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Bridging the Gender Gap in Artificial Intelligence and Data Science: Opportunities and Challenges for Women in Emerging Technologies in India

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Abstract:

The rapid advancement of emerging technologies such as Artificial Intelligence (AI) and Data Science has significantly transformed global economies, governance systems, and the research landscape. These technologies increasingly influence decision-making processes in sectors such as healthcare, finance, education, and public administration. Despite their growing importance, women remain significantly underrepresented in technological innovation and leadership roles. Persistent gender disparities in Science, Technology, Engineering, and Mathematics (STEM) continue to limit women's participation in emerging technological domains, particularly in specialised areas such as AI and Data Science.

This paper examines the status, participation, and leadership of women in Artificial Intelligence and Data Science in India. It analyses the structural, sociocultural, and institutional barriers that restrict women's entry, retention, and advancement in emerging technological sectors. The study adopts a descriptive and analytical approach based on secondary data drawn from academic literature, policy reports, and publications of international organisations.

The findings indicate that although women's participation in higher education has increased in recent years, their representation in advanced technological roles and leadership positions remains limited. Several factors contribute to this disparity, including gender stereotypes in STEM education, limited access to mentorship and professional networks, workplace bias, and challenges related to work–life balance and caregiving responsibilities. These barriers not only restrict women's career progression but also reduce diversity in technological innovation.

The study emphasises the importance of targeted policy interventions, educational initiatives, and institutional support mechanisms to promote gender inclusivity in emerging technologies. Strengthening women's participation and leadership in AI and Data Science is

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essential for fostering inclusive technological development and ensuring equitable and sustainable innovation.

Keywords:

Women Leadership, Artificial Intelligence, Data Science, Gender Gap in STEM, Women in Technology, Emerging Technologies

Introduction:

Emerging technologies such as Artificial Intelligence (AI), Machine Learning, and Data Science are transforming economic systems, governance structures, and technological innovation worldwide. These technologies play a critical role in sectors such as healthcare, education, finance, cybersecurity, and public policy. As societies increasingly rely on data-driven decision-making, the demand for skilled professionals in AI and Data Science continues to grow. Despite the expansion of technological sectors, gender disparities remain significant in science and technology professions. Women continue to be underrepresented in STEM-related fields globally. Globally, women account for only around 28% of the technology workforce, highlighting the persistent gender imbalance in digital and emerging technological sectors. Studies indicate that women constitute less than one-third of the global research workforce, reflecting persistent structural inequalities in technological sectors (UNESCO, 2019).

The presence of diverse perspectives in technological innovation is essential for developing inclusive and ethical technological solutions. Women's participation in emerging technologies can contribute to reducing biases in algorithmic systems and designing technology that reflects the needs of diverse populations. However, various socio-cultural and institutional barriers continue to limit women's participation in these fields.

In the context of India, the rapid growth of digital technologies and government initiatives promoting digital transformation have created new opportunities for technological development. Nevertheless, women's representation in advanced technological fields such as Artificial Intelligence and Data Science remains relatively limited. Studies suggest that women constitute only around 20% of the AI and machine learning workforce in India, demonstrating a significant gender gap in emerging technological fields. Also, women hold less than 10% of leadership roles in India's technology sector, showing that gender disparity increases at higher organisational levels.Artificial Intelligence has increasingly become an important tool in governance and public policy worldwide. Governments are using AI-driven technologies to improve public service delivery, enhance administrative efficiency, and support data-driven decision-making. In India, digital governance initiatives and smart city

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programs increasingly rely on data analytics and artificial intelligence to optimise policy implementation. However, the growing use of AI in governance also raises concerns regarding inclusivity, transparency, and ethical decision-making. Greater diversity in technological leadership, particularly increased participation of women, is therefore essential to reduce algorithmic bias and ensure that AI-driven innovations address the needs of diverse sections of society.This paper, therefore, examines the status of women in emerging technologies in India and analyses the challenges and opportunities associated with women's leadership in AI and Data Science.

Literature Review:

The issue of gender disparity in Science, Technology, Engineering, and Mathematics (STEM) has received considerable attention in academic research and policy discussions over the past few decades. Scholars and international organisations have consistently highlighted the underrepresentation of women in technological fields, particularly in emerging sectors such as Artificial Intelligence (AI), Data Science, and Machine Learning.

According to a report by UNESCO (2019), women constitute less than 30% of the global research workforce in STEM fields. Although women's participation in higher education has increased significantly, their representation in technical disciplines such as engineering, computer science, and artificial intelligence remains comparatively low. The report emphasises that structural barriers, gender stereotypes, and institutional limitations contribute significantly to the persistent gender gap in scientific and technological careers.

Research conducted by Cheryan et al. (2017) highlights the role of social and cultural stereotypes in shaping career choices in STEM fields. The authors argue that perceptions of technical professions as male-dominated discourage many women from entering these fields. This phenomenon begins at an early stage of education, where girls are often less encouraged to pursue mathematics, computer science, and engineering-related subjects.

In the context of Artificial Intelligence, concerns regarding gender imbalance have become increasingly significant. West, Whittaker, and Crawford (2019) argue that the lack of diversity in AI development teams can result in biased technological systems that may unintentionally reinforce social inequalities. Their study emphasises that diverse participation, including women's leadership in AI development, is essential for creating ethical and socially responsible technological solutions.

The World Economic Forum (2023) also highlights the growing gender gap in emerging technological sectors. Despite the expansion of digital economies and increasing demand for technology professionals, women continue to be underrepresented in roles related to data

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science, machine learning, and artificial intelligence. The report suggests that limited access to mentorship, professional networks, and leadership opportunities restricts women's advancement in these fields.

Several studies have also examined the role of institutional support and policy interventions in improving women's participation in STEM. Buvinic and Furst-Nichols (2016) emphasise the importance of education policies, financial incentives, and leadership development programs in promoting women's economic empowerment in technology-driven sectors. These initiatives can help reduce structural barriers and create supportive environments for women professionals.

In India, the technology sector has expanded rapidly over the past two decades, yet gender disparities persist in advanced technological roles. Reports by industry organisations such as NASSCOM indicate that although women constitute a significant portion of the IT workforce, their representation in specialised technological fields and leadership positions remains limited. Cultural expectations, career interruptions, and limited institutional support are often cited as key factors influencing women's participation in these sectors.

Overall, existing literature suggests that improving women's participation and leadership in emerging technologies requires a combination of educational reforms, institutional support systems, and inclusive workplace policies. Addressing these structural and cultural barriers is essential to ensure that women can actively contribute to technological innovation and leadership in fields such as Artificial Intelligence and Data Science.

Theoretical Perspectives on Gender and Technology:

Scholars studying gender inequality in technological fields often use several theoretical frameworks to explain the persistent underrepresentation of women in science and technology sectors. One important concept is the Gender Digital Divide, which refers to the gap between men and women in access to digital technologies, digital literacy, and participation in technological innovation. According to international development studies, unequal access to technological education and digital resources can limit women's opportunities to participate in emerging technological sectors such as Artificial Intelligence and Data Science.

Another important theoretical perspective is Feminist Technology Theory, which examines how technological systems are shaped by social structures and power relations, including gender. Example sentence:

Scholars such as Judy Wajcman argue that technologies are not neutral but are often developed within social contexts that reflect existing gender inequalities. Studies on gender and technology highlight that structural inequalities within technological systems can

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reinforce gender disparities in technical professions (Cockburn, 1992; Wajcman, 2004).As a result, the lack of women's participation in technology design and development can reinforce gender biases in technological systems.

The concept of Algorithmic Bias has also gained significant attention in recent years, particularly in discussions related to Artificial Intelligence. Algorithmic bias occurs when AI systems produce discriminatory outcomes due to biased training data or the absence of diverse perspectives in the development process. Researchers argue that increasing the representation of women and other underrepresented groups in AI development can help reduce biases in algorithmic systems and promote more inclusive technological innovation.

These theoretical perspectives highlight that gender inequality in emerging technologies is not only a matter of workforce participation but is also linked to broader structural and social dynamics. Addressing these issues requires inclusive policies, equitable access to technological education, and increased representation of women in technological leadership.

Research Methodology:

This study adopts a descriptive and analytical research design based on secondary data sources. The data used in this research have been collected from academic literature, international reports, policy documents, and industry publications related to women in technology and emerging technological sectors.

Sources of data include reports from organisations such as UNESCO, the World Economic Forum, OECD, and NASSCOM, as well as scholarly articles examining gender disparities in science and technology. The collected data has been analysed to understand the status of women in Artificial Intelligence and Data Science and to identify the challenges and opportunities influencing their participation in these fields.

Status of Women in Artificial Intelligence and Data Science in India:

The participation of women in Science, Technology, Engineering, and Mathematics (STEM) has improved globally over the past few decades; however, significant gender disparities remain in emerging technological fields such as Artificial Intelligence (AI) and Data Science. In India, although women have increasingly gained access to higher education, their representation in advanced technological sectors and leadership positions continues to remain relatively low.

India has witnessed substantial growth in its digital economy, supported by initiatives such as digital governance, technological innovation, and the expansion of the information technology industry. Despite these advancements, women remain underrepresented in core technology roles. According to industry reports, women constitute approximately 34–36% of

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the workforce in India's IT sector, but their representation declines significantly in specialised roles such as AI engineering, data science, and machine learning research. Furthermore, the proportion of women occupying senior leadership positions in technology companies is even smaller.

The gender gap begins at the educational level. Although women account for a considerable proportion of students in higher education, their enrolment in STEM disciplines such as computer science, artificial intelligence, and data analytics remains comparatively limited. Cultural expectations, gender stereotypes, and a lack of encouragement for girls to pursue careers in technical fields contribute to this disparity. As a result, fewer women enter technology-driven professions, which subsequently reduces their representation in leadership positions within emerging technological sectors.

Another factor affecting women's participation in AI and Data Science is the limited availability of mentorship opportunities and professional networks. Many women professionals face challenges in accessing career guidance, industry exposure, and leadership development programs. These limitations often hinder their career progression in highly competitive technological fields. Additionally, workplace environments sometimes reflect implicit gender biases that affect hiring, promotion, and recognition of women's contributions in technology sectors.

Work–life balance and caregiving responsibilities also influence women's career trajectories in emerging technologies. The demanding nature of technology-driven careers, combined with societal expectations related to family and caregiving roles, often creates additional pressures for women professionals. As a result, many women either leave the workforce or face difficulties in maintaining continuous career progression in fields such as Artificial Intelligence and Data Science.

Despite these challenges, several positive developments have emerged in recent years. Government initiatives, educational programs, and industry-led diversity initiatives have started encouraging women's participation in technology. Programs promoting digital literacy, coding education for girls, and scholarships for women in STEM are gradually expanding opportunities for women in emerging technological domains. Technology companies are also introducing diversity and inclusion policies to support women professionals and increase their representation in leadership roles.

Therefore, while the representation of women in Artificial Intelligence and Data Science in India remains limited, ongoing policy interventions, institutional support systems, and educational initiatives have the potential to significantly improve women's participation and leadership in these rapidly evolving technological fields.

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Table 1: Global Gender Distribution in STEM and Technology

Sector	% of Women	% of Men
STEM Research Workforce	30%	70%
Global Technology Workforce	28%	72%
Artificial Intelligence Specialists	22–25%	75–78%

Source: UNESCO (2019); World Economic Forum (2023)

The table highlights the persistent gender imbalance in global STEM and technology sectors, where women remain significantly underrepresented.

Table 2: Women's Participation in India's Technology Sector

Category	% of Women
IT Workforce in India	34-36%
AI and Machine Learning Professionals	~20%
Senior Leadership Roles in Technology	<10%

Source: NASSCOM (2022); Industry Reports

Despite relatively higher participation in the general IT workforce, women's representation declines significantly in advanced technological roles and leadership positions.

Challenges Faced by Women in Emerging Technologies:

Despite growing awareness about gender equality and increased participation of women in higher education, several structural and socio-cultural challenges continue to limit women's participation and leadership in emerging technological fields such as Artificial Intelligence (AI) and Data Science. These barriers operate at multiple levels, including education, workplace environments, and broader societal expectations.

One of the primary challenges is the persistence of gender stereotypes in STEM education. Technical fields such as computer science, engineering, and artificial intelligence have traditionally been perceived as male-dominated domains. These stereotypes often discourage young girls from pursuing careers in science and technology. Lack of early

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exposure to coding, data analysis, and computational thinking further contributes to the underrepresentation of women in these disciplines.

Another significant barrier is the limited access to mentorship and professional networks. Mentorship plays a critical role in guiding professionals toward career advancement and leadership opportunities. However, many women in emerging technology sectors lack access to mentors, role models, and supportive professional networks. This absence of guidance often affects career progression and reduces opportunities for women to occupy leadership positions in technological industries.

Workplace challenges also contribute to the gender gap in AI and Data Science. Women professionals frequently encounter implicit biases in recruitment, promotion, and recognition of their work. In many organisations, leadership positions in technological fields continue to be dominated by men, which can limit the visibility and career advancement of women professionals.

Additionally, work–life balance and caregiving responsibilities pose significant challenges for women pursuing careers in demanding technological sectors. Societal expectations often place a disproportionate share of family and caregiving responsibilities on women, which may interrupt their career trajectories. The fast-paced and competitive nature of emerging technology industries sometimes makes it difficult for women to maintain continuity in their professional development.

Furthermore, the lack of gender-sensitive policies in educational and professional institutions also contributes to the underrepresentation of women in leadership roles within AI and Data Science. Insufficient maternity support, limited flexible work options, and inadequate institutional support systems can discourage women from sustaining long-term careers in technology.

These challenges collectively highlight the need for targeted interventions aimed at addressing gender disparities in emerging technological fields.

Opportunities and Policy Interventions:

Despite the challenges women face in emerging technological fields, several initiatives and policy interventions have been introduced to promote women's participation and leadership in Artificial Intelligence, Data Science, and other STEM disciplines. Governments, educational institutions, international organizations, and private companies are increasingly recognizing the importance of gender diversity in technological innovation.

One important area of intervention is education and skill development programs aimed at encouraging girls to pursue STEM education from an early stage. Introducing coding,

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computational thinking, and digital literacy at school levels can significantly increase women's participation in technological fields. Global initiatives such as the 'Girls Who Code' program aim to reduce the gender gap in technology by providing training, mentorship, and coding education to young girls. Such initiatives play a crucial role in building early interest and confidence among female students in technology-related subjects.

Government-led initiatives also play a significant role in supporting women in science and technology education. In India, the 'PRAGATI Scholarship for Girl Students', implemented by the All India Council for Technical Education (AICTE), provides financial assistance to female students pursuing technical education in fields such as engineering, information technology, and computer science. Similarly, the 'WISE-KIRAN program' (Women in Science and Engineering – Knowledge Involvement in Research Advancement through Nurturing) launched by the Department of Science and Technology supports women researchers through fellowships, training programs, and career development initiatives. These programs aim to reduce gender disparities in scientific research and encourage women to pursue careers in technology and innovation.

In addition to government initiatives, corporate and industry-led programs also contribute significantly to increasing women's participation in emerging technological sectors. For instance, the 'Women Engineers (WE) Program' supported by Google and implemented by TalentSprint provides advanced technical training, mentorship, and career guidance to female engineering students in India. Such initiatives help bridge the skill gap by providing women with opportunities to develop expertise in advanced computing and artificial intelligence.

Various scholarships and fellowships also support women pursuing higher education in science and technology disciplines. 'The L'Oréal India For Young Women in Science Scholarship' provides financial assistance to talented female students pursuing higher education in scientific fields. Similarly, international organisations such as the 'Society of Women Engineers (SWE)' offer scholarships and mentorship opportunities for women studying engineering and technology worldwide. Programs such as the 'Progress Software Akanksha Scholarship for Women in STEM' further support Indian women pursuing education in computer science, software engineering, and information technology.

These initiatives demonstrate that increasing women's participation in emerging technological fields requires a combination of educational support, financial assistance, mentorship opportunities, and institutional policies that promote gender inclusivity. Strengthening such programs can help create an enabling environment for women to pursue careers in Artificial Intelligence and Data Science and contribute more effectively to technological innovation and leadership.

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Conclusion:

The rapid advancement of emerging technologies such as Artificial Intelligence and Data Science has created significant opportunities for innovation, economic growth, and knowledge development. However, the benefits of these technological transformations cannot be fully realised without ensuring inclusive participation, particularly from women. Despite improvements in education and growing awareness of gender equality, women remain underrepresented in technological leadership and specialised roles within AI and Data Science.

This study examined the status of women in emerging technological sectors in India and identified structural, social, and institutional barriers that restrict their participation and advancement. Gender stereotypes in STEM education, limited mentorship opportunities, workplace biases, and challenges related to work–life balance continue to shape women's career trajectories in technology-driven fields. These barriers not only hinder women's professional growth but also limit diversity and inclusivity in technological innovation.

Addressing these disparities requires targeted interventions such as encouraging girls' participation in STEM education, promoting digital skill development, and implementing inclusive institutional and industry policies. Strengthening such initiatives can create supportive environments that enable women to contribute more effectively to technological advancement.

Promoting women's leadership in Artificial Intelligence and Data Science is therefore not only a matter of gender equality but also essential for ensuring ethical, inclusive, and socially responsible technological development.

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