

Gender Disparities in STEM Education at the Tertiary Level in The Gambia: Barriers and Enablers

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ABSTRACT

Gender equality in education is a central objective of global development agendas; however, persistent disparities continue to characterize participation in Science, Technology, Engineering, and Mathematics (STEM), particularly at the tertiary level. While women's access to higher education has improved globally, their representation in STEM disciplines remains disproportionately low, especially in developing countries. This study examines gender disparities in STEM education at the tertiary level in The Gambia, with a focus on identifying key barriers that limit female participation, retention, and success, as well as enablers that support women's engagement in STEM fields.

The study adopts a mixed-methods research design, integrating quantitative data from institutional enrollment records and student surveys with qualitative insights from semi structured interviews involving students, faculty members, and academic administrators. The findings reveal persistent gender gaps across STEM programs, particularly in engineering, information technology, and physical sciences. Major barriers include socio-cultural norms, financial constraints, limited access to female role models, gender-insensitive institutional environments, and psychological factors such as low self-efficacy. Conversely, targeted scholarships, mentorship programs, supportive family attitudes, and emerging gender-responsive policies emerge as critical enablers. The study contributes to the limited empirical literature on gender and STEM education in The Gambia and provides evidence-based recommendations for promoting gender equity in tertiary STEM education.

Keywords: Gender disparities; STEM education; Tertiary education; Women in STEM; Higher education

The Gambia

INTRODUCTION

Gender equality is widely recognized as both a fundamental human right and a prerequisite for sustainable social and economic development. Over the past several decades, global initiatives have significantly improved girls' access to education, resulting in increased female participation at all levels of schooling. Despite these advances, gender disparities persist in Science, Technology, Engineering, and Mathematics (STEM) education, particularly at the tertiary level (Wang & Degol, 2020; UNESCO, 2022). STEM disciplines are increasingly central to innovation, industrial development, and global competitiveness, yet women remain underrepresented in these fields worldwide (Cheryan et al., 2021).

Globally, women now represent a substantial proportion of tertiary-level students; however, their participation in STEM fields such as engineering, computer science, and physical sciences remains

disproportionately low (Xu, 2021). Research suggests that this imbalance is driven by a combination of socio-cultural norms, economic barriers, institutional practices, and psychological factors that shape educational aspirations and academic persistence (Stoet & Geary, 2020; Sáinz & Müller, 2021). These challenges are particularly acute in developing regions, including Sub-Saharan Africa, where structural inequalities and limited educational resources further constrain women's opportunities in STEM education (Banda & Mutanga, 2020; Ouma & Dimova, 2022).

In The Gambia, the expansion of tertiary education has been accompanied by national and international commitments to gender equality. Female enrollment has increased across many academic disciplines, particularly in education, health sciences, and social sciences. However, women remain significantly underrepresented in STEM programs, especially in engineering, information technology, and applied sciences (Oloruntegbe & Akomolafe, 2021; World Bank, 2022). This pattern reflects broader regional trends and raises concerns about the long-term implications for labor market equity, income distribution, and national development. The underrepresentation of women in STEM education has significant economic and social consequences. STEM-related fields are often associated with higher wages, stronger employment prospects, and greater opportunities for innovation-driven growth. As such, limited female participation in STEM education contributes to wider gender inequalities in the labor market and restricts the pool of skilled human capital available for national development (Xu, 2021; OECD, 2023). In The Gambia, where economic diversification and digital transformation are key development priorities, promoting women's participation in STEM education is both a social justice imperative and a strategic economic necessity.

This study seeks to examine gender disparities in STEM education at the tertiary level in The Gambia by addressing three central research questions: (1) What is the nature and extent of gender disparities in tertiary STEM education? (2) What barriers hinder female participation, retention, and success in STEM disciplines? and (3) What enablers support women's engagement and persistence in tertiary STEM education? By addressing these questions, the study aims to generate context-specific evidence that can inform policy interventions and institutional reforms aimed at advancing gender equity in STEM education.

LITERATURE REVIEW

Global Gender Disparities in STEM Education

Gender disparities in STEM education have been widely documented across both developed and developing countries. Despite improvements in women's overall access to tertiary education, their participation in

STEM fields remain uneven and discipline specific. Women are particularly underrepresented in engineering, computer science, and physical sciences, while achieving relatively higher representation in biological and health-related sciences (Wang & Degol, 2020; Cheryan et al., 2021). This pattern suggests that gender disparities in

STEM is not solely a function of academic ability but are shaped by broader structural and socio-cultural influences. Global research highlights the role of early socialization processes in shaping gendered educational pathways. From an early age, girls are often exposed to fewer STEM related learning opportunities and receive less encouragement to pursue technical subjects compared to boys (Hyde & Mertz, 2020; Kim et al., 2020). These early experiences influence self-efficacy, interest, and academic identity, which in turn affect subject choice at the secondary and tertiary levels. The persistence of gender stereotypes that associate scientific competence with masculinity further reinforces these patterns, contributing to women's underrepresentation in STEM education globally (Sáinz & Müller, 2021).

Theoretical Perspectives on Gender and STEM Participation

Several theoretical frameworks have been used to explain gender disparities in STEM education. Social role theory emphasizes the influence of culturally prescribed gender roles on educational and career choices, arguing that societal expectations shape perceptions of appropriate fields of study for men and women (Eagly & Wood, as cited in Stoet & Geary, 2020). In this context, STEM fields are often perceived as

incompatible with traditional female roles, discouraging women's participation. Human capital theory suggests that individuals invest in education based on expected returns; however, gendered labor markets and discrimination can reduce the perceived benefits of investing in STEM education for women (Xu, 2021). Additionally, stereotype threat theory highlights the psychological impact of negative stereotypes on women's performance and persistence in STEM, demonstrating that awareness of such stereotypes can undermine confidence and academic outcomes (Dasgupta & Stout, 2020).

Together, these theoretical perspectives underscore the multidimensional nature of gender disparities in STEM education and highlight the need for interventions that address structural, cultural, and psychological factors simultaneously.

Gender Disparities in STEM

Education in Sub-Saharan Africa

In Sub-Saharan Africa, gender disparities in STEM education are particularly pronounced. Although female participation in tertiary education has increased across the region, women remain significantly underrepresented in STEM disciplines (Banda & Mutanga, 2020; UNESCO Institute for Statistics, 2023). Studies attribute this pattern to limited access to quality secondary education, especially in mathematics and science, as well as sociocultural norms that prioritize male education and technical careers (Ogbogu, 2020; Oloruntegbe & Akomolafe, 2021). Research from West Africa indicates that gender norms continue to shape educational aspirations and institutional practices.

Female students pursuing STEM often face discrimination, isolation, and lack of academic support in male-dominated environments (Bediako & Sefah, 2021; Fakunle & Alebiosu, 2023). The shortage of female faculty members and mentors in STEM departments further reinforces perceptions that these fields are unsuitable or unattainable for women (Morley & Crosscourt, 2022).

Economic constraints also play a significant role in shaping gender disparities in STEM education in Africa. STEM programs are often more expensive due to laboratory requirements and extended study periods, disproportionately affecting women from low-income households (Kalu & Okafor, 2023; Ouma & Dimova, 2022). These financial barriers contribute to lower enrollment and higher attrition rates among female STEM students.

Socio-Cultural Barriers to Female Participation in STEM

Socio-cultural norms remain a critical barrier to women's participation in STEM education. In many African societies, including The Gambia, traditional gender roles emphasize women's responsibilities within the household, limiting the time and resources available for demanding academic programs (Tamale & Bennett, 2021). STEM careers are often perceived as incompatible with family life, discouraging women from pursuing long-term technical education. Parental expectations and community attitudes also influence girls' educational choices. Studies show that girls who lack family support for STEM aspirations are less likely to enroll and persist in STEM programs (Aina & Akintunde, 2021; United Nations, 2021). Early marriage and caregiving responsibilities further constrain women's educational trajectories, particularly in technical fields requiring sustained engagement.

Institutional Barriers and Learning Environments

Institutional factors play a central role in shaping gender disparities in tertiary STEM education. Gender-insensitive curricula, lack of mentorship opportunities, and male dominated classroom environments contribute to feelings of exclusion and marginalization among female students

(Henning & Roberts, 2020; Makarova et al., 2020). Weak enforcement of gender equity policies and limited academic support services further exacerbate these challenges (Fakunle & Alebiosu, 2023). Female students often report limited access to academic advising and psychosocial support, which are critical for navigating

challenging STEM programs. The absence of female role models in STEM departments reinforces gender stereotypes and undermines women's confidence and sense of belonging (Buse et al., 2022; Fassinger & Li, 2022).

Enablers of Women's Participation in STEM Education

Despite persistent barriers, the literature identifies several enablers that support women's participation and success in STEM education. Financial support mechanisms, including scholarships and bursaries, are consistently associated with increased female enrollment and retention in STEM programs (World Bank, 2020; UNESCO, 2022). Mentorship and peer support initiatives play a crucial role in enhancing academic confidence, providing role models, and fostering a sense of belonging among female STEM students (Sanni & Alabi, 2023).

Supportive family and community attitudes also serve as powerful enablers. When families encourage girls' education and challenge traditional gender norms, women are more likely to pursue and persist in

STEM education (Aina & Akintunde, 2021). At the institutional level, gender-responsive policies, inclusive teaching practices, and efforts to recruit female faculty members contribute to more supportive learning environments (European Commission, 2021; Zulu & Banda, 2024).

METHODOLOGY

Research Design

This study adopts a mixed-methods research design to examine gender disparities in

STEM education at the tertiary level in The Gambia. A mixed-methods approach was considered appropriate because it allows for a comprehensive understanding of both the extent of gender disparities and the underlying factors that shape women's participation, retention, and success in STEM disciplines. By integrating quantitative and qualitative data, the study is able to triangulate findings and provide a more nuanced analysis than would be possible using a single methodological approach (Wang & Degol, 2020; Creswell, as cited in Ouma & Dimova, 2022). The quantitative component focuses on identifying patterns and trends in gender participation across STEM programs, while the qualitative component explores lived experiences, perceptions, and contextual factors influencing female students' engagement in STEM education. This design aligns with existing gender and education research that emphasizes the importance of combining statistical evidence with contextual insights to understand complex social phenomena (Morley & Crossouard, 2022).

Study Area and Institutional Context The study was conducted within selected tertiary institutions in The Gambia that offer STEM-related programs. These include public and private higher education institutions providing degrees in computer science, information technology, environmental science, mathematics, and engineering-related fields. The Gambian higher education context is characterized by expanding enrollment, limited resources, and ongoing efforts to promote gender equity, making it a relevant setting for examining gender disparities in STEM education (World Bank, 2022; UNESCO Institute for Statistics, 2023).

Population and Sampling Techniques

The study population comprised undergraduate STEM students, STEM faculty members, and academic administrators within the selected institutions. A multi-stage sampling technique was employed to ensure representation across disciplines and institutional roles.

For the quantitative component, stratified random sampling was used to select undergraduate STEM students. Students were stratified by discipline and year of study to capture variations in gender participation and academic experiences. This approach helped ensure adequate representation of female students, who are often underrepresented in STEM programs (Banda & Mutanga, 2020). For the qualitative

component, purposive sampling was employed to select participants for semi-structured interviews. Interview participants included female STEM students, male STEM students, faculty members, and academic administrators. This sampling strategy enabled the study to capture diverse perspectives on barriers and enablers affecting women's participation in STEM education (Fakunle & Alebiosu, 2023). **3.4**

Data Collection Methods

Quantitative Data Collection

Quantitative data were collected from two primary sources. First, institutional records were reviewed to obtain genderdisaggregated data on enrollment, retention, and completion rates across STEM programs. Second, a structured questionnaire was administered to undergraduate STEM students. The questionnaire captured demographic information, academic background, perceptions of learning environments, financial challenges, and access to support mechanisms.

The survey instrument was informed by existing studies on gender and STEM education and was pilot-tested to ensure clarity, reliability, and contextual relevance (Ayalew & Zeleke, 2022; Sáinz & Müller, 2021).

Qualitative Data Collection

Qualitative data were collected through semi-structured interviews. Interview guides were designed to explore participants' experiences in STEM education, perceived barriers to female participation, and factors that enable women's persistence and success. Interviews were conducted in a confidential setting to encourage open and honest responses.

The use of semi-structured interviews allowed for flexibility in probing emerging themes while ensuring consistency across participants (Henning & Roberts, 2020; Buse et al., 2022).

Data Analysis Procedures

Quantitative data were analyzed using descriptive statistical techniques, including frequencies, percentages, and crosstabulations, to assess gender disparities in STEM enrollment, retention, and progression. These analyses provided an overview of gender patterns across disciplines and levels of study (Wang & Degol, 2020).

Qualitative data were transcribed verbatim and analyzed using thematic analysis. An inductive coding approach was employed to identify recurring themes related to sociocultural, economic, institutional, and psychological barriers, as well as key enablers of women's participation in STEM education. Thematic analysis enabled the study to capture nuanced insights into participants' experiences and perspectives (Makarova et al., 2020; Morley & Crossouard, 2022).

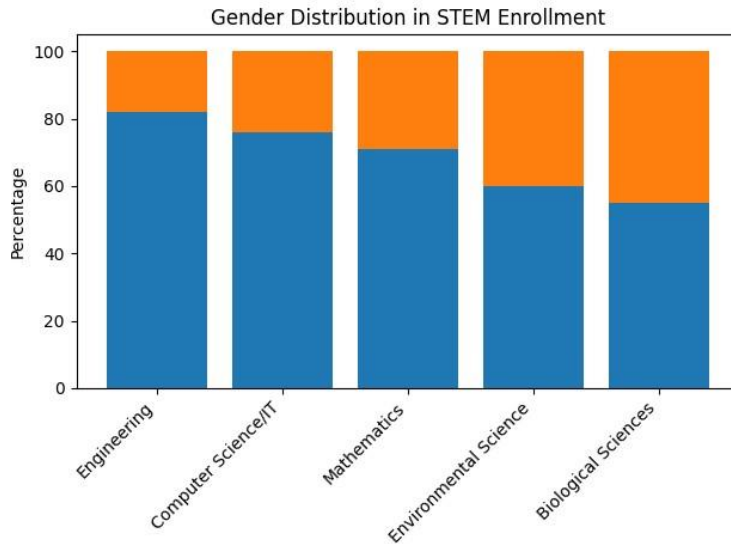
Validity and Reliability

To enhance the validity and reliability of the findings, multiple strategies were employed. Triangulation of data sources and methods helped ensure consistency and credibility of results. The survey instrument was pilot tested, and interview guides were reviewed by experts in education and gender studies to ensure content validity. During qualitative analysis, coding decisions were reviewed to minimize researcher bias and enhance dependability (Fassinger & Li, 2022).

Ethical Considerations Ethical considerations were central to the research process. Ethical approval was obtained from relevant institutional authorities prior to data collection. Participation was voluntary, and informed consent was obtained from all participants. Confidentiality and anonymity were ensured by removing identifying information from transcripts and datasets. Participants were informed of their right to withdraw from the study at any time without consequence (UNESCO, 2020; United Nations, 2021).

RESULTS

This section presents the findings of the study on gender disparities in STEM education at the tertiary level in The Gambia. The results are organized into six subsections: gender distribution in STEM enrollment, retention and progression patterns, socio-cultural barriers, economic constraints, institutional barriers, psychological factors, and key enablers



Gender Distribution in Tertiary STEM Enrollment

Analysis of gender-disaggregated enrollment data from selected tertiary institutions indicates a persistent gender imbalance across STEM programs. Male students dominate enrollment in most STEM disciplines, particularly in engineering, information technology, computer science,

Figure 1 illustrates the distribution of male and mathematics-related programs. Female and female students across selected STEM students constitute less than one-third of disciplines in tertiary institutions in The total enrollment in these fields, with the Gambia. The figure shows a clear gender widest gaps observed in engineering and imbalance, with male students dominating computing disciplines. enrollment in engineering, computer Conversely, relatively higher female science, and mathematics-related programs. participation was observed in biological

Female participation is comparatively sciences and environmental science higher in biological and environmental programs, although women still did not sciences but remains below parity. This achieves parity with male students.

These pattern highlights the discipline-specific findings are consistent with regional and nature of gender disparities in STEM global trends that show women are more education and reflects broader regional and likely to enroll in life sciences than in global trends of female underrepresentation technically intensive STEM fields (Wang & in technically intensive fields. Degol, 2020; Oloruntegbe & Akomolafe, 2021). The results suggest that gender

Retention and Academic Progression disparities in STEM education in The Patterns Gambia is discipline-specific and reflect

Retention and progression data reveal broader patterns of gender segregation notable gender differences in persistence within STEM fields (Xu, 2021). within STEM programs. Female students were more likely than male students to report academic difficulties, particularly during the first and second years of study. Institutional records indicate higher dropout rates among female students in engineering and computer science programs compared to their male counterparts.

Qualitative interview data further suggest that female students are more likely to consider switching to non-STEM disciplines due to academic stress, lack of confidence, and limited support.

These findings align with existing research showing that women are more likely to exit STEM pathways at critical transition points, particularly when foundational courses in mathematics and programming are perceived as challenging (Henning & Roberts, 2020; Legewie & DiPrete, 2021).

TABLE TITLE Table 1: Retention Rates of STEM Students by Gender

Gender	Retention Rate (%)	Dropout Rate (%)
Male	84	16
Female	68	32

Table 1 presents retention and dropout rates of male and female students enrolled in

STEM programs. The table indicates that female students have a substantially lower retention rate and a higher dropout rate compared to male students. This finding suggests that women face greater challenges in persisting through STEM programs, reinforcing the need for targeted academic, financial, and psychosocial support mechanisms to improve female retention in tertiary STEM education.

Socio-Cultural Barriers to Female Participation

Socio-cultural norms emerged as a major barrier influencing women's participation in tertiary STEM education. Survey responses and interview narratives indicate that STEM fields are widely perceived as masculine domains, while women are expected to pursue careers considered more compatible with traditional gender roles. Female students reported experiencing discouragement from family members, peers, and, in some cases, educators when expressing interest in STEM disciplines. Participants highlighted the influence of early socialization processes, including limited encouragement to pursue mathematics and science subjects during secondary education. These findings support previous studies emphasizing the role of gender stereotypes and cultural expectations in shaping educational aspirations and self-efficacy among women (Cheryan et al., 2021; Sáinz & Müller, 2021). In some cases, expectations related to marriage and caregiving responsibilities further constrained women's ability to commit to demanding STEM programs (Tamale & Bennett, 2021).

Economic and Financial Constraints Economic barriers were identified as a significant factor affecting women's enrollment and persistence in STEM education. Female students were more likely than male students to report financial difficulties related to tuition fees, laboratory costs, learning materials, and transportation. STEM programs often involve higher costs due to laboratory requirements and extended study periods, disproportionately affecting women from low-income households. Interview participants emphasized that limited access to scholarships and financial aid restricts women's ability to enroll and remain in STEM programs. These findings are consistent with previous research highlighting the impact of financial constraints on women's participation in STEM education in developing countries (Kalu & Okafor, 2023; Ouma & Dimova, 2022). Financial stress was also reported to negatively affect academic performance and increase dropout intentions among female students.

Institutional and Learning Environment Barriers

Institutional factors also emerged as critical barriers to women's participation in STEM education. Female students reported limited access to female faculty members and mentors, reinforcing perceptions that STEM fields are male-dominated. Some participants described classroom environments that were unwelcoming or

dismissive of female contributions, negatively affecting their sense of belonging and academic confidence. Inadequate academic advising, limited psychosocial support services, and gender insensitive curricula further compounded these challenges. These findings reflect broader institutional barriers identified in the literature, including weak enforcement of gender equity policies and lack of inclusive teaching practices (Fakunle & Alebiosu, 2023; Morley & Crossouard, 2022). Such environments contribute to higher attrition risks among female STEM students.

Psychological Factors and Self Efficacy

Psychological factors, particularly self-efficacy and stereotype threat, were identified as important determinants of women’s persistence in STEM programs. Many female students reported lower confidence in their academic abilities compared to male peers, especially in mathematics-intensive and technical courses. Fear of failure and concern about confirming negative stereotypes were frequently cited during interviews. These findings are consistent with research demonstrating that stereotype threat and low self-efficacy can undermine women’s performance and persistence in STEM education, even when academic ability is comparable to that of male students (Stoet & Geary, 2020; Dasgupta & Stout, 2020). The cumulative effect of these psychological stressors contributes to higher dropout intentions among female STEM students.

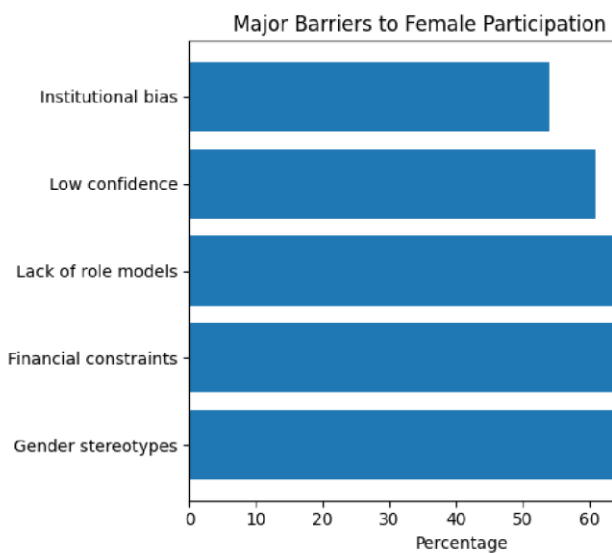


Figure 2 summarizes the major barriers reported by female students that hinder participation in STEM education. Gender stereotypes emerge as the most significant barrier, followed closely by financial constraints and lack of female role models. Psychological factors such as low academic confidence and perceived institutional bias are also prominent. The figure underscores the multidimensional nature of barriers facing women in STEM, highlighting the interplay between socio-cultural, economic, and institutional factors.

Enablers of Female Participation in STEM Education

Despite persistent barriers, the study identified several enablers that support women’s participation and success in tertiary STEM education. Financial support mechanisms, including scholarships, bursaries, and fee waivers, were consistently cited as critical factors enabling female students to enroll and remain in STEM programs. Students who received financial assistance reported reduced economic stress and increased academic motivation.

Mentorship and peer support programs also emerged as key enablers. Female students with access to mentors—particularly female faculty members or senior students—reported higher levels of confidence, stronger academic identity, and greater persistence in STEM programs. These findings align with existing

literature highlighting the role of mentorship in supporting women's engagement in STEM education (Sanni & Alabi, 2023; Buse et al., 2022).

Supportive family attitudes further enhanced women's ability to pursue STEM education. Female students who reported encouragement from parents and guardians were more likely to persist despite academic and social challenges. This finding underscores the importance of family and community support in contexts where social norms strongly influence educational choices (Aina & Akintunde, 2021; United Nations, 2021).

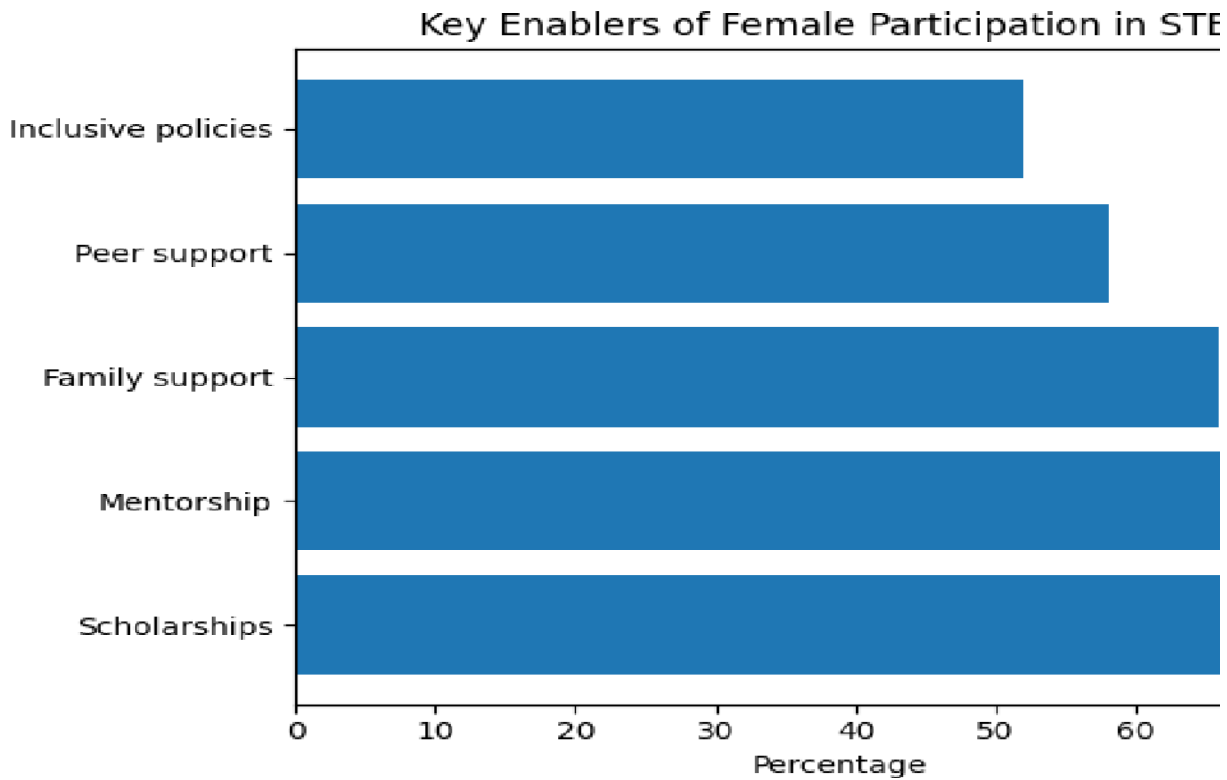


Figure 3 illustrates the key enablers that support women's participation and persistence in STEM education. Scholarships and financial aid are identified as the most influential enablers, followed by mentorship programs and family support. Peer support networks and gender-inclusive institutional policies also play important roles. The figure demonstrates that while barriers are substantial, targeted support mechanisms can significantly enhance women's engagement and success in tertiary STEM education.

DISCUSSION

This study set out to examine gender disparities in STEM education at the tertiary level in The Gambia, with a focus on identifying key barriers and enablers shaping women's participation, retention, and success. The findings reveal persistent and multidimensional gender inequalities that reflect both global patterns and context specific dynamics. This discussion situates the results within existing theoretical and empirical literature, highlighting their implications for gender equity, higher education policy, and national development.

Gender Disparities in STEM Enrollment and Persistence

The findings confirm that women remain significantly underrepresented in tertiary STEM programs in The Gambia, particularly in engineering, computer science, and mathematics-related disciplines. This pattern is consistent with global evidence demonstrating that women's participation in STEM remains uneven and highly segregated by discipline (Wang & Degol, 2020; Cheryan et al., 2021). The relatively higher female representation observed in biological and environmental sciences aligns with research suggesting that

women are more likely to participate in STEM fields perceived as socially oriented or aligned with caregiving roles (Xu, 2021). The observed gender gaps in retention and progression further underscore the cumulative nature of disadvantage faced by female STEM students. Higher dropout rates and increased intentions to switch disciplines among women reflect findings from prior studies indicating that women are more likely to exit STEM pathways at critical academic transition points (Henning & Roberts, 2020; Legewie & DiPrete, 2021). These outcomes suggest that access alone is insufficient; sustained institutional support is essential to ensure women's persistence in STEM education.

Socio-Cultural Norms and Gendered Educational Pathways

Socio-cultural norms emerged as a central factor shaping women's participation in STEM education. The perception of STEM fields as masculine domains continues to influence educational aspirations and career choices, reinforcing gender segregation in higher education. These findings are consistent with social role theory, which posits that culturally prescribed gender roles shape expectations and behaviors related to education and work (Stoet & Geary, 2020; Sáinz & Müller, 2021).

In the Gambian context, expectations related to marriage, caregiving, and domestic responsibilities place additional constraints on women's ability to pursue demanding STEM programs. Similar patterns have been documented across Sub-Saharan Africa, where traditional gender norms continue to limit women's engagement in technical fields (Tamale & Bennett, 2021; Banda & Mutanga, 2020). Early socialization processes that discourage girls from pursuing mathematics and science further reduce the pipeline of women eligible for tertiary STEM education (Hyde & Mertz, 2020; Kim et al., 2020).

Economic Constraints and Unequal Access to Resources

Economic barriers were found to significantly affect women's enrollment and persistence in STEM education. The higher costs associated with STEM programs, including laboratory fees and extended study durations, disproportionately disadvantage women from low-income households. These findings align with human capital theory, which suggests that individuals' educational investments are shaped by perceived costs and expected returns (Xu, 2021). In contexts such as The Gambia, where household resources are often limited, financial constraints interact with gender norms to reduce women's access to STEM education. Prior studies similarly highlight the role of economic barriers in shaping gender disparities in STEM participation in Africa (Kalu & Okafor, 2023; Ouma & Dimova, 2022). The absence of targeted financial support mechanisms further exacerbates these inequalities, underscoring the importance of gender-responsive scholarship programs.

Institutional Culture and Learning Environments

Institutional factors emerged as critical determinants of women's experiences and outcomes in STEM education. Male dominated classrooms, limited access to female faculty members, and gender insensitive curricula contribute to feelings of isolation and marginalization among female students. These findings are consistent with research emphasizing the role of institutional culture in shaping gender disparities in higher education (Morley & Crossouard, 2022; Fakunle & Alebiosu, 2023).

The lack of mentorship and academic advising further undermines women's persistence in STEM programs. Mentorship plays a vital role in fostering academic confidence, professional identity, and a sense of belonging, particularly for underrepresented groups (Buse et al., 2022; Fassinger & Li, 2022). Without deliberate institutional efforts to create inclusive learning environments, gender disparities in STEM education are likely to persist.

Psychological Factors and Stereotype Threat

Psychological factors, particularly low self-efficacy and stereotype threat, were identified as significant barriers to women's persistence in STEM education. Female students' concerns about confirming negative stereotypes regarding women's abilities in mathematics and science reflect broader patterns documented in

the literature (Dasgupta & Stout, 2020; Stoet & Geary, 2020). These psychological pressures can negatively affect performance, confidence, and long-term engagement in STEM fields. The findings suggest that psychological barriers do not operate in isolation but are reinforced by socio-cultural and institutional factors. Supportive learning environments, positive role models, and inclusive teaching practices are therefore essential for mitigating stereotype threat and enhancing women's academic confidence in STEM education.

Enablers and Pathways to Gender Equity in STEM

Despite persistent barriers, the study identifies several enablers that hold promise for advancing gender equity in tertiary STEM education. Financial support mechanisms, such as scholarships and bursaries, emerged as powerful tools for reducing economic barriers and increasing women's participation in STEM programs. These findings align with evidence from global and regional studies demonstrating the positive impact of targeted financial support on women's educational outcomes (World Bank, 2020; UNESCO Institute for Statistics, 2023).

Mentorship and peer support programs also play a critical role in enabling women's success in STEM education. Access to female mentors and supportive peer networks enhances academic identity, confidence, and persistence, particularly in male-dominated fields (Sanni & Alabi, 2023; Buse et al., 2022). Supportive family attitudes further reinforce these enablers, highlighting the importance of community engagement in challenging traditional gender norms (Aina & Akintunde, 2021; United Nations, 2021). At the policy level, gender-responsive strategies that address structural inequalities and promote inclusive institutional cultures are essential. Evidence from African contexts suggests that coordinated interventions involving governments, educational institutions, and development partners can yield meaningful improvements in women's participation in STEM education (UNESCO, 2020; Zulu & Banda, 2024).

CONCLUSION AND POLIC RECOMMENDATIONS

Conclusion

This study examined gender disparities in STEM education at the tertiary level in The Gambia, with the aim of identifying the barriers that hinder female participation and the enablers that support women's engagement and success in STEM disciplines. The findings demonstrate that despite progress in women's access to higher education, significant gender gaps persist in STEM programs, particularly in engineering, computer science, and mathematics-related fields. These disparities reflect a complex interaction of sociocultural, economic, institutional, and psychological factors.

The study confirms that socio-cultural norms continue to shape gendered educational pathways, reinforcing perceptions of STEM as a masculine domain and limiting women's aspirations and confidence in technical fields (Cheryan et al., 2021; Sáinz & Müller, 2021). Economic constraints, including high tuition and program-related costs, disproportionately affect women from low-income households and contribute to lower enrollment and higher attrition rates in STEM programs (Kalu & Okafor, 2023; Ouma & Dimova, 2022). Institutional barriers such as male dominated learning environments, limited access to female mentors, and gender insensitive curricula further undermine women's sense of belonging and academic persistence (Morley & Crossouard, 2022; Fakunle & Alebiosu, 2023). Psychological factors, particularly low self-efficacy and stereotype threat, were also found to negatively influence women's performance and persistence in STEM education. These findings align with existing research demonstrating that psychological barriers are often reinforced by structural and cultural constraints, leading to cumulative disadvantage for female STEM students (Dasgupta & Stout, 2020; Stoet & Geary, 2020). Together, these barriers contribute to the continued underrepresentation of women in STEM education in The Gambia. At the same time, the study highlights several enablers that have the potential to advance gender equity in tertiary STEM education. Financial support mechanisms, mentorship and peer support programs, supportive family attitudes, and gender responsive institutional policies emerged as critical factors enabling women's participation and success in STEM fields (Buse et al., 2022; Sanni & Alabi, 2023; Aina & Akintunde, 2021). These findings underscore the importance of coordinated and context-specific interventions that address

barriers across multiple levels. Overall, the study contributes to the limited empirical literature on gender and STEM education in The Gambia and West Africa more broadly. By providing evidence-based insights into both barriers and enablers, the study offers a foundation for designing policies and institutional reforms aimed at promoting gender equity in tertiary STEM education. Advancing women's participation in STEM is not only a matter of social justice but also a strategic investment in The Gambia's human capital development and long-term economic growth (OECD, 2023; World Bank, 2022).

Policy Recommendations

Based on the findings of the study, the following policy and practice recommendations are proposed: First, governments and higher education institutions should expand gender responsive financial support mechanisms for STEM students. Targeted scholarships, bursaries, and fee waivers for female STEM students can help reduce economic barriers and improve enrollment, retention, and completion rates (World Bank, 2020;

UNESCO Institute for Statistics, 2023). Financial aid programs should prioritize students from low-income households and be complemented by transparent and accessible application processes. Second, mentorship and role-model initiatives should be institutionalized within tertiary STEM programs. Establishing structured mentorship programs that connect female students with faculty members, industry professionals, and senior peers can enhance academic confidence, professional identity, and persistence in STEM education (Buse et al., 2022; Sanni & Alabi, 2023). Efforts should also be made to recruit and retain female faculty members in STEM departments to increase the visibility of women in technical leadership roles.

Third, tertiary institutions should strengthen gender-responsive teaching and learning environments. This includes integrating gender-sensitive pedagogical approaches into STEM curricula, providing training for academic staff on inclusive teaching practices, and enforcing zero-tolerance policies toward discrimination and harassment (Morley & Crossouard, 2022; Fassinger & Li, 2022). Improved academic advising and psychosocial support services are also essential for supporting female students through challenging STEM programs.

Fourth, early interventions should be implemented to strengthen the pipeline of female students into tertiary STEM education. Partnerships between secondary schools, tertiary institutions, and community organizations can promote girls' engagement with mathematics and science subjects and challenge gender stereotypes at an early stage (Hyde & Mertz, 2020; Kim et al., 2020). Outreach programs, STEM camps, and career guidance initiatives can help build confidence and interest among girls. Finally, national and institutional policies should adopt a holistic and data-driven approach to gender equity in STEM education. Regular collection and analysis of gender-disaggregated data can inform targeted interventions and support monitoring and evaluation efforts. Collaboration among government agencies, higher education institutions, civil society, and development partners is essential for sustaining progress toward gender equity in STEM education (UNESCO, 2020; Zulu & Banda, 2024).

Limitations and Future Research

Limitations of the Study

While this study provides important insights into gender disparities in STEM education at the tertiary level in The Gambia, several limitations should be acknowledged. First, the study relies on data collected from a selected number of tertiary institutions offering STEM programs. Although these institutions represent the major providers of STEM education in the country, the findings may not fully capture variations across all higher education institutions, particularly smaller or newly established private institutions. As a result, caution should be exercised when generalizing the findings to the entire tertiary education sector in The Gambia (Ouma & Dimova, 2022; World Bank, 2022). Second, the quantitative component of the study primarily employs descriptive statistical analysis. While this approach is appropriate for identifying patterns and trends in gender participation, it limits the ability to establish causal relationships between identified barriers and educational outcomes. More advanced statistical techniques, such as multivariate or

longitudinal analyses, could provide deeper insights into the determinants of women's participation and persistence in STEM education (Wang & Degol, 2020; Xu, 2021). Third, the study relies in part on self-reported data from student surveys and interviews. Self-reported data may be subject to recall bias and social desirability bias, particularly when discussing sensitive issues such as discrimination, confidence, and family expectations. Although efforts were made to ensure confidentiality and encourage honest responses, these biases may have influenced participants' accounts (Henning & Roberts, 2020; Morley & Crossouard, 2022).

Fourth, the cross-sectional nature of the study limits its ability to capture changes in women's experiences over time. Gender disparities in STEM education are shaped by cumulative processes that unfold across the educational lifecycle, from early schooling to labor market entry. A cross-sectional design provides a snapshot of these dynamics but cannot fully account for changes in participation, motivation, and persistence across different stages of study (Legewie & DiPrete, 2021; Stoet & Geary, 2020).

Directions for Future Research

Future research should build on the findings of this study by adopting longitudinal research designs that track students' educational trajectories from secondary school through tertiary education and into the labor market. Longitudinal studies would provide valuable insights into the critical transition points at which female students are most likely to exit STEM pathways and the factors that influence long-term persistence and career outcomes (Hyde & Mertz, 2020; Xu, 2021). Further research should also employ more advanced quantitative methods to examine the relative influence of socio-cultural, economic, institutional, and psychological factors on women's participation in STEM education. Multivariate and experimental approaches could help identify causal mechanisms and assess the effectiveness of specific interventions, such as scholarship programs or mentorship initiatives (Ayalew & Zeleke, 2022; Kalu & Okafor, 2023). In addition, future studies should explore intersectional dimensions of gender disparities in STEM education. Factors such as socioeconomic status, geographic location, disability, and ethnicity may interact with gender to shape educational experiences and outcomes in complex ways. Intersectional analyses would provide a more nuanced understanding of inequality and inform more inclusive policy responses (Fassinger & Li, 2022; UNESCO, 2022). Comparative studies across West African countries could also enhance understanding of how national policies, institutional contexts, and cultural norms influence gender disparities in STEM education. Such comparative research would allow for the identification of best practices and policy lessons that could be adapted to the Gambian context (Bediako & Sefah, 2021; Zulu & Banda, 2024).

Finally, future research should examine the transition of female STEM graduates into the labor market. Understanding how gender disparities in education translate into employment outcomes, career progression, and earnings is essential for assessing the broader impact of STEM education on gender equality and economic development (OECD, 2023; World Bank, 2022). Research in this area would provide valuable evidence to inform policies aimed at strengthening the link between STEM education and inclusive labor market outcomes.

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