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Role of Artificial Intelligence in Alleviating Gender Disparity in STEM Education: A Review

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Abstract:

Gender disparity in STEM education is still considered a global concern, particularly in developing nations where socio-cultural and economic barriers influence this disparity. In this conceptual review paper, an attempt has been made to explore whether Artificial Intelligence (AI) tools could play a role in alleviating gender disparity in STEM. This study is based on three objectives such as a) to understand the gender disparity in access and participation in STEM education, b) to study the factors influencing the gender digital divide, and c) to analyse the role of Artificial Intelligence in alleviating gender disparity in STEM education. Findings reveal that a persistent gender disparity has been seen in India from 2012-2022 in STEM education. Lack of an inclusive curriculum, female STEM role models and the existence of gendered stereotypes led to the disparity in STEM education. Training of teachers in AI tools can bridge the gap in the gender digital divide and enhance participation of male and female students in STEM courses. The paper clearly emphasises integrating AI in the school curriculum, especially in remote and vulnerable areas, to promote gender equality in STEM education.

Keywords: *Gender disparity, STEM Education, Artificial Intelligence, Role of AI Tools, Gender Digital Divide*

1. Introduction:

The gender in science, technology, engineering and mathematics in education continues as a global challenge. Though there are lots of advancements in terms of educational access and infrastructure, still, females and gender minorities are still underrepresented in STEM fields, which limits social advancement and innovational growth. Research has shown that due to factors like societal stereotypes, lack of role models, biased teaching and learning processes contribute to the existence of gender disparity in STEM education.

Artificial Intelligence (AI) can reduce this gender disparity by changing the way of teaching learning process has been conducted. AI can generate a personalized and adaptive learning atmosphere for the students. The AI tools can provide the opportunity to students to overcome their obstacles that prevent them to pursue STEM education and career. This article explores how does AI can be useful in education and how does it can provide a significant and accessible atmosphere to all the underrepresented genders to pursue STEM education and career.

2. Objectives:

(i) To understand the gender disparity in access and participation in STEM education
(ii) To study the factors influencing the gender digital divide
(iii) To analyze the role of Artificial Intelligence in alleviating gender disparity in STEM education

3. Research Methodology:

3.1 Research Design:

The present study is based on literature reviewed to understand the knowledge on AI, gender equality, STEM education and the gender disparity between men and women in terms of accessing digital services. This approach was chosen as it brings mixed ideas from education, technology, and gender studies. This study only used secondary data, and no primary data was collected for the study.

3.2 Timeline of Reviewed Literature:

Most of the sources that were used in the review are based on the timeline from 2005-2025, and most of them come under the timeline/period of 2023 to 2025, which focus on the growing discussions on AI and gender equality in STEM. Early studies discuss the basic problems that women find in accessing technology. Studies from 2020-2022 basically explain about the importance of AI skills and the gaps identified in online and digital learning. Recent studies from 2023-2025 include new emerging dimensions such as AI bias in teaching and different ways to involve women in STEM fields.

3.3 Search strategy:

Table 1: Search strategy

Aspects	Description
Database Used	Scopus; Web of Science; Google Scholar; SpringerLink; ScienceDirect;
Time Period Covered	2005–2025, with emphasis on recent studies from 2019–2025 on AI, STEM, ICT and gender.

Core search Keywords	gender gap in STEM education"; "gender disparities in STEM India"; "gender digital divide in education"; "gender digital divide ICT"; "women in ICT fields"; "AI in STEM education"; "artificial intelligence in education"; "AI literacy"; "AI and women empowerment"; "AI gender bias"; "gender bias in AI tools"; "AI and gender equality in STEM"; "AI to support girls in STEM"; "female participation in STEM careers".

4. Gender Disparity in STEM Education:

Gender disparity in STEM refers to the unequal representation of men and women in STEM fields. Studies show that women are mostly underrepresented in many STEM courses in comparison to men (Singh & Singh, 2025)[1]

Currently, various gender gaps limit women compared to their male counterparts in various spheres, such as education, work, society, and the digital world (Cimpian, 2020). A constant gender disparity has existed in STEM (Science, Technology, Engineering and Mathematics) education and career on a global level for decades. This gender gap is visible in both enrolment and career aspects, where women and girls are majorly underrepresented, especially in advanced studies and STEM professions, despite major growth having taken place in education levels (Sonia Verdugo-Castro, 2022)[2].

A constant gender disparity can be seen in India from 2012 to 2022 in STEM education. A Study shows the level of male domination in engineering fields, particularly at undergraduate and PhD levels, while female participation is comparatively high in science disciplines at postgraduate and MPhil levels. Women face structural barriers and societal stereotypes that limit their progress in STEM, especially in engineering and advanced research fields. (Dr. Sindhu K, 2025)[3]. As per the European Commission report, the dropout rate of girls in STEM subjects is higher than boys due to the lack of female role models in the curriculum (Commission, 2024)[4]

[1] Singh, D. J., & Singh, D. O. (2025). Gender disparities in STEM education in India: A comparative study of socioeconomic factors. *International Education & Research Journal*, *11*(7), 61–66.

[2] Sonia Verdugo-Castro, S., González-Holgado, A., & Sánchez-Gómez, M. C. (2022). The gender gap in higher STEM studies: A systematic literature review. *Heliyon, 8*(8), e10300. **https://doi.org/10.1016/j.heliyon.2022.e10300**

[3] Dr. Sindhu, K., & D. S. (2025). Gender disparities in STEM education and patterns of female participation in India. *South Eastern European Journal of Public Health.*

[4] Commission, E. (European Commission). (2024). *New report addresses the gender gap in STEM education across educational levels.* European Commission

(Sonia Verdugo-Castro M. C.-G., 2023)[5] conducted a study in Spain which revealed that due to the lack of female role models in STEM lead to the increasing rate of the gender gap in STEM in Spain. This study also highlighted the other issues as the women get an unsupportive institutional environment and low encouragement from their family members. The compilation of these factors affects women's entry into STEM fields. Gender disparity in STEM starts very early stage due to societal stereotypes (Cimpian J. R., 2020)[6]

Many empirical studies show that due to the constant stereotypes, a societal structure has been created where boys and girls are differentiated in terms of pursuing STEM education. Due to these factors, fewer women and girl students get the confidence to build interest to pursue STEM as academic choices and career choices (Francisca Beroíza-Valenzuela, 2024)[7]

Due to the lack of Inclusive curriculum, existence of gendered teaching practices and the absence of female role models and female mentors in secondary and higher education led to the "Leaky Pipeline" aspect where the representation of women getting decreased at the stage of career advancement (Hernández-Pérez, 2024)[8]. Studies shows when girls get exposure to STEM through hands-on activities like coding or robotics can boost their interest and aspirations as well the confidence level in STEM (commision, 2024)[9]

4.1 Gender Digital Divide:

Women are still underrepresented in ICT, with only about 17-19% professionals, and 25% of ICT graduates in the European Union are females. This constant gender gap shows a dominated work-culture, lower self-confidence limits women's entry into ICT education and careers (bank,

[5] Sonia Verdugo-Castro, S., González-Holgado, A., Sánchez-Gómez, M. C., & co-authors. (2023). Factors associated with the gender gap in the STEM sector: Comparison of theoretical and empirical concept maps and qualitative SWOT analysis. *Heliyon, 9*(7), e18628. **https://doi.org/10.1016/j.heliyon.2023.e18628**

[6] Cimpian, J. R. (2020). Understanding persistent gender gaps in STEM. *Science, 368*(6497), 131–132. **https://doi.org/10.1126/science.aba7377**

[7] Francisca Beroíza-Valenzuela, N., Salas-González, S., & co-authors. (2024). STEM and gender gap: A systematic review in WoS, Scopus, and ERIC databases (2012–2022). *Frontiers in Education, 9*, 1378640. **https://doi.org/10.3389/feduc.2024.1378640**

[8] Hernández-Pérez, M. (2024). The lack of STEM vocations and gender gap in secondary education students. *Frontiers in Education, 9*, 1338732. **https://doi.org/10.3389/feduc.2024.1338732**

[9] Commission, E. (European Commission). (2024). *New report addresses the gender gap in STEM education across educational levels.* European Commission

2023)[10]; (Shah, 2025)[11]. Globally, around 24-25% of learners in ICT fields are females, whereas in India, it drops to about 22% in data science and 20-21% in software development (Bank, 2025)[12]. Findings show that, globally, only a few girls have digital skills in comparison to boys. Globally, almost 75% of young boys and girls between the age group of 15-24 use the internet, which shows improvements in accessing the internet among youths, but in lower-income countries, only 21% of women use the internet, while 32% of men use the internet (Union, 2023)[13]. (Peláez-Sánchez)[14] identified three major issues for girls in digital education, which are a lack of internet access, poor digital skills and low confidence in technology.

Due to social stereotypes that portray ICT and STEM fields as male-dominated, which discourage girls and women from pursuing these fields (Traidi, 2024)[15].

(Waninga Willy, 2024)[16] highlights that many institutions are not able to access the necessary ICT infrastructure, such as computers, internet access. The ICT industry is a kind of male-dominated industry where women are often underrepresented and face barriers to entry, leadership and advancement (East, 2024)[17]. Women are underrepresented as ICT professionals and researchers due to the existence of early gaps in digital skills education and the lack of confidence in using digital technologies (Traidi, 2024)[18] A Study revealed that more than 90% of respondents

[10] Bank, W. (World Bank). (2023). *Closing gender gaps in digital development.* Washington, DC: World Bank. **https://documents1.worldbank.org/curated/en/099022924054584089/pdf/P1805721f6ca4402c1905b12c4337f89bb8.pdf**

[11] Shah, S. S. (2025, January 8). Gender bias in artificial intelligence: Empowering women through digital literacy. *Premier Journal of Artificial Intelligence, 1*(1), 1–13. **https://doi.org/10.70389/PJAI.1000088**

[12] Bank, W. (World Bank). (2025). *Digital progress and trends report 2025: Strengthening AI foundations.* Washington, DC: World Bank. **https://www.worldbank.org/en/publication/dptr2025-ai-foundations**

[13] [13] Union, I. T. (International Telecommunication Union). (2023). *Youth internet use statistics (15–24 years).* Geneva: ITU. **https://www.itu.int/itu-d/reports/statistics/2023/10/10/ff23-youth-internet-use**

[14] Peláez-Sánchez, I. C. (n.d.). Gender digital divide in education 4.0: A systematic literature review of factors and strategies for inclusion. *Future in Educational Research, 1*(2). doi: https://doi.org/10.1002/fer3.16

[15] Traidi, A. (2024, October 3). Gender digital divide: The new face of inequality in the MENA region. *Global Campus of Human Rights.* **https://www.gchumanrights.org/preparedness/gender-digital-divide-the-new-face-of-inequality-in-the-mena-region**

[16] Waninga Willy, O. J. (2024). Exploring barriers to ICT integration and gender inclusivity in physics teaching: A study in teacher training institutions in Uganda. *International Journal of Research and Innovation in Social Science, 8*(6), 123–131

[17] East, T. R. (2025, January 5). Women in ICT: Breaking gender barriers in the industry. *Telecom Review.* **https://www.telecomreviewcanada.com/reports-and-coverage/1243-women-in-ict-breaking-gender-barriers-in-the-industry**

[18] Traidi, A. (2024, October 3). Gender digital divide: The new face of inequality in the MENA region. *Global Campus of Human Rights.* https://www.gchumanrights.org/preparedness/gender-digital-divide-the-new-face-of-inequality-in-the-mena-region

reported that gender stereotypes and a lack of female role models in ICT fields directly reduce the confidence of females to pursue ICT fields as careers (Souza, 2025)[19]. (Shah, 2025)[20] reported that only about 22% of people working in AI and ICT-related jobs are women, which reflects existing social biases that limit women's participation in ICT jobs.

Research shows that women who enrolled in ICT programs at the undergraduate level often witness discrimination, gender stereotypes, interruptions during classes and feel less capable than men (Souza, 2025)[21]. They are facing some structural challenges like insufficient technological set-up, high cost of technological devices, and specific gendered responsibilities hamper women in terms of accessing digital resources (Banerjee, 2019)[22]. The gender digital divide limits women's ability to use and benefit from technology, but at the same time it restricts their opportunities in education and career related to ICT and STEM (Kurti, 2024)[23]. The presence of gender bias in AI tools is a significant issue that reflects the existing societal inequalities (Ho, 2025)[24]. AI tools can learn data on societal biases that already exist in society (Russo, 2025)[25]. AI tools collected data from existing databases where societal biases and gender stereotypes on men and women exist, and those AI tools work according to the database (Voutyrakou, 2025)[26].

Research shows that AI can hire more males than females if previous database recorded as more male hiring than females (Sheard, 2025)[27]. ChatGPT recommends more leadership roles for men and caregiving roles for women in terms of career suggestions, which leads to gender bias (Ho,

[19] Souza, A. P. (2025). Overcoming obstacles: Challenges of gender inequality in undergraduate ICT programs. *arXiv.* https://doi.org/10.48550/arXiv.2505.02857

[20] Shah, S. S. (2025, January 8). Gender bias in artificial intelligence: Empowering women through digital literacy. *Premier Journal of Artificial Intelligence, 1*(1), 1–13. https://doi.org/10.70389/PJAI.1000088

[21] Ibid; See Footnote-19.

[22] Banerjee, P. (2019). Gender digital divide – Examining the reality. *International Journal of Innovative Technology and Exploring Engineering, 8*(11S), 215–220. https://doi.org/10.35940/ijitee.K1044.09811S19

[23] Kurti, E. (2024). Closing the gender gap in ICT higher education: Exploring women's motivations in pursuing ICT education. *Frontiers in Education, 9*, 1356243. https://doi.org/10.3389/feduc.2024.1356243

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2025)[28]. UNESCO (2024) also reported that AI tools generated gendered stereotypes it showing that, number of women is less in the technological field and men are more involved in the technological field (UNESCO, 2024)[29]. AI tools also generated biased images that contribute to gender biases in society. Due to the existing traditional gender roles, it reflects through images in digital platforms, and AI gathered those data and provided biased images as outputs (GEO, 2023)[30]

4.2 Role of Artificial Intelligence in Alleviating Gender Disparity in STEM Education:

AI literacy is basically having the skills to understand, to use and think critically about the careful use of AI tools (Magerko, 2020). AI technologies can analyse students' or learners' existing strengths and gaps in real time through enabling customized content delivery, which improves engagement and knowledge retention (Shan Wang, 2024)[31]. Integrating AI in assessment processes can enhance the grading efficiency, and it helps teachers to work more on creativity and critical thinking to encourage the students in a better way (Muhammad Tahir, 2024). AI is widely used to support students' needs and adjust the lessons for each student's needs, which can help the learners to learn at their own speed and give the opportunity for progress (Thomas K.F. Chiu, 2023)[32].

NEP 2020 suggest that AI can help a student by providing a personalized learning experience to adapt education to the needs and interests of the student (Moharana, 2025)[33] . New Generative AI make chatbots smarter and better in terms of conducting conversations with students (Namsoo Shin, 2025)[34]. These chatbots have the ability to understand the different series of questions and answering as per the situation and also have the abilities to explain why they

[28] Ibid; See Footnote-23

[29] UNESCO. (2024, March 24). Generative AI: UNESCO study reveals alarming evidence of regressive gender stereotypes. UNESCO. https://www.unesco.org/en/articles/generative-ai-unesco-study-reveals-alarming-evidence-regressive-gender-stereotypes

[30] GEO, M. (2023, March 23). Gender bias in AI: Uncovering the roots and shaping inclusive futures. *Mondo Internazionale.* https://mondointernazionale.org/focus-allegati/gender-bias-in-ai-uncovering-the-roots-and-shaping-inclusive-futures

[31] Shan Wang, S., et al. (2024). Artificial intelligence in education: A systematic literature review. *Expert Systems with Applications, 252*, 124167. https://doi.org/10.1016/j.eswa.2024.124167

[32] Thomas K. F. Chiu, & Xie, Q. (2023). Systematic literature review on opportunities, challenges, and future research recommendations of artificial intelligence in education. *Computers and Education: Artificial Intelligence, 4*, 100118. https://doi.org/10.1016/j.caeai.2022.100118

[33] Moharana, S. (2025). Prospects of artificial intelligence (AI) and personalized learning in inclusive education integrated to NEP-2020. *Asian Journal of Education and Social Studies, 52*(2), 109–116.

[34] Namsoo Shin, N., & H., K. (2025, February). The potential of using AI to improve student learning in STEM: Now and in the future. *CADRE Brief, Community for Advancing Discovery Research in Education.* https://cadrek12.org/sites/default/files/2025-02/CADRE-Brief-AI-Learning-2025.pdf

provide particular feedbacks. This helps the students to go more depth into the topics and get a detailed analysis of the questions.

As per UNESCO when STEM and Artificial Intelligence assist each other's then it has the possibility to improve the robotics and cloud computing learnings. Human machine collaboration can improve the gender sensitivity aspects in teaching -learning process (Okoye, 2024)[35]. NEP, 2020 focuses on bridging the social category gaps in terms of access, participation and learning outcomes which includes providing greater access to women (MOE, 2025)[36].

Based on the reviewed literature, the following key aspects have been identified to reflect how AI can address the gender disparity in STEM education. These approaches collectively underline the potential role of AI in promoting inclusive and effective education for all.

a) AI-Powered Personalised STEM Learning:

AI-generated personalized learning platforms can modify STEM content to individual learners, which can reduce the challenges faced by girls and women in pursuing STEM subjects (Ajuwon, 2024)[37]. Through AI-generated learning tools, it can be easy to design a suitable syllabus, study materials that will be impactful for the girls. AI-generated lesson plans, which offered STEM-specific content specially for girls, can motivate the girls to develop an interest in pursuing STEM education.

AI technologies can provide personalized support to students with diverse learning needs, including people with disabilities (Okoye, 2024)[38] AI can help the students as per their own needs and interests. AI could become helpful for students with special needs. AI-generated technologies such as speech recognition and Text-to-Speech can help the students with hearing or visual disabilities to enter them into the STEM education (Fitas, 2025)[39].

[35] Okoye, M. C., & Mante, D. A. (2024). The nexus between artificial intelligence and STEM education transformation in Nigeria. *International Journal of Research and Innovation in Social Science, 8*(9), 3793–3809.

[36] Ministry of Education (MOE). (2025). *Steps taken to ensure equal access to education for women.* Delhi: Press Information Bureau.

[37] Ajuwon, O. A. (2024). Promoting STEM education through AI and interactive learning technologies: Strategies for engaging and preparing future innovators. *International Journal of Engineering Research and Development, 20*(8), 279–289.

[38] Ibid; See Footnote-33.

[39] Fitas, R. (2025). Inclusive education with AI: Supporting special needs and tackling language barriers. *arXiv.* (Preprint; no DOI assigned.)

These AI generated technologies can break the physical and communication barriers for students with disabilities where girls and women with disabilities face multiple challenges in STEM education due to their disabilities and social biases. AI-driven platforms can boost women's employability by 28% through personalized skill training (Meena, 2023)[40] AI-driven vocational platforms boost women's employability by 28% through personalized skills training, with Meena recommending financial literacy integration for maximum empowerment.

b) AI Explanations for Complex STEM Concepts

Ai can be helpful for the students to learn and explore scientific experiments and complex scientific and technological explanation which inspire both boys and girl students to having their interest to explore the STEM related fields (Okoye, 2024)

AI can reduce the gender barriers in STEM education by providing personalized learning opportunities to girls which also help them fight against the cultural stereotypes that exist in India (Sharma, 2025)[35] This approach can be useful to reduce the gender barriers and gender gaps through creating the atmosphere of accessibility STEM education among girl students and at making the STEM education more relatable for the girl students can prepare the girls to pursue STEM careers in an AI-driven ecosystem. This approach can break down the gender barriers by providing the sufficient tools, support to the girls to enter and pursue STEM careers.

c) AI support for specific areas:

AI can make STEM education accessible and available to remote and underserved areas where there is limited infrastructure and skilled STEM educators (Okoye, 2024)[41]. In such places, the girls might face challenges in accessing education in a proper way. By using AI-driven platforms, virtual labs and personalized AI tutors in these places, both the boys and girls can learn STEM education in a very effective way, like other parts and cities beyond these remote areas.

Study found that gender inequality still exists as a major issue in Nigeria's STEM education where due to the social, cultural barriers female's participation in STEM is still limited. Female students are not able to gain confidence to pursue the STEM courses at pre-University level and they bound to choose non-STEM courses. AI has a significant role in reducing gender disparities in STEM education in Nigeria by implementing an inclusive and personalized learning atmosphere (Okoye, 2024)[42] AI has the potentialities to bridge the gaps in terms of accessibility of STEM

[40] Meena, B. (2023). Impact of Artificial Intelligence on Women Empowerment. *International Journal of Novel Research and Development, 8*(6). Retrieved from https://ijnrd.org/papers/IJNRD2306462.pdf

[41] Ibid; See Footnote-33.

[42] Ibid; See Footnote-33.

education in remote and undeserved regions as there is lack of sufficient resources in those places.

d) Recruitment of AI experts to train teachers:

Government schools can take initiatives to recruit AI educators to train the teachers to implement AI tools in their teaching practices (Okoye, 2024)[43]. Through this initiative, the teachers can implement AI tools in their teachings, and if this training majorly focuses on female teachers, it will give a new direction to the female teachers to promote STEM education among girl students. NEP 2020 emphasizes providing training to teachers to learn the new-age technologies, including AI tools to implement in the classrooms (Moharana, 2025)[44]. Teachers can use AI tools to demonstrate the difficult concepts in a simple way to the students. The female teachers can explain the girl students why AI is beneficial for their academics and careers, and also, they can motivate the girl students to pursue their careers in AI developing industries, for which they need to pursue STEM-related education. Thus, AI has a potentiality to reduce the gaps or stereotypes among girl students on STEM education and career.

5. Suggestions:

(i) Educators can learn AI tools that emphasize on gender fairness and avoid bias or discrimination in gender sensitive topics.

(ii) Policy makers may focus on funding and research for AI programs which will be inclusive for all, and also to check any biased AI tools before implementing them in education.

(iii) Initiatives can be taken by policymakers and the government by connecting AI with students through different STEM mentors.

(iv) Researchers can conduct research studies on the impact of AI in reducing the gender gaps in society and developing guidelines on how AI can be ethically used in education.

6. Conclusion:

The gender gap in STEM education is a very relevant issue which caused by many social and educational factors. Artificial Intelligence (AI) can provide significant opportunities to the students to learn as per their needs, through AI, students can receive personalized education. AI can be useful in reducing the gender gaps that exist in STEM education. AI can generate female role models for the girl students so that girls can have interest in pursuing STEM education. AI

[43] Ibid; See Footnote-33.

[44] Moharana, S. (2025). Prospects of artificial intelligence (AI) and personalized learning in inclusive education integrated to NEP-2020. Asian Journal of Education and Social Studies, 52(2), 109–116.

can inspire the girl students by providing more information on women's achievements and contribution in STEM. AI driven tools can support in a better way to girls and gender minorities in STEM subjects. Apart from that, it is also be important to use AI in a very careful way to ensure security of data, privacy. Through research and collaborative efforts by stakeholders, AI has the potentiality to play a crucial role in empowering the students to get success in STEM

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