

The rise of women in STEM education: gender equality strategies and innovative teaching methods

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Abstract: Women's participation in global STEM education is gradually increasing but still faces severe challenges. Gender stereotypes, unsuitable educational environments, and workplace discrimination restrict women's full engagement. Promoting women's development in STEM is critical for gender equality and global innovation. The paper explores the existing context, driving factors and international strategies, and recommends inclusive policy measures and human-centered teaching practices to empower women in STEM fields.

Keywords: STEM education; gender equality strategies; teaching innovation; global perspective

1 Introduction

STEM education serves as the cornerstone of scientific innovation and economic growth. However, women remain underrepresented in most STEM fields worldwide [1]. Although some regions have seen rising female enrollment, persistent barriers including social stereotypes, male-favored teaching practices, and career "glass ceilings" continue to limit women's progress. Promoting gender equality in STEM requires systematic cooperation among policy, education, and society. This paper analyzes the status quo, constraints, and practical strategies to improve women's participation and achievement in STEM education.

2 The status quo of women in STEM education

2.1 Gender gaps in participation

Women's participation in STEM lags behind men's throughout basic to higher education. According to 2018 statistics released by the U.S. National Science Foundation, engineering and computer science remain predominantly male disciplines. In Europe, fewer girls choose physics and chemistry at secondary school [2]. At the doctoral level, especially in physics, female representation remains very low across many countries [3]. The "leaky pipeline" effect describes the continuous attrition of women at every progressive stage of academic study and professional career.

2.2 Career development barriers

Women in STEM careers face widespread workplace discrimination. The World Economic Forum (2018) confirms that women struggle to reach senior technical and management positions due to the "glass ceiling". Meanwhile, traditional gender norms place more family responsibilities on women, making work-life balance extremely difficult [4]. Many women have to pause or quit STEM careers, resulting in low retention of female talents.

3 Factors affecting women's STEM development

3.1 Social and cultural factors

Deep-rooted gender stereotypes suggest men are more capable in logic and technology, while women belong to humanities and service fields. Early gendered toy choices further weaken girls' interest in STEM [5]. In traditional cultures, especially some Asian societies, women are expected to prioritize family, which discourages them from pursuing long-term STEM development [6].

3.2 Educational environment factors

Some teachers hold implicit bias and pay more attention to male students in STEM classes [7]. Traditional teacher-centered teaching ignores women's strengths in cooperative and contextual learning. In addition, most textbooks lack female scientists' stories and gender-inclusive content, reducing female students' sense of belonging [8].

4 Global gender equality strategies

4.1 Policy level

The EU provides exclusive scholarships and establishes gender equality monitoring systems [9]. To guarantee female rights in STEM sectors, the U.S. has implemented the *Equal Opportunity in Science and Engineering Act*. UNESCO advocates gender mainstreaming, integrating gender equality into curriculum, resource allocation, and teacher training [10].

4.2 Media advocacy and cultural transformation

Media advocacy. The media have a powerful influence on reshaping public perceptions. By positively promoting women's achievements in STEM fields, gender stereotypes can gradually be broken down. For example, the BBC has launched a series of documentaries and features on women scientists and engineers, showcasing the remarkable contributions of women in STEM fields and raising public awareness of women's capabilities in STEM fields (BBC, 2019).

Community and family support. Community and family support is critical to the advancement of women in STEM education. Communities can organize a variety of STEM-related activities to encourage women's participation. At home, parents should give their daughters the same support and encouragement as their sons to develop their interest in STEM subjects. For example, "Girls Who Code" initiatives in some communities enable young girls to gain exposure to computer programming, sparking their interest in STEM fields [11].

5 Innovation of teaching methods

5.1 Student-centered teaching methods

Project-based learning (PBL) is a student-centered approach to teaching that places learning in real problem situations and allows students to gain knowledge and skills through collaborative problem-solving. This approach is conducive to the development of women's ability to cooperate and solve practical problems. For example, in a project-based study on environmental science, students work in groups to study local environmental pollution problems and propose solutions. Studies have found that female students are highly motivated and creative in this project-based learning, and they are able to give full play to their communication and teamwork skills [12].

Inquiry-based learning encourages students to explore questions independently, propose hypotheses, and test them. This method can stimulate women's curiosity and exploration spirit. In science classes, teachers can guide students to raise questions about natural phenomena, and encourage them to conduct independent exploration through data research and experimental design. For example, in experiments exploring the relationship between plant growth and light, female students were able to observe and record data in detail, and provide unique insights when analyzing the results [13].

5.2 Diversified teaching resources

Introducing female role models into the teaching process can enhance female students' identification with STEM subjects. Teachers can tell the stories of female scientists such as Marie Curie, or they can invite contemporary female

STEM professionals to the classroom to share their experiences. For example, the media can give more coverage to the success stories of female scientists and engineers, changing society's stereotype of women in STEM fields. Research has shown that when female students see successful role models of the same gender as themselves, they are more likely to develop an interest in STEM subjects and stick with them [14].

The development of gender-inclusive teaching materials is an important aspect of the innovation of teaching resources. Textbooks should incorporate more examples of women's contributions to STEM fields, and present gender equality in illustrations, stories, etc. For instance, several newly compiled mathematics textbooks not only contain biographies of male mathematicians, but also add the introduction of the deeds of female mathematicians, and balance the images of men and women in the illustrations, which helps to increase the interest of female students in mathematics subjects [15].

6 Conclusion

Women's advancement in STEM is essential for global gender equality and innovation. While considerable challenges still exist, sound policy support, inclusive teaching practices, social promotion and family care help address this issue. With joint efforts, the gender gap can be narrowed. Women's full participation will deliver diverse perspectives, enhance creativity, and shape a more equitable and innovative future for global STEM development.

Conflicts of interest

The author declares no conflicts of interest regarding the publication of this paper.

References

- [1] National Science Board. Science and engineering indicators 2017 [R]. [S.l.]:National Science Board, 2017.
- [2] European Commission. Gender differences in STEM education in Europe[R]. Luxembourg:European Commission, 2016.
- [3] IUPAP. Report on female participation in physics research[R]. [S.l.]: IUPAP, 2019.
- [4] Hakim C. Work-life balance[J]. Employee Relations, 2017, 39(4): 411–429.
- [5] Cheryan S, Ziegler S A, Montoya A K, et al. Why do women opt out?[J]. Journal of Personality and Social Psychology, 2017, 112(4): 407–428.
- [6] Kang S J. Gendered family ideology and women's career choices[J]. Gender, Work & Organization, 2016, 23(4): 419–436.
- [7] Sadker D, Sadker M. Teacher bias in STEM education[J]. Educational Psychology Review, 2016.
- [8] Blickenstaff J C. Women and science careers: Leaky pipeline or gender filter[J]? Gender and Education, 2005, 17(4): 369–386.
- [9] European Commission. Policy initiatives for women in STEM[R]. Luxembourg: European Commission, 2020.
- [10] National Science Foundation. STEM enrollment data by gender[R]. [S.l.]: National Science Foundation, 2018.
- [11] Girls Who Code. 2019 Annual Report[R/OL]. [S.l.]: Girls Who Code, 2019.
<https://girlswhocode.com/2019report/>
- [12] Thomas J W. Project-based learning for female STEM students[J]. Journal of STEM Education, 2018.
- [13] Scardamalia M, Bereiter C. Knowledge Building and Learning Sciences[M]. [S.l.]: Routledge, 2017.
- [14] Lockwood P. Same-gender role models[J]. Psychological Science, 2006, 17(3):195–199.
- [15] Goodwin A L. Gender-inclusive textbooks[J]. Journal of Curriculum Studies, 2018.

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