

Breaking Barriers: Overcoming Challenges for Women in STEM in India-A Conceptual Perspective

Trupti Jiwaji Arolkar*

Abstract

STEM education which brings together Science, Technology, Engineering, and Mathematics has become the foundation for success in today's fast-changing, technology-driven world. It helps students think critically, solve real-world problems, and adapt to new innovations like artificial intelligence, robotics, data science, and biotechnology. In a country like India, where digital transformation is reshaping every sector, STEM education is not just an academic choice but a key to national growth and progress. Yet, despite its importance, the number of girls choosing careers in STEM fields remains disappointingly low. Encouraging female participation in STEM is much more than a matter of fairness it's about empowering the nation's future. When girls are given equal chances to explore science and technology from a young age, they bring fresh ideas, creativity, and balance to the workforce. Unfortunately, many social and cultural barriers still hold them back. Deep-rooted traditions and gender expectations often teach girls that science and technology are "for boys," while their roles are expected to revolve around home and family. In several parts of India, parents still hesitate to let their daughters pursue higher education or careers in technical fields, fearing social judgment or challenges in marriage prospects. Additionally, the lack of visible female role-models in science and technology further reinforces the problem. Many girls rarely see women leading research labs, engineering projects, or tech companies which makes it harder for them to imagine themselves in such roles. Subtle biases in classrooms, unequal access to resources, and discouraging comments from teachers or peers can lower their confidence and interest in STEM subjects. To bring real change, we need a combined effort from schools, families, and policymakers. Schools must adopt teaching methods that make girls feel equally capable and included. Mentorship programmes, scholarships, and awareness campaigns can motivate girls to follow their passion in science and technology. Parents and communities also need to understand that empowering their daughters through education benefits not just the family, but society as a whole. True gender equality in STEM education is not just about numbers it's about creating an India where talent and curiosity know no gender. By giving girls equal space to dream, learn, and innovate, we can build a brighter, fairer, and more sustainable future for everyone.

Keywords: Science, technology, engineering, mathematics, STEM education, 21st Century skills, Gender equality.

*Author for Correspondence

Trupti Jiwaji Arolkar
E-mail: truptiarolkar7@gmail.com

Research Scholar, Dr. D. Y. Patil College of Education,
Pimpri, Pune, Maharashtra, India

Received Date: April 22, 2025
Accepted Date: June 10, 2026
Published Date: July 11, 2026

Citation: Trupti Jiwaji Arolkar. Breaking Barriers: Overcoming Challenges for Women in STEM in India-A Conceptual Perspective. Journal of Education Sciences. 2026; 3(2): 8–13p.

INTRODUCTION

India is a rapidly growing country as a global leader in technology and innovation. But the under-representation of women in STEM is one of the main issues. Recently Narendra Modi while addressing the International Telecommunication Union World Telecommunication Standardization Assembly and the India Mobile Congress 2024 highlighted the importance of women in STEM. Bridging the gap in India's tech industry is not just a matter of equality, it's important for the country's economic growth and innovation [1].

The involvement of women in scientific, technological, engineering and mathematical fields is crucial not only for the nation's socioeconomic growth but also for enhancing women's quality of life. In India where females make up nearly half (47.5%) of the population, their participation in STEM education is as essential as that of men. Women are instrumental in advancing families, communities and nations, while also contributing to the national economy. Through education in science, technology and engineering women can empower themselves and others.

Women are a formidable force demonstrating resourcefulness, passion, creativity and equal contribution to the nation's economic and social progress. The absence of women in STEM fields would result in loss of innovative ideas. Research indicates that investing in women, particularly in their education, yields numerous benefits not only for themselves but also for their off-springs and households. These advantages enhance the quality of life for women and families while simultaneously addressing poverty and stimulating economic growth [2].

The fields of science, technology, engineering and maths have the potential to enhance or develop various aspects including concepts, theories, models, techniques, instrumentation, software and operational methods. Evidence suggests that women play a crucial role in initiating new creations. Consequently, it is essential to encourage female participation in STEM [3].

Women's participation in STEM education and career is gradually increasing but challenges remain. Nearly 43% of women enrol in STEM courses at undergraduate level (ClearIAS, [2] 2023). Representation decreases at higher levels of education such as postgraduate studies and PhD programs [4-10]. Women's representation in STEM careers remains low. Only about 14% to 16% of STEM jobs in India are held by women (ClearIAS,[2] 2023; Jaiswal A, [11] 2024). Sometimes women face workplace biases, lack of mentorship, and structural barriers affect their career growth in STEM fields.

Indian government and private companies have introduced many programmes to encourage women's participation in STEM, however India still lags behind many developed nations regarding female representation in STEM. Women's participation in STEM education remains a significant challenge, with female representation diminishing at various stages of the education pipeline. The gender gap is particularly pronounced in mathematics-intensive STEM fields such as physics, computer science, engineering, and mathematics (Madara DS et al. [4] 2016). Structural barriers, such as gender-insensitive environments, limited mentorship, and biased hiring practices, further restrict their progression (Amirtham & Kumar, [1] 2023). Mental health issues, harassment, and financial constraints also hinder participation, particularly among socioeconomically disadvantaged students (Jaiswal A, [11] 2024).

In conclusion, while India has shown promising trends in women's participation in certain STEM fields like computer science, there are still barriers to overcome. The complex interplay of societal norms, familial pressures, workplace discrimination continues to shape women's experiences in STEM education and careers in India. Addressing these challenges will be crucial for achieving gender equality in STEM and fostering innovation in the country. So, this study aims to find out various barriers which oppose female growth in STEM fields and to develop strategies to overcome challenges and bring gender equality in STEM education in India [5].

What is STEM?

STEM is an acronym for Science, Technology, Engineering and Mathematics. It integrates Science, Technology, Engineering and Mathematics into all areas of the curriculum. This concept is being picked up from the USA. It is not just an acronym it is an approach to develop multiple skills at the same time. These fields are essential for innovation, problem-solving and for developing 21st century skills as well as economic growth. These fields give greater opportunities but they are male-

dominated and women have struggled to gain equal opportunities (Figure 1).

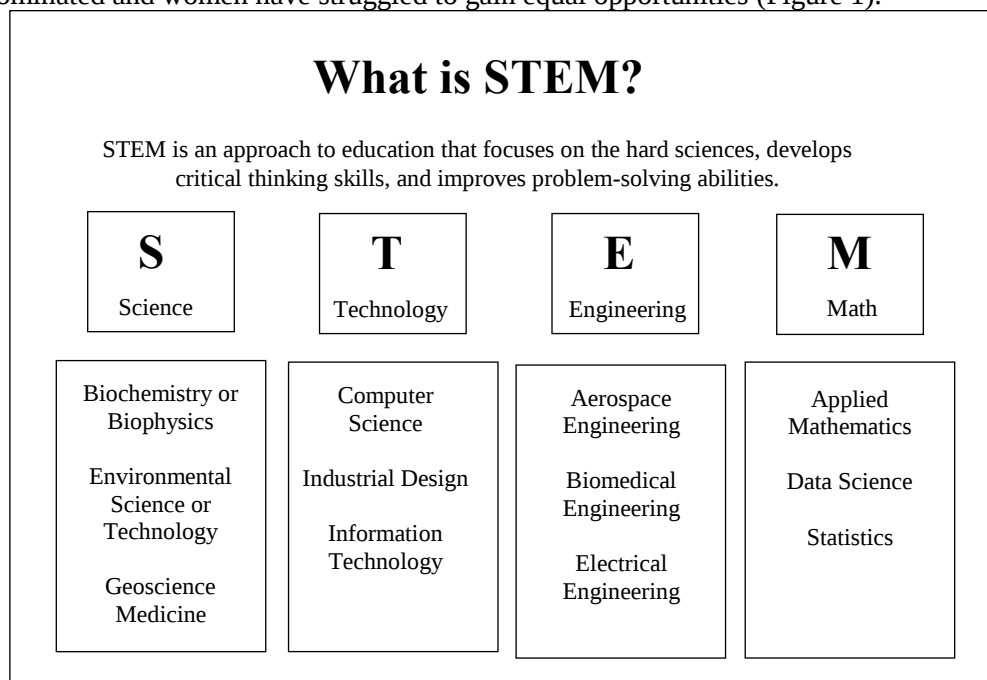


Figure 1. Overview of STEM (Science, Technology, Engineering, and Mathematics) and its core disciplines.

The Current Scenario: Women in STEM in India

In India only about 14% of women are employed in STEM roles. While globally working women in STEM, this number grows to 43%. But we see the fact that India has a significant number of female STEM graduates around 40% of STEM graduates in India are women (ClearIAS,[2] 2023). Many of them do not enter or remain in STEM careers. The “leaky pipeline” metaphor shows the gradual decreasing rate of women within STEM fields as they move from entry to employment towards leadership (Table 1).

THEORETICAL BACKGROUND

STEM education is based on educational theories such as constructivism, experiential learning and enquiry-based approaches. Social cognitive theory plays a crucial role in STEM education. Building self-efficacy is essential in STEM education. When students tackle various challenging tasks in STEM, they are more likely to persist and excel. SCT focuses on observational learning [12-15]. By following female role-models in STEM they can find their own path of success. Hands-on projects, problem-solving activities develop various skills essential for future. Critical gender theory identifies and critiques the obstacles that women face in STEM and serves as a guide for more inclusive education. Empowerment theory aims to teach students to trust their strengths instead of focusing on their weaknesses (Perkins & Zimmerman, [14] 1995). Similar to empowerment theory, feminist theory aimed to understand gender inequality focusing on gender power relations and the promotion of women’s rights and interests. projects, problem solving activities develop various skills essential for future. Critical gender theory identifies and critiques the obstacles that women face in STEM and serves as a guide for more inclusive education. It helps women to grow in STEM fields. Empowerment theory aims to teach students to trust their strengths instead of focusing on their weaknesses (Perkins & Zimmerman [14], 1995) Similar to empowerment theory, feminist theory aimed to understand gender inequality focusing on gender power relations and the promotion of women’s rights and interests (Poorman, [15] 2003 [10]).

Tabel 1. Percentage of Women.

Category	Description	Percentage of Women	Source
STEM Graduates (India)	Women who complete STEM education (Science, Technology, Engineering, Mathematics)	40%	ClearIAS (2023) [2]
STEM Employment (India)	Women currently employed in STEM-related jobs	14%	ClearIAS (2023) [2]
STEM Employment (Global)	Global average of women employed in STEM roles	43%	ClearIAS (2023) [2]
Leaky Pipeline Effect	Decrease in the proportion of women from education to employment and leadership in STEM fields	—	Conceptual (ClearIAS, 2023) [2]

BARRIERS FOR WOMEN IN STEM EDUCATION

According to recent studies, though India has seen some progress in gender equality, it still faces many challenges. A recent study found that only 16.6 percent of the overall STEM faculty in Indian universities were women. Social norms. In India traditional views still exist that women have to focus on household responsibilities rather than careers, early matrimony, mobility restrictions during puberty, discrimination and sometimes harassment in the workplace make it difficult for women to focus on their work [6].

- *Limited access to resources:* In India, schools in rural areas lack necessary infrastructure such as laboratories and computers. It makes it difficult for girls to follow their future career in the STEM field. Some girls are from low-income families; they can't get proper resources to complete their education. The centres giving higher education in STEM fields are in cities or at a long distance from villages so it gets difficult for girls in poor families to continue their education. Coaching institutes are expensive too [7].
- *Dual burden on women:* Dual burden of household responsibilities and workplace commitments became a major reason to block career progress of women. Social expectations, long working hours, limited childcare options create struggles for women trying to do both roles effectively [8].
- *Lack of role-models:* Very few women are at top-level positions, making it difficult for young women to find their role-models. They have to create their own path to be successful in their career [9].

Social Norms

Female participation in STEM career can be increased through various ways. Introduce STEM education in the middle stage introduce young girls to STEM education in their early school days. It will increase their interest in STEM subjects; it will foster their creativity, problem-solving ability, critical thinking ability the skills which they need in future for their career growth [10].

- *Reduce cost of coaching:* Some provisions should be done to reduce cost of coaching. Making coaching institutes affordable definitely will increase the percentage of girls to enter into STEM-related courses [11].
- *Scholarships and financial support:* Though the Government has introduced many schemes providing scholarships and financial support, much support is needed to bring women into STEM careers [12].
- *Implement intervention in the education such as the training program:* Improved training programmes are needed for teachers to make children STEM-ready. Teachers need continuous training to stay updated on the latest development in STEM areas [13].
- *Better infrastructure and safety measures:* Creating a secure and well-equipped infrastructure is necessary to ensure equal opportunities for women in STEM education and careers. Teachers, parents and other community members can also play an essential role in promoting women in STEM education. They can break down social and cultural norms and provide a free and

supportive environment for their future growth in the STEM field [14].

Thus, the National Education Policy 2020 also focuses on STEM education by introducing coding-based activities from 6th standard. It will also help to give equal opportunities to women to start their STEM education at an early age. The Atal Innovation Mission has been launched by Niti Aayog; Atal tinkering labs are set up in schools to provide students the proper infrastructure. But still rural schools need better labs and trained teachers. The challenges which women are facing are complex but many solutions can help to bring gender equality.

Limited Access to Resources

In India, schools in rural areas lack necessary infrastructure such as laboratories and computers. It makes it difficult for girls to follow their future career in the STEM field. Some girls are from low-income families. They can't get proper resources to complete their education. The centers giving higher education in STEM fields are in cities or at a long distance from villages so it gets difficult for girls in poor families to continue their education. Coaching institutes are expensive too.

Dual Burden on Women

Dual burden of household responsibilities and workplace commitments became the major reason to block career progress of women. Social expectations, long working hours, limited child-care options create struggles for women trying to do both roles effectively.

Lack of Role Models

Very few women are at top level positions, making it difficult for young women to find their role models. They have to create their own path to be successful in their career.

Ways to Overcome these Barriers

Female participation in STEM career can be increased through various ways.

Introduce STEM Education in the Middle Stage

Introduce young girls to STEM education in their early school days. It will increase their interest in STEM subjects. It will foster their creativity, problem-solving ability, critical thinking ability -the skills which they need in future for their career growth.

Reduce Cost of Coaching

Some provisions should be done to reduce cost of coaching.

Making coaching institutes affordable definitely will increase the percentage of girls to enter into STEM related courses.

Scholarships and Financial Support

Though the Government has introduced many schemes providing scholarships and financial support, much support is needed to bring women into STEM careers.

Implement Intervention in the Education such as the Training Program

Improved training programs are needed for teachers to make children STEM ready. Teachers need continuous training to stay updated on the latest development in STEM areas.

Better Infrastructure and Safety Measures

Creating and Secure and well-equipped infrastructure is necessary to ensure equal opportunities for women in STEM education and careers.

Teachers, parents and other community members can also play an essential role in promoting women in STEM education. They can break down social and cultural norms and provide a free and supportive environment for their future growth in the STEM field.

Thus, NEP 2020 also focuses on STEM education by introducing coding-based activities from 6th

std. It will also help to give equal opportunities to women to start their STEM education at an early age. Atal innovation mission has been launched by Niti Aayog Atal tinkering labs are set up in schools to provide students the proper infrastructure. But still rural schools need better Labs and trained teachers. The challenges which women are facing are complex but many solutions can help to bring gender equality [15].

CONCLUSION

Increasing female participation in STEM education is essential for achieving gender equality, driving innovation, and supporting India's long-term development. Breaking stereotypes, providing equal opportunities, and creating a supportive learning environment will empower more girls to pursue careers in science, technology, engineering, and mathematics. With the combined efforts of families, schools, communities, and policymakers, India can unlock the full potential of its young women. When girls are encouraged to dream without limitations, STEM becomes not only a pathway to personal success but also a powerful force for building a more inclusive, innovative, and prosperous nation.

REFERENCES

1. Amirtham S N, Kumar A. The underrepresentation of women in STEM disciplines in India: a secondary analysis. *International Journal of Science Education*. 2023 Aug 13;45(12):1008-31.
2. Satish S. Women in STEM. ClearIAS. 2023. <https://www.clearias.com/women-in-stem/>
3. Sagala R, Umam R, Thahir A, Saregar A, Wardani I. The effectiveness of stem-based on gender differences: The impact of physics concept understanding. *European Journal of Educational Research*. 2019 Jul 15;8(3):753-61.
4. Madara DS, Cherotich S. Female underrepresentation in undergraduate education: Case study in school of engineering. *Research on Humanities and Social Sciences*. 2016;6(14):157-75.
5. Sharma P, Rao S, Krishna Kumar P, R. Nair A, Agrawal D, Zadey S, Surendran G, George Joseph R, Dayma G, Rafeekh L, Saha S. Barriers and facilitators for the use of telehealth by healthcare providers in India—A systematic review. *PLOS Digital Health*. 2024 Dec 6;3(12):e0000398.
6. Sardenberg C, Mano MK, Sacchet T. Confronting backlash against women's rights and gender equality in Brazil: A literature review and proposal. *Revista Feminismos*. 2020 May;8(2):57-97.
7. Tripathi H, Joshi R, Singh DK, Agrawal A, Agrawal RC. Assessing factors motivating female students to pursue agricultural higher education in India. *The Journal of Agricultural Education and Extension*. 2025 Oct 20;31(5):757-84.
8. Aji ZM, Mohd SA, Osman WR, Yusop NI. A Conceptual Model for Psychological Empowerment of Telecentre Users. *Comput. Inf. Sci*. 2010 Aug 1;3(3):71-9.
9. Locke MA, Guzman V, Hallaran AE, Arciniegas M, Friedman TE, Brito A. Counternarratives as DisCrit praxis: Disrupting classroom master narratives through imagined composite stories. *Teachers College Record*. 2022 Jul;124(7):150-73.
10. Thompson A. Caring in context: Four feminist theories on gender and education. *Curriculum Inquiry*. 2003 Jan 1;33(1):9-65.
11. Jaiswal A, Namrata, Kumar H. A phenomenological study of women's everyday lived experiences and perceptions in science research organizations in India. *Gender, Technology and Development*. 2024 Sep 1;28(3):446-67.
12. Procentese F, Fasanelli R, Carnevale S, Esposito C, Pisapia N, Arcidiacono C, Napoli ID. Downside: The perpetrator of violence in the representations of social and health professionals. *International Journal of environmental research and public health*. 2020 Oct;17(19):7061.
13. Follmer DJ, Hut M, Santiago LY. Examining Change in Non-Calculus-Ready Students' Engineering Self-Efficacy in an Introductory Course in Engineering Reasoning. *Journal for STEM Education Research*. 2026 Jan;9(1):192-208.
14. Perkins DD, Zimmerman MA. Empowerment theory, research, and application. *American journal of community psychology*. 1995 Oct;23(5):569-79.
15. Seelau EP, Seelau SM, Poorman PB. Gender and role-based perceptions of domestic abuse: Does

sexual orientation matter?. Behavioral Sciences & the Law. 2003 Mar;21(2):199-214.