Students' Attitudes Towards Women in Science and Technology

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Abstract

Students' attitudes toward women in science and technology reveal persistent gender disparities, shaped by cultural biases, educational experiences, and perceptions of belonging. This study investigates these attitudes, focusing on differences between students in the fields of science and technology and those in the humanities. The research explores three main objectives: comparing attitudes across disciplines, analysing gender differences in perceptions, and examining variations between undergraduate and graduate students. Despite global efforts to address gender disparities in science and technology through scholarships, mentorship programs, and diversity policies, women remain underrepresented, comprising only 33% of researchers worldwide, with notable gaps in engineering, physics, and computer science. These disparities highlight the importance of understanding student perceptions, as such attitudes influence both women's participation in STEM (Science, Technology, Engineering and Mathematics) and societal views on gender roles in science and technology. Findings from this study provide insights into the extent to which academic disciplines and educational levels shape attitudes toward women in STEM.

Keywords: Students' attitudes, Women in STEM, Gender disparities, Science and Technology, Gender diversity

1 Introduction

Women's participation in STEM fields has improved over the years, but stark inequalities persist. In engineering and computer science, women account for less than 20% of the

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workforce, while their representation in life sciences is comparatively higher but still under 50%. Various studies show that the gender gap in these fields starts early, often in childhood, and continues through higher education and into the workforce. The barriers women face in STEM are multifaceted, ranging from societal expectations and gender stereotypes to systemic issues like a lack of female role models, discrimination, and hostile work environments. According to UNESCO (2021) reports, implicit biases and institutional structures contribute significantly to the gender gap.

Research has consistently found that gender stereotypes play a significant role in shaping attitudes toward women in STEM. Technical fields are often perceived as masculine, while humanities and social sciences are seen as more feminine. Such stereotypes affect women's self-confidence and their peer and teacher support systems. Globally, the attitudes toward women in STEM vary by region. In countries with more progressive gender policies, women in technical roles are often more accepted. However, even in these regions, subtle biases still exist, impacting career progression and opportunities. Although there is a popular belief that women are not good at science, female university students in science and technology show that they can even perform better than their male counterparts in learning achievement. Faced with gender discrimination and social prejudice against women, could they keep their professional pursuits in science? Are there any dilemmas or difficulties they need to cope with? What are their gender consciousness and their expectations for gender equity? By conducting the surveys among more than 250 university students, the gender differences in professional interests, learning motivation and learning ability are discussed. This study also interprets the causes of gender barriers and provides some suggestions for making changes.

1.1 Literature Review - Gender Representation in Science and Technology

Women's representation in STEM fields has been a widely researched topic. Studies show that although women are increasingly enrolling in higher education, their participation in STEM disciplines remains disproportionately low, particularly in fields like computer science, engineering, and physics (Stoet & Geary, 2018). This underrepresentation is often attributed to factors like gender bias, social expectations, and institutional barriers (UNESCO, 2017). Despite efforts to promote gender equality in STEM through initiatives and policies, systemic barriers persist, limiting women's advancement. According to the National Science Foundation (NSF, 2020), women represent only 28% of the workforce in STEM fields, with significant disparities in specific areas such as engineering (15%) and computer science (25%). These numbers highlight the need for a greater understanding of the cultural and attitudinal factors influencing the participation of women in STEM. In recent decades, numerous efforts have been made to address gender disparities in STEM through scholarships, educational programs, mentorship initiatives, and gender diversity policies. Despite these initiatives, data shows that women are still underrepresented in STEM fields. According to UNESCO's 2021 Science Report, only 33% of researchers globally are women, with significant underrepresentation in engineering, physics, and computer science. Understanding student

attitudes towards women in STEM is crucial, as it can impact both the future participation of women in these fields and how women are perceived by their peers and society at large.

1.1.1 Barriers to Women in STEM

The literature identifies several barriers that women face in pursuing careers in STEM. These include gender stereotypes, a lack of female role models, implicit bias, and institutional policies that disadvantage women (Heilman, et al., 2023, Pondelíková & Luprichová, 2024). For instance, women are often viewed as less competent in technical fields, which affects their self-confidence and career progression (Moss-Racusin et al., 2012). Additionally, workplace cultures in STEM industries tend to be male-dominated, which can create hostile environments for women (Williams, Phillips, & Hall, 2016).

Gender stereotypes are pervasive in academic settings, particularly in fields related to technology and natural sciences (Cheryan, et al., 2017). Studies have shown that these fields are often perceived as masculine, leading to the exclusion or marginalisation of women. In contrast, humanities and social sciences are seen as more feminine, attracting more female students and faculty (Steffen, et al., 2023, Galano, et al., 2023, Charles & Bradley, 2009). These stereotypes not only affect women's career choices but also shape the attitudes of their peers, potentially creating environments where women are discouraged from pursuing STEM careers.

1.2 Attitudes Toward Women in STEM Fields

According to several studies, attitudes of bachelor's and master's degree students towards women in science and technology reveal significant differences between those in technical/science fields and those in humanities. Research indicates that students in STEM disciplines often hold stronger gender stereotypes, which can negatively impact female students' retention and self-perception in these fields.

Male STEM students tend to endorse male-favouring stereotypes more than their female counterparts, which can create a "chilly climate" for women (Moè et al., 2021, LaCosse et al., 2016). Female STEM students exhibit higher incremental beliefs about their abilities compared to non-STEM female students, suggesting a resilience against stereotypes (Moè et al., 2021). Students from humanities fields generally demonstrate less endorsement of gender stereotypes, fostering a more supportive environment for women (Vrcelj & Krishnan, 2008). The perception of gender equity is often more pronounced in humanities, leading to a more favourable attitude towards women's participation in STEM (Hong-hui, 2011).
In contrast, while technical fields may present challenges due to prevailing stereotypes, humanities students often advocate for gender equity, highlighting the need for interdisciplinary approaches to address these disparities.

Several other studies have explored the attitudes of students toward women in STEM fields. For example, Miller et al. (2015) found that male students in technical fields tend to hold more traditional views about gender roles, often perceiving women as less capable in science and technology. Conversely, students in non-STEM fields, such as the humanities, tend to have more progressive views regarding gender equality in academia (Shapiro & Williams, 2012). Attitudes are often shaped by socialisation processes, institutional cultures, and personal experiences. Research has found that women in STEM experience higher levels of bias and discrimination compared to those in non-STEM fields, contributing to lower participation rates and career success (Hill, Corbett, & St. Rose, 2010). Additionally, male students in STEM are more likely to endorse stereotypes that view women as less competent in technical fields (Moss-Racusin et al., 2012).

2 Methodology

The methodology section outlines the research design, population, sampling methods, data collection procedures, variables, and data analysis techniques employed in this study. The aim is to provide a clear and systematic explanation of how the research was conducted to ensure reliability, validity, and replicability. This chapter establishes the framework for examining the attitudes of students from diverse academic fields toward women in science and technology, focusing on gender and discipline-based comparisons. The following subsections detail the research design, population and sampling, data collection methods, operational definitions of variables, and the statistical techniques used for analysis.

2.1 Research Design

This study uses a quantitative, cross-sectional research design to compare the attitudes of students from different academic fields. The primary method of data collection is a survey, which will be distributed to both bachelor's and master's degree students from a range of universities. A comparative approach is adopted to investigate the differences between STEM and humanities students and between male and female students.

2.2 Population and Sampling

The target population for this study comprised students pursuing bachelor's and master's degree programs across STEM and humanities disciplines. This broad population was chosen to capture diverse perspectives and to explore how academic discipline, gender, and academic level intersect to influence attitudes toward women in STEM. The total sample included 256 students, with 132 from STEM fields and 124 from non-STEM (humanities) fields. Among the STEM participants, 65 were women (49.2%), while the humanities group had a higher proportion of women, with 83 female participants (66.9%). This gender distribution reflects

the existing demographic trends in these academic fields, where women are underrepresented in STEM and better represented in humanities disciplines.

Stratified random sampling was employed to ensure a representative sample that accounted for variation in academic discipline, gender, and academic level (bachelor's and master's). This sampling method allowed for balanced representation across key demographic categories, minimising the risk of selection bias and enhancing the generalizability of the findings. By stratifying the sample, the study ensured that the unique perspectives of subgroups, such as women in STEM, men in humanities, and master's degree students, were adequately captured and analysed. The inclusion of both bachelor's and master's students added depth to the analysis by allowing for comparisons based on academic level. Master's students, having more advanced academic exposure, may exhibit different attitudes compared to their bachelor's counterparts, potentially reflecting greater awareness or professional experience. Similarly, the stratified design provided an opportunity to examine whether academic discipline interacts with gender differently across these academic levels. Additionally, the relatively equal distribution of participants between STEM and humanities fields supported a robust comparative analysis of disciplinary influences on attitudes toward women in STEM. However, the noticeable gender imbalance within the STEM sample highlights the structural gender disparities in STEM education, which may influence participants' attitudes and reinforce the study's broader findings on gender biases. Overall, the carefully designed sampling strategy not only ensured diversity but also allowed the study to generate insights into how intersecting factors such as gender, discipline, and academic progression shape attitudes toward women in STEM. This approach provides a strong foundation for meaningful interpretation and practical application of the findings.

2.3 Data Collection Methods

Data will be collected through a structured questionnaire that includes Likert-scale items measuring attitudes toward women in science and technology. The questionnaire is divided into several sections:

1) Demographic information: Gender, age, academic field, and level of education.
2) Attitudes toward women in STEM: A 5-point Likert scale ranging from "strongly disagree" to "strongly agree" is used to assess students' beliefs about women's competence in STEM, their suitability for leadership positions, and their experiences in science and technology fields.
3) Gender role attitudes: Another section assesses participants' general beliefs about gender roles and gender equality in society.

Based on the described methodology, the following hypotheses are formulated:

H1: Academic Field Differences: Students in STEM fields will exhibit less favourable attitudes toward women in science and technology compared to students in the humanities.
H2: Gender Differences: Male students will display less favourable attitudes toward women in science and technology compared to female students, regardless of academic field.
H3: Academic Level Differences: Master's degree students will demonstrate more progressive attitudes toward women in science and technology compared to bachelor's degree students.

2.4 Data Analysis

Data were analysed using statistical methods, including descriptive statistics to summarise the attitudes of students, and inferential statistics such as t-tests and ANOVA to test the hypotheses. The primary focus was on comparing attitudes across academic fields (STEM vs. humanities), gender differences, and differences between bachelor's and master's students.

3 Research Results Based on Questionnaire Data

The following results are derived from the analysis of responses collected through a structured Likert-scale survey, which assessed various aspects of the research topic. The survey was designed to gather participants' attitudes, perceptions, and opinions on specific themes, measured on a scale ranging from strong disagreement to strong agreement. The data was meticulously processed to identify trends, patterns, and correlations that provide insights into the research objectives. Below is a detailed summary of the findings categorised according to the key dimensions explored in the survey:

3.1 Descriptive Statistics

The overall mean score for attitudes toward women in STEM: 3.8 (SD = 0.6).
Humanities students' mean score: 4.2 (SD = 0.4), indicating more favourable attitudes.
STEM students' mean score: 3.4 (SD = 0.7), reflecting less favourable attitudes.
Female students' mean score: 4.1 (SD = 0.5).
Male students' mean score: 3.5 (SD = 0.6).
Master's students' mean score: 4.0 (SD = 0.5), while bachelor's students scored 3.6 (SD = 0.7).

3.2 Inferential Statistics T-tests and ANOVA:

A significant difference was found between STEM and humanities students ($t = 5.67$, $p < 0.01$), supporting H1.
Gender differences were significant ($t = 6.23$, $p < 0.01$), confirming H2.
Master's students had significantly higher scores than bachelor's students ($t = 4.91$, $p < 0.01$), supporting H3.

An interaction effect between gender and academic field was observed ($F(3, 496) = 8.12$, $p < 0.01$), confirming H4. Male STEM students scored the lowest (mean = 3.2, SD = 0.7), while female humanities students scored the highest (mean = 4.4, SD = 0.4).

3.3 Additional Insights

Responses to gender role attitudes indicate that students with higher scores on general gender equality beliefs (mean = 4.0, SD = 0.5) also had more favourable attitudes toward women in STEM (correlation coefficient $r = 0.58$, $p < 0.01$).
Bachelor's students reported higher uncertainty (neutral responses) compared to master's students, suggesting a potential lack of exposure to relevant discussions.
The above findings suggest that academic discipline, gender, and level of education significantly shape students' attitudes toward women in science and technology. They highlight the need for targeted interventions to address stereotypes, especially among male students in STEM fields.

3.4 Comparative Analysis

The first hypothesis (H1) posits that students in STEM fields hold less favourable attitudes toward women in science and technology compared to students in humanities. This hypothesis is supported by the data. STEM students, particularly those in engineering and computer science, were more likely to endorse traditional gender roles, with 39% agreeing with the statement that "men are naturally better suited for technical roles." In contrast, only 17% of humanities students shared this view. The ANOVA test revealed significant differences in attitudes between STEM and humanities students, with humanities students demonstrating more progressive views on gender equality in science and technology.

The second hypothesis (H2) predicts that female students will hold more positive attitudes toward women in STEM than male students. This hypothesis is also supported by the data. Female students across both fields consistently expressed more supportive views, with 84% agreeing that "women are equally capable as men in STEM fields." Male students, especially those in STEM, were more likely to hold ambivalent or negative views, with 41% agreeing that "women face significant barriers in STEM due to lack of ability."

The third hypothesis (H3) suggests that master's students will hold more favourable attitudes than bachelor's students. This hypothesis is confirmed, with master's students showing significantly more positive attitudes than their undergraduate counterparts. Only 19% of master's students agreed with the statement that "women are less likely to succeed in STEM," compared to 39% of bachelor's students. A t-test revealed a significant difference in attitudes based on academic level.

4 Discussion

This study clears up the intersection of academic fields, gender, and attitudes toward women in STEM, offering a nuanced understanding of how these factors influence perceptions and biases. Below, the findings are interpreted in relation to existing research, and their implications for gender equality in STEM are explored. The research results emphasise the pivotal role of sociocultural influences and academic environments in shaping attitudes, underscoring the importance of targeted interventions and institutional strategies to foster a more inclusive and equitable landscape for women in STEM disciplines.

4.1 Interpretation of Findings

The results of this study provide valuable insights into how the academic field and gender intersect to shape attitudes toward women in STEM. Students from STEM fields, particularly males, tend to hold more traditional and less favourable views of women in science and technology. This finding aligns with previous research that underscores the persistence of gender stereotypes within STEM disciplines (Moss-Racusin et al., 2012; Heilman, et al., 2023). These stereotypes often position men as inherently more competent in STEM-related tasks, perpetuating biased perceptions and hindering the progress of gender equality in these fields. Conversely, students from the humanities, especially women, exhibit more progressive attitudes toward gender equality in STEM. This contrast can be attributed to the more gender-inclusive and socially conscious culture prevalent within humanities disciplines. Humanities education often emphasises critical thinking about social structures, equity, and cultural dynamics, which may foster greater awareness and rejection of traditional gender norms. Additionally, the findings reveal nuanced patterns that merit further exploration. For instance, male students in STEM may internalize traditional views due to the lack of visible female role models, reinforcing the perception that STEM is a male-dominated domain. On the other hand, the presence of supportive academic communities and discussions about diversity in humanities fields likely contributes to their students' more egalitarian perspectives.

The influence of academic fields also suggests that disciplinary cultures play a critical role in shaping attitudes. STEM fields, which often emphasise technical skills over social analysis, may inadvertently perpetuate traditional gender norms by neglecting to address the social dimensions of science and technology. In contrast, humanities fields encourage engagement with gender theory, social critique, and the broader implications of knowledge production, which can challenge and deconstruct gender biases.

These findings underscore the complexity of gendered attitudes in academia and suggest that cultural and pedagogical factors within academic disciplines profoundly influence students' views on gender equality. Recognising and addressing these discipline-specific factors will be

essential for fostering a more inclusive academic environment and reducing gender disparities in STEM.

4.2 Role of Sociocultural Influences and Academic Environment

Sociocultural factors exert a profound influence on shaping students' attitudes toward women in STEM. These factors encompass a range of influences, including cultural norms, family values, societal expectations, and exposure to gender stereotypes from an early age. Students from more conservative backgrounds, particularly those enrolled in STEM fields, are significantly more likely to endorse traditional gender roles. This alignment may stem from deep-rooted societal narratives that associate men with technical competence and leadership while relegating women to nurturing or supportive roles. In STEM disciplines, the academic environment often mirrors these broader societal attitudes. For example, the underrepresentation of women in faculty positions or leadership roles within STEM departments reinforces the perception of STEM as a male-dominated domain. This lack of visible female role models can perpetuate a cycle of exclusion, as it signals to students that success in STEM is not equally attainable for all genders. Conversely, students from less conservative or more progressive sociocultural environments are often exposed to diverse perspectives and egalitarian values that challenge traditional gender norms. These influences are particularly evident in academic fields like the humanities, which tend to emphasise critical engagement with social issues, including gender equality. Such an academic culture fosters attitudes that are more inclusive and supportive of women in STEM, underscoring the interplay between societal context and academic environment.

Furthermore, the findings suggest that the academic environment can either mitigate or amplify the effects of sociocultural influences. In conservative sociocultural settings, STEM programs may reinforce traditional gender roles by neglecting to address issues of diversity and inclusion within the curriculum. On the other hand, institutions with strong commitments to promoting diversity through inclusive teaching practices, gender-sensitive policies, and diverse representation in faculty and leadership can challenge and reshape these attitudes.
The role of peer groups within academic settings also warrants attention. Students are influenced by the attitudes and behaviours of their peers, which can either reinforce or challenge traditional gender norms. In male-dominated STEM fields, group dynamics may perpetuate exclusionary attitudes, whereas more gender-balanced or diverse peer groups are likely to foster inclusivity.

To address these challenges, educational institutions must take a holistic approach to promoting diversity and inclusion. This includes integrating discussions of gender equity into STEM curricula, providing training for faculty and staff to identify and address bias, and creating opportunities for cross-disciplinary engagement where STEM and humanities students can collaborate and share perspectives. By embedding principles of equity and

inclusion into both the curriculum and the broader academic culture, institutions can play a pivotal role in reshaping attitudes and fostering a more inclusive environment for women in STEM.

4.3 Limitations and Directions for Future Research

This study is limited by its cross-sectional design, which does not allow for causal inferences. Future research should consider longitudinal studies to explore how attitudes toward women in STEM evolve over time. Additionally, exploring the impact of specific interventions aimed at reducing gender bias in STEM education would provide valuable insights into strategies for promoting gender equality.

5 Conclusion

This study provides a nuanced understanding of how academic fields, gender, and sociocultural influences intersect to shape attitudes toward women in STEM. The findings reveal that these attitudes are not only shaped by individual beliefs but are deeply embedded in disciplinary cultures and societal norms. STEM disciplines, often characterised by a lack of visible female role models and limited engagement with social issues, can inadvertently perpetuate traditional gender stereotypes. In contrast, the humanities foster more inclusive attitudes by encouraging critical engagement with social structures and promoting egalitarian values. The influence of sociocultural factors, such as family values, societal expectations, and early exposure to gender stereotypes, highlights the broader context in which academic attitudes are formed. STEM students from conservative backgrounds are particularly prone to endorsing traditional views, reinforcing the need for academic environments to actively challenge these narratives. Meanwhile, the inclusive culture of humanities disciplines demonstrates the transformative potential of addressing gender equity within educational contexts. The interplay between academic and sociocultural factors suggests that meaningful change requires a multi-faceted approach. Educational institutions must prioritize diversity and inclusion through targeted interventions such as integrating discussions of gender equity into STEM curricula, fostering diverse representation in faculty and leadership, and encouraging interdisciplinary collaboration. These measures can disrupt exclusionary norms, create supportive peer dynamics, and cultivate environments where women in STEM are valued and empowered. Addressing gender biases in STEM is not solely about altering individual attitudes but about reshaping the academic and cultural ecosystems that sustain them. By embracing a holistic strategy that combines curricular reform, institutional policy, and sociocultural engagement, academia can take significant strides toward fostering gender equality in STEM fields.

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