International Journal on Science and Technology (IJSAT)
E-ISSN: 2229-7677 ● Website: www.ijsat.org ● Email: editor@ijsat.org

Concerning Gender Parity in Mathematics Education in India

Dr. Y. Sreekanth[1], Dr. S.V.S. Girija[2]

[1,2]Lecturer in Mathematics, Hindu College, Guntur
[1]sreekanth76.y@gmail.com, [2]svs.girija@gmail.com

ABSTRACT

Motivated by the articles on Gender Studies, in particular, Gender differences in Mathematics Learning, a deep search is made. In that context an innovative paper titled GENDER PARITY IN MATHEMATICS EDUCATION IN INDIA published with a peer reviewed journal viz., International Research Journal of Modernization in Engineering Technology and Science is identified and it was authored by Ankur Nandi, Amit Bagdi, Anita Chatterjee, Barsha Ghosh, Supriya Dutta, Soumen Roy, Dr. Tapash Das and Dr. Lutful Haque. This paper is a review article on Gender differences in Mathematics Education in India.

This study investigates gender parity in mathematics education at the higher education level (Bachelor of Mathematics, Master of Philosophy in Mathematics, and Doctor of Philosophy in Mathematics) in India. The study employs qualitative methods and documentary analysis. Documentary analysis addresses the goals of the study by reviewing the available reports from the Department of Higher Education, Government of India's All- India Survey on Higher Education. It was found that there was a notable increase in the percentage of female students enrolling in M.Sc. Mathematics programs, with female enrolment surpassing that of male students during this period; the percentage of female students enrolling in the M.Phil. program in Mathematics has been rapidly increasing, the enrolment rate of female students has surpassed that of male students; more male students enrolled in the Mathematics Ph.D. program compared to females, but the percentage of female enrolment steadily rose over the years. In the academic session of 2021-2022, the percentage of female enrolment surpassed male enrolment, with 51% of students being female (Ankur Nandi et al 2024).

1. INTRODUCTION

Gender parity in education has long been a topic of significant concern and debate worldwide. In the context of mathematics education in India, this issue takes on added urgency due to the critical role that mathematical skills play in the nation's scientific and technological development. Mathematics is often perceived as a gateway to lucrative and prestigious careers in science, technology, engineering, and mathematics (STEM) fields, yet persistent gender disparities threaten to undermine equitable access to these opportunities.

India, with its diverse socio-cultural fabric, presents a unique landscape for examining gender disparities in education. Despite numerous policy interventions and initiatives aimed at improving female participation in education, gender gaps remain stark, particularly in STEM disciplines. The pursuit of

mathematics at higher educational levels—namely, Bachelor of Mathematics, Master of Philosophy in Mathematics, and Doctor of Philosophy in Mathematics—reveals a complex interplay of factors influencing gender parity.

This study aims to investigate the extent of gender parity in mathematics education in India across these three critical academic stages. By examining enrolment data this research seeks to provide a comprehensive understanding of the current state of gender parity in mathematics. Furthermore, it explores the underlying factors contributing to gender disparities, including societal norms, institutional biases, and the presence (or absence) of role models and mentors.

The significance of this study lies in its potential to inform policy and practice, offering evidence-based recommendations to promote gender equity in mathematics education. Addressing gender disparities in this field is not only a matter of social justice but also essential for harnessing the full potential of the nation's talent pool. By fostering a more inclusive academic environment, India can better position itself to meet the demands of an increasingly knowledge-based global economy.

2. LITERATURE REVIEW

Gender inequality is prevalent in developing countries across various aspects of life (Ahn, Hahn, & Yoon, 2022). Mathematics, as a science subject, is examined by gender-based science researchers, who note that both 'feminist empiricists' and 'liberal feminist critics' agree that women can produce the same scientific knowledge as men if scientific inquiries are conducted with sufficient rigor (Howes, 2002; Barton, 1998; Sinnes, 2006). There is a common belief that women excel in linguistics, history, and arts subjects that rely on language and memory, while men are perceived to be better at mathematics, physics, and science subjects that require logical reasoning (Xie & Liu, 2023). Bondar (n.d.) pointed out that despite equal educational opportunities for both genders, this equality is not consistently realized in all subjects, particularly in mathematics. The gender imbalance in STEM education not only limits the potential development of female students and affects the overall educational standards in STEM fields but also undermines societal principles of equality (Huang, Li, & Zheng, 2022).

While considerable attention has been devoted to exploring gender disparities in STEM education, particularly within the context of mathematics, there remains a research gap in understanding the evolving landscape of female inclination toward STEM fields in India. Existing literature predominantly focuses on Western contexts or generalizes findings across diverse cultural settings, overlooking the nuanced socio-cultural factors influencing female participation and achievement in mathematics education. Moreover, few studies have delved into the intersectional aspects of gender, socioeconomic status, and regional disparities that may further compound the challenges faced by female students in accessing and excelling in STEM fields, particularly mathematics, in India. Therefore, there is a pressing need for research that examines "Female Inclination towards STEM: Changing Landscape of Gender Disparity in Mathematics Education in India."

STATEMENT OF THE PROBLEM

In India, the participation of women in higher education, particularly in mathematics, has historically been low. This research aims to explore and analyze these changes, focusing specifically on

mathematics education at the higher education level. Thus, the researcher stated in the present study "GENDER PARITY IN MATHEMATICS EDUCATION IN INDIA"

OBJECTIVES OF THE STUDY

Objectives of the study were

1. To examine the gender parity in Bachelor in Mathematics in India.
2. To study the gender parity in Masters of Philosophy in Mathematics in India.
3. To reveal the gender parity in Doctor of Philosophy in Mathematics in India.

DELIMITATIONS OF THE STUDY

The study has the following delimitation-

- This study focuses on specific datasets and parameters relevant to the research objectives and scope. As such, data related to M.Sc. in Mathematics programs have not been included due to data unavailability in the report of All India Survey on Higher Education, Department of Higher Education, Ministry of Education, Govt. of India.
- This paper is set to be published in 2024, a time when the M.Phil. (Master of Philosophy) degree is no longer recognized as a valid academic credential in many educational systems, including those of the region under study. Instead, the focus will be on degrees and credentials that are recognized and valid as of 2024, ensuring the relevance and applicability of the research findings to contemporary academic and professional standards. This change in the status of the M.Phil. degree will have implications for the applicability and relevance of the research findings, especially in contexts where the qualification was previously considered a significant academic milestone.

3. METHODOLOGY OF THE STUDY

This study is entirely qualitative, involving the collection and analysis of qualitative data. The approach used is documentary analysis, which entails a thorough review and evaluation of both textual and electronic sources (Bowen, 2009). Qualitative research methods, including documentary analysis, are particularly effective for in-

depth exploration of issues (Creswell, 2013). For this study, data was gathered from AISHE reports, books, research papers, doctoral theses, national and international magazines, state reports, newspapers, websites, and other sources.

DATA PRESENTATION AND ANALYSIS

Objective – 1: To examine the gender parity in Bachelor in Mathematics in India.

Table 1: Gender gap in Bachelor in Mathematics (B.Sc. Math.) in India.

Year	Total (Male & Female)	Total Male	Total Female	% of Male	% of Female	Gender Gap
2011-2012	84537	37914	46623	44.84	55.15	10.31

2012-2013	97892	43512	54380	44.44	55.55	11.11
2013-2014	123543	53920	69623	43.64	56.35	12.71
2014-2015	121911	48331	73580	39.64	60.35	20.71
2015-2016	129604	50081	79523	38.64	61.35	22.71
2016-2017	143762	54458	89304	37.88	62.11	24.23
2017-2018	155239	62698	92541	40.38	59.61	19.23
2018-2019	136236	47024	89212	34.52	65.48	30.96
2019-2020	143116	51613	91503	36.06	63.93	27.87
2020-2021	104269	41681	68588	39.97	65.77	25.8
2021-2022	70843	29370	41473	41.45	58.54	17.09

Source: AISHE reports (2011-12 to 2021-2022)

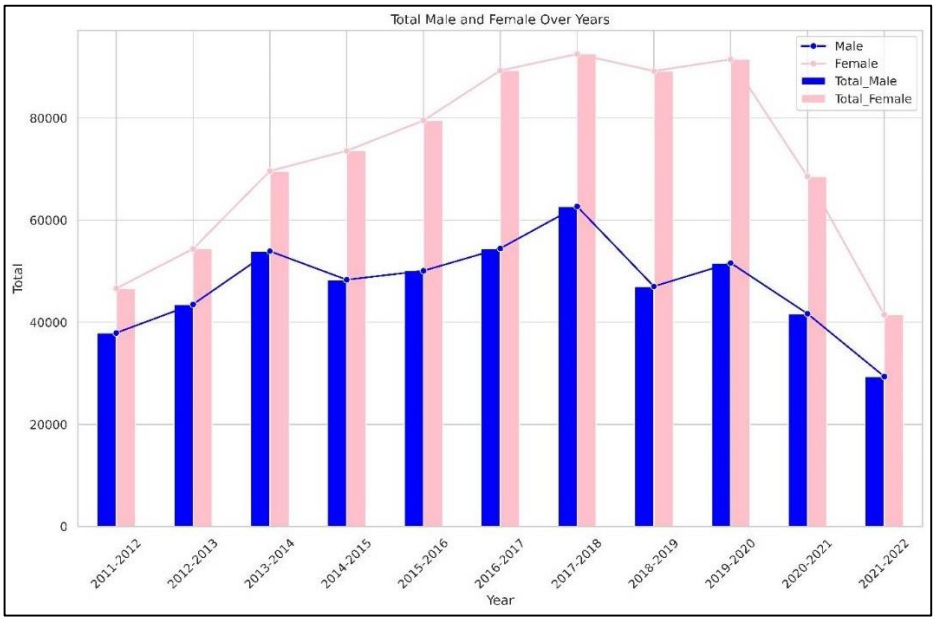

Figure 1: Gender gap in Bachelor in Mathematics (B.Sc. Math.) in India.

Interpretation: The data from 2011-2022 reveals a consistent trend of a higher female participation rate compared to males in the specified context, with the percentage of females steadily increasing over the years. Starting at 55.15% in 2011-2012, female participation peaked at 65.48% in 2018-2019. Meanwhile, male participation decreased from 44.84% to 34.52% over the same period, reaching its lowest in 2018-2019. The gender gap, indicating the difference in participation rates between males and females, widened significantly from 10.31 in 2011-2012 to 30.96 in 2018-2019, before slightly narrowing in the subsequent years, ending at 17.09 in 2021-2022. The overall data highlights a significant shift towards greater female involvement and a corresponding decline in male participation over the observed decade.

Objective – 2: To study the gender parity in Masters of Philosophy in Mathematics in India. Table 2: Gender gap in Masters of Philosophy (M.Phil.) in Mathematics in India.

Year	Total (Male & Female)	Total Male	Total Female	% of Male	% of Female	Gender Gap
2011-2012	1718	653	1065	38	61.99	23.99
2012-2013	1880	678	1202	36.06	63.93	27.87
2013-2014	1927	713	1214	37	62.99	25.99
2014-2015	2369	868	1501	36.63	63.36	26.73
2015-2016	2813	816	1997	29	70.99	41.99
2016-2017	3277	850	2427	25.93	74.06	48.13
2017-2018	2755	674	2081	24.46	75.53	51.07
2018-2019	2043	559	1484	27.36	72.63	45.27
2019-2020	1496	313	1183	20.92	79.07	58.15
2020-2021	872	195	677	22.36	77.63	55.27
2021-2022	388	50	338	12.88	87.11	74.23

Source: AISHE reports (2011-12 to 2021-2022)

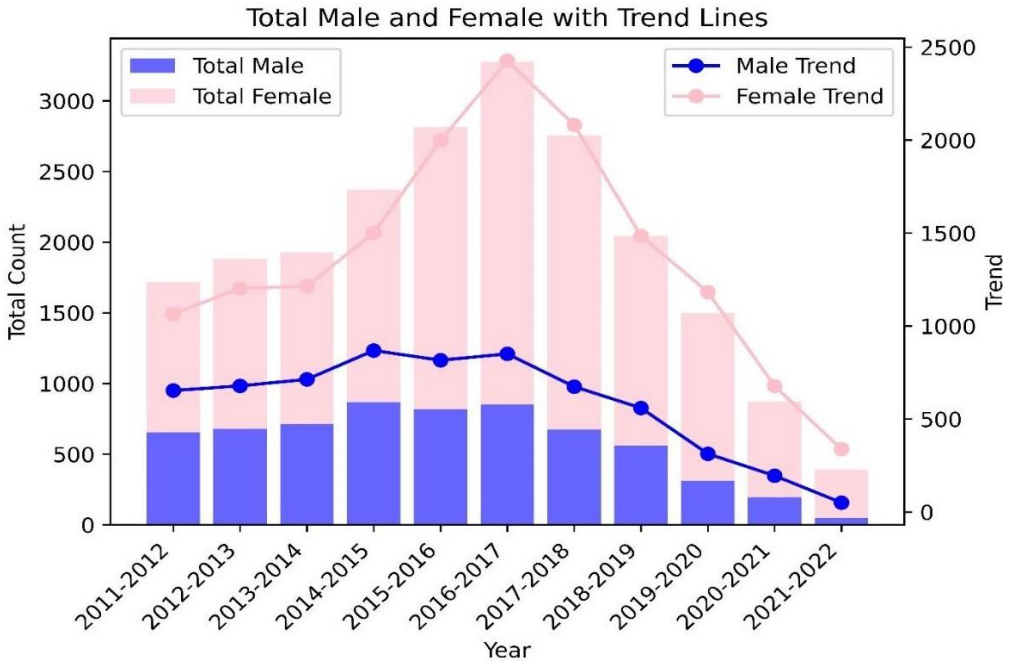

Figure 2: Gender gap in Masters of Philosophy (M.Phil.) in Mathematics in India.

Interpretation: The data presents a clear trend of increasing female dominance in the total count over the years from 2011-2012 to 2021-2022. Initially, in 2011-2012, the percentage of females was 61.99%, which increased steadily over the years, reaching 87.11% in 2021-2022. Concurrently, the percentage of males decreased from 38% to 12.88%. The gender gap, reflecting the difference between the percentages of females and males, also widened significantly from 23.99% in 2011-2012 to 74.23% in 2021-2022. This indicates a growing disparity with a notable shift towards a higher female representation over this period.

Objective – 3: To reveal the gender parity in Doctor of Philosophy in Mathematics in India. Table 3 Gender gap in Doctor of Philosophy (Ph.D.) in Mathematics in India.

Year	Total (Male & Female)	Total Male	Total Female	% of Male	% of Female	Gender Gap
2011-2012	2347	1407	940	59.95	40.5	19.45
2012-2013	2663	1545	1118	58.02	41.98	16.04
2013-2014	2759	1562	1197	56.61	43.38	13.23
2014-2015	2508	1443	1065	57.54	42.46	15.08
2015-2016	2870	1632	1238	56.86	43.14	13.72
2016-2017	3335	1908	1427	57.21	42.78	14.43
2017-2018	3894	2143	1751	55.03	44.96	10.07
2018-2019	4504	2446	2058	54.30	45.69	8.61
2019-2020	5284	2924	2360	55.33	44.66	10.67
2020-2021	4537	2567	1970	56.57	43.42	13.15
2021-2022	1943	941	1002	48.43	51.56	3.13

Source: AISHE reports (2011-12 to 2021-2022)

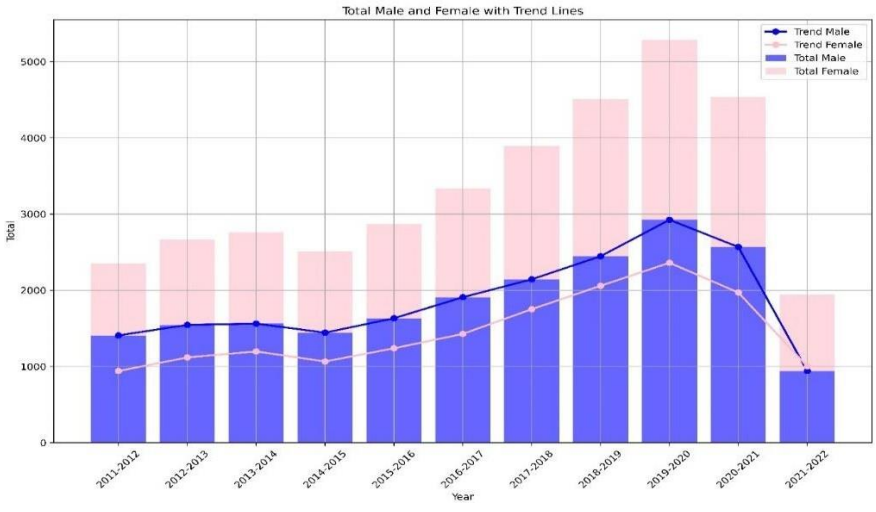

Figure 3: Gender gap in Doctor of Philosophy (Ph.D.) in Mathematics in India.

Interpretation: The data presents a ten-year overview of total participants, separated by gender, and the corresponding percentages and gender gap in participation. Over the period from 2011 to 2022, there is a general trend of increasing total participation until a peak in 2019-2020, followed by a notable decrease in 2020-2021 and a more significant drop in 2021-2022. Initially, males consistently represented a higher percentage of participants, with the gender gap gradually narrowing over the years. By 2021-2022, females slightly outnumbered males, marking the smallest gender gap of 3.13%. This shift indicates a

trend towards more balanced gender participation over the decade, reflecting changes in gender dynamics and possibly the impact of initiatives aimed at encouraging female participation.

4. RESULTS OF THE STUDY

1. It was found that a clear upward trend in the percentage of female enrolment at the post-graduate level in M.Sc. in Mathematics. Female students are enrolled higher percentage than male students between 2010-2011 to 2021-2022.
2. It has been revealed that the enrolment percentage of female students in the M.Phil. program in Mathematics is rapidly increasing between 2010-2011 to 2021-2022. Female students are enrolled higher percentage than male students between 2010-2011 to 2021-2022.
3. It has been shown that the enrolment percentage of male students in the Ph.D. program in Mathematics was higher than females between 2010-2011 to 2020-2021. The percentage of enrolment among female students increasing year by year. A higher percentage of female students (51%) enrolled in the academic session 2021- 2022.

5. DISCUSSION

Firstly, the upward trend in the percentage of female enrolment in M.Sc. in Mathematics programs is noteworthy. This increase suggests a growing interest and participation of women in advanced studies in mathematics, a field traditionally dominated by men. The higher percentage of female students compared to male students in this period indicates that efforts to promote gender equity at the master's level may be yielding positive results. Factors contributing to this trend could include targeted scholarships, mentorship programs, and initiatives aimed at encouraging women to pursue STEM fields.

Similarly, the rapid increase in female enrolment in the M.Phil. program in Mathematics reflects a positive shift towards gender balance in higher-level research qualifications. The increased representation of women at this level suggests that more female students are not only entering but also continuing their academic journey in mathematics. This trend could be attributed to a supportive academic environment, role models, and societal changes that encourage women to pursue advanced degrees.

On the other hand, the Ph.D. program in Mathematics initially showed a higher percentage of male enrolment compared to females from 2010-2011 to 2020-2021. However, the data indicate that the percentage of female enrolment has been increasing year by year, culminating in a higher percentage of female students (51%) enrolled in the academic session 2021-2022. This shift signifies a critical turning point and suggests that the gap at the highest level of academic qualification in mathematics is closing. This change may reflect broader societal shifts towards gender equality and the success of specific interventions aimed at supporting women in doctoral programs.

The gradual increase in female representation in Ph.D. programs could be influenced by various factors such as increased funding opportunities, flexible study options, and the growing presence of female academics and researchers who can serve as role models. Additionally, institutional policies aimed at reducing barriers to female participation in research, such as addressing implicit biases and providing family-friendly policies, could be contributing to this positive trend.

6. CONCLUSION

In conclusion, the findings highlight a positive trajectory toward gender balance in postgraduate mathematics education. The increase in female enrolment at the M.Sc. and M.Phil. levels, coupled with the recent rise in female Ph.D. candidates, underscores the importance of continued support and targeted initiatives to sustain and further this progress. This indicates a significant shift towards greater gender parity and female representation in higher education mathematics programs.

REFERENCES

1. Thelwall, M., Bailey, C., Makita, M., Sud, P. & Madalli, D. (2019). Gender and Research Publishing in India: Uniformly high inequality?. Journal of Informetrics, 13 (1), 118-131.
2. http://dx.doi.org/10.1016/j.joi.2018.12.003
3. Global Partnership for Education (2019). Achieving Gender Equality in and Through Education: A Knowledge and Innovation Exchange (KIX) Discussion Paper.
4. https://www.researchgate.net/publication/
5. House of Commons Science and Technology Committee (2022-2023). Diversity and inclusion in STEM. https://publications.parliament.uk/
6. Ahn, S. Y., Hahn, Y., & Yoon, S. (2022). Can STEM Learning Opportunities Reshape Gender Attitudes for Girls?: Field Evidence from Tanzania.
7. Xie, G., & Liu, X. (2023). Gender in mathematics: how gender role perception infuences mathematical capability in junior high school. Springer open: The Journal of Chinese Sociology, 10 (10), 1-23.
8. https://doi.org/10.1186/s40711-023-00188-3
9. United Nations Educational Scientific and Cultural Organization (2020). STEM Education for Girls and Women: Breaking Barriers and Exploring Gender Inequality in Asia. http://www.unesco.org/open- access/terms-use-ccbysa-en
10. Huang, J., Li, Y., & Zheng, Y. (2022). Gender Discrimination in STEM Education. Proceedings of the 2022 6th International Seminar on Education, Management, and Social Sciences (ISEMSS 2022).
11. https://doi.org/10.2991/978-2-494069-31-2_155
12. Bondar, K.L. (n.d.). Gender Differences in Mathematical Abilities and Achievements among Post Graduate Mathematics Students.
13. https://shodhgangotri.inflibnet.ac.in/bitstream/20.500.14146/8621/1/01_synopsis.pdf
14. Paudel, T. (n.d.). Gender Issue in Teaching and Learning Mathematics.
15. https://www.researchgate.net/publication/342437701_GENDER_ISSUE_IN_TEACHING_AND_LEARNIN G_MATHEMATICS
16. Howes, E. V. (2002). Connecting girls and science. Constructivism, feminism, and education reform. New York: Teachers College Press.
17. Barton, A. C. (1998). Feminist Science Education. New York: Teachers College Press.
18. Sinnes, A. T. (2005). Approaches to gender equity in science education. Two initiatives in sub-Saharan African seen through a lens derived from feminist critique of science. http://www.ils.u10.no/forskninig/palidrgrad/doktorarhandlinger/docs/AstridSin

19. Sattva Knowledge Institute. (2023). Advancing Gender Equality in Science Technology Engineering Mathematics (STEM) Education in India. http://www.sattva.co.in/knowledge-institute/
20. Ankur Nandi, Amit Bagdi, Anita Chatterjee, Barsha Ghosh, Supriya Dutta, Soumen Roy, Dr. Tapash Das, Dr. Lutful Haque. (2024). Gender Parity in Mathematics Education in India. International Research Journal of Modernization in Engineering Technology and Science, **Volume: 06/Issue:07,** e-ISSN: 2582-5208.