Volume 13 (2025), pp. 57-84
American Journal of STEM Education: Issues and Perspectives
Star Scholars Press
https://doi.org/10.32674/6xz0w635

Advancing Equity in STEM Education for Girls in Sub-Saharan Africa: A Systematic Review Through an Intersectional Lens

Akem Solange Ojong, PhD Student
Drexel University, School of Education, USA

Edouard Kareem, PhD
Drexel University, School of Education, USA

ABSTRACT

Persistent gender inequality in STEM education across Sub-Saharan Africa is driven not only by unequal access but also by deep-rooted socio-cultural, economic, and institutional barriers. Although there has been an increase in enrollment in general education, girls remain significantly underrepresented in STEM fields, with an average participation rate of just 21% in Cameroon. Grounded in Crenshaw's (1989) theory of intersectionality, this literature review examines current academic studies and policy reports from five countries: Cameroon, Kenya, Nigeria, Ghana, and South Africa. The findings identify key barriers like harmful cultural norms, poverty, early marriage, adolescent pregnancy, and institutional neglect. These factors combine to limit girls' sustained participation and success in STEM education. The review proposes inclusive learning, support for adolescent mothers, curriculum reform, and data-driven policies. It calls for a STEM ecosystem that empowers African girls to become leaders and innovators.

Keywords: STEM education, gender inequality, intersectionality, Sub-Saharan Africa, girls' education, inclusive policy, educational equity

INTRODUCTION

Gender disparities in STEM (Science, Technology, Engineering, and Mathematics) education remain a deeply entrenched and systemic issue across Sub-Saharan Africa (SSA). Although access to education at the primary, secondary, tertiary, and higher levels has expanded in many countries, the full and equitable participation of girls in STEM continues to be impeded by complex and intersecting structural barriers. According to Mkhize (2022), African women's limited presence in mathematics is linked to their socio-political marginalization. Mkhize (2025) found that despite post-apartheid transformation efforts, STEM fields in South African universities remain dominated by white men, with institutional structures continuing to marginalize African women. The study shows that African women experience a "violence of inclusion" that limits their recruitment, retention, and success, ultimately undermining transformation in these disciplines.

A study by Onana et al. (2019) indicated that women are underrepresented in physics worldwide due to limited access to resources and opportunities. The study also showed that in Cameroon, women's participation in physics drops sharply at postgraduate level and in academic careers, with many barriers still limiting their success. Still in In Cameroon, Courage et al. (2024) found that women face major barriers in STEM education and careers, with low participation in fields such as computer science. The study highlights strong gender inequality, limited opportunities for women, and a weak pipeline for innovation due to low female enrolment (Courage et al., 2024). Abdullahi et al. (2019) reported that female students in Nigeria are underrepresented in science and technology subjects such as mathematics, physics, chemistry, and engineering due to cultural beliefs, early marriage, religious factors, and limited parental support.

This review recognizes that the underrepresentation of girls in STEM fields is not simply a matter of access or personal interest; rather, it reveals how educational systems have historically been constructed to privilege certain groups while excluding others. Across SSA, many girls demonstrate both interest and potential in STEM fields, yet their engagement is undermined by socio-cultural norms that frame STEM as a male domain, economic challenges that make sustained schooling inaccessible, and institutional environments lacking in supportive infrastructure, mentorship, and gender-responsive pedagogical practices (Courage et al., 2024). The need, therefore, is for a paradigm shift, not only in identifying the barriers but in reimagining the ecosystems that support girls' STEM engagement across their educational journey. Most studies agree that despite numerous efforts to address gender disparities, female participation in STEM disciplines in higher education remains low (Baguant, 2021; Kahamba et al., 2017; Kassie, 2018; Sanga et al., 2013), although some improvement has been reported in certain contexts, such as Ghana (Appiah-Castel et al., 2020).

Since Marie Curie received the Nobel Prize in 1903, only 17 women have won Nobel Prizes in Physics, Chemistry, or Medicine, compared to 572 men (UNESCO, 2017). Women make up just 28% of the world's researchers, a statistic that underscores the systemic inequality in science and technology education (UNESCO, 2021). These disparities are not merely about numbers; they reflect the broader reality that girls and women are consistently held back by discrimination, implicit biases, and social norms that shape the quality and type of education they receive from early childhood through higher education. These barriers influence not only access but also choices, pushing girls away from STEM fields and limiting their participation in innovation and research. As UNESCO's former Director-General Irina Bokova emphasized in the foreword of the organization's 2017 report, addressing these challenges requires more than increasing enrollment. It demands early stimulation of interest, gender-sensitive curricula, mentorship, teacher training, and a collective effort to challenge and change the cultural stereotypes that define STEM as a male-dominated domain (UNESCO, 2017). Her vision provides a framework of both urgency and optimism, especially for Sub-Saharan Africa, where girls' underrepresentation in STEM education significantly hinders progress toward the Sustainable Development Goals.

This literature review explores the necessity of transitioning from short-term interventions to the development of comprehensive, inclusive, and sustainable STEM ecosystems. Such ecosystems must be strategically designed to foster early engagement, continued participation, and eventual leadership among girls in STEM fields. While numerous countries have adopted policies promoting gender equity in education, implementation gaps persist. For instance, a 2021 UNICEF report indicated that only 12% of secondary schools in Malawi offered STEM clubs or mentoring initiatives for girls. Similarly, studies in Nigeria highlight the absence of institutional support for girls dealing with early pregnancy, caregiving responsibilities, or school re-entry. These are not isolated administrative oversights, but rather structural deficiencies that systematically displace girls from educational trajectories in STEM. The imperative is to develop culturally responsive and gender-sensitive educational environments that not only deliver content but also affirm girls' identities and experiences. This includes mentorship programs connecting students with women in STEM, integration of gender sensitivity in teacher training, and reformed classroom practices that actively challenge gender stereotypes.

Moreover, systemic change cannot rely solely on educational institutions; it necessitates community engagement, parental involvement, and partnerships with local leaders and private-sector stakeholders to reshape dominant narratives about girls and STEM. Flexible learning modalities such as digital platforms, evening classes, and mobile education must be normalized to support learners navigating complex socio-economic conditions. Grounded in Kimberlé Crenshaw's (1989-2013) theory of intersectionality, this review systematically examines empirical

studies and policy reports to explore the socio-cultural, economic, and institutional barriers that sustain gender disparities in STEM education across Sub-Saharan Africa. The aim is not only to identify these barriers but to highlight transformative, country-driven strategies that position African girls not as passive recipients of educational policy but as active agents in shaping the future of STEM.

Review Objectives

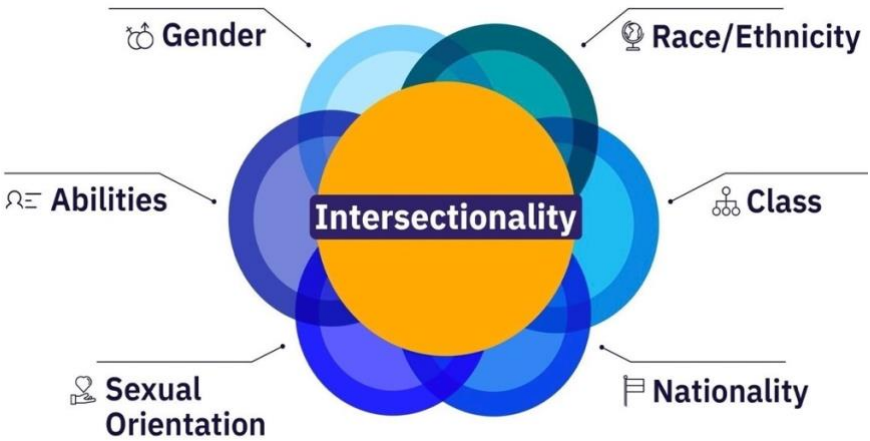
This literature review aims to achieve the following objectives:

1. Identify and analyze the main socio-cultural, economic, and institutional barriers that limit girls' access to and participation in STEM education across Sub-Saharan Africa.
2. Examine existing interventions, both within and outside the region that have effectively promoted gender equity in STEM education.
3. Develop context-specific recommendations to address the gender gap in STEM education in Sub-Saharan Africa.

LITERATURE REVIEW/ THEORETCAL FRAMEWORK

Intersectionality Theory

Figure 1: Visual representation of intersectionality as the overlapping of multiple social identities.



Intersectionality is a theory that helps us understand how different parts of a person's identity, such as gender, race, class, nationality, sexual orientation, and abilities interact to shape their experiences in society. It explains that people are not shaped by one identity alone but by several overlapping identities. These intersections can lead to unique experiences of discrimination, inequality, or privilege (Collins & Bilge, 2016). The term *intersectionality* was first introduced

by Kimberlé Crenshaw, a legal scholar and civil rights advocate, in her 1989 article *Demarginalizing the Intersection of Race and Sex*. Crenshaw used this concept to explain how Black women face a combination of racial and gender-based discrimination that cannot be fully understood if race and gender are treated as separate issues. She criticized legal systems and feminist theories of the time for ignoring the lived realities of women who belong to more than one marginalized group (Crenshaw, 1989 as cited in 2013). Before Crenshaw, scholars like W.E.B. Du Bois had discussed how race, class, and culture interact to shape social inequality, although he did not include gender in his work. In the 1970s, the Combahee River Collective, a group of Black lesbian socialist feminists, further developed the idea by talking about "interlocking oppressions" such as racism, sexism, and heteronormativity (Atewologun, 2018; Avraamidou, 2020).

Since its introduction, intersectionality has expanded beyond legal theory to become a central tool in education research. It has been used to explore how students' identities affect their access to learning, the curriculum, and school environments. For example, intersectionality has guided research on how poverty, racism, and gender bias combine to exclude girls from science, technology, engineering, and mathematics (STEM) education (Avraamidou, 2020). As Atewologun (2018) notes, intersectionality is a framework that explains how social categories and systems are interconnected and shape one another. In schools and universities, educators and researchers have used this theory to improve teaching practices, curriculum design, and school policies. It encourages schools to recognize the diverse backgrounds of students and adapt teaching to meet their needs. This means not only addressing gender inequality but also how race, class, location, and disability impact learning (Atewologun, 2018).

Globally, intersectionality has influenced education policies focused on equity and inclusion. In countries like the United States, it is used to analyze how school systems can better serve students from marginalized backgrounds. Levine-Rasky (2011) applied intersectionality to examine power and privilege, specifically how whiteness and middle-class status intersect to shape domination, not just oppression. The study shows how these social positions interact with ethnicity and gender to maintain inequality and how domination and oppression exist together in social relations. Across African contexts, the theory helps show how one-size-fits-all solutions often fail to address the needs of learners facing multiple, overlapping challenges.

This literature review employs intersectionality as its core theoretical framework to examine the complex barriers that hinder girls' participation in STEM education across Sub-Saharan Africa. Intersectionality provides a lens through which to understand how gender inequality is compounded by additional factors such as socio-cultural norms, economic hardship, institutional structures, and geographical disadvantage. These intersecting forces create multi-layered forms of exclusion that cannot be fully understood by examining gender

alone. An intersectional approach allows for a more comprehensive understanding of these dynamics and supports the development of targeted, context-specific solutions. By framing this review through an intersectional lens, the analysis moves beyond one-dimensional explanations of gender disparity in STEM. It demonstrates how structural, cultural, and institutional barriers interact to produce varied and often compounded disadvantages. In the context of Sub-Saharan Africa, intersectionality provides a robust framework for informing equitable education policy and practice, ensuring that solutions address not only gender but also the full spectrum of social factors affecting girls' access to and success in STEM.

RESEARCH METHOD

This literature review uses the 2020 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to examine how intersectional barriers affect girls' participation in STEM (Science, Technology, Engineering, and Mathematics) fields across Sub-Saharan Africa (SSA). PRISMA 2020 is a set of standards that helps researchers clearly explain how they conducted their review and what they found, making the process transparent and reducing bias. Rather than collecting new data, this review draws from existing research to identify common challenges, trends, and strategies that can help improve gender equity in STEM education. The review is guided by intersectionality, an approach that examines how overlapping factors, such as gender, poverty, ethnicity, geography, and social class, influence girls' educational experiences. This work builds on earlier systematic reviews that also used PRISMA and keyword-based search methods, including studies by (Ilma et al., 2023; Hasanah (2020), Kraus et al. (2024), Xiong et al., 2021, as well as Aguinis et al. (2023), Ar et al. (2023), and Oldemeyer et al. (2025).

Databases and Sources Searched

To ensure comprehensiveness, this review drew on a wide range of academic databases, including JSTOR, Scopus, Web of Science, ERIC, APA PsycNet, Wiley Online Library, PubMed, Google Scholar, and ResearchGate. In addition, grey literature was reviewed from reputable institutional sources such as UNESCO, UNICEF, the World Bank, the African Union, and various regional education ministries to capture policy-level insights and context-specific reports.
To further strengthen the search, cross-referencing techniques were also used. The reference lists of selected high-quality papers were reviewed to identify additional relevant studies that aligned with the focus of this review but were not retrieved through the initial database searches. This approach helped capture important literature that might have been missed due to variations in terminology or indexing.

Search Strategy: A combination of keyword and Boolean search techniques was used to identify relevant literature. Core terms included: "STEM education," "Sub-Saharan Africa," "Black African girls," "gender disparities," "intersectionality," "educational barriers," and related variations. Boolean operators (AND, OR, NOT) were applied to ensure broad coverage and to account for terminological differences across sources.

Inclusion and Exclusion Criteria

Inclusion Criteria:

- Publications from 2000 to 2025
- Written in English
- Focused on Sub-Saharan African countries
- Empirical studies using qualitative, quantitative, or mixed methods
- Addressing intersectional gender barriers in STEM education
- Peer-reviewed journal articles or credible reports from institutional sources

Exclusion Criteria:

- Theoretical or opinion-based papers with no empirical data
- Studies outside the SSA region
- Studies not addressing intersectional barriers (e.g., gender only)
- Publications with poor methodological quality
- Non-English language articles

These criteria were adapted from best-practice models used in recent systematic reviews (e.g., Wood & Malik, 2024; Kurniawan et al., 2022).

Data Extraction and Synthesis

To ensure consistency and accuracy, the authors used a structured data extraction form to collect important information from each study. This form included details such as the author's name, year of publication, country or region studied, research methods used, key barriers identified, and the interventions or strategies discussed in the study. By using the same format for every article, the authors could easily compare results across different sources and reduce the risk of missing important information. Data extraction was carried out carefully by the authors to improve the reliability of the review.

Each study was reviewed in full, and information was recorded independently, then cross-checked to ensure that all relevant details were included correctly. This process helped ensure that the findings were based on accurate and trustworthy sources. After extracting the data, the authors employed thematic narrative analysis to interpret the results. This means that the studies were grouped and analyzed based on common themes and patterns. The analysis was guided by Crenshaw's (1989) theory of intersectionality and expanded using the work of Collins and Bilge (2016). The authors identified three major themes that appeared across the studies:

1. Socio-cultural barriers (Gender Roles and Social, Gender Stereotypes and Early Socialization, Expectations, Early Marriage and Adolescent Pregnancy).
2. Economic barriers (Poverty and Financial Constraints, Unequal Access to Resources and Infrastructure).
3. Institutional barriers (Lack of Female Role Models in STEM Fields, Gender-Biased Curricula and Inadequate Teacher Training and Classroom Bias). These themes were used to organize the findings across different country contexts in Sub-Saharan Africa and to highlight shared challenges as well as country-specific issues.

Study Quality

The quality assessment focused on three main areas:
Clarity of research objectives: Was the study's purpose clearly explained?
Methodological soundness: Were the methods appropriate and clearly described?
Relevance to the topic: Did the study address intersectional barriers in STEM education in Sub-Saharan Africa? Studies that were found to have high risk of bias, for example, because they lacked clear data, used weak research methods, or were not directly relevant to the review, were excluded. This step ensured that the final review was based on a credible and reliable evidence base. The quality review process followed best practices from previous studies, such as those by Anwar et al. (2019) and Lyon and Magana (2020). By combining careful data extraction with a strong focus on quality, this review presents findings that are both meaningful and trustworthy.

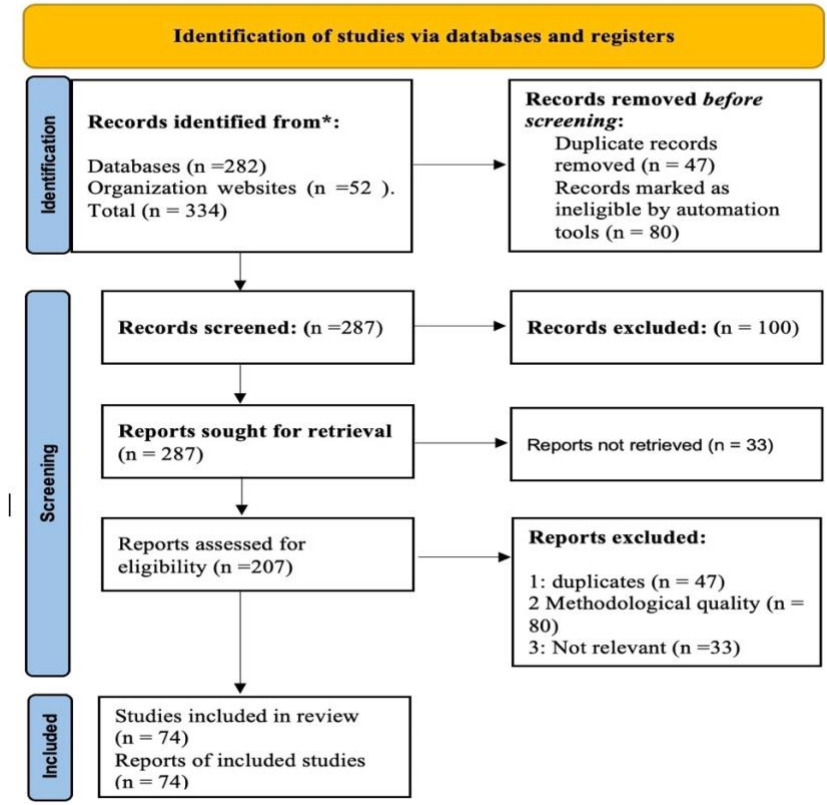
Screening and Selection Process

This review followed the PRISMA 2020 guidelines to ensure that the selection of studies was clear, organized, and free from bias. In total, 334 records were found through the search process, 282 from academic databases and 52 from institutional sources such as government and international organization websites. All the records were saved and organized using the Mendeley reference manager, which helped the authors sort the articles and keep track of which ones were reviewed. The authors read, scanned, and skimmed through the articles to remove any duplicates and organize the literature for further screening.

After removing 47 duplicates, 287 articles remained for the next step. The authors then screened the titles and abstracts of these 287 articles to decide whether each one was related to the topic of STEM education, Sub-Saharan Africa, and gender or intersectional barriers. Based on this step, 80 articles were excluded because they did not meet the basic relevance criteria. Next, the authors carefully read the full texts of the remaining 207 articles. At this stage, each article was

checked against the inclusion and exclusion criteria. Articles were excluded if they did not apply an intersectional approach or if they focused only on single categories like gender without considering other factors such as poverty or ethnicity. A total of 100 articles were excluded for not using an intersectional framework.

Figure 2: PRISMA 2020 flow diagram for new systematic reviews which included searches of databases and registers only



Additionally, 33 articles were excluded due to their low methodological quality. These articles lacked clear research questions, strong data, or reliable methods. The authors used accepted quality standards from previous reviews (such as Malik et al., 2024; Kurniawan et al., 2022; Moyo, 2022) to make these decisions. Ultimately, 74 high-quality studies were included in the final review. These studies provided strong evidence and covered a range of countries, challenges, and strategies. They form the basis for the findings and recommendations discussed in this review. A PRISMA flow diagram (Figure 2) is included above to show the steps taken during the selection process.

RESULTS

Drawing on the systematic review methodology outlined above, this section presents key findings on the socio-cultural, economic, and institutional barriers that limit girls' access to and success in STEM education across Sub-Saharan Africa. The analysis groups recurring themes from the reviewed literature under three main categories: (1) Socio-Cultural Norms, (2) Economic Constraints, and (3) Institutional Barriers. This structured approach highlights how these interconnected challenges influence the educational pathways of Black African girls in STEM.

Socio-cultural barriers

Gender Roles and Social Expectations*:* In many parts of Sub-Saharan Africa, gender roles are still strongly shaped by tradition. Men are expected to be breadwinners, while women are expected to manage the home. These beliefs limit girls' opportunities to explore or pursue education in Science, Technology, Engineering, and Mathematics (STEM) (Toolo, 2018; Courage et al., 2024). From an early age, girls are taught, directly or indirectly that STEM is not for them. This discouragement is even more pronounced in rural and low-income families, where scarce resources often lead to boys being favored for education (Acheampong, 2014). The result is that girls are pushed away from high-potential careers before they even had a chance to explore them. According to UNESCO (2021), only 30% of STEM graduates in SSA are women, with even lower representation in engineering and ICT (as cited in Courage et al., 2024). This gap reflects not a lack of ability, but a system that consistently tells girls they do not belong. To change this, there must be a cultural shift that values girls' education equally. Policymakers, leaders, educators, and parents must be engaged in redefining what success looks like for girls, and education systems must support that vision through inclusive, gender-sensitive practices.

Female Genital Mutilation (FGM): Female Genital Mutilation (FGM), as defined by the World Health Organization (WHO, 2002; Queen, 2016), encompasses all procedures involving the partial or total removal of external female genitalia or other injury to the female genital organs for non-medical reasons. Abdalla and Galea (2019) reported that the exact number of women and girls who have experienced female genital mutilation/cutting is unknown but estimates suggest that more than 200 million are affected worldwide. The harmful physical effects of this practice are well documented. Studies also show that FGM/C has serious psychological effects on women and girls, including long-term emotional and mental health problems (Queen, 2016). Pesambili and Mkumbo (2018) found that female genital mutilation (FGM) negatively affects girls' wellbeing in Tarime, Tanzania, leading to early marriage, stigma, loss of interest in schooling, and poor

educational performance. Circumcised girls avoid stigma but lose educational opportunities, while uncircumcised girls face isolation and discrimination. Similarly, Pesambili (2013) found that uncircumcised schoolgirls experience stigma, isolation, forced circumcision, and forced marriage, all of which disrupt their education. The study also showed that girls use coping strategies such as seeking support from family, schools, religious institutions, and government, but that effective support systems remain limited.

For many girls, undergoing FGM means missing school for recovery or dropping out from school completely. It often marks the start of early marriage and adult responsibilities, ending their chance to continue learning. In communities where FGM is seen as a rite of passage, girls who refuse may be bullied, isolated, or considered unfit for marriage. These social pressures force families to choose between their daughters' well-being and social acceptance. STEM education, which requires time, concentration, and confidence, becomes nearly impossible under such circumstances. To make progress, FGM must be addressed not only as a harmful tradition but as a systemic obstacle to girls' futures. Ending this practice is essential to building safe, inclusive, and empowering educational spaces where girls can thrive and contribute meaningfully to science and society.

Early Marriage and Adolescent Pregnancy: Early marriage and adolescent pregnancy are among the most serious threats to girls' education in Sub-Saharan Africa. Nhampoca and Maritz (2022) reported that early marriage and adolescent pregnancy are common in Mozambique, with 48% of girls marrying and 40% becoming pregnant before the age of 18. When girls marry before the age of 18, they are often forced to leave school and take on adult responsibilities that make it nearly impossible to return. In Ghana, De Groot, Kuunyem, and Palermo (2018) reported that child marriage remains common, with one in five girls marrying before age 18 and one in twenty before age 15. The study found that child marriage is linked to poorer health, higher child mortality, and lower personal agency among women, particularly in very poor households. Whereas Budu et al. (2021) reported that across 31 sub-Saharan African countries, women who married before age 18 were significantly less likely to have sexual autonomy than those who married later. The study also found that low education, poverty, unemployment, and limited media exposure further reduced women's sexual autonomy. Bayisenge (2010) reported that early marriage in Africa is driven by poverty, family and peer pressure, and cultural and religious beliefs. The study also added that early marriage violates girls' human rights, forces many girls to drop out of school, and negatively affects community wellbeing and national development.

Early marriage and adolescent pregnancy directly reduce the number of girls who enter and remain in STEM education. When girls marry or become pregnant before the age of 18, they are often forced to leave school and take on adult roles

such as childcare and household work. For instance, Raj et al. (2019) examined how early marriage disrupts girls' education in Ethiopia and India. This makes it very difficult for them to continue learning, especially in demanding subjects like science, technology, engineering, and mathematics. Studies from Mozambique, Ghana, and across sub-Saharan Africa show that child marriage is linked to school dropout, poor health, low personal agency, and limited decision-making power for girls and women. These conditions weaken girls' ability to stay in school long enough to build the skills needed for STEM careers.

Low education, and social pressure further limit their choices and reduce their confidence to pursue science-related fields (Mensch et al., 2005; (Otoo-Oyortey & Pobi, 2003). In Cameroon, Among the 18,791 single mothers, 41.6% had dropped out of school because of pregnancy (Sobngwi-Tambekou et al., 2022). STEM education requires time, focus, and long-term commitment. Young wives and mothers rarely have access to these resources. Many also face stigma, lack childcare support, and receive little encouragement to return to school. In poor communities, families often see marriage as more valuable than education, believing that a girl's success benefits her husband rather than herself. As a result, fewer girls reach higher levels of education where STEM pathways begin, leading to the continued underrepresentation of women in STEM fields. Protecting girls from early marriage, supporting young mothers to return to school, and promoting the value of girls' education are essential steps toward increasing female participation in STEM and breaking cycles of poverty and inequality.

Economic Barriers

Financial Constraints: Economic inequality remains one of the most persistent and deeply rooted challenges limiting girls' access to STEM education in Sub-Saharan Africa (SSA). In many low-income households, the cost of education school fees, uniforms, transportation, and learning materials forces families to make difficult choices. When resources are scarce, boys' education is often prioritized, while girls are expected to contribute to household labor or informal income-generating activities (UNESCO, 2021; UNICEF, 2022). This exclusion is not simply a matter of affordability, it reflects deeply ingrained gendered assumptions about value, potential, and return on investment. According to UNESCO (2022, as cited in Nwodo et al., 2025), the female literacy rate in Nigeria is 59.3%, compared to 71.3% for males. This gap is wider in rural areas, where poverty limits girls' access to education. Studies show that gender inequality in education is more severe in rural Nigeria due to deep-rooted economic factors (Okonkwo & Agu, 2020, as cited in Nwodo et al., 2025).

In many rural households, boys' education is prioritised because they are viewed as future breadwinners, while girls are expected to marry early and take on domestic roles. In some cases, girls are withdrawn from school to support household income through labour, which increases female dropout rates. Nwodo

et al. (2025) argue that economic hardship is a major factor affecting school attendance and retention, particularly for girls. Many families cannot afford school fees, uniforms, and related costs (Aikman & Rao, 2019, as cited in Nwodo et al., 2025).Furthermore, Nwodo et al. (2025) found that financial constraints were the leading cause of school dropout for both boys and girls, but the impact was greater on girls. Their survey showed that 41.2% of girls left school due to financial difficulties, compared to 32.1% of boys. These patterns of low literacy, poverty, and school dropout reduce the number of girls who reach secondary and tertiary education, where STEM subjects are introduced and developed. As a result, fewer girls are prepared or able to pursue STEM pathways, contributing to the continued underrepresentation of women in STEM fields in Nigeria.

Inadequate Resources and Infrastructure: Poor school infrastructure is another major barrier to girls' education in rural Nigeria. The World Bank (2021, as cited in Nwodo et al., 2025) reports that many rural schools lack basic facilities such as proper classrooms, desks, and sanitary facilities, which affect girls more than boys. In this study, 78.5% of female students reported that the lack of sanitary facilities caused frequent absenteeism, compared to 45.1% of boys. This finding supports UNICEF (2021), which notes that poor sanitation discourages girls from attending school, especially during menstruation. Long distances to school also raise safety concerns, making many parents reluctant to allow girls to continue their education. Similarly, in Cameroon, inadequate school infrastructure remains a serious challenge.

Ndindeng (2024) reports that poor educational facilities limit students' learning opportunities, particularly in rural areas. About 25% of rural schools operate without permanent structures, and many lack basic resources such as desks and textbooks (Ngwane, 2022, as cited in Ndindeng, 2024). These conditions further restrict girls' access to education and contribute to their continued underrepresentation in higher education and STEM fields. Whereas in South Africa, Sikhwari (2024) found that socio-economic factors such as poverty and lack of financial resources significantly contribute to high dropout rates among girls in rural areas, highlighting the need for gender-sensitive education policies. Similarly, in Ghana, Kissi and Issaka (2023) reported that financial difficulties are the main barrier to girls' retention in school and recommended stronger measures to prevent teenage pregnancy, which remains a leading cause of school dropout among girls. Based on these findings, inadequate resources and poor school infrastructure directly contribute to the low participation of girls in STEM. Frequent absenteeism, school dropout, and limited access to learning materials weaken girls' foundations in mathematics and science.

Without stable learning environments, proper facilities, and consistent attendance, girls are less able to progress to higher levels of STEM education, leading to their continued underrepresentation in STEM fields. Science labs are

rare, teachers lack training, and electricity or internet access is often unreliable. These structural gaps particularly harm girls, who already face internal and external doubts about their place in STEM. In Kenya, for example, only 22% of rural girls have access to computers, compared to 39% of boys (UNESCO, 2022). The digital divide not only limits learning opportunities but reinforces the narrative that STEM is not for them. Without urgent investment in equitable infrastructure, the promise of digital and scientific literacy will continue to exclude the most marginalized girls.

Institutional Barriers

Beyond household economics, institutions themselves often reproduce the very inequalities they claim to address. Schools, curricula, and teacher practices are not neutral, they either affirm girls' potential or reinforce their exclusion. For many girls in Sub-Saharan Africa, the structure of education does not support their success in STEM; instead, it quietly erodes their confidence, restricts their choices, and limits their visibility in science and technology spaces.

Lack of Female Role Models in STEM Fields: Another persistent barrier to girls' participation in STEM is the absence of female role models in science and technology fields. Representation matters and shapes aspiration for both men and women. When girls never see women leading in STEM, as teachers, scientists, engineers, they struggle to imagine themselves in those roles. Girls of colour remain underrepresented in STEM because of long-standing systemic barriers and cultural stereotypes in education and society. The absence of relatable role models reduces their confidence and interest in STEM subjects (Amaka, 2024). Studies also show that when families, schools, and teachers provide support, young women are more likely to choose STEM degrees, yet women still face lower participation and greater challenges in STEM careers than men (Tandrayen-Ragoobur & Gokulsing, 2022).

Siwale and Mwalemba (2023) reported that gender stereotypes, limited access to role models, weak family support, and lack of early exposure to technology negatively affect girls' participation in STEM, although these same factors can motivate participation when adequate support is present. The absence of female mentors reinforces stereotypes that STEM is for men, creating a self-perpetuating cycle of underrepresentation (Siwale & Mwalemba, 2023). In countries like Tanzania, Kenya, South Africa, Ghana and Cameroon, girls avoid physics or ICT not due to lack of ability but because they have never seen women succeed in those subjects. When women make up only 17% of university STEM faculty in countries like Nigeria (UNESCO, 2022), the message is clear: these spaces are not designed with girls in mind. Changing this requires deliberate visibility of women in STEM through policy, recruitment, and mentorship to break cycles of doubt and disconnection.

Inadequate Teacher Training and Classroom Bias*:* Teachers hold the power to inspire or discourage students in their lifelong education journey. Yet many are not equipped to challenge gender bias or support girls in male-dominated subjects. In Ghana, Cameroon, Nigeria, and South Africa, studies show that boys are called on more in science classes and given leadership in labs, while girls are sidelined or expected to observe. This invisibility affects girls' participation, confidence, and achievement. In Cameroon, Ndindeng (2024) found that a shortage of qualified teachers and poor teacher training reduce the quality of education, especially for girls. In some areas, the pupil-to-teacher ratio exceeds 70:1, far above the UNESCO-recommended 40:1 (UNESCO, 2024). The study also showed that many teachers in the northern regions had not received professional development in recent years, which weakens teaching quality. In Ghana, Forsgren et al. (2019) reported that lack of access to education and inadequate teacher training disproportionately affect girls due to persistent gender inequality in the education system. This limits girls' learning opportunities and long-term development.

Similarly, in Kenya, Kipkulei et al. (2012) found that teachers' negative attitudes negatively affect their academic performance, especially in certain subjects. The study also showed that providing sanitary towels improved girls' school attendance and academic outcomes. In South Africa, du Plessis and Mestry (2019) identified low parental involvement, underqualified teachers, and multi-grade teaching as major barriers to effective education. These challenges reduce the quality of learning for many students, particularly girls in rural areas. Together, these barriers limit girls' participation in STEM by weakening their foundation in mathematics and science. Poor teaching quality, negative teacher attitudes, lack of support, and missed school days reduce girls' confidence and interest in STEM subjects. As a result, fewer girls progress to higher levels of education where STEM careers begin, reinforcing the underrepresentation of women in STEM fields. Without gender-responsive training, even well-meaning educators may unconsciously reinforce the very barriers that hold girls back. Empowering teachers with the tools to support all learners is critical to dismantling institutional bias and ensuring girls see themselves as future scientists, engineers, and problem-solvers.

Current Interventions Supporting Girls in STEM

To overcome the complex and deeply rooted barriers limiting girls' participation in STEM across Sub-Saharan Africa (SSA), a growing number of global and national interventions have been designed to address both immediate educational needs and the broader structural and cultural challenges that girls face. These programs go beyond improving access, they seek to transform the very systems that marginalize girls by addressing gender norms, poverty, institutional

bias, and harmful practices like early marriage and female genital mutilation (FGM). The examples discussed below illustrate how well-targeted and culturally adapted interventions can play a transformative role in opening STEM pathways for African girls. Non-governmental organisations (NGOs) play a key role by providing financial, social, and academic support to vulnerable girls, especially in low-income contexts. For example, Charles and Machumu (2025) examined the contribution of the Campaign for Female Education (CAMFED) in Tanzania and found that girls who received CAMFED support performed better academically than non-supported girls. This shows that targeted financial and educational support can improve girls' school outcomes and increase their chances of continuing into higher education, including STEM fields.

At the school and community level, partnerships between universities and basic education institutions have also shown positive results. In the United States, a partnership between California State University San Marcos and local elementary schools improved science learning by involving STEM university students in teaching hands-on science lessons in under-resourced schools. The programme increased learners' interest and performance in STEM subjects (Lopez et al., 2017). Early exposure to engaging STEM activities is important for building confidence and long-term interest, particularly among girls. At the higher education level, Kleinschmit et al. (2023) highlight the importance of strengthening STEM teaching through faculty collaboration and the use of open educational resources. Improving teaching quality and learning materials helps create more inclusive learning environments that can better support female students in STEM.

Foundations and mentorship initiatives are also making important contributions. The Imbuto Foundation in Rwanda has focused on keeping girls in school through scholarships, learning materials, and technology training. Although gender parity has improved at primary and secondary levels, the foundation continues to encourage girls to pursue science, technology, engineering, and vocational fields where gaps remain. Similarly, mentoring programmes across Africa, including those highlighted by Ngugi (2024), show that mentorship helps increase women's confidence, retention, and career progression in STEM. In Kenya, mentorship initiatives led by professional bodies and international partners have supported women's participation in STEM by offering career guidance, internships, leadership training, and professional networks. These programmes help reduce isolation, challenge gender stereotypes, and strengthen women's pathways into STEM careers. Overall, these interventions show that financial support, early STEM exposure, quality teaching, mentorship, and strong partnerships are effective strategies for increasing girls' and women's participation in STEM.

Courage et al. (2024), reported that Cameroonian government has also introduced several policies to reduce gender inequality in education, including in

STEM fields. Through the Ministry of Higher Education and the Ministry of Women's Empowerment and the Family, initiatives have been launched to encourage women to pursue scientific and technical studies. One such initiative is the Women in Science and Technology Initiative, which provides scholarships, mentorship, and academic support to female students in STEM. Cameroon has also taken part in regional programmes such as the African Union's Agenda 2063 and STEM for Women in Africa, which aim to increase women's representation in STEM across the continent. These efforts focus on improving girls' access to education, especially in rural areas where traditional gender norms often restrict educational opportunities. National awareness campaigns have also been used to challenge stereotypes that portray science and technology as male fields, encouraging girls to consider technical careers. However, despite these efforts, major challenges remain. A 2023 report from the Ministry of Higher Education shows that limited infrastructure and inadequate funding continue to restrict the implementation of large-scale programmes, particularly in remote regions. In addition, strong cultural beliefs and family expectations often reduce the effectiveness of these policies, especially when community attitudes toward girls' education are not directly addressed (Courage et al., 2024).

Non-governmental organisations (NGOs) in Cameroon play an important role in filling the gap between policy and practice by providing targeted support for women and girls in STEM. For example, the SheCodes Foundation offers coding workshops and mentorship to girls from underserved communities, helping them develop technical skills and confidence through exposure to female role models in technology. Similarly, TechWomen Cameroon supports young women through training programmes, workshops, and seminars that build both technical and soft skills needed for careers in the technology sector (Courage et al., 2024) Although these NGO-led initiatives have positively impacted many participants, their overall reach remains limited. Funding constraints, logistical challenges, and poor access to rural communities continue to limit programme coverage, particularly in areas where gender inequality in education is most severe. This suggests that while government policies and NGO initiatives are important, stronger coordination, increased investment, and deeper community engagement are needed to achieve lasting improvements in girls' and women's participation in STEM.

In Canada, Promo Science and Can Code provide funding and resources for organizations that deliver STEM education to underrepresented youth, particularly girls. These programs introduce young learners to coding, robotics, and digital tools in inclusive, hands-on environments. As a result of these early interventions, female representation among STEM graduates in Canada has increased to 41% (Statistics Canada, 2022). This is a compelling model for SSA, where early exposure to STEM could help change long-standing patterns of exclusion. In addition, the NSF advance and STEM Equity Pipeline programs in the United

States have helped universities and high schools improve gender inclusivity through leadership training, mentoring networks, and teacher professional development. These programs help institutions actively challenge gender norms and support the academic growth of women in science. In SSA, integrating similar training into national teacher education frameworks could significantly reduce the biases that discourage girls from fully engaging in STEM. Despite national and regional reform efforts, systemic obstacles continue to limit women and girls' participation in STEM.

DISCUSSION

Addressing the underrepresentation of girls in STEM education within Sub-Saharan Africa requires a deep and layered understanding of the intersecting barriers that shape their educational journeys. These challenges are not isolated, they are embedded in socio-cultural norms, economic hardship, and institutional neglect, all of which combine to limit meaningful access to and success within STEM learning environments. Yet the urgency of this issue goes beyond simple inclusion. It is about reimagining STEM as a space where girls particularly those from historically marginalized communities can not only participate, but lead, shape, and redefine what counts as STEM knowledge and innovation.

This work calls for a shift away from deficit-based approaches that try to "fix" girls and instead focuses on challenging the systems that exclude them. Expanding access to STEM should not be limited to tracking enrollment numbers or counting programs. It means creating pathways that respect girls lived experiences, cultural knowledge, and personal goals. These efforts are not just educational; they are about justice. When we center girls' voices, support their full participation, and design spaces where they can see themselves reflected in both the content and the culture of STEM, we open the door to more than individual success. We contribute to a broader global vision of innovation, equity, and shared future-making. This is not simply about creating more seats at the table; it is about co-constructing new tables altogether, where girls from Sub-Saharan Africa are not just included in STEM they are leading its transformation.

This literature review operates from that position. It is not only an examination of the barriers that exist, but a call to think critically and act boldly. The review analyzes how interventions, policies, and support systems have been deployed, and how they must be redesigned to serve girls not as passive recipients of education but as central architects of what STEM can become. One of the most pressing institutional challenges in advancing gender equity in STEM across Sub-Saharan Africa is the absence of sustained, supportive structures within educational systems. While national policies often articulate commitments to gender equality, the reality on the ground reveals a deep disconnect between policy rhetoric and practical implementation. A 2021 UNICEF report, for example, found

that only 12% of secondary schools in Malawi had established STEM clubs or mentoring programs tailored specifically for girls. In Nigeria, despite alignment with the SDG 4 framework, many schools lack operational systems to support girls navigating life circumstances such as early pregnancy, caregiving responsibilities, or economic hardship. Re-entry policies for girls who drop out due to these challenges are often poorly enforced or missing entirely resulting in reduced school completion rates and limited pathways into STEM careers.

This gap points to a broader structural failure: the lack of intentional, long-term investment in the environments that make participation in STEM not only possible, but sustainable. We cannot continue to rely on isolated or short-term interventions. What is urgently needed is the creation of educational ecosystems that maintain consistent support, mentorship, and culturally responsive programming for girls across their academic journeys. These are not temporary fixes they must be foundational infrastructures that recognize and respond to the full realities of girls' lives. Moreover, this is not just an issue of gender.

Often, both boys and girls in under-resourced communities lack access to the tools, networks, and spaces needed to thrive in STEM. But the compounded challenges faced by girls, shaped by patriarchy and gender-based exclusion, require targeted solutions. Building inclusive STEM ecosystems means designing with intersectionality at the core ensuring that spaces are not only accessible, but affirming, adaptable, and grounded in the real-world needs of the learners they aim to serve. This calls for a paradigm shift: from program-based thinking to systems-building work. We need to cultivate networks of resource-sharing, mentorship pipelines, and community-rooted partnerships that form a sustainable infrastructure of support. It is only through this kind of deep, structural commitment that we can ensure girls not only enter STEM spaces but are equipped to lead, transform, and redefine them.

RECOMMENDATIONS

To create meaningful and lasting change in STEM (Science, Technology, Engineering, and Mathematics) education for girls in Sub-Saharan Africa (SSA), a broad coalition of stakeholders must act, including governments, educators, community leaders, NGOs, private sector partners, and international organizations. This transformation requires more than isolated programs; it demands a coordinated, systemic approach that addresses the socio-cultural, economic, and institutional barriers limiting girls' participation. Below are comprehensive, action-oriented recommendations for stakeholders, rooted in global best practices and adapted to the SSA context.

Transform Socio-Cultural Norms Through Community Engagement

For Governments and NGOs: Localize successful public campaigns like *HeForShe* and *Girls in STEM* by training female scientists, engineers, and ICT professionals to serve as ambassadors in their own communities. These women should lead school outreach, community forums, and radio programs in local languages. Stakeholders should work with religious and traditional leaders to challenge stereotypes and redefine gender roles, framing girls' education in STEM as a community strength, not a deviation from tradition.
For Educators: Integrate STEM activities into early childhood development programs. Drawing inspiration from Canada's *PromoScience*, ministries of education should provide resources such as science kits and coding games in kindergartens and lower primary grades, especially in underserved areas. Early, playful engagement in STEM helps build curiosity and dismantle stereotypes before they take root.

Address FGM and Promote Inclusive Learning Environment
For Policymakers and Donors: Scale UNICEF's Joint Programme on FGM by embedding anti-FGM education in school curricula and teacher training. Ministries should create strong referral systems for support and ensure schools are safe spaces for girls resisting FGM. Policies must mandate re-entry pathways for affected girls.
For Schools and Civil Society Organizations (CSOs): Set up "safe STEM clubs" based on successful models like Rwanda's *Girls in ICT* initiative. These clubs should offer mentorship, counseling, peer support, and access to digital tools, all within a safe and supportive environment. In schools, they should be seen as empowerment zones where girls not only build STEM skills but also grow in confidence, take on leadership roles, and push back against harmful social norms. Civil Society Organizations, such as local nonprofits, advocacy groups, and community-based initiatives, can partner with schools to help run these clubs, provide trained mentors, and ensure the spaces remain inclusive and protective.

Tackle Early Marriage and Adolescent Pregnancy
For Ministries of Education and Health: Adapt India's *UDAAN* and *Beti Bachao Beti Padhao* models by offering scholarships, flexible school re-entry policies, and legal protections for young mothers. National programs should include vocational-STEM hybrids in re-entry centers, giving adolescent mothers the tools to pursue careers in science, agriculture, or tech.
For Social Protection Agencies: Implement Conditional Cash Transfer (CCT) programs that incentivize families to keep girls in school, especially during transition years (Grades 6–10). Funds should be tied to attendance and STEM subject enrollment. This reduces the economic rationale for early marriage and child labor.

Reduce Economic and Infrastructure Barriers

For Governments and Development Partners: Expand World Bank programs like the *Adolescent Girls Initiative* and *Gender Innovation Lab* by integrating STEM-focused vocational training, digital skills, and entrepreneurship modules. Mobile tech training programs in urban slums and rural areas can offer practical pathways to employment and empowerment.

For Private Sector Stakeholders: Launch public-private partnerships to deliver low-cost laptops, solar charging kits, and mobile science labs. Inspired by China's rural access model, companies can support "STEM hubs" in remote regions through Corporate Social Responsibility (CSR) initiatives. These hubs would serve as digital learning centers where girls access the internet, study, and engage in science safely.

Improve Institutional Support and Representation

For Teacher Training Colleges and Universities: Adapt the *NSF ADVANCE* model by providing fellowships and leadership development programs for women in STEM. These institutions must also recruit and support female science educators in rural areas where girls have little exposure to role models. Representation will shift mindsets and inspire aspirations.

For Education Ministries: Replicate Rwanda's Imbuto Foundation approach by launching national STEM literacy campaigns. These should include digital bootcamps, peer-to-peer learning programs, and regional science fairs where girls can showcase innovation. Policies should fund teacher training in digital pedagogy and curriculum development with a gender lens.

Reform Curriculum and Teaching Practices

For Curriculum Developers and Publishers: Localize Finland's gender-sensitive curriculum framework by revising science textbooks to include African women scientists and engineers. Lessons should focus on real-life STEM solutions relevant to rural and urban African contexts clean water tech, sustainable farming, health innovation.

For Teacher Training Institutes: Institutionalize gender-inclusive pedagogy in pre-service and in-service training. Teachers should be trained to actively encourage girls in lab work, group leadership, and public speaking. Classroom environments must promote equal participation and counter implicit bias.

Use Data to Drive Policy and Scale Impact

For National Education Authorities and Research Institutes: Implement UNESCO's *SAGA Toolkit* to monitor gender equity in STEM through sex-disaggregated data. Ministries should create national observatories to track STEM participation, dropout rates, and teacher gender balance across regions. Transparent data will inform better policy and funding allocation.

For Multilateral Agencies and Funders: Support governments in scaling successful pilots, like World Bank-backed programs that increased girls' STEM participation by up to 10%. Fund longitudinal studies to assess the long-term impact of STEM interventions on girls' economic outcomes and community development. The path to STEM equity for African girls is not linear, but it is achievable. It requires an ecosystem approach where every stakeholder, including government, schools, parents, donors, companies, and communities, plays a role. What is needed now is not more programs, but transformative alignment of vision, funding, and action. Girls in Sub-Saharan Africa are not lacking in talent; they are lacking in opportunity. By adapting global solutions with cultural intelligence, political will, and institutional accountability, stakeholders can build a future where girls not only enter STEM but shape it. This is not just an educational issue, it is a justice issue. The future of science in Africa depends on the brilliance, resilience, and leadership of its girls. Let's give them the tools, the space, and the support to thrive.

CONCLUSIONS

Bridging the gender gap in STEM education across Sub-Saharan Africa is not a matter of access alone, it is a matter of equity, justice, and structural transformation. This review makes it clear that short-term programs and content delivery are insufficient. What is needed is a reimagining of STEM ecosystems that are inclusive by design, culturally grounded, and responsive to the complex realities African girls face. Using the lens of intersectionality, this study has shown that barriers to STEM are not experienced in isolation. Gender interacts with poverty, geography, ethnicity, and social norms to shape girls' experiences in unique and compounding ways. Addressing only one dimension fails to capture the depth of exclusion. Effective solutions must account for these intersecting inequalities and recognize that girls are not a homogenous group, they navigate different, often overlapping, forms of marginalization. Policies alone cannot close the gender gap in STEM. Sustainable change requires investment in mentorship, gender-responsive pedagogy, flexible learning options for young mothers, and school environments that reflect and affirm girls lived experiences. Girls are not required to adapt to broken structures; they are empowered to redefine them. At its core, this paper insists that equitable STEM education is not a favor to girls, it is a necessity for Africa's future. When we build with girls, not just for them, we don't just open doors, we change what lies behind them.

REFERENCES

Abdalla, S. M., & Galea, S. (2019). Is female genital mutilation/cutting associated with adverse mental health consequences? A systematic review of the evidence. *BMJ global health*, *4*(4).https://doi.org/10.1136/bmjgh-2019-001553

Abdullahi, N., Abubakar, A., Abubakar, M. J., & Aliyu, A. C. (2019). Gender gap in science and technology education in Nigeria. *International Journal of Education and Evaluation*, *5*(3), 6-13. https://ijee.io/get/IJEE/VOL.%205%20NO.%203%202019/Gender%20Gap%20in%20Science.pdf

Aguinis, H., Ramani, R. S., & Alabduljader, N. (2023). Best-Practice Recommendations for Producers, Evaluators, and Users of Methodological Literature Reviews. *Organizational Research Methods*. https://doi.org/10.1177/1094428120943281

Al-Ansi, A. M., Jaboob, M., Garad, A., & Al-Ansi, A. (2023). Analyzing augmented reality (AR) and virtual reality (VR) recent development in education. *Social Sciences & Humanities Open*, *8*(1), 100532. https://doi.org/10.1016/j.ssaho.2023.100532

Amaka, N. S. (2024). Systemic Barriers and Cultural Stereotypes: Understanding the Underrepresentation of Girls of Colour in Stem Fields. *International Journal of Research Publication and Review*, *5*(11), 4016-4029.

Appiah-Castel, M. V. D., Lamptey, R. B., Titiloye, K., & Pels, W. A. (2020). Female enrolments in STEM in higher education: Trend analysis from 2003–2018: KNUST as a case study. Library Philosophy and Practice (e-journal), 4327.

Atewologun, D. (2018). Intersectionality theory and practice. In *Oxford research encyclopedia of business and management*. https://doi.org/10.1093/acrefore/9780190224851.013.48

Atewologun, D. (2018). Intersectionality theory and practice. In *Oxford research encyclopedia of business and management*. https://doi.org/10.1093/acrefore/9780190224851.013.48

Avraamidou, L. (2020). Science identity as a landscape of becoming: Rethinking recognition and emotions through an intersectionality lens. *Cultural Studies of Science Education*, *15*(2), 323-345.

Baguant, N. D. (2021). Gender and civil engineering in higher education: The case of Mauritius. International Journal of Higher Education, 10(1), 157–165. https://doi.org/10.5430/ijhe.v10n1p157

Bayisenge, J. (2010). Early marriage as a barrier to girl's education. *Retrieved on*, *1*(10), 2010.

Budu, E., Ahinkorah, B. O., Seidu, A. A., Agbemavi, W., Frimpong, J. B., Adu, C., Dickson, K. S., & Yaya, S. (2021). Child Marriage and Sexual Autonomy among Women in Sub-Saharan Africa: Evidence from 31 Demographic and Health Surveys. *International Journal of Environmental Research and Public Health*, *18*(7).https://doi.org/10.3390/ijerph18073754

Charles, G., & Machumu, H. (2025). Contribution of CAMFED on vulnerable girls' performance in Tanzania community secondary schools. The International Journal of Learning Space Studies (IJLSS), 2(4):31- 46. DOI: 10.22034/lss.2024.480500.1021.https://lss.artahub.ir/article_208793_e30bf43e7b92fbb1d394a01874fa28b3.pdf

Collins, P. H., & Bilge, S. (2016). *Intersectionality*. Polity Press.

Courage, F. K. P., Cyrielle, N. N. T., & Andigema, A. S. (2024). An In-Depth Review of Barriers, Strategies, and Opportunities for Enhancing Female Participation in STEM. https://doi.org/10.20944/preprints202411.0697.v1

Crenshaw, K. (2013). Demarginalizing the intersection of race and sex: A black feminist critique of antidiscrimination doctrine, feminist theory and antiracist politics. In *Feminist legal theories* (pp. 23-51). Routledge.

Crenshaw, Kimberlé (1989). Demarginalizing the Intersection of Race and Sex: A Black Feminist Critique of Antidiscrimination Doctrine. University of Chicago Legal Forum, 1989: 139–168.

De Groot, R., Kuunyem, M. Y., & Palermo, T. (2018). Child marriage and associated outcomes in northern Ghana: a cross-sectional study. *BMC public health*, *18*(1), 285. https://doi.org/10.1186/s12889-018-5166-6

Despite the ubiquity of intersectionality in feminism and allied methodologies, it is typically associated with the elaboration of oppression.

du Plessis, P., & Mestry, R. (2019). Teachers for rural schools – a challenge for South Africa. *South African Journal of Education*, *39*(4). https://doi.org/10.4314/saje.v39i4.

Forsgren, Harper; Haslam, Asia; Hunt, Shelby; Heim, Nathan; and Wirkus, Andrew (2019) "Girls' Access to Education in Ghana," *Ballard Brief*: Vol. 2019: Iss. 3, Article 4.
Available at: https://scholarsarchive.byu.edu/ballardbrief/vol2019/iss3/4

Hasanah, U. (2020). Key definitions of STEM education: Literature review. *Interdisciplinary Journal of Environmental and Science Education*, *16*(3), e2217. **https://rwandadispatch.com/imbuto-foundations-20-year-journey-boosts-girls-education-and-national-growth/**

Ilma, A. Z., Wilujeng, I., Nurtanto, M., & Kholifah, N. (2023). A systematic literature review of STEM education in Indonesia (2016-2021): Contribution to improving skills in 21st century learning. *Pegem Journal of Education and Instruction*, *13*(2), 134-146.

Imbuto Foundation, (2005)Boosts Girls' Education and National Growth

Kabeer, N., & Mahmud, S. (2004). Globalization, gender and poverty: Bangladeshi women workers in export and local markets. *Journal of international development*, *16*(1), 93-109.

Kahamba, J. S., Massawe, F. A., & Kira, E. S. (2017). Awareness and practice of gender responsive pedagogy in higher learning institutions: The case of Sokoine University of Agriculture, Tanzania. Journal of Education, Humanities and Sciences, 6(2), 1–16.

Kassie, K. (2018). Gender difference in higher education in Ethiopia: A case of Addis Ababa University (AAU). Africa Review, 10(2), 157–172. https://doi.org/10.1080/09744053.2018.1485254

Kipkulei, B. C., Chepchieng, M. C., Chepchieng, M. J., & Boitt, L. M. (2012). Selected factors affecting girls' participation in primary school education in Kenya. *Problems of Education in the 21st Century*, *48*, 52.

Kissi, B. A., & Issaka, J. (2023). Barriers Affecting Retention of Girls in Schools in the Amasaman Circuit in the Ga West Municipality of the Greater Accra Region of Ghana. *Ghana Journal of Geography*, *15*(2), 61–87. https://doi.org/10.4314/gjg.v15i2.3

Kleinschmit, A.J., Rosenwald, A., Ryder, E.F. *et al,* (2023). Accelerating STEM education reform: linked communities of practice promote creation of open educational resources and sustainable professional development. *IJ STEM Ed* **10**, 16. https://doi.org/10.1186/s40594-023-00405-y

Kraus, S., Bouncken, R. B., & Yela Aránega, A. (2024). The burgeoning role of literature review articles in

Kurniawan, K., Yosep, I., Maulana, S., Mulyana, A. M., Amirah, S., Abdurrahman, M. F., Sugianti, A., Putri, E. G., Khoirunnisa, K., Komariah, M., Kohar, K., & Rahayuwati, L. (2022). Efficacy of Online-Based Intervention for Anxiety during COVID-19: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *Sustainability*, *14*(19). https://doi.org/10.3390/su141912866

Levine-Rasky, C. (2011). Intersectionality theory applied to whiteness and middle-classness. *Social Identities*, *17*(2), 239–253. https://doi.org/10.1080/13504630.2011.558377

Levine-Rasky, C. (2011). Intersectionality theory applied to whiteness and middle-classness. *Social identities*, *17*(2), 239-253.

Lopez, C. A., Rocha, J., Chapman, M., Rocha, K., Wallace, S., Baum, S., Lawler, B. R., & Mothé, B. R. (2017). Strengthening STEM Education through Community Partnerships. *Science Education & Civic Engagement : An International Journal*, *8*(2), 20. https://pmc.ncbi.nlm.nih.gov/articles/PMC5512595/

Malik, M., Malik, S., Karur, G. R., Mafeld, S., & McInnis, M. C. (2024). Cardiothoracic Imaging for Outcome Prediction in Chronic Thromboembolic Pulmonary Hypertension after Pulmonary Endarterectomy or Balloon Pulmonary Angioplasty: A Scoping Review. *Journal of Clinical Medicine*, *13*(17). https://doi.org/10.3390/jcm13175045

management research: an introduction and outlook. *Review of Managerial Science*, *18*(2), 299-314.

Mensch, Barbara, Susheela Singh, and John B. Casterline. (2005). "Trends in the timing of first marriage among men and women in the developing world," Policy Research Division Working Paper no. 202. New York: Population Council. Version of record: https://doi.org/10.17226/11524

Mkhize, Z. V. (2025). The violence of inclusion in South African universities: The experiences of African early career women in STEM. *Transformation in Higher Education*, *10*, 446. https://hdl.handle.net/10520/ejc-thed_v10_n1_a446

Mkhize, Z., 2022, "They are just women, what do they know?": The lived experiences of African women doctoral students in the mathematics discipline in South African universities', Transformation in Higher Education 7(0), a218. **https://doi.org/10.4102/the.v7i0.218**

Moyo, Z. (2022). Confronting Gender Inequalities in Education Leadership: A Case of Zimbabwe. *Gender Questions*, *10*(1). https://journals.co.za/doi/abs/10.25159/2412-8457/7218

Ndindeng, A. (2024). Factors Influencing Under-Education in Cameroon: A Comprehensive Analysis. *African Educational Research Journal*, *12*(3), 182-201.

Ngugi, N. (2024). *Mentoring as a pathway toward increasing African women in STEM*. RWSN Blog. https://rwsn.blog/2024/02/29/mentoring-as-a-pathway-toward-increasing-african-women-in-stem/

Nhampoca, J. M. ., & Maritz, J. . (2022). Early marriage and adolescent pregnancy in Mozambique. *African Journal of Reproductive Health*, *26*(3), 114–123. https://doi.org/10.4314/ajrh.v26i3.

Nwodo, S. N., Nwodo, E. E., & Umoh, B. (2025). GENDER INEQUALITY IN ACCESS TO EDUCATION IN RURAL COMMUNITIES OF ENUGU STATE, NIGERIA. *INT'L JOURNAL OF EDUCATION, MANAGEMENT SCIENCES AND PROFESSIONAL STUDIES*, *1*(2), 829-841.. https://journals.iempsglobal.org/index.php/IJEMPS/article/view/186

Oldemeyer, L., Jede, A., & Teuteberg, F. (2025). Investigation of artificial intelligence in SMEs: a systematic review of the state of the art and the main implementation challenges. *Management Review Quarterly*, *75*(2), 1185-1227.

Onana, M. B., Sendja, B. T., Ngano, O. S., & Onanena, R. (2019, June). Shortage of women teaching physics in Cameroonian universities. In *AIP Conference Proceedings* (Vol. 2109, No. 1, p. 050009). AIP Publishing LLC. https://doi.org/10.1063/1.5110083

Otoo-Oyortey, N., & Pobi, S. (2003). Early marriage and poverty: exploring links and key policy issues. *Gender & Development*, *11*(2), 42–51. https://doi.org/10.1080/741954315

Pesambili, J. C. (2013). Consequences of female genital mutilation on girls' schooling in Tarime, Tanzania: Voices of the uncircumcised girls on the experiences, problems and coping strategies. *Journal of Education and Practice*, *4*(16), 109-119.

Pesambili, J. C., & Mkumbo, K. A. K. (2018). Implications of female genital mutilation on girls' education and psychological wellbeing in Tarime, Tanzania. *Journal of Youth Studies*, *21*(8), 1111–1126. https://doi.org/10.1080/13676261.2018.1450969

Queen, C. C. (2016). *Female Genital Cutting/Mutilation: An Exploratory Study of the Psychological Health Outcomes in Tanzania* (Doctoral dissertation, University of Pittsburgh).

Raj, A., Salazar, M., Jackson, E. C., Wyss, N., McClendon, K. A., Khanna, A., ... & McDougal, L. (2019). Students and brides: a qualitative analysis of the relationship between girls' education and early marriage in Ethiopia and India. *BMC public health*, *19*(1), 19.

Sanga, C., Magesa, M. M., Chingonikaya, E., & Kayunze, K. A. (2013). Can e-learning promote participation of female students in STEM disciplines in higher learning institutions of Tanzania? International Journal of Education and Development using ICT, 9(3), 86–102.

Sikhwari, M. (2024). Gender Disparities in Educational Wastage: Analysing the Factors Contributing to Female Dropout Rates in Rural South Africa. *African Journal of Development Studies (formerly AFFRIKA Journal of Politics, Economics and Society)*, *2024*(si1), 289-303.https://journals.co.za/doi/abs/10.31920/2634-3649/2024/sin1a14

Siwale, K., & Mwalemba, G. (2023). Societal influences on career decision making: Perspectives of A frican women pursuing technology-related professions. *The Electronic Journal of Information Systems in Developing Countries*, *89*(4), e12259.

Sobngwi-Tambekou, J. L., Tsague-Agnoux, M., Fezeu, L. K., & Ndonko, F. (2022). Teenage childbearing and school dropout in a sample of 18,791 single mothers in Cameroon. *Reproductive health*, *19*(1), 10. https://doi.org/10.1186/s12978-021-01323-4

Tandrayen-Ragoobur V, Gokulsing D (2022), "Gender gap in STEM education and career choices: what matters?". *Journal of Applied Research in Higher Education*, Vol. 14 No. 3 pp. 1021–1040, doi: https://doi.org/10.1108/JARHE-09-2019-0235

Toolo, L. L. (2018). *An awareness programme to improve participation of young women in the science, technology, engineering and mathematics (STEM) fields in South African universities*. University of South Africa (South Africa).

UNESCO. (2021). Her education, our future: Accelerating progress toward gender equality in education. UNESCO. Retrieved from https://www.unesco.org

UNESCO. (2022). Global education monitoring report: Gender equality in education. UNESCO. Retrieved from https://ww w.unesco.org

UNICEF. (2021). Girls' education in Nigeria: Barriers and opportunities. Retrieved from https://www.unicef.org.

UNICEF. (2021). Let us learn: Empowering girls through education. UNICEF. Retrieved from https://www.unicef.org

Wanjama, L. N., & Njuguna, F. W. (2016). Documentation of gender responsive pedagogy as a best practice by the Forum for African Women Educationalists (FAWE). *UNGEI, FAWE, nd https://www. enspired. net/sites/default/files/uploaded-files/fawe-ungei-final_0. pdf*.

World Health Organization. (2000). *Female genital mutilation: a handbook for frontline workers* (No. WHO/FCH/WMH/00.5). World Health Organization.

Xiong, X., Wang, C., Wang, B., Shen, Z., Jiang, K., Gao, Z., & Ye, Y. (2021). Can transanal endoscopic microsurgery effectively treat T1 or T2 rectal cancer? A systematic review and meta-analysis. *Surgical oncology*, *37*, 101561.

Zubairu, Z. (2025). BRIDGING THE GENDER GAP IN STEM EDUCATION THROUGH INCLUSIVE TEACHING PRACTICES IN SECONDARY SCHOOLS OF KADUNA STATE, NIGERIA. *KOGI JOURNAL OF EDUCATION AND PEDAGOGY*, *4*(2), 26-33. https://kojep.org.ng/index.php/journal/article/view/39

Bios

Akem Solange Ojong is a PhD student in the School of Education at Drexel University, with a focus on Education. Her research interests include STEM education, global and international education, educational technology, social justice, multilingual education, and educational policy evaluation. She is an educator and pragmatic researcher committed to bridging educational divides by promoting equitable access, inclusion, and belonging in learning environments. Email: aso43@drexel.edu

Kareem Edouard, PhD, is an Assistant Professor in the School of Education, Drexel University. His research interests include digital equity, STEM education, academic access for underserved communities, and the development of cognitive and social skills through the integration of technology. He focuses on bridging the digital divide by ensuring equal and equitable access to the internet and computer technologies for minority students, enabling their full participation in a digitally connected and STEM-driven world. Email: ke388@drexel.edu

Acknowledgment Section

The authors did not use OpenAI's ChatGPT or any other AI tools for drafting, editing, or refining this manuscript. However, Grammarly was used to check for grammar and spelling errors.