SOTANG : सोताङ
[Yearly Peer Reviewed Journal]
ISSN: 2676-1440
Year 4, Volume 4, Issue 1, June 2023
Published by Sotang Public Campus

Gender Differences in STEM Education : A Review Study

Bhawani Pathak

Article History : Submitted 16 June 2022; Reviewed 13 July 2022; Accepted 25 Aug. 2022
Author : Bhawani Pathak Email: bhawanipathak2018@gmail.com
DOI:

Abstract

The low participation of females in STEM (Science, Technology, Engineering, and Mathematics) subjects is a worldwide issue. There are so many problems being raised in the context of studying higher education for females. The purpose of this study is to explore the effecting factors in enrollment and success in STEM education for females. It is based on the review of literature on female enrollment and participation in STEM education. Due to several factors such as stereotypes and biases, societal and cultural misconceptions, lack of confidence and self-perception, and gender-based discrimination are the major causes to enhance the gender gap in STEM education. To create a more inclusive environment for females in STEM education the role of nation, society, and family is to be supportive. Women should fight against all kinds of discrimination based on their willpower. This study would help to empower women and also contribute to investigate the cause of gender inequality in STEM education and enhancing gender equality. This study can be important for states and organizations to make policies and plans to improve the education status of women in STEM education.

Keywords: Gender differences, gender inequality in STEM education, stereotype and bias, gender disparity

Introduction

Gender is a social phenomenon. It refers to the social distinction between men and women (Bardley, 2013). So, the social discrimination based on sex is called gender. It seems that gender problems have arisen in various fields such as education, politics, jobs, social activities, etc. Connel (2009) states that many people believe that women and men are psychologically opposite, that men are more intelligent than women, that men are naturally powerful, and that gender patterns never change but all these beliefs are factually wrong. In the situation from past to present, we can see that in our male-

dominated society female has been back warded from the behaviors of family, society, and state. Different preferences, where societal preconceptions play a significant influence, help to partially explain the disparity in gender representation across knowledge disciplines (Blau & Kahn, 2017). The equal participation of females in every sector of society creates a balanced and dignified society with social justice (Subrahmanian, 2005). In order to ensure the active participation of Females in every field, access to higher-level education should be secured. Gender difference in the STEM disciplines is widespread in most countries and mathematics is the only subject where girls tend to underperform with respect to boys (Contini, Di Tommaso &Mendolias, 2017). Women still struggle to find a stable foothold in tech (Rana, 2023) which can lead women to anxiety and difficulty in education. The STEM gender gap is an international issue. Tandrayen-Ragoobur & Gokulsing (2022) argue that there is lower participation of women in STEM professions as well as significant challenges which women in STEM careers face compared to their male colleagues. According to the report of the Council for technical education and vocational training (2022), very few females are enrolled in technical education and vocational training. Girls' participation is low in technical education (Acharya, 2021). Many researchers find that there are very few females enrolled and completed their degree in STEM education so, to find why this situation falls is an important study. This study examines the emerging issues in STEM education for females. The purpose of this study is to review the articles related to gender in STEM education and explore the affecting factors of enrollment and success in STEM education for females.

There are so many problems being raised in the context of studying higher education for Females. Maider (2023) found that maternity and caring, female health and body, gender discrimination, and violence against women are the affecting factors for females' science careers. In the fields like STEM (science, technology, engineering, mathematics) there is a low number of females participating. This study will be important to understand problems and challenges for the females in study of STEM education. As a result, the relevant agencies will also help to address the issue while making policies. Therefore, this study helps to know why females rarely study subjects like science, technology, engineering, and mathematics. It is hoped that this study would assist in focusing stakeholders – teachers, professors, and parents, ministry of Education, science, and Technology in higher education for females. This study could also contribute to investigating the cause of gender inequality in STEM education and enhance gender equality. So, this study will be important to explore the affecting factors enrollment and success in STEM education for females.

This is a review study based on the literature on female enrollment and participation in STEM education. The keywords such as 'gender differences in mathematics education', 'gender differences in STEM education', ' participation of female in STEM education', and 'enrollment of female in mathematics education' had

been used in the ProQuest database and Google Scholar while searching the literature. The Findings and conclusion of previous research have been analyzed in detail to generate different themes and related ideas were discussed on those themes. The result has been explored descriptively.

Statement of the problem

The participation of females in STEM subjects is significantly low. However, their participation rate is high in general and language subjects. Bordon et. al. (2020) has identified that Women are overrepresented in the social sciences, humanities, and education around the world but underrepresented in fields related to science, technology, engineering, and mathematics. The present status of girls' participation in higher education has increased significantly but the enrollment rate of female students is higher in general subjects than in technical subjects (Acharya, 2021).

In the world history of STEM, we can rarely find the name of a female. All the literature shows low enrollment of females in STEM education which is a worldwide issue. What are the things that affect the equal participation of females in STEM education? Previously, a lot of research related to females and STEM education has been done. But I did not find the study related to women's issues in STEM education analyzed from a feminist perspective. In this study, I want to analyze the issues related to females in STEM education from the liberal feminist point of view.

Literature review

Previous research has established that in the early years, boys perform better than girls in mathematics but, this gender gap disappears later. Despite this, girls are still less likely to opt for scientific careers, indicating that gender biases could still be obstacles to the pursuit of further education in the science, technology, engineering, and mathematics (STEM) fields (UNESCO,2023). The research of Arias et al (2020) shows that competitive tests affect women negatively. According to the result of competitive tests, the researcher has taken, there is a gender disparity in favor of males in mathematics, this difference increases on the university admission exam. In high school standardized language tests, women outperform men, while the situation is the opposite for university entrance exams. According to Arias et al (2020) the gender gap may be linked to women's risk aversion, lower self-confidence, lower preference for competition, as well as the effect of answering a test under time pressure.

Onyekwelu (2019) also concluded that in the area of higher education such as science, technology, engineering, and mathematics the participation and contribution of females both seem to be minimal. The researcher studied for 5 years and found a low participation rate of females in STEM education. Similarly, Researchers have recommended the idea to encourage female in Science, technology, engineering, and mathematics.

The previous study 'Gender differences in mathematics Achievement' revealed that male and female students did not significantly differ in achievement and retention scores, thereby revealing that male and female students are capable of competing and collaborating in mathematics (John T & Benjamin I, 2015). So, according to this study, we can conclude that performance is a function of orientation, not gender.

Acharya's (2021) study of 'Status of Girls' Participation in Higher Education in Nepal' examine that enrollment and participation in higher education have increased from 19% to 40% during the thirty years But the enrollment of girls in STEM education is still less. The study suggests that underprivileged groups and rural areas should have easier access to technical higher education. Biases and stereotypes are still affecting the performance and learning outcomes of females. Women are negatively stereotyped in mathematics. Due to the negative gender stereotypes in mathematics, successful women may be penalized. (Arias et al, 2023). Women's self-confidence and self-efficacy in their mathematics ability cause stereotypes and often challenge success in mathematics (Fletcher, 2009).

Mellissa (2023) found that despite ongoing attempts to reduce gender inequality in Science, Technology, Engineering, and Mathematics (STEM), still the least participation of women found in Australian universities in STEM. According to the researcher, the origin of gender stereotypes surrounding engineering identity appears to be gendered views of femininity and masculinity. These have a negative impact on women's experiences outside of universities as well and also put up structural obstacles in the opportunities and workplace of the future. These misperceptions have made obstacles in the STEM future of Women.

Maider (2023) focused that, gender differences in learning styles and recommended teaching methodologies most preferred for female learners in STEM courses. Maternity and caring, female health and body, gender discrimination, and violence against women are the affecting factors for females' science careers. Government, organizations, schools, teachers, and families all should support and help women to build a future in STEM education. However, Initiatives have been started by government agencies and scientific institutions to encourage women to pursue careers in science.

The unfair belief that men are more talented than women in mathematics, science, and technology created gender inequality. According to Eizmendi & Pena (2022) in the case of STEM subjects, gender stereotypes and ideas connected with inequality are those which, by prioritizing their feminine role, undermine the scientific role of these women. Despite the advances that women have demonstrated both in the academic world and in scientific activities.

Feminist theory advocates for the empowerment and emancipation of women. According to liberal feminism, men's superior opportunities and segregation from women

are the causes of women's inferior place in society (Baehr, 2007). Pandey (2076) said that feminist theory provides a basis for gender analysis based on experiences, perspectives, and perceptions. Thus from the literature, it is clear that feminist theory clarifies social problems, trends, and issues associated with women. It raises the question of the male power that is traditionally firmly rooted within the social theory and takes the initiative to build a foundation for the equal identity of women (p. 9-27). Therefore, this study emphasizes empowering women to reduce the gender gap in STEM education from a feminist point of view.

Discussion

Gender Disparity

There is a vast gender disparity between men and female in every sector of society. The gender disparity may be due to women's higher risk aversion, weaker self-confidence, and disinterest in competitiveness (Arias, 2023). On an international level, there are found large gender differences regarding participation in Mathematics Olympiads. Males clearly outperformed female participants at the Olympiads, with the smallest differences in the biology Olympiad (Steegh, Keller & Parchmann, 2019). There are still large differences between males and females in the STEM field as well as politics, social work, and the job sector.

According to Beauvoir (2007) women of any class or community face discrimination. Patriarchy is always trying to establish the narrative that women are weak. Daly (1993) in her study 'Beyond God the Father' gave a message that women should fight against all kinds of discrimination based on their willpower. Liberal feminism can play a crucial role to improve the status of women in society. It advocates achieving gender equality through individual rights and freedoms (Baehr, 2007). Within the current social, political, and economic systems, it promotes equal opportunity and treatment for women. The emphasis of feminists is to establish their existence in every sector of society such as social, cultural, and political.

Socio Cultural Context

There is no difference between men and women by birth and equal justice is necessary in every sector to create equality among males and females. In STEM education, gender prejudices and stereotypes are allegedly widespread. Because of social perceptions that STEM areas are more suited for men, women are frequently discouraged from entering STEM fields. These prejudices can take many different forms, including unequal cultural and social norms, unfemale role models in STEM fields, and biased instructor expectations (Ali & Buratai, 2020).

Women are held back from careers due to social prejudice and discrimination (Prieto-Rodriguez et al., 2022). Women are being back from engaging in STEM fields due to social responsibilities and social factors. "Women have 'survived' their work

environments despite structural barriers, only due to their determination, resilience, and fervent interest" (Prieto-Rodriguez et al., 2022). There are lots of cultural and behavioral issues (Rana,2023). There are issues including motherhood and childrearing, female health and the body, gender discrimination and violence against women, and prejudice, are addressed (Eizmendi & Pena, 2022).

Equal participation of males and females in every sector of society creates a balanced and dignified society with social justice (Pandey, 2076). To ensure the active participation of females in society, access to higher-level education should be secured. To ensure equal participation of females and males in every field, there should be equal opportunities and participation in higher education as well. Keyway & Gough (2008) believed that girls' educational chances are diminished and marginalized in STEM and mathematics education. To improve this status of females in the STEM field there is an important role of society.

From the study of previous literature it can be concluded that country with better socioeconomic status, the gender gap is less (Bertoletti et al., 2023). However, the enrollment and succession of females in Science, technology, engineering, and mathematics are not satisfactory. The education system overall influences the performance of males and females. By incorporating and inspiring female students in reading activities and encouraging teamwork, schools, and teachers can support female students' learning. Additionally, regardless of the socioeconomic status of their families, schools need to focus more on providing girls the resources they need to culturally emancipate themselves. Indeed, personal conceptions and self-beliefs have important in promoting females' success. The Government, society, family, and school should enable to encourage, empower and motivate females to enroll in mathematics and should be given equal opportunities to learn (C & Ravindran, 2020).

Stereotype Thought

The women who believe in any stereotype lose their performance in mathematics at any level. The absence of stereotyping on the part of the women may account for their high levels of self-assurance and perceived mathematical aptitude. When a woman does a mathematical activity, she encounters the prejudice that women have weak mathematical abilities if she does not complete the work successfully. When stereotype danger is present, women perform less well than their male counterparts. However, the gender gap goes away when the stereotype threat is eliminated (Spencer et al., 1999).

Indeed, prior research has highlighted the significance of personal conceptions and self-beliefs in promoting females' success (Bertoletti et al., 2023). The women who believe in any stereotype lose their performance in mathematics at any level. The absence of stereotyping on the part of the women may account for their high levels of self-assurance and perceived mathematical aptitude. When a woman does a mathematical activity, she encounters the prejudice that women have weak mathematical abilities if she

does not complete the work successfully. When stereotype danger is present, women perform less well than their male counterparts. However, the gender gap goes away when the stereotype threat is eliminated (Spencer et al., 1999).

Conclusion

From the study of the previous literature, it is clear that there is a huge disparity in the enrollment of females into science, technology, engineering, and mathematics course worldwide when compared with males. Due to several factors such as stereotypes and biases, societal and cultural misconceptions, lack of confidence and self-perception, maternity and caring responsibility, female health and body and gender-based discrimination are the major causes to enhance the gender gap in STEM education. To create a more inclusive environment for females in STEM education the role of nation, society, and family is to be supportive. Men can help to improve the status of women's participation in STEM education. Despite this, women should fight against all kinds of discrimination based on their willpower. This study can be important for states and organizations to make policies and plans to improve the education status of women in STEM education. At last, this study will be relevant to empowering women and maintaining social justice. It would be necessary to do additional research to thoroughly investigate the issues raised by this study.

References

Acharys, D. (2021). Status of Girls' Participation in Higher Education in Nepal. *Open Journal In Education*. pp. 68-85. https://doi.org/10.32674/jimphe.v6i2.3922

Ajai, J. T., & Benjamin, I. I. (2015). Gender Differences in Mathematics Achievement and Retention Scores: A Case of Probleem-Based Learnig Method. *International Journal of Research in Education and Science*. Vl nl pp. 45-50 Win 2015.

Ali, M. A., & Buratai, H. A. (2020). Women and gender equality: Justice or civilization? *Journal of Liberty and International Affairs*, *5*(3), 55-68.

Arias, O., Canals, C., Mizala, A., & Meneses, F. (2023). Gender gaps in Mathematics and Language: The bias of competitive achievement tests. *Plos one*, *18*(3), e0283384. https://doi.org/10.1371/journal.pone.0283384.

Bardley, H. (2013). *Gender*. John Wiley & Sons. Polity press.

Baehr, A. R. (2007). Liberal feminism. *Feminist interpretations of john rawls*, *150*.

Bertoletti, A., Cannistrà, M., Diaz Lema, M., Masci, C., Mergoni, A., Rossi, L., & Soncin, M. (2023). The Determinants of Mathematics Achievement: A Gender Perspective Using Multilevel Random Forest. *Economies*, *11*(2), 32.

C, Anita., & Ravindran, D. (2020). Enrolment of Women in Higher Education: A Comparative Study on Women's Equity in Governance and Employment Status in India. *Journal of International Women's Studies* Vol. 21, No. 5 August 2020. https://vc.bridgew.edu/jiws/vol21/iss5/7

Connel, R. (2009). *Gender* (vol.14). Polity press.

Contini, D., Di Tommaso, M.L &Mendolias, S. (2017). The gender gap on mathematics achievement: Evidence from Italian data. *Economics of Education Review*. P.32-42 https://doi.org/10.1016/j.econedurev.2017.03.001

Daly, M. (1993). *Beyond God the father: Toward a philosophy of women's liberation*. Beacon Press.

De Beauvoir, S. (2007). The second sex. *Understanding Inequality: the intersection of race/ethnicity, class, and gender*, 75-82.

Eizmendi-Iraola, M., & Peña-Fernández, S. (2022). Gender stereotypes make women invisible: The presence of female scientists in the media. *Social Sciences*, *12*(1), 30. https://doi.org/10.3390/socsci12010030

Fletcher, J. (2009). Participation of women in mathematics at the university level. *Adults learning mathematics*, 3, 1-13

Onyekwelu, B. A.(2019). Comparative Empirical Analysis of Female University Enrolment in STEM Courses in the Geopolitical Zones in Nigeria. *I.J. Modern Education and Computer Science*, 2019, 1, 24-32 Published Online January 2019 in MECS. (http://www.mecs-press.org/) DOI: 10.5815/ijmecs.2019.01.03

Pandey, B. (2076). *Steps to Equality: A Feminist Analysis of Political Movements*. Kathmandu: Fine print.

Paudel, T.(2020). Gender Issues in Teaching and Learning Mathematics.

Prieto-Rodriguez, E., Sincock, K., Berretta, R., Todd, J., Johnson, S., Blackmore, K., ... & Gibson, L. (2022). A study of factors affecting women's lived experiences in STEM. *Humanities and Social Sciences Communications*, *9*(1), 1-11.

Rana, P.S. (2023, May 13). Why aren't there mare women in IT . *The Kathmandu Post.*

Spencer, S. J., Steele, C. M., & Quinn, D. M. (1999). Stereotype threat and women's math performance. *Journal of experimental social psychology*, *35*(1), 4-28.

Steegh, A. M., Höffler, T. N., Keller, M. M., & Parchmann, I. (2019). Gender differences in mathematics and science competitions: A systematic review. *Journal of Research in Science Teaching*, *56*(10), 1431-1460.

Subrahmanian, R. (2005). Gender equality in education: Definition and measurements. *International Journal of Educational Development*, 25(4), 395-407. DOI:10.1016/j.ijedudev.2005.04.003

Tandrayen-Ragoobur, V., & Gokulsing, D. (2022). Gender gap in STEM education and career choices: what matters?. Journal of Applied Research in Higher Education, 14(3), 1021-1410.

UNESCO(2023). Globle Education Monitoring Report.

https://www.unesco.org/en/articles/girls-performance-mathematics-now-equal-boys-unesco-report