1

BRIDGING THE GENDER GAP IN ARTIFICIAL INTELLIGENCE EDUCATION: A SYSTEMATIC REVIEW OF STEM-BASED EMPOWERMENT STRATEGIES FOR AFRICAN GIRLS

Dr. Prisca Oluchi Chuks-Ibe[1] Dr. Fatimah Jibril Abduldayan[2] & Martha Tizhe[3]
Head of Department, Library and Information Science, Federal University of Technology, Minna[1]
Corresponding author: pochuksibe@futminna.edu.ng[1]
https://orcid.org/0000-0003-3135-2124
&
University Librarian
Nigeria Maritime University, Okerenkoko, Delta State[2]
https://orcid.org/0000-0001-6588-0860[2]
&
Department of Library and Information Science, Federal University of Technology, Minna[3]
https://orcid.org/0009-0004-9984-6862[3]

Abstract

Purpose*: This study examines how STEM-based initiatives are being used to bridge the gender gap in artificial intelligence (AI) education among African girls. It aims to identify key barriers, explore existing interventions, and highlight strategies that promote inclusive participation in AI-related learning across the continent.*

Design/Methodology/Approach*: The study adopted a systematic review design using a narrative synthesis approach. Five research objectives and corresponding research questions guided the study. Relevant literature published between 2015 and 2025 was retrieved from databases such as Scopus, Web of Science, ERIC, AJOL, and Google Scholar, alongside grey literature from international organisations. A keyword-based search strategy with Boolean operators was used to identify studies focusing on STEM education, gender inclusion, and AI in Africa. Selected studies were screened through titles, abstracts, and full-text reviews based on defined inclusion and exclusion criteria. Data were analysed thematically to identify recurring patterns and key insights.*

Findings*: Findings: The findings reveal that African girls continue to face barriers such as cultural stereotypes, limited access to quality STEM education, inadequate digital infrastructure, and lack of mentorship. However, several effective strategies were identified, including grassroots digital empowerment programmes, mentorship and scholarship initiatives, coding and AI training camps, and continent-wide programmes such as African Girls Can Code. The study also found that partnerships between governments, NGOs, and private organisations play a critical role in expanding access and improving participation.*

Implication**:** *The study suggests that increasing girls' participation in AI education requires a combination of policy support, investment in digital infrastructure, and gender-responsive STEM curricula. There is also a need for sustained mentorship programmes, teacher training, and targeted funding to ensure that interventions are scalable and sustainable across different African contexts.*

Originality/Value**:** *This study is original and contributes to existing literature by providing a consolidated and up-to-date synthesis of STEM-based strategies aimed at promoting gender inclusion in AI education in Africa. It offers practical insights for policymakers, educators, and development partners seeking to design effective and context-relevant interventions.*

Keywords*: African Girls; Artificial Intelligence Education; Digital Inclusion; Gender Gap; STEM Education.*

Paper type: *Systematic Review*

Introduction

The value of education in human lives cannot be overstated in today's modern education because it enhances both human and material resources. According to Karmanje and Alhassan (2018), education was obtained one-on-one in the human history of civilisation, using face-to-face direct teaching and learning techniques. There were insufficient instructional resources to support teachers in their teaching. Teachers and students made every effort to make teaching and learning practicable, accessible, and unhindered. However, today's technology is increasingly

used in teaching and learning (Kataria, 2018). One technological advancement, artificial Intelligence (AI), has made considerable progress in becoming an essential component of the education sector. According to the United Nations Educational, Scientific and Cultural Organisation (UNESCO, 2021a), fifty percent of worldwide organisations have incorporated artificial Intelligence into their day-to-day functions. Similarly, educational and training institutes teach their teachers and students the skills of artificial intelligence. Artificial Intelligence (AI), according to Wartman and Combs (2018), is the ability of a machine or computer to act or think like a human being, to imitate and accomplish things that people do. Similarly, Mohammed and Watson (2019) defined artificial Intelligence as the skillful manner of machines or technologies programmed to imitate humans. Artificial Intelligence (AI) has infiltrated every aspect of human activity, including education, and hence, the areas of science, technology, engineering, and mathematics (STEM) are not immune to its impact.

In Africa, a significant digital divide persists, disproportionately affecting women and girls. The gender digital divide in Africa is a complex, multifaceted phenomenon (ImpactHER, 2024). For example, data from the International Telecommunication Union reveals that women in Africa are significantly less likely than men to own a mobile phone and to use the internet, with a digital access gender gap of 37% exacerbating these disparities. This divide is further deepened in AI-based education, where women, especially those in rural areas, find themselves at a disadvantage due to socio-cultural norms, economic barriers and limited access to necessary digital infrastructure. As a result, their participation in the digital economy is markedly restricted, curtailing the potential for growth and innovation. This divide is not just about connectivity; it’s about access, skills, and the ability to leverage technology for personal and economic growth (ImpactHER, 2024).

Africa's future hinges on transforming science, technology, engineering, and mathematics (STEM) education to unlock the talent of its youth and power sustainable development. By 2030, young Africans are expected to make up 42 percent of the world’s youth and account for 75 percent of those under age 35 in Africa, highlighting the need to improve STEM education to harness their potential (Population Reference Bureau, 2024). This demographic boom presents a significant opportunity for economic growth, innovation, and job creation, but it also highlights the pronounced skills gap in STEM fields that poses a serious challenge to the continent. To meet the anticipated demand for skilled professionals in engineering, healthcare, IT, and other vital sectors, Africa needs an

additional 23 million STEM graduates by 2030 to fill key roles. According to the United States Department of Education (2007 p.11), "STEM education programs are defined as those primarily intended to provide support for or to strengthen science, technology, engineering, or mathematics (STEM) education at the elementary and secondary through postgraduate levels, including adult education. Also, UNESCO (2022) reported that the increasing advancement of artificial Intelligence in conjunction with STEM has greatly assisted in learning robotics and cloud computing, transforming disciplines, economies, and industries through human/machine collaboration. UNESCO believes that STEM courses are critical in preparing youth for the future. STEM is key to drive innovation, economic growth and sustainable development in Africa. The increasingly more educated population is no doubt the strongest asset for the continent.

The growing influence of artificial intelligence (AI) across all sectors necessitates inclusive participation in its development and application. However, a significant gender gap persists globally in AI education and the broader STEM fields, with African girls particularly underrepresented. Factors such as cultural biases, limited access to quality STEM education, inadequate mentorship, and digital exclusion have created systemic barriers that deter female participation. Gender disparity is not only a matter of representation but also has significant implications for scientific innovation, economic growth, and societal equity. According to the United Nations (2021), increasing gender diversity in STEM leads to more inclusive technological advancements and fosters economic resilience. Addressing this gap requires targeted efforts to engage young women in STEM education from an early stage. Studies suggest that encouraging girls to participate in pre-college robotics activities can create pathways toward STEM careers, where female representation remains low (Dirsuweit & Gouws, 2023). Furthermore, UNESCO's Policy Guidelines on Inclusion for Education highlight ER's potential to promote gender balance and support inclusive education (Daniela & Lytras, 2019). Research also indicates that ER activities can enhance girls' motivation in STEM by familiarising them with coding and engineering concepts in an engaging way (Mauk *et al*., 2020). As AI becomes more embedded in education, health, agriculture, and governance, the exclusion of African girls threatens to widen gender inequities in the future workforce. While several interventions and policies have aimed to foster inclusion, there is a need to critically synthesise evidence on what works, where, and for whom. This study conducts a systematic review of STEM-based strategies that empower African girls and promote gender equity in AI education.

Statement of the Problem

Despite global advocacy for gender equality in education and technology, African girls continue to face exclusion from AI learning opportunities. Most STEM and AI curricula in the continent are either not accessible or not gender-responsive, resulting in a widening digital skills gap. Initiatives targeting girls in technology education often lack scalability, sustainability, or contextual fit. Moreover, the intersection of poverty, gender norms, and infrastructural limitations further compounds this disparity. There is limited consolidated evidence on the efficacy of STEM-based interventions in addressing this gender gap in AI education in Africa.

Despite progress, women and girls continue to face significant barriers, including cultural biases, limited access to female role models, and insufficient supportive policies. These challenges contribute to stark disparities, exemplified by the fact that women constitute less than 15% of engineering and technology researchers in some West and Central African countries. This gender gap not only stifles individual potential but also constrains the diversity of ideas, perspectives, and solutions essential for meaningful innovation and progress (UNESCO, 2022).

Objectives of the Study

The main objective of this review is to systematically examine STEM-based strategies and interventions aimed at bridging the gender gap in AI education among African girls. Specifically, the review seeks to:

1. examine the existing gender gap in Artificial Intelligence (AI) education within the African context, with emphasis on challenges faced by girls in STEM participation.
2. determine the role of STEM education in equipping African girls with the foundational skills
3. analyse STEM-based strategies that promote African girls' participation in AI education.

Research Questions

1. What are the existing gender gap in Artificial Intelligence (AI) education within the African context?
2. What are the roles of STEM education in equipping African girls with the foundational skills?
3. What are the STEM-based strategies that promote African girls' participation in AI education?

Theoretical Framework

Gender and Technology Theory and Social Cognitive Career Theory (SCCT) will guide this review.

The Gender and Technology Theory emerged in the late 1980s and 1990s through feminist scholars such as Judy, Wajcman (1991; 2004) and Cockburn (1992), who argued that technology is not neutral but

shaped by existing gender relations and cultural norms. This perspective highlights how the design, accessibility, and use of technology often reproduce patriarchal structures that marginalise women and restrict their participation in science and technology fields. In the context of artificial intelligence education, the theory helps to explain why AI and other STEM subjects are often perceived as male-dominated, and how cultural stereotypes, institutional biases, and unequal access to resources reinforce the exclusion of African girls from meaningful engagement in these areas.

The Social Cognitive Career Theory (SCCT) was introduced by Lent, Brown, and Hackett in 1994, building on Bandura's earlier Social Cognitive Theory (1986). SCCT explains how individuals' career interests and decisions are shaped by self-efficacy beliefs, outcome expectations, and personal goals, alongside environmental factors such as mentorship, role models, and institutional support. Applied to AI education, SCCT sheds light on how African girls' confidence in their abilities, the presence or absence of female mentors, and societal expectations influence their pursuit of careers in AI and STEM. By combining these two frameworks, this study can explore both the broader socio-cultural and institutional forces that limit girls' access to AI education, and the psychological processes that affect their aspirations, persistence, and eventual success in non-traditional fields.

Methodology

This study used a systematic review approach with a narrative synthesis method. The purpose of a systematic review is to bring together existing studies in a transparent and repeatable way, while reducing bias in how studies are selected, reviewed, and reported (Liberati *et al*., 2009). This method makes it possible to gather all available evidence on a topic, assess its quality, and provide a balanced summary. Narrative synthesis was chosen because it allows findings from different types of studies such as reports, case studies, and journal articles to be compared and discussed in a structured way (Lamé, 2019).

Search Strategy

A clear search strategy was developed to ensure that only the most relevant studies were identified (Atkinson & Cipriani, 2018). The process began by breaking down the research question into main concepts and identifying the key words used for each. These words were then combined into search strings using Boolean operators (AND, OR, NOT). The strings were adapted for each database to ensure compatibility. Searches were restricted to works published between January 2015 and May 2025. The use of Boolean operators made the search more precise: OR helped to capture any of the related words, AND ensured that all chosen words were included, while NOT

excluded unrelated results (Lawless & Foster, 2020).

Word Strings

From the central research question How can STEM-based interventions empower African girls to bridge the gender gap in AI education? the following search terms were created: "Artificial Intelligence education," "Gender gap in STEM," "African girls in STEM," "Girls in technology education," "STEM empowerment Africa," "AI inclusion and gender," "Women and digital skills Africa," and "STEM interventions Sub-Saharan Africa." The databases searched included Scopus, Web of Science, ERIC (ProQuest), Education Research Complete (EBSCO), ScienceDirect (Elsevier), AJOL, ResearchGate, and institutional repositories. Additional searches were carried out in Google Scholar, Semantic Scholar, and in grey literature sources such as reports from UNESCO, UNICEF, and the African Union.

Study Selection

The study selection process took place in three steps: title review, abstract review, and full-text review. Duplicate entries were removed first. Titles and abstracts were then screened to remove clearly irrelevant studies, and the remaining papers were read in full to check if they met the study requirements. Studies with relevant abstracts but no full text were excluded. To ensure only strong evidence was used, studies were included if they were peer-reviewed articles, conference papers, theses, or institutional reports, published between 2015 and 2025, and focused on African girls in STEM or AI education. Studies from outside Africa were only included if they offered lessons relevant to the African context. Studies focused on boys alone, general ICT programmes without a gender angle, non-African contexts with no relevance, or opinion pieces without data or evaluation were excluded. The selected studies were recorded in an Excel sheet to keep the process organised and transparent (Hornsberger and Sneha, 2020). The flow of the selection process is shown in a PRISMA diagram below:

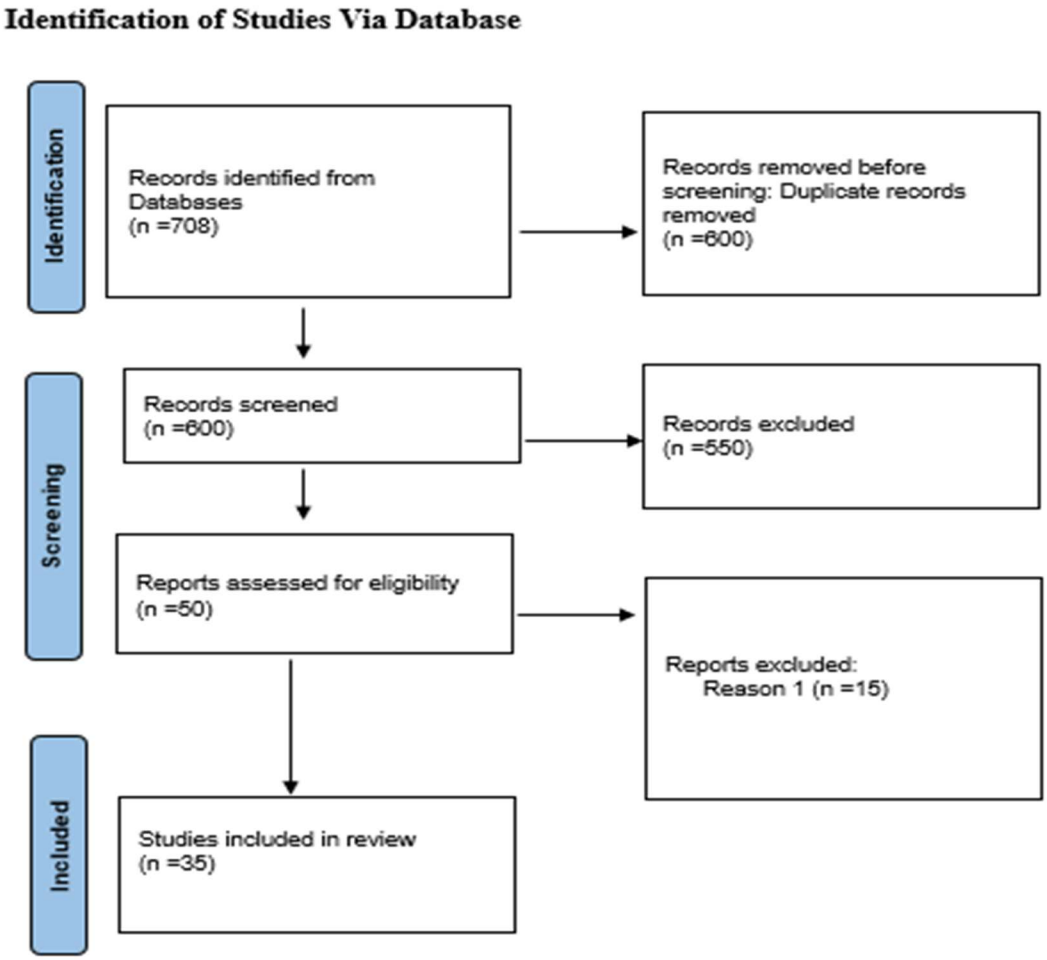

Figure 1: PRISMA Flow Diagram for the systematic review

Findings and Thematic Focus

The review organises findings into major themes:

Existing Gender Gap in Artificial Intelligence (AI) in Africa

The world has a gender equality problem, and Artificial Intelligence (AI) mirrors the gender bias in our society. Although globally more women are accessing the internet every year, in low-income countries, only 20 per cent are connected. The gender digital divide creates a data gap that is reflected in the gender bias in AI. Who creates AI and what biases are built into AI data (or not), can perpetuate, widen, or reduce gender equality gaps (United Nation Women Africa, 2024). The World Economic Forum reported in 2023 that women accounted for just 29 per cent of all science, technology, engineering and math (STEM) workers. Although more women are graduating and entering STEM jobs today than ever before, they are concentrated in entry level jobs and less likely to hold leadership positions. This gender imbalance is a multifaceted issue, with several contributing factors identified in the literature. One significant challenge is stereotype threat. The anxiety that one's performance will be judged based on a negative stereotype. Existing biases and

societal norms shape girl's confidence and interest in these traditionally male-dominated fields (Mauk *et al.,* 2020). Research suggests that children begin developing gender-related stereotypes as early as age five and apply them to themselves and others (Avalos *et al*., 2024). By the age of eight, they start making assumptions based on these stereotypes. For instance, they may associate trucks with masculinity because boys like trucks. During the early years of schooling, gender-based stereotypes become ingrained and normalised within the educational environment through unconscious biases (Dirsuweit & Gouws, 2023). Additionally, parents' and teachers' perceptions and stereotypes influence children's decisions and performance (Schön et al., 2020).

Career choices are largely shaped by the age of thirteen and some students decide against pursuing engineering studies as early as elementary school (i.e., by age twelve). Stereotypes and biases restrict young girls' educational and career choices, limiting their freedom to pursue STEM-related fields (Avalos et al., 2024). Wang et al. (2019) emphasise that although 67% of elementary-aged children express an interest in science, the percentage of girls interested drops significantly as they enter middle school.

To address these disparities, it is crucial to emphasise that gender does not determine ability or interest, and that everyone has the potential to succeed in STEM. Research shows no significant differences in academic performance between girls and boys in STEM subjects and studies confirm that women possess the same intellectual capabilities as men. While men tend to exhibit greater confidence in their abilities during introductory STEM courses, all students demonstrate equivalent competency by the end of these courses, reaching similar levels of computational skill development. Moreover, although initial self-confidence levels may vary, both boys and girls perform equally well in STEM-related subjects like coding and robotics when completing a full curriculum. Notably, research indicates that women's confidence in STEM increases with practice (Tosato & Banzato, 2017).

Role of STEM Education in Equipping African Girls

STEM education plays a transformative role in shaping the future of girls, particularly within the African context where educational inequalities remain deeply entrenched. Research has shown that access to science, technology, engineering, and mathematics subjects not only enhances girls' cognitive and technical competencies but also empowers them to participate actively in innovative sectors such as Artificial Intelligence (AI), which is increasingly driving global development (UNICEF, 2020). By cultivating analytical thinking, problem-solving, and digital literacy, STEM learning equips girls

with the foundational tools required to thrive in AI-driven economies (UNESCO, 2021b). Furthermore, the empowerment derived from STEM education extends beyond personal development; it contributes to wider social and economic transformation. Studies indicate that when girls are supported to pursue STEM, they not only increase their own earning potential but also foster innovation that addresses community challenges, such as healthcare access, climate adaptation, and digital inclusion (World Bank, 2018). Within the scope of AI, ensuring that girls participate equitably in STEM education enhances diversity in innovation processes, producing technologies that are more inclusive and responsive to the needs of society. According to UNICEF (2020) the following are the importance of STEM-based education for African girls:

- A STEM education a improves girls' awareness and capacity to participate in actions that protect the environment and that can position them as leaders in their communities, actively engaged in building greener and a more sustainable society
- Girls who develop STEM skills are better prepared to contribute to scientific research and to technological development initiatives heading to innovative solutions in industrial sectors.
- Access to STEM education contributes to girls' opportunities to develop transferable, technical and vocational skills, for employment, decent jobs and entrepreneurship, has the potential to accelerate limination of gender disparities and access to digital technologies and digital learning and positions girls and women as apable players in the promotion of sustainable development and gender equality in all spheres of life.
- STEM for girls can enhance their access and decision-making in relation to their sexual and reproductive health and reproductive rights, and can strengthen their use of enabling technology, in particular information and communications technology in ways that can potentially enlarge their lives and work-related opportunities.
- STEM knowledge and skills can equip girls with the tools to transition from education to employment so that young women improve their livelihoods and contribute to poverty reduction and economic growth.

STEM-based strategies that promote African girls' participation in AI education. Across Africa, several STEM-based strategies have been implemented to increase the participation of girls in Artificial Intelligence (AI) and related fields. In Ethiopia, the

African Girls Can Code Initiative (AGCCI) has played a central role, combining coding boot camps with policy advocacy aimed at mainstreaming coding and gender-responsive curricula into the national education system (United Nation Women, 2025a). In Ghana, the government-led Girls-in-ICT Program has provided coding and ICT training to over 5,000 girls since 2012, with recent partnerships expanding its reach and strengthening girls' digital literacy (United Nation Women, 2025a).

Similarly, South Africa's GirlCode has trained tens of thousands of young women through hackathons, coding clubs, and internship placements, while Women in AI Africa focuses on early AI literacy and mentorship (United Nation Women, 2025b). In Kenya, organisations like AkiraChix provide intensive training in coding, robotics, and entrepreneurship, targeting girls from disadvantaged communities, while Technovation teams from Nairobi have developed AI-based applications addressing local challenges such as healthcare and agriculture. Collectively, these examples illustrate that strategies range from policy-driven approaches (e.g., Ethiopia, Ghana), to community and NGO-driven interventions (e.g., Nigeria, Kenya, South Africa), each designed to create pipelines for girls' entry into AI education. The following are STEM-based Strategies Empowering African Girls in AI Education:

1. Youth-Led Technology Empowerment Initiatives (Tanzania)

In Tanzania, an NGO called Her Initiative, founded by Lydia Charles Moyo in 2019, is providing technology-driven pathways to empower young women. The organisation combines education with entrepreneurial training, using digital tools to close the gender gap in the country's digital economy. Moyo's work has received international recognition, including the Global Citizen Prize (April 2024) and the KBF Africa Prize (June 2024), demonstrating the transformative power of community-led, women-centred approaches (Obonyo, 2024).

2. Advocacy and Mentorship for Women in STEM (Ghana)

In Ghana, Larisa Akrofie, founder of Levers in Heels, advocates for stronger investment in STEM education for women. Speaking at a forum organised by MEST Africa, she argued that greater participation requires not only quality education but also mentorship, scholarships, vocational training, and networking opportunities. Such support helps to remove financial and social barriers that often prevent girls from pursuing careers in STEM and related fields, including AI.

3. Cross-Border AI and Coding Programmes (Africa-wide)

A continental initiative, African Girls Can Code, connects girls from different countries to digital learning opportunities. The programme introduces participants to artificial intelligence (AI), the Internet of Things (IoT), and coding for gaming, whilst also fostering peer support and cross-cultural collaboration. By doing so, it builds the foundation for young African women to enter the AI ecosystem with confidence and relevant skills (Obonyo, 2024).

4. Multi-Stakeholder Digital Literacy Campaigns (Pan-African)

The African Union's Make Africa Digital (M.A.D.) Campaign, in partnership with Afreximbank and Google, has already provided over 4,000 young people—including a significant number of girls—with essential digital literacy skills. Although not solely AI-focused, such initiatives prepare girls with the baseline technological competence needed to transition into more advanced fields such as data science and artificial intelligence (Obonyo, 2024).

5. Policy and Mentorship Support (Nigeria)

Nigeria's adoption of a Science, Technology, and Innovation (STI) policy since 2012 has created a framework for women's increased involvement in STEM. While the article highlights broader policy developments rather than specific AI projects, the inclusion of mentorship and institutional support within this framework demonstrates how government-led strategies can create enabling environments for young women to access AI-related education and careers (Obonyo, 2024)..

These strategies highlight the importance of context-sensitive approaches that respond to the cultural, economic, and educational barriers faced by African girls. They demonstrate that closing the gender gap in AI is not simply about providing access to technology, but also about combining skills development, mentorship, financial support, and policy change. Furthermore, many of these initiatives rely on partnerships between governments, NGOs, and private organisations, ensuring wider reach and sustainability. Together, they contribute to creating a pipeline of digitally literate young women who are not only equipped with the technical knowledge but also the confidence and networks required to succeed in AI education and careers (Obonyo, 2024).

Discussion of Findings

Theme	Key Points	Implications
Existing gender gap in Artificial Intelligence (AI)	Cultural stereotypes, lack of mentorship, gender bias, limited infrastructure, and the digital divide restrict girls' participation. Confidence gaps emerge early in schooling.	Barriers need structural responses policy reforms, mentorship, teacher training, and inclusive curricula

Role of STEM Education in Equipping African Girls	Revealed that STEM education plays a central role in empowering African girls and narrowing the gender gap in Artificial Intelligence education. Evidence shows that exposure to STEM subjects enhances girls' digital literacy, critical thinking, and problem-solving abilities, which are essential for participation in AI-related fields	Expanding access to STEM education for girls is not merely a matter of educational equity but a strategic investment in Africa's socio-economic and technological future. If girls are systematically supported to pursue STEM, they are more likely to contribute meaningfully to Artificial Intelligence development, ensuring that innovation reflects diverse perspectives and serves wider societal needs
STEM-based strategies	Initiatives like AGCCI (Ethiopia), Girls-in-ICT (Ghana), GirlCode (South Africa), AkiraChix (Kenya), and policy frameworks (Nigeria) provide training, mentorship, coding boot camps, hackathons, and advocacy	Show that diverse approaches (policy-driven, NGO-led, community-based) are effective in increasing girls' participation in AI education
Policy and practice implications	Early gender-responsive AI curricula, teacher training in STEM–AI pedagogy, long-term government funding, and multi-stakeholder partnerships are crucial	Sustainable inclusion requires systemic support, not just short-term interventions

Implications for Policy and Practice

1. Integrating Gender-Responsive AI Curricula at Early Levels

Introducing AI education at foundational stages of schooling embed with gender sensitivity is crucial to precluding entrenched stereotypes that STEM is a male domain. A recent Nigerian initiative, STEMXX Nigeria, demonstrates the power of such approaches. Since its launch, it has reached over 2,500 marginalised rural girls aged 9–16, fostering interest in STEM and boosting confidence by up to 85 %—all through hands-on, gender-responsive lessons and community-based mini-projects (). Moreover, the need for a clear policy framework to govern AI use in early education has been emphasised by Aliyu (2025), who warns that generative AI's rapid introduction into early childhood settings risks eroding equity, inclusion, and human agency unless accompanied by strong safeguards and governance. Together, these developments underscore the importance of embedding AI literacy early—with curricula that are both gender-aware and ethically regulated.

2. Teacher Training in STEM–AI Pedagogy

Effective AI education depends on educators who are technically capable and gender-conscious in their pedagogy. European efforts under Horizon 2020 have led to the establishment of Gender Equality Academies and Communities of Practice to support teachers in adopting gender-responsive pedagogy (GRP) an approach that fosters inclusive learning by challenging stereotypes, recognising intersectionality, and promoting equity. Meanwhile, explorations into the use of large language models (LLMs) show promise: the CulturAIEd tool aids K–12 teachers in embedding culturally responsive practices into AI-literacy curricula, improving educators' confidence and implementation efficiency. These findings point to the necessity of blended training models not only in AI but also in gender-inclusive, culturally relevant pedagogy that empowers teachers to bring transformative learning to diverse classrooms.

3. Government Support and Funding for Girl-Focused STEM Programmes

Pilot interventions often falter without sustained government backing. In Australia, the "Boosting the Next Generation of Women in STEM" program allocates AUD 42.4 million (approx.) over seven years to support women pursuing advanced STEM qualifications through scholarships and associated support. Closer to home, Nigeria's MAY-I (Motivating African Youths Initiative) has pledged to empower one million women and girls in STEM and AI, while urging policy reform to reinforce institutional support (The Guardian Nigeria). These examples highlight the critical role of long-term investment and policy commitment shifting girl-centric programming from marginal pilots to integral components of national education strategies aligned with Sustainable Development Goals.

4. Partnerships between Schools, NGOs, and Tech Industries

Scaling girl-focused STEM and AI education requires effective collaboration across sectors. In Nigeria, Solar Sister and the ExxonMobil Foundation jointly launched a national STEM education project to engage over 300 schoolgirls aged 11–14, enabling hands-on experience and sparking curiosity across geopolitical zones (The Guardian Nigeria). Similarly, the Telangana government in India partnered with multiple NGOs—EkStep, Physics Wallah, Khan Academy, Pi Jam, Educate Girls to expand AI-facilitated learning, coding education, exam coaching, and girls' literacy across thousands of schools (The Times of India). These multi-stakeholder models illustrate how schools, NGOs, and the private sector can pool resources, align technical and community expertise, and ensure TEL (technology-enhanced learning) initiatives are scalable, context-relevant, and inclusive.

Conclusion

This systematic review will consolidate existing knowledge on bridging the gender gap in AI education in Africa through STEM strategies. By mapping barriers, evaluating interventions, and highlighting policy gaps, the study aims to offer practical and scalable recommendations for policymakers, educators, and development partners. Ensuring girls' inclusion in the future of AI is not only a matter of equity but also a strategic imperative for Africa's development. As AI continues to change and affect our world, it must support equal rights for men and women. We can work towards a more fair and inclusive AI future that helps everyone by teaching girls how to use technology and fixing the biases that are built into the AI development proces

Recommendations

1. Expand Free Internet Access Points: Create more public access points with free Wi-Fi in both urban and rural areas to improve internet accessibility.

2. Community Tech Hubs: Establish community tech hubs or centers that offer access to digital devices, internet, and training resources, specifically targeting underserved regions.

3**.Online Platforms for Digital Skills Sharing:** Create online platforms or forums where women can share digital skills, experiences, and resources with each other.

4.Incentivise Private Sector Involvement: Offer tax incentives or other benefits to private sector companies that actively participate in digital literacy initiatives for women and girls.

5. Tailored AI Curriculum Development: Develop AI curricula that address the specific needs and interests of women and girls, incorporating real-world applications that demonstrate the impact of AI in various fields. To prepare students (girls) for the future workforce, it is essential to modernise the

curriculum by integrating data literacy and AI concepts. This includes introducing new STEM courses focused on the practical applications of AI and embedding AI-related topics into existing STEM curricula. Such revisions will help them understand AI's influence across various industries and equip them with the necessary skills.

6. Advocacy and Policy Reform: Advocate for policy reforms that support digital inclusion and education for girls, such as laws that facilitate internet access and protection against online harassment. Policymakers should mandate the strategic incorporation of advanced AI technologies into educational frameworks. This initiative will revolutionise teaching and learning by fostering a more dynamic, adaptive, and personalised educational environment aligned with the 21st-century knowledge economy's demands

7. **Gender-sensitive Teacher and Trainer Training Programs:** Implement training programs for teachers and trainers to enhance their capacity to deliver effective digital literacy and AI education, with a focus on gender-sensitive teaching methodologies. The government should prioritise the recruitment of AI experts to train educators, empowering them to harness AI in their teaching practices. Transforming teachers into tech-savvy facilitators will maximize AI's potential to create engaging, individualised learning experiences, enhancing STEM education

8. Promoting Inclusion and Diversity: Stakeholders, should collaborate to promote inclusion and diversification in STEM fields. Initiatives should target girls from marginalised or underprivileged areas and leverage AI to create flexible learning environments that accommodate diverse student needs, ensuring that every learner has the opportunity to excel.

References

Avalos, S., Granados, C., Tafur, M., Arroyo, D., & Roncal, S. J. (2024, March). Allybot: Design studio to enhance girls' participation in technology and art. In Companion of the 2024 ACM/IEEE international conference on human-robot interaction (pp. 219–222). Association for Computing Machinery

Bandura, A. (1986). Social foundations of thought and action: A social cognitive theory. Englewood Cliffs, NJ: Prentice Hall.

Cockburn, C. (1992). The circuit of technology: Gender, identity and power. In R. Silverstone & E. Hirsch (Eds.), Consuming technologies: Media and information in domestic spaces (pp. 32–47). London: Routledge.

Daniela, L., & Lytras, M. D. (2019). Educational robotics for inclusive

education. Technology, Knowledge and Learning, 24, 219–225.

Dirsuweit, T., & Gouws, P. (2023). Barriers to the full participation of girls in robotics: A case study of a South African community of practice. Interchange, 54(4), 439–457

Hornsberger, B and Sneha, R. (2020) *Designing Inclusion and Exclusion Criteria.* University of Pennsylvania.

ImpactHER. (2024, September 29). From disparity to digital empowerment: Bridging the divide for women and girls. ImpactHER. Available at https://share.google/4MIvllHTswDcxtoUQ/(Acessed on 7/2/2026)

Karmanje, A. R. &Alhassan, N. S. (2018). Impact of technology on teaching and learning. International Journal of Research and Analytical. Available at: https://doi.org/10.7921/g0pn93hq/(Accessed on 24/11/2025)

Kataria, M. V. (2018). Challenges in effective implementation of e-learning platforms in apparel education. International Journal of Research and Analytical Reviews, 5, 1 – 14.

Mohammed P.S., & Watson E. N. (2019). Towards inclusive education in the age of artificial Intelligence: Perspectives, challenges, and opportunities. In: Knox J., Wang Y., Gallagher M. (eds) Artificial Intelligence and Inclusive Education. Perspectives on Rethinking and Reforming Education. Singapore: Springer. Available at https://doi.org/10.1007/978-981-13-8161-4_2/ (Accessed on 8/2/2026)

Lamé G., (2019) *Systematic Literature Review*s: An Introduction. International Conference on Engineering Design. Delft, Netherlands. pp.1633-1642,

Lawless J. & Foster M. J., (2020) Searching Systematically and Comprehensively. In C.E. Toronto, and R. Remington, (Eds.), A Step-by-Step Guide to Conducting an Integrative Review. p.22-43. Switzerland: Springer Nature. National research council, (2012). Education for life and work developing transferable knowledge and skills in 21st Century. Washington DC, National Academies Press.

Liberati, A., Altman, D.G., Tetzlaff, J., Mulrow, C., Gøtzsche, P.C., Ioannidis, J.P.A., Clarke, M., Devereaux, P.J., Kleijnen, J. and Moher, D. (2009) "The PRISMA Statement for Reporting Systematic Reviews and Meta-Analyses of Studies That Evaluate Health Care Interventions: Explanation and Elaboration", PLOS Medicine, Vol. 6 No. 7, Available

http://doi.org/10.1371/journal.pmed.1000100/ (Accessed on 12/12/2025)

Obonyo, R. (2024). Empowering girls in Africa to embrace STEM. Africa Renewal Available at:https://africarenewal.un.org/en/magazine/empowering-girls-africa-embrace-stem/ (Accesses 14/11/2025)

Schön, S., Rosenova, M., Ebner, M., & Grandl, M. (2020). How to support girls' participation at projects in makerspace settings. Overview on current recommendations. In Educational robotics in the context of the maker movement (pp. 193–196). Springer International Publishing.

Tosato, P., & Banzato, M. (2017, July 3–6). Gender difference in handmade robotics for children. IFIP World Conference on Computers in Education (pp. 209–220), Dublin, Ireland.

United Nations. (2021). Progress on the sustainable development goals: The gender snapshot 2021. United Nations. Available online:https://unstats.un.org/sdgs/gender-snapshot/2021/ (accessed on 1 February 2025)

United Nations Children's Fund (UNICEF). (2020). Reimagining girls' education through STEM: Summary. UNICEF. https://www.unicef.org/media/84051/file/Reimagining-girls-education-through-stem-summary-2020.pdf

United Nations Educational, Scientific and Cultural Organisation UNESCO (2021a). Understanding the impact of artificial intelligence on skills development. UNESCO-UNEVOC International Centre for Technical and Vocational Education and Training. Available at: http://creativecommons.org/licenses/by sa/3.0/igo/./(Accesses 12/12/2025)

United Nations Educational, Scientific and Cultural Organisation (UNESCO). (2021b). Unlocking Africa's potential: Investing in STEM education. UNESCO. https://www.unesco.org/en/articles/unlocking-africas-potential-investing-stem-education

United Nations Educational, Scientific and Cultural Organisation UNESCO (2022). Science, Technology, Engineering and Mathematics lay the way for AI in Africa. Available at: https://www.unesco.org/en/articles/science-technology-engineering-and-mathematics-lay-way-ai-africa//(Accesses 12/12/2025)

United Nations Women Africa (2024). Artificial Intelligence and gender equality. Available at

https://www.google.com/url?sa=t&source=web&rct=j&opi=89978449&url=https://africa.unwomen.org/en/stories/news/2024/05/artificial-intelligence-and-genderequality&ved=2ahUKEwi325jqiMaPAxV4T0EAHdAaJmkQFnoECCIQAQ&usg=AOvVaw1yVep-nzftMRlsx1ZDB72O. /./(Accesses 12/12/2025)

United Nations Women. (2025a, August). African Girls Can Code Initiative (AGCCI). UN Women Africa – Liaison Office to AU and UNECA. Availabe at https://africa.unwomen.org/en/where-we-are/eastern-and-southern-africa/liaison-office-to-au-and-uneca/african-girls-can-code-initiative-agcci//./(Accesses 02/12/2025)

United Nations Women. (2025b, August). Five ways African Girls Can Code is changing young women's lives in South Africa. UN Women Africa – Take Five Story. Available at https://africa.unwomen.org/en/stories/take-five/2025/08/five-ways-african-girls-can-code-is-changing-young-womens-lives-in-south-africa/(Accesses 17/11/2025)

United States Department of Education (2007). Artificial Intelligence – Office of Educational Technology. Available at: https://nces.ed.gov/pubs2007/2007064.pdf/ (Accesses 17/11/2025)

Wajcman, J. (1991). Feminism confronts technology. Cambridge: Polity Press.

Wartman, S. A., & Combs, C. D. (2018). Medical education must move from the information age to the age of Artificial Intelligence. Academic Medicine, 93(8), 1107-1109.

Wang, S., Andrei, S., Urbina, O., & Sisk, D. A. (2019, October 16–19). A coding/programming academy for 6th-grade females to increase knowledge and interest in computer science. 2019 IEEE Frontiers in Education Conference (FIE) (pp. 1–8), Covington, KY, USA

World Bank. (2018). Missed opportunities: The high cost of not educating girls. Washington, DC: World Bank. Available at https://documents.worldbank.org/en/publication/documents-reports/documentdetail/120381538135007444/missed-opportunities-the-high-cost-of-not-educating-girls/(Accesses 17/02/2026)