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# Factors Shaping Female Representation in STEM Career in Nigeria

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**ABSTRACT:** The underrepresentation of females in Science, Technology, Engineering, and Mathematics (STEM) disciplines remains a significant concern in many parts of the world and Nigeria is not an exception. This paper investigates the multifaceted factors influencing the representation of females in STEM disciplines within the Nigerian context by drawing upon existing literature and statistical data. The study employs a quantitative method to investigate the relationship between STEM and female participation. Using random sampling technique, 139 secondary students in Nigeria was selected as our respondents. The data collection was administered through a self-monitored questionnaire. Multiple regression analysis was used to test the relationship between STEM and female participation by investigating the various socio-cultural, educational, and institutional factors that could have an impact on the participation of women in STEM careers.

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This study confirms that several factors such as societal perceptions of gender roles, geographical region, influence from family, parents' level of education and significantly influences female's participation in STEM careers within the Nigeria context. Additionally, the paper examines potential strategies and interventions to address these challenges and promote gender equity and inclusivity in STEM fields. This study's findings underscore the importance of targeted initiatives at multiple levels at both local and national levels – to foster a supportive environment for female's participation and advancement in STEM disciplines in Nigeria. This research contributes to the growing body of knowledge on gender diversity in STEM and offers valuable insights for policymakers, educators, employers, and advocates working towards gender equality in science and technology disciplines in Nigeria and beyond.

**KEYWORDS:** STEM, Gender, Education, STEM in Nigeria, STEM in sub-Sahara Africa, Female Representation

## Introduction

■ **The field of STEM is an important driver of innovation, economic growth, and societal development in the 21st century. However, despite growing recognition of the importance of diversity and inclusion in these fields, women continue to be significantly underrepresented (Black et al., 2021). This underrepresentation is particularly pronounced in countries such as Nigeria, where cultural, social, and institutional barriers persistently impede women's involvement and progression in STEM disciplines (Amoo et al., 2019).**

The issue of gender disparity in STEM is not unique to Nigeria, it is a global challenge with implications for individual opportunity, economic prosperity, and the advancement of scientific knowledge. Studies conducted in various countries have consistently highlighted the high gender gap in STEM fields, revealing disparities in educational attainment, career progression, and representation in leadership roles (Makarova, Aeschlimann & Herzog, 2019; Cimpian, Kim & McDermott, 2020). While progress has been made in recent years to address these disparities, significant challenges remain, particularly in regions marked by socio-cultural conservatism and structural inequalities.

Nigeria, Africa's most populous country and largest economy, presents a convincing case study for examining the factors influencing the representation of women in STEM. Despite notable strides in educational attainment and economic development, Nigeria continues to grapple with deep-rooted gender inequalities that manifest in various spheres of life, including education, employment, and decision-making (Eche, 2022). Infact studies carried out by (Ayeni, 2024) and (Bako, 2018) indicate that these inequalities manifest in multiple ways, shaping the experiences and opportunities available to women pursuing careers in science and technology (Abolle-Okeagu, Onoja & Onoshakpor, 2023).

One of the primary factors influencing the representation of women in STEM in Nigeria is the prevailing societal perception of gender roles and expectations. Just like many other societies, Nigeria has traditionally assigned specific roles and responsibilities to men and women, often reinforcing stereotypes that associate STEM fields with masculinity and technical competence. These stereotypes amongst others not only discourage girls and women from pursuing STEM education and careers but also contribute to a lack of visibility and recognition for women's achievements in these fields. Addressing these deeply ingrained beliefs and attitudes is essential for challenging gender norms and promoting greater diversity in STEM.

Furthermore, geographical region and family influence affects disparities in educational access and opportunities perpetuate gender gaps in STEM participation (Verdugo-Castro, 2022). Despite significant progress in expanding access to education in Nigeria, girls and women still face numerous barriers, including limited access to quality schooling, cultural biases favouring male education, and societal expectations regarding early marriage and child-rearing responsibilities (Ibeji, 2023). As a result, fewer girls enroll in STEM-related subjects at the secondary and tertiary levels, leading to a smaller pool of female talent in these fields. Therefore, efforts to bridge this gap must prioritise

interventions that promote gender-sensitive education policies, provide targeted support for girls' STEM education, and challenge stereotypes about women's intellectual capabilities.

In addition to socio-cultural factors, institutional barriers within the STEM system also hinders women's representation and advancement (Nyamongo, 2021). Also, studies have shown that discriminatory practices in recruitment, promotion, and workplace culture often create hostile environments for women in STEM professions, leading to high attrition rates and limited career progression opportunities. Moreso as noted by Ayeni (2024), the lack of female role models and mentors further exacerbates feelings of isolation and alienation among women in STEM. To address these challenges, it is imperative to implement gender-sensitive policies and initiatives that promote diversity, equity, and inclusion in STEM workplaces, including mentorship programs, leadership training, and initiatives to combat gender bias and discrimination.

In conclusion, the underrepresentation of women in STEM fields in Nigeria is a multifaceted issue rooted in socio-cultural norms, educational disparities, and institutional barriers amongst others. Addressing these challenges requires a concerted effort from local communities, policymakers, educators, non-governmental organizations, government at both national and federal levels to dismantle gender stereotypes, promote inclusive educational practices, and create supportive work environments.

The paper aims to combine existing literature, empirical evidence, statistical analysis from questionnaires administered to 139 students, to critically examine the complex array of factors that contribute to the underrepresentation of women in STEM fields in Nigeria. By analysing these questionnaires, this study aims to deepen our understanding of the socio-cultural, educational, and institutional dynamics that shape female participation and experiences in STEM disciplines. Through this exploration, we seek to identify barriers to gender equity in STEM and propose strategies for fostering a more inclusive and supportive environment for women in these fields.

It is believed that by advancing gender equity in STEM, Nigeria can harness the full potential of its human capital and drive innovation, economic growth, and social progress in the years to come. This paper seeks to contribute to this important dialogue by shedding light on the factors shaping women's participation in STEM and offering actionable recommendations for fostering greater diversity and inclusion in Nigeria's scientific and technological sectors.

This research has the following hypothesis:

H1: level of education can significantly affect girls' aspirations in STEM.
H2: type of secondary school attended (public vs. private) significantly influences on girls' representation in STEM fields.
H3: exposure to role models and mentors plays a crucial role in encouraging girls to pursue STEM careers.
H4: a supportive and encouraging family environment plays a critical role in shaping girls' career aspirations.

## Literature review

The participation of women/girls in STEM can be viewed at different stages of career development. From access to education, to academic progression to higher institution, to getting into the right STEM career and making career progression (Blickenstaff, 2005). This literature review will extensively focus on the initial phase, which is accessing the education needed to make further career progression.

A structured literature search was conducted to identify papers that addresses or contributes to the discussion of gender equality in STEM education in Nigeria. The selected papers must address gender equality in Nigeria or Africa with at least one of the authors as a Nigerian, this was the criteria used in streamlining the literature search.

To understand the extent to which women participate in STEM education in Nigeria, the literature review addressed 6 questions. (1) Why is women participation in STEM is important? (2) What are the factors that hinders the participation of women in STEM education? (3) Which of those factors are peculiar in the Nigerian context? (4) Which of the factors in the Nigerian context are the most significant? (5) Are the factors interdependent or related? (6) What are the recommendations or proposed solutions to achieving gender equality in STEM education?

## Importance of female participation in STEM

According to the Sustainable Development Goals 2023 report, the realisation of universal education and gender parity by 2023 necessitates a heightened level of commitment, owing to the sluggish

pace of advancement witnessed in the aftermath of the COVID-19 pandemic (United Nations, 2023). Gender equality within STEM education corresponds to the objectives outlined in SDG Goals 4 and 5, emphasising quality education for all and gender equity. Facilitating equal opportunities across genders fosters innovation and harnesses human potential. Particularly within STEM disciplines, gender equality holds promise, as critical thinking and technical proficiencies play pivotal roles in societal development (Fatourou et al., 2019) assert that the attainment of gender equality will notably bolster the STEM workforce, spur research and innovation, fortify the economy, and mitigate the risk of women's social marginalisation, thereby benefiting society.

Economic dividends, including heightened employment rates and annual GDP growth, are evident in environments where gender parity is enhanced. Projections indicate that by 2030, augmenting women's participation in STEM-related fields could elevate the EU's GDP per capita by 0.7–0.9.6 and yield a 610–820-billion-euro enhancement in GDP (EIGE, 2018). Moreover, effective implementation of pertinent European Commission measures is anticipated to elevate women's employment rates, productivity, and wages, thereby fostering the long-term competitiveness of the EU economy and enhancing trade balances (EIGE, 2018).

Considering that women constitute 49.4% of the Nigerian population, with comparable annual GDP growth rates to the EU according to World Bank data, the attainment of gender equality within STEM fields in Nigeria holds significant potential for economic advancement.

## Factors hindering the participation of women in STEM

However, there are several factors that hinders the participation of women in STEM. These are broadly categories as sociocultural, psychological, systemic, and educational environment factors (Akinsowon et al., 2014). While some literatures have focused on how each factor impact the participation of women in STEM, other have looked at the impact of the interdependence or intersection of these factors.

Within the Nigerian context, various factors influence the female gender participation in STEM. One common factor that has been identified (Table 1) by various authors is the cultural role of women in the society. Women are expected by society to provide care for the children and support for their husbands. In some parts of the country, women are not considered to be intellectually equal as men. These perception of women in society reflects on their interest in pursuing STEM subjects, their enrolment in the academic institution, their participation in STEM areas and limit their potentials in contributing to the society. Other authors have argued is the lack of individual interests of female gender to pursue STEM education and careers, but this cannot be disconnected from the societal perception of the role of women (Okorafor et al., 2015).

**Table 1.** Empirical studies demonstrating the factors hindering the participation of females in STEM

| Factor(s) Identified | Category | Recommendations | Reference |
|---|---|---|---|
| Individual interest, societal perception on the role of women, gender representation in teaching, work-life balance, curriculum development | Psychological, socio-cultural, systemic | Preparation of girls for STEM, public orientation, removing stereotypes, female role models, scholarship for women, competency-based learning, mentoring | (Akinsowon et al., 2014) |
| Cultural belief and socialisation pattern | Sociocultural | Reorientation campaign, gender representation among Teachers, role models, learning environment, scholarship, employment, and promotion | (Okorafor et al., 2015) |
| Gender disparity in STEM education is caused by interest rather than achievement. There is "perceived difficulty" in technological subjects for girls than boys | Psychological (self-efficacy) | Attitude and interests are important for understanding gender disparity in STEM, Policies should focus on encouraging girls to take up technological paths | (Erinosho, 1999) |

| Factor(s) Identified | Category | Recommendations | Reference |
|---|---|---|---|
| Limited women representation in scientific leadership positions in Africa | Systemic | Tracking and monitoring women representation, Recognition of achievement of women in STEM, skill-building, and mentorship | (Tiedeu et al., 2019) |
| Lower number of women enrol in higher education, work-life balance, societal expectations, shortage of female role models | Educational environment, sociocultural | Women need to be seen as intellectually equal to men, access to benefit will enhance women participation in science | (Roca et al., 2018) |
| Lower enrolment of women into tertiary institutions | Educational environment | Policy formulation to address gender difference | (Oludayo et al., 2019) |
| Patriarchal society, gender roles seen as complementary | Sociocultural | Gender equality enhances sustainable development | (Olonade et al., 2021) |
| Energy poverty promote gender inequality in education | Education environment (infrastructural) | Energy poverty reduction policies are crucial for reducing gender inequality in education, access to clean cooking fuels and technologies is associated with improvement in gender parity | (Acheampong et al., 2024) |
| Low representation of women at leadership positions | Systemic | Recommended positive actions to reverse gender disparity in earth science courses | (Mosuro et al., 2023) |

## Contextualizing barriers to STEM careers to Nigeria as the research context

While the role of women in the society and the influence of cultural belief are at the forefront of factors that hinders women participation in STEM, there are other factors that must be brought to light. One of such factors is the low representation of women at leadership positions in Nigeria. The lack of role models can leave young school-goers uninspired to pursue STEM careers. Another peculiar factor in Nigeria is that gender disparity in education has been found to be connected to the lack of access to electricity and clean fuel in some rural and urban areas (Acheampong et al., 2024). This inequality in education translate to STEM education where fewer female participates. The most impactful factors that hinders women participation in STEM in Nigeria have not been clearly identified in the literature. This is because the interdependence of these factors needs to be understood in order to identify the most impactful ones. Within the Nigeria context, there are limited contributions in literature that highlights the interdependence of these factors. As presented in Table 1 above, several literatures recommended solutions ranges from policies implementation at the national level to the change of the perceived role of women in the society. This is where this research proves useful, to elucidate the relationship between these factors and STEM participation.

## Methodology

This research is a quantitative study, using descriptive analysis and multiple linear regression analysis. The population in this study was 139 students of secondary students of both private and public schools in Nigeria. Probability sampling technique was used for this study and questionnaires was used for data collection. A structured questionnaire was administered to collect quantitative data from 139 students on their perception of STEM education barriers. The questionnaire analyses 5 dimensions (interest, parent influence, exposure to STEM, mentorship, role of teachers) consisting of 10 questions. The survey included Likert-scale, multiple choice, and open-ended questions to capture wide perspectives. The demographic data of the respondents are presented below.

## Demographic data

Out of the 139 responses received, 89 (64%) were from the female student and 50 (36%) came from the male students. Student within the age range 10–13 gave the highest response of 47.5%, while the 41.7% responses came from students with the age range 14–16 and only 10.8% were from students between 17–19 years. We gather insights from students attending both private and public secondary schools to have a broad view of the challenges of STEM students in Nigeria. The response from private secondary school is 75.5%, which is three times the responses from students in public schools. The sample also comprises of 43.2% JSSS1-JSSS3 (junior secondary school) students and 59.7% SSS1-SSS3 students (senior secondary school). There was also a geographical spread of the students across five geopolitical zones in Nigeria: the southeast had the highest share with 49.6%, southern region with 27.3%, western region with 18.7% and northern Nigeria with 4.3% respondents. Table 2 shows the distribution of students based on their career intention post-secondary school.

**Table 2.** Distribution of students based on their career intention post-secondary school

| Gender | Arts | Engineering | Mathematics | Science | Technology |
|---|---|---|---|---|---|
| Female | 9.0% | 4.5% | 10.1% | 70.8% | 5.6% |
| Male | 10.0% | 26.0% | 20.0% | 38.0% | 6.0% |
| Total | 9.4% | 12.5% | 13.7% | 59.0% | 5.8% |

## Results and Findings

The result of the analysis revealed two factors that affect the representation of females in STEM career in Nigeria. The place of role models or mentors and girls' representation in STEM fields and influence of family. This is discussed in more details below. The results of the multiple linear regression analysis (Table 3) provides valuable insights into the factors shaping female representation in STEM fields among secondary school girls in Nigeria. The overall model was statistically significant, $F(9, 79) = 3.59$, $p < .001$, and explained 29% of the variance in the dependent variable ($R^2 = 0.29$). See table 3 below.

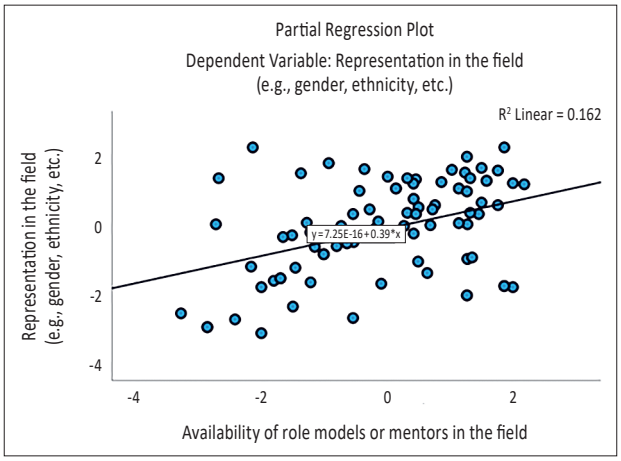
**Table 3.** Multiple Linear Regression Analysis of Factors Influencing Perceived Representation of Women in STEM Fields

| | B | SE | β | t | p-value | Tolerance | VIF |
|---|---|---|---|---|---|---|---|
| (Constant) | 0.13 | 1.45 | | 0.09 | 0.93 | | |
| Availability of role models or mentors | 0.39 | 0.10 | 0.40 | 3.91 | <.001 | 0.88 | 1.13 |
| Influence from family | 0.23 | 0.09 | 0.24 | 2.40 | <.01 | 0.90 | 1.11 |
| Age: Under 13 | 0.97 | 0.67 | 0.33 | 1.45 | 0.15 | 0.17 | 5.86 |
| Age: 14–16 years | 0.41 | 0.59 | 0.14 | 0.70 | 0.49 | 0.23 | 4.34 |
| Type of secondary school attended | -0.40 | 0.50 | -0.10 | -0.80 | 0.43 | 0.55 | 1.84 |
| Current Level of Education | 0.51 | 0.40 | 0.18 | 1.30 | 0.20 | 0.49 | 2.03 |
| Southern Nigeria | 0.12 | 0.77 | 0.04 | 0.15 | 0.88 | 0.15 | 6.73 |
| Eastern Nigeria | -0.02 | 0.71 | -0.01 | -0.03 | 0.98 | 0.15 | 6.49 |
| Western Nigeria | -0.48 | 0.83 | -0.13 | -0.58 | 0.56 | 0.19 | 5.30 |
| | | | | | | | |
| F (9, 79) | 3.59 | | | | <.001 | | |
| $R^2$ | 0.29 | | | | | | |

Note. Dependent Variable: Representation in the field

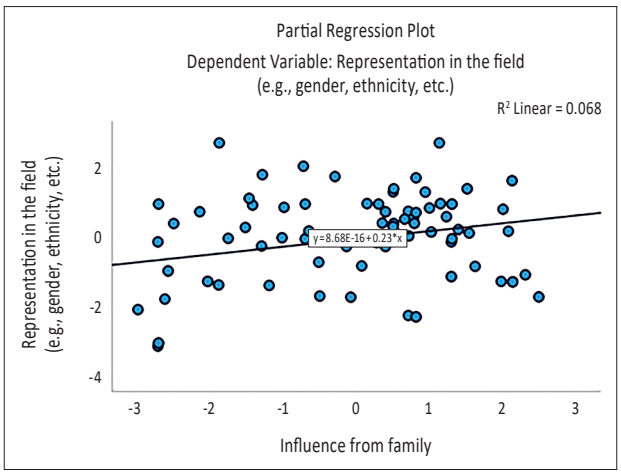
First, the analysis revealed a statistically significant positive relationship between the availability of role models or mentors and girls' representation in STEM fields ($B = 0.39$, $SE = 0.10$, $\beta = 0.40$, $t = 3.91$, $p < .001$). This finding supports hypothesis H3, suggesting that exposure to role models and mentors plays a crucial role in encouraging girls to pursue STEM careers. The positive beta coefficient indicates that with each unit increase in the perceived availability of role models/mentors (on the 5-point Likert scale), girls reported a higher likelihood of being represented in STEM fields. This highlights the importance of mentorship programs and initiatives that connect girls with successful women in STEM fields. By providing relatable role models and mentors, girls can gain inspiration, guidance, and a sense of belonging in STEM, potentially overcoming stereotypes and self-doubt.

**Fig 1.** Scatterplot showing Relationship between availability of role model or mentors and representation of females in the field




Second, the influence from family also emerged as a significant positive factor influencing girls' representation in STEM ($B = 0.23$, $SE = 0.09$, $\beta = = 0.24$, $t = 2.40$, $p < .01$). This supports hypothesis H4, suggesting that a supportive and encouraging family environment plays a critical role in shaping girls' career aspirations. The positive beta coefficient indicates that with a stronger perceived influence from family members (on the Likert scale), girls reported a higher likelihood of being represented in STEM fields. This emphasises the need for family engagement in educational and career guidance for girls. By actively promoting STEM education and careers, families can counteract negative societal stereotypes and provide crucial support for girls' academic pursuits in these fields.

**Fig 2.** Scatterplot showing Relationship between influence from family and representation of females in the field




The analysis did not yield statistically significant results for the age categories (Under 13, 14–16 years) compared to the reference category (17–19 years). This suggests that age may not be a significant factor influencing girls' career choices in STEM within the age range studied. However, further research exploring a wider age range or potential interactions between age and other variables might be beneficial. The type of secondary school attended (public vs. private) (H2) did not show a statistically significant influence on girls' representation in STEM fields. This implies that attending a private school may not necessarily provide an advantage in terms of encouraging girls towards STEM careers. Future research might delve deeper into the specific programs and resources offered by different school types to understand if there are any nuanced effects. The current level of education (SSS1-SSS3 vs. JSS1-JSS3) (H1) also did not produce a statistically significant effect on girls' aspirations in STEM. This suggests that girls' career choices in STEM might not be significantly influenced by their current academic progress within the secondary school system. However, it is important to note that this might be due to the relatively early stage (SSS1-SSS3) at which the data was collected. Further research following these girls through their senior secondary school years or even into university could provide more insights into how their educational progress interacts with their STEM aspirations. The analysis did not reveal any statistically significant differences in girls' representation in STEM based on the geographical region of residence (Southern, Eastern, Western Nigeria) compared to the reference category (Northern Nigeria). This suggests that geographical location might not be a major factor influencing girls' career choices in

STEM within the regions examined. However, it is important to consider potential variations within these regions or explore a more granular geographical classification in future studies.

The analysis also checked for multicollinearity among the predictor variables, using the tolerance and VIF values. The tolerance values ranged from 0.15 to 0.90, and the VIF values ranged from 1.11 to 6.73. These values indicate that there was no serious multicollinearity problem in the model, as the tolerance values were above 0.10 and the VIF values were below 10 (Field, 2013). The results of this study have important implications for female representation in Nigeria for STEM. The results indicate that to increase the participation and retention of girls and women in STEM fields, there is a need to provide more role models and mentors, and to foster a supportive and encouraging family environment. Role models and mentors can inspire and motivate girls and women to pursue STEM careers, by providing guidance, feedback, advice, and emotional support. They can also challenge the negative stereotypes and expectations that may discourage girls and women from STEM fields, by showcasing their achievements, skills, and contributions. Family members can also play a vital role in influencing the career choices and aspirations of girls and women, by providing encouragement, affirmation, and resources. They can also help to create a positive and conducive learning environment for girls and women in STEM, by supporting their academic and personal development, and by respecting their decisions and preferences. These findings are consistent with previous studies that have highlighted the importance of social support and encouragement for girls and women in STEM (Dasgupta & Stout, 2014; Eccles, 2007; Wang & Degol, 2017).

## Conclusion and Recommendation

In conclusion, to promote gender equality and diversity in STEM fields in Nigeria, there is a need to implement effective interventions and policies that can increase the availability and accessibility of role models and mentors, and that can enhance the family involvement and support for girls and women in STEM. Some possible strategies include: First, creating and expanding mentorship programs that can connect girls and women in STEM with experienced and successful female STEM professionals, who can provide guidance, feedback, advice, and emotional support. Second, organising and facilitating STEM outreach activities and events that can expose girls and women to various STEM fields and careers, and that can showcase the achievements, skills, and contributions of female STEM role models. Third, developing and disseminating educational materials and media that can highlight the stories, experiences, and perspectives of female STEM role models, and that can challenge the negative stereotypes and expectations that may discourage girls and women from STEM fields. Fourth, providing and promoting family education and counseling services that can inform and educate parents and other family members about the benefits and opportunities of STEM fields and careers for girls and women, and that can address their concerns and questions. Fifth, encouraging and supporting family involvement and communication in the academic and personal development of girls and women in STEM, by providing opportunities for family members to participate in STEM-related activities and events, and by facilitating regular and constructive feedback and dialogue.

Through implementing some of these recommended strategies, it is hoped that more girls and women in Nigeria can be inspired and empowered to pursue and succeed in STEM fields and careers, and that the gender disparities and imbalances in STEM can be reduced and eliminated. This will not only benefit the individual girls and women, but also the society and the world at large, as they can contribute to the advancement of science, technology, engineering, and mathematics, and to the achievement of the Sustainable Development Goals.

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