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Case report

African women in science and development, bridging the gender gap

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ABSTRACT

Science and technology play a fundamental role in driving social progress and economic growth in today's rapidly evolving world. Yet, despite considerable advancements, the gender gap in science remains a harsh reality, particularly for African women. This inequality directly impedes their invaluable perspectives and contributions to scientific advancements and innovations. Africa's development requires significant investment in science, technology, engineering, and mathematics (STEM) fields and leadership. This opinion piece delves into the gender disparity prevailing in STEM, emphasizes the challenges that African women experience, highlights the immense potential that African women possess, and finally advocates for immediate efforts to bridge this gap.

1. Introduction

Global economic and social prosperity considerably rely on the progress made in science, technology, engineering, and mathematics (STEM) (Hammond, Matulevich, Beegle, Kumaraswamy, & Krishna, 2020). STEM innovations play an instrumental role in solving global challenges such as poverty, communicable and non-communicable diseases, climate change, and in increasing energy access and quality education (Hammond et al., 2020). Yet, women who represent half of the world's population, are still significantly underrepresented in higher education studies and careers in STEM fields (Hammond et al., 2020). This is particularly true in sub-Saharan Africa, where women make up only 30% of STEM-related careers (UNESCO, 2017).

In the realm of science and development, African women have been hidden and unsung heroes, striving to make significant contributions while facing multifaceted challenges. Their journey has been hampered by a persistent gender gap worsened by the African context that, limits their access to opportunities and recognition. This opinion paper thus aims to (i) explore the gender gap in science and development, (ii) shed light on the challenges faced by African women entering or pursuing a career in STEM, and (iii) propose strategies that are imperative to overcome these barriers for a brighter future.

2. The gender gap in science and development: A bleak reality

The gender gap in science and development is an undeniable reality that impedes progress and innovation. The compounding factors contributing to gender bias and stereotype disparities in STEM fields emerge as early as kindergarten in female life. Gender stereotypes affect career choices, hinder the retention of women in STEM fields and

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furthermore diminish their perceived potential (McKinnon & O'Connell, 2020). Gender stereotypes also discourage young girls from pursuing scientific careers and undermine their potential towards diverse perspectives in research and development (R&D) and innovation (McKinnon & O'Connell, 2020).

Advances in STEM fields necessitate harnessing human resources of both men and women (Fisher, Nyabaro, Mendum, & Osiru, 2020). A report revealed a decreased trend in the number of girls and women from 53% in high school to 28% at the Ph.D. levels (Huyer, 2015). While acquiring PhDs is a significant milestone in the academic journey, it should not be considered in silos to drive progress but must be accompanied by a broader ecosystem that fosters R&D and innovation. Nurturing a culture of exploration and usability from the earliest onset of STEM education is instrumental to sustainably unlock the full potential of African women, and to ensure that they contribute to leadership roles, and influence scientific advancements globally (Babalola, du Plessis, & Babalola, 2021). Identifying and addressing the challenges that contribute to barriers being faced by women from engaging in the STEM fields would be critical in bridging this gender gap.

3. A career in science, technology, engineering and mathematics: A dive into the bottlenecks of African women

While gender disparity affects women across the world, it is exacerbated for African women in STEM where the bottlenecks are varied and deeply entrenched in societal structures. These challenges are of great concern as they contribute to a vicious cycle that perpetuates disparity, reinforces gender stereotypes, narrows mentorship and role models, limits equal access to resources and opportunities, and finally disturbs work-life balance (Hammond et al., 2020; Babalola et al., 2021; United Nations Children's Fund & Itu, 2020).

3.1. Limited access to quality education

Access to quality education is a fundamental prerequisite for pursuing a career in STEM. Unfortunately, African women often encounter barriers such as limited resources, inadequate infrastructure, and cultural biases that prioritize male education. Cultural norms that occur early in life notably family life like early marriage, and societal expectations often prioritize household duties over education, leaving many aspiring female scientists with limited opportunities to excel (Hammond et al., 2020). These cultural biases perpetuate the belief that women lack the intellectual capacity to succeed in science and development. Limited access to quality education thus restricts their ability to gain the necessary knowledge and skills to excel in STEM fields, further widening the gender gap.

3.2. Societal stereotypes and gender biases

African women in STEM education and careers face deep-seated societal stereotypes and gender bias including early marriage, traditional gender role prioritizing family and motherhood over career, stereotype threat and limited educational opportunities, that act as significant deterrents (Babalola et al., 2021). These societal stereotypes and biases emerge early in life, before the education path, is reinforced along the education path cutting across environments, from parents to peers, teachers to classroom materials, and policymakers to policies (Hammond et al., 2020). Such prejudices restrict the career advancement of African women and undermine their self-confidence, aspirations, identity, interest, motivation, mindset, and self-efficacy (Hammond et al., 2020). Addressing these biases is crucial to empower women and create an environment that nurtures their interest and aptitude in STEM.

3.3. Lack of role models and mentorship

The low number, combined with the suboptimal visibility of female role models and mentors in STEM careers, poses a significant challenge for African women. The scarcity of female representation in STEM fields deprives young women of relatable figures who can inspire and guide them. Establishing mentorship programs and promoting the visibility of successful African women in STEM can provide guidance, support, and encouragement to aspiring individuals (Babalola, du Plessis, & Babalola, 2023).

3.4. Insufficient networking opportunities

Networking plays a vital role in career advancement, knowledge sharing, and accessing opportunities. African women often face limited networking avenues, that can hinder their professional growth in STEM. Establishing inclusive networks can help African women connect with peers, industry professionals and potential collaborators. This can also help foster a sense of belonging and open doors to new possibilities (Fisher et al., 2020). Outreach events targeting young girls early in life (primary or secondary school) or engaging with parents can also stimulate vocation in STEM (Hammond et al., 2020).

3.5. Work-life balance and family pressures

Balancing personal and professional responsibilities can be particularly challenging for African women pursuing careers in STEM. Traditional gender roles and societal expectations often place additional pressures on women to prioritize family obligations over their professional aspirations. Lack of support systems and flexible policies often forces them to choose between their careers and family, affecting their aspirations and limiting their contributions. Implementing family-friendly policies and facilities that acknowledge women's roles as wives and mothers, promoting equal sharing of domestic responsibilities, and challenging gender norms can contribute to a more supportive environment for African women in STEM (Fisher et al., 2020; Babalola et al., 2021).

4. Unleashing the potential of African women: The power of representation and role models

Africa's achievement of the 2063 African Union goals could be hampered without considerable investment in STEM education and leadership (AU, 2063). Multifaceted, tailored, and all-inclusive strategies are urgently needed to stimulate girls and women to undertake and remain in STEM fields (Table 1). These strategies include encouraging interest in STEM early in education, using role models, creating learning resources that portray girls and women in STEM, better equipping teachers, and supporting a shift in classroom dynamics (Fisher et al., 2020). Detailed below are the key strategies that we identified as of paramount importance to bridge the gender gap in Africa.

4.1. Strengthening political will

Governments and stakeholders must prioritize investments in girls' education and break down barriers that prevent African women from accessing equal learning opportunities in as far as quality education is concerned. Funding agencies should actively expand scholarships, grants, and initiatives that target young girls, female students, and women researchers. This strategy may empower them to pursue their endeavours in STEM. Academic and research institutions must take proactive measures to eliminate gender biases in recruitment, promotion, as well as sexual harassment and gender-based violence (Babalola et al., 2021). Implementing transparent and equitable policies along with childcare assistance and infrastructure can foster a supportive and inclusive environment. Establishing supportive policy and regulatory

Table 1
Summary of challenges, impact and proposed strategies to bridge gender gap in Africa.

Challenges	Impact	Proposed Strategies
Limited Access to Quality Education	Unequal Access to Resources and Opportunities	Enhancing Access to Quality Education
		Promote societal and behavioral changes
	Narrowed Skill Development and Expertise	Strengthen global collaboration and partnerships
	Missed Talent and Potential	Inspiring young girls and women from home throughout their life journey
	Lost Economic Opportunities	Funding and Infrastructure
Societal Stereotypes and Gender Biases	Reinforcing Gender Stereotypes	Increase representation and visibility of female role models and mentors
		Empowerment and Gender Equality
	Reduced Influence on policies and practices	Addressing Societal and Institutional Biases
Lack of Role Models and Mentorship	Reduced role modeling and mentorship	Addressing Societal Challenges
		Empowerment and Gender Equality
		Fostering Mentorship and Support Networks
		Encouraging Female Participation in Research & Development
Insufficient Networking Opportunities	Limited Access to Opportunities	Capacity Building and Knowledge
		Strengthen public–private/ academic-industry collaboration and partnerships
Work-Life Balance and Family Pressures	Depression, loss of self-confidence, abandon	Policy and Regulatory Frameworks
	Absence of supportive environment	Funding and Infrastructure
	Lack of Diverse Perspectives	Promoting Entrepreneurship and Innovation

frameworks for R&D activities such as incentives for innovation, streamlined approval processes, intellectual property protection, and fair and transparent funding mechanisms is essential to harness the immense talent of African women (Hammond et al., 2020; Babalola et al., 2021). Furthermore, encouraging translational-based studies that seek practical alternatives for real-world solutions will boost entrepreneurship within the scientific community, provide incubation centres and start-ups, and promote technology transfer essential to bridge the gap between academia and industry.

4.2. Role model, mentorship and networking opportunities

Visible role models and representation of successful African women scientists play a pivotal role in inspiring the next generation. Celebrating African women's achievements can empower young girls to dream big and believe that they too can make a difference in today's world (Babalola et al., 2023). Such celebration should not only target established women but also peers and young girls. Supportive and tailored mentorship programs and networks for African women in science and development can provide guidance and encouragement. Several initiatives exist to bridge the gender gap and support women in STEM with the most notable examples being Girls Who Code (https://girlswhocode.com/), TechWomen (https://www.techwomen.org/), Association for Women in Science (https://awis.org/), 500 women scientists (https://500womenscientists.org/), H3ABioNET (https://www.h3abionet.org/), African Women in Science and Engineering (https://aawse.org/), African Academy of Science (https://aasciences.africa/), and Organization for Women in Science for the Developing World (https://owsd.net/), among others. These initiatives offer vital opportunities for skill development, networking, and personal growth, helping women overcome barriers and thrive in their chosen fields. Other programs and organisations exist globally but much is needed to sustainably raise the potential and close gender gaps of African women in STEM and thereby contribute to Africa's sustainable development.

5. Conclusion

Bridging the gender gap in science and development is not just an issue of fairness; it is imperative for unleashing the full potential of African women and accelerating societal progress. Investing in quality education, dismantling biases, providing equal opportunities, and fostering inclusive and supportive environments. It can unlock their immense potential and lead to a future where African women drive innovations and contribute to sustainable development. Let us champion their cause and recognize that their success is intertwined with the progress of our societies as a whole.

CRediT authorship contribution statement

Luria Leslie Founou: Conceptualization, Methodology, Writing – original draft. **Kaunda Yamba:** . **Vinie Kouamou:** Writing – review & editing. **Esther Eyram Asare Yeboah:** Writing – review & editing. **Binta Saidy:** Writing – review & editing. **Lalia A. Jawara:** Writing – review & editing. **Haddy Bah:** Writing – review & editing. **Bissoume Sambe Ba:** Writing – review & editing. **Mabel Kamweli Aworh:** Writing – review & editing. **Saffiatou Darboe:** Conceptualization, Methodology, Supervision, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

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