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Barriers Women Encounter in STEM Literacy

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Abstract:

This review synthesizes research on barriers which women face in STEM and in digital literacy including social, educational, and also economic factors in order to address persistent gender disparities along with underrepresentation. The review intended to evaluate knowledge about these barriers and benchmark approaches to gender equity. It also sought to identify intersectional influences, analyse cultural plus institutional roles, with a comparison of regional trends in female STEM participation. Sixty-nine studies underwent systematic analysis including varied global contexts with methodologies examining social norms, educational structures, economic constraints, intersectionality, and intervention effectiveness. Findings reveal that secured social as well as cultural norms critically limit women's STEM engagement because these norms include stereotypes along with family responsibilities educational barriers impede enrollment plus retention because these barriers are biased curricula together with a lack of role models economic factors restrict career progression because these factors include wage gaps in addition to workplace discrimination and intersectional identities exacerbate challenges particularly for women of colour plus marginalized groups. Though promising, mentorship and policy reforms require rigid longitudinal evaluation. Disparities of the regional kind are highlighting obstacles of context. These findings underscore the complex multifactorial nature of barriers that obstruct women's full participation in STEM and digital literacy. The review stresses the need of intersectional strategies that are evidence-based along with systemic reforms so as to foster environments that are inclusive for educational reasons and professional reasons, and it informs research that is future-based in addition to policy that is aimed at advancing equity in gender in STEM fields all over the world.

Keywords: *Women in STEM; Digital Literacy; Gender Inequality; Gender Gap; Social Barriers; Educational Barriers; Economic Barriers; Intersectionality; Gender Stereotypes; Digital Divide; STEM Education; Women Empowerment; Inclusive Education; Workforce Participation; Gender Equity; Policy Interventions*

Introduction:

Investigating the obstacles women encounter in STEM and digital literacy has become an essential field of study owing to ongoing gender imbalances that hinder women's involvement and progress in these areas (Niño-Cortés et al., 2024) (Roy et al., 2024). In recent decades, research has shown the changes in gender disparities in STEM education and jobs, emphasizing the impact of societal standards, educational methods, and financial limitations (Musundire, 2024) (Varavva, 2024). In spite of worldwide initiatives to advance gender equality, women continue to be underrepresented in STEM fields, evidenced by data indicating that female IT professionals make up only 16.5% of the workforce in Europe (Szlávi, 2021) and that women possess less than 30% of STEM degrees in numerous nations (Stoet & Geary, 2018). This lack of representation carries important social and economic consequences, as it limits diversity, innovation, and fair access to digital economies (Idris et al., 2024) (Lechman & Popowska, 2022).

This review focuses on the complex obstacles—social, educational, and financial—that impede women's participation and achievement in STEM and digital literacy (Avolio et al., 2020) (Owuondo, 2023). Although many studies have pinpointed elements like gender stereotypes, absence of role models, and institutional biases (Graham et al., 2016) (Aljuaid & Liu, 2023), a knowledge gap persists concerning how these obstacles overlap and differ in various cultural and socioeconomic settings (Szlavi et al., 2023) (Angelo, 2023) (Mkhize & Idahosa, 2025). Debates continue regarding the significance of personal choice compared to structural barriers in women's involvement in STEM, with certain studies focusing on individual academic abilities while others point out systemic bias (Stoet & Geary, 2018) (Avolio et al., 2020). The effects of this disparity involve ongoing gender inequality in STEM professions, economic setbacks for women, and a forfeiture of potential talent for innovation in technology (Courage et al., n.d.) (Maisiri, 2024).

This assessment employs a conceptual framework that combines gender obstacles, digital literacy, and STEM involvement, based on intersectionality theory and social justice viewpoints (Szlavi et al., 2023) (Scott & Elliott, 2020). It characterizes barriers as societal norms and biases, educational factors as the accessibility and quality of STEM education, and economic factors as the availability of resources and labour market situations, underscoring their interconnected impacts on women's paths in STEM (Avolio et al., 2020) (Owuondo, 2023). This framework directs the examination of how these aspects together impact women's participation in digital and STEM fields.

This systematic review aims to consolidate existing literature to clarify the intricate challenges women encounter in STEM and digital literacy, highlight areas of misunderstanding, and suggest approaches to promote inclusion (Roy et al., 2024) (Courage et al., n.d.). The review seeks to enlighten policymakers, educators, and stakeholders on addressing the intersectional aspects of these challenges to create effective interventions that foster gender equity in STEM areas (Graham et al., 2016) (Olufemi et al., 2023).

The analysis utilizes an extensive literature search and thematic examination of recent empirical and theoretical research, concentrating on international and regional viewpoints (Niño-Cortés et al., 2024) (Idris et al., 2024). Results are structured to emphasize social, educational, and financial obstacles, followed by an exploration of suggested solutions and policy ramifications (Szlávi, 2021) (Graham et al., 2016).

Purpose and Scope of the Review:

Statement of Purpose:

The purpose of this report is to analyse the current studies on "Barrier's women encounter in STEM and digital literacy, encompassing societal, educational, and economic aspects," to offer a thorough insight into the diverse obstacles that impede women's complete involvement and progress in these areas. This review holds significance as, despite worldwide initiatives to advance gender equality, women continue to be considerably underrepresented in STEM fields and areas of digital literacy. Through the integration of existing knowledge, the report seeks to pinpoint ongoing challenges, highlight deficiencies in the literature, and guide upcoming interventions and policies that can promote more inclusive educational and professional settings. This review aims to aid in creating strategies that empower women and enhance fair access to STEM education and digital skills.

Objectives:

- To assess existing understanding of societal, educational, and economic obstacles impacting women's involvement in STEM and digital literacy.
- Analysing how women's participation in STEM fields is impacted by intersecting factors like race and socioeconomic status; analysing how institutional policies and cultural norms affect women's experiences in STEM and digital literacy; and analysing regional and global trends in women's representation and retention in STEM fields and digital technology industries.

Results:

- **Descriptive Synopsis of the Research:**
  This section provides an overview of the literature on the challenges faced by women in STEM and digital literacy, encompassing societal, educational, and economic aspects. The analysed research covers a wide variety of geographic settings, spanning Africa, Asia, Europe, and the Americas, emphasizing both educational and occupational contexts. Methodologies range from qualitative interviews and case studies to systematic literature reviews and quantitative analyses, illustrating the diverse challenges women face. This comparative analysis is essential for comprehending ongoing challenges, overlapping influences, and the success of interventions, thus tackling the research questions regarding societal, educational, economic, and intersectional elements affecting women's participation in STEM and digital literacy.
- **Critical Analysis and Synthesis:**
  The research on obstacles encountered by women in STEM and digital literacy highlights a complex and interconnected issue influenced by social, educational, and economic elements. Numerous studies offer detailed insights into ongoing gender inequalities, emphasizing cultural standards, systemic biases, and financial limitations as significant obstacles. Despite an increasing awareness of intersectionality and the necessity for customized interventions, research frequently faces regional constraints, methodological discrepancies, and an absence of longitudinal data. Additionally, despite the proposal of various strategies and policies, there is a lack of empirical assessments of their effectiveness, hindering the application of findings in meaningful ways.

Theoretical Implications:

- By highlighting the interplay of societal, educational, economic, and intersectional factors, the synthesised data highlight the complexity of the challenges faced by women in STEM and digital literacy.
- By emphasising that gender alone cannot account for disparities without taking into account race, class, and oth er identities, this complexity supports intersectionality theory as a crucial framework for analysing women's ex periences in STEM (Mkhize & Idahosa, 2025; Rankin & Thomas, 2020; Angelo, 2023).
- The glass ceiling theory and stereotype inoculation frameworks are correlated with the persistence of gender st ereotypes, the lack of role models, and systemic biases, confirming that organisational and cultural norms conti nue to impede women's participation and advancement in STEM fields (Owuondo, 2023) (Szǎvi, 2021) (Dabic e t al., n.d.).
- Naive views about equality are called into question by the paradoxical finding that greater gender equality at the national level can occasionally be linked to lower female participation in STEM fields, showing that

individual academic aptitude, cultural norms, and financial incentives interact intricately to shape educational and career decisions (Stoet & Geary, 2018).

- The literature supports social cognitive career theory and expectancy-value theory as frameworks for comprehending women's participation in STEM (Kanta et al., 2024; Thomas et al., 2024; Ross et al., 2020) by highlighting the importance of social support, mentorship, and the presence of female role models in fostering women's STEM identity and persistence. The digital gender gap exposes systematic biases in technology design and AI development and encompasses not only accessibility but also digital literacy and empowerment. This highlights the necessity of incorporating feminist and critical digital literacy theories into STEM education and policy (Roy et al., 2024) (Shah, 2025) (Huyer & Nuñez, 2022).

Practical Implications:

- Policy measures should implement an intersectional strategy that tackles the intersecting obstacles connected to gender, race, socioeconomic status, and cultural context to successfully enhance the inclusion and retention of women in STEM and digital literacy initiatives (Mkhize & Idahosa, 2025) (Olufemi et al., 2023) (Rankin & Thomas, 2020).
- Educational reforms need to emphasize early engagement with STEM, culturally relevant curricula, and the incorporation of digital literacy skills, in addition to mentorship initiatives that include relatable female role models to boost self-efficacy and challenge stereotypes (Kanta et al., 2024) (Szlávi & Bernát, 2021) (Graham et al., 2016).
- Industry and organizational practices should concentrate on establishing inclusive and adaptable work settings that consider women's varied life situations, address unconscious bias, and proactively advance women into leadership positions to minimize attrition and encourage career advancement (Varavva, 2024) (Graham et al., 2016) (Herman, 2014).
- To enable women to fully participate in and have an impact on the digital economy, digital literacy programs that address systemic biases in technology and AI as well as skill inadequacies must be developed (Roy et al., 2024; Shah, 2025; Kamberidou & Pascall, 2019).
- To reduce geographical and economic barriers and ensure that women have equitable access to STEM education and digital technologies, governments and stakeholders must invest in infrastructure and targeted programs in disadvantaged areas (Nabizada et al., 2024; Ahmed et al., 2022; Shaikh et al., 2019).
- To continue reducing the gender gap, legislators, educators, business executives, and non-governmental organisations must work together. This calls for evidence-based policies, awareness campaigns, and support networks that address the evolving challenges faced by women in STEM and digital literacy fields (Olufemi et al., 2023; Karapetyan, 2024; Graham et al., 2016).

Conclusion:

1. The body of research demonstrates that a variety of social, educational, and financial barriers contribute to women's under-representation and challenges in STEM and digital literacy. Deeply ingrained gender stereotypes, patriarchal pressures, and household responsibilities frequently serve as the main obstacles to women's engagement in STEM fields and digital technology. These cultural barriers influence educational choices, confidence, and career aspirations, sometimes discouraging women from pursuing STEM careers while having comparable interests and abilities. Furthermore, institutional cultures and societal perspectives are intertwined since workplace norms and gender biases hinder women's advancement and retention in STEM and digital sectors.
2. Educational systems serve as both obstacles and opportunities. Structural challenges like stereotype threat, absence of female role models, exclusive curricula, and rigid learning environments hinder women's involvement and continuation in STEM education and digital literacy advancement. Early engagement in STEM, mentorship initiatives, and inclusive educational methods show promise in enhancing involvement and retention. Nonetheless, the success of educational interventions is frequently constrained by a lack of long-term assessment and systemic opposition to change. Online and digital educational settings provide new opportunities for skill enhancement but also highlight ongoing gender disparities, especially influenced by access and sociocultural elements.
3. Economic elements exacerbate these issues via workplace segregation, salary disparities, and insufficient family-friendly policies, which heavily affect women's advancement in STEM careers. Financial limitations and insufficient institutional backing further limit access and retention, particularly in developing settings. The literature emphasizes that economic empowerment via digital literacy is essential yet insufficiently examined, with minimal attention given to informal employment sectors and intersecting economic inequalities.

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Conflicts of interest
The authors declare that there are no conflicts of interest regarding the publication of this paper.

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