.

It is important to create more encouraging environments and provide appropriate support for females in these fields, thus promoting a more positive approach and improving their chances of success. Additionally, it is important to develop initiatives and provide opportunities for professional development and growth. By focusing on these goals, we can ensure that females could utilize their full potential in STEM.

Author contributions

Rrezart Prebreza: Conceptualization, Methodology, Formal analysis, Writing – Original Draft, Results analysis; Besart Prebreza: Data Curation, Writing – Review & Editing, Survey creation and distribution; Bleona Beqiraj: Software, Validation, Visualization, Survey creation; Arianit Krypa: Investigation, Resources, Results analysis; Marigona Krypa: Supervision, Project Administration, Results analysis.

Acknowledgments

The activity is funded as part of the Uni-Universum International College – STEM Programme in Kosovo.

Conflict of interest

The authors declare that there is no conflict of interest in this paper.

Ethics declaration

The research data collection was approved by the Uni-Universum International College, Pristina, Kosovo.

References

1. AAUW. (n.d.). *The STEM gap: Women and girls in science, technology, engineering, and mathematics*. Retrieved from: https://www.aauw.org/resources/research/the-stem-gap/
2. Australian Government Department of Industry, Science, Energy and Resources, *Second national data report on girls and women in STEM*, 2021. Retrieved from: https://www.industry.gov.au/news/second-national-data-report-on-girls-and-women-in-stem
3. Australian Government Department of Industry, Science, Energy and Resources, *STEM equity monitor report*, 2022. Retrieved from: https://www.industry.gov.au/data-and-publications/stem-equity-monitor
4. Australian Government Department of Industry, Science, Energy and Resources, *STEM equity monitor*, 2023. Retrieved from https://www.industry.gov.au/publications/stem-equity-monitor
5. Berwick, C., *Keeping girls in STEM: 3 barriers, 3 solutions*, 2019. Edutopia. Retrieved from: https://www.edutopia.org/article/keeping-girls-stem-3-barriers-3-solutions
6. Ceci, S.J. and Williams, W.M., Understanding current causes of women's underrepresentation in science. *Proceedings of the National Academy of Sciences*, 2011, 108(8): 3157–3162. https://doi.org/10.1073/pnas.1014871108
7. Choney, S., *Why do girls lose interest in STEM? New research has some answers — and what we can do about it*. Microsoft News, 2018. Retrieved from: https://news.microsoft.com/features/why-do-girls-lose-interest-in-stem-new-research-has-some-answers-and-what-we-can-do-about-it/
8. Eurostat, *Women in STEM in the European Union – Facts and figures*, 2021. Retrieved from: https://ec.europa.eu/eurostat/web/products-eurostat-news/w/ddn-20240308-2
9. European Commission, *She figures 2021: Gender in research and innovation*, 2021. Retrieved from: https://op.europa.eu/en/publication-detail/-/publication/fe78cb67-b78f-11ec-b999-01aa75ed71a1/language-en
10. European Commission, *We still need more women in science*, 2024. Retrieved from: https://ec.europa.eu/commission/presscorner/detail/en/statement_24_732
11. EIT RawMaterials, *Pioneering STEM initiative achieves 100% surge in young women's participation*, 2023. Retrieved from: https://eitrawmaterials.eu/pioneering-stem-initiative-achieves-100-surge-in-young-womens-participation/
12. Gender Section, Programme Division, UNICEF, *A new era for girls: Taking stock of 25 years of progress*, 2020. Retrieved from: https://www.unicef.org/media/65586/file/A-new-era-for-girls-2020.pdf

13. Gibbs, K., *Diversity in STEM: What it is and why it matters*. *Scientific American*, 2014. Retrieved from: https://blogs.scientificamerican.com/voices/diversity-in-stem-what-it-is-and-why-it-matters/
14. Hill, C., Corbett, C. and Rose, A., *Why so few? Women in science, technology, engineering, and mathematics*. AAUW, 2010. Retrieved from: https://www.aauw.org/app/uploads/2020/03/why-so-few-research.pdf
15. Hussain, K., *Women in STEM 2021: Girls regularly outperform boys in STEM subjects*. Women in STEM, 2021. Retrieved from: https://www.womeninstem.co.uk/breaking-stereotypes/girls-regularly-outperform-boys-in-stem-subjects/
16. Kalia, S., *Gender stereotypes can drop girls' interest in STEM by 50%, suggests research*. The Swaddle, 2021. Retrieved from: https://theswaddle.com/gender-stereotypes-can-drop-girls-interest-in-stem-by-50-suggests-research/
17. Law, F., McGuire, L., Winterbottom, M. and Rutland, A., Children's gender stereotypes in STEM following a one-shot growth mindset intervention in a science museum. *Frontiers in Psychology*, 2021, 12: 641695. https://doi.org/10.3389/fpsyg.2021.641695
18. Maryville University Online, *Women in STEM: A guide to bridging the gender gap*. Maryville University, 2019. Retrieved from: https://online.maryville.edu/blog/women-in-stem-a-guide-to-bridging-the-gender-gap/
19. McKinnon, M. and O'Connell, C., Perceptions of stereotypes applied to women who publicly communicate their STEM work. *Humanities and Social Sciences Communications*, 2020, 7(1). https://doi.org/[DOI number, if available]
20. Microsoft, *Why Europe's girls aren't studying STEM*, 2017. Retrieved from: https://news.microsoft.com/wp-content/uploads/2017/02/Microsoft_girls_in_STEM_finalWhitepaper.pdf
21. Samuel, S., *Women in science are up against a lot of unconscious bias. Here's how to fight it*. Vox, 2020. Retrieved from: https://www.vox.com/future-perfect/2019/8/28/20833505/women-science-unconscious-gender-implicit-bias-study
22. Settles, I.H., Cortina, L.M., Malley, J. and Stewart, A.J., The climate for women in academic science: The good, the bad, and the changeable. *Psychology of Women Quarterly,* 2006, 30(1): 47–58. https://doi.org/[DOI number, if available]
23. Taylor & Francis Insights, *Getting more girls in STEM: How to maintain participation through school and higher education*, 2023. Retrieved from: https://insights.taylorandfrancis.com/social-justice/girls-stem
24. UNESCO, *Girls' and women's education in science, technology, engineering and mathematics (STEM)*, 2017. Retrieved from: https://unesdoc.unesco.org/ark:/48223/pf0000253479/PDF/253479eng.pdf.multi
25. UNESCO, *Global education monitoring report 2020: Gender and education*, 2020. Retrieved from: https://en.unesco.org/gem-report
26. U.S. Census Bureau, *Income and poverty in the United States: 2021*. U.S. Department of Commerce, 2021. Retrieved from: https://www.census.gov/library/publications/2022/demo/p60-276.html

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