

Shifting Gender Dynamics in Indian Higher Education: PG and Ph.D. Enrolment Trends

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ABSTRACT

Indian higher education is experiencing a rise in female enrolment in higher education and female students became higher than that of male students for the first time in 2019-20. However, when analyse discipline wise trend of girls' enrolment in Postgraduate (PG) and Doctoral (Ph.D.) programs, we find contrasting trends highlight a complex dynamic. By leveraging data from the All-India Survey on Higher Education (AISHE) reports, this analysis sheds light on the current representation of female students in higher education with focus on PG and Ph.D. programs. The contrasting enrolment patterns in PG and Ph.D. programs highlight the uneven progress towards gender equality in education across different fields of higher education in India. This study aims to contribute to a deeper understanding of these dynamics and the persistent barriers that hinder the achievement of true gender parity.

KEYWORDS: Higher Education; Human Capital; Gender Inequality; Gross Enrolment Ratio; Leaky Pipeline; All-India Survey on Higher Education (AISHE); STEM Subjects.

INTRODUCTION

A well-educated workforce is the backbone of a nation's progress. When individuals are equipped with knowledge and skills, they can generate innovative ideas that lead to better job opportunities. This, in turn, fuels increased productivity and economic growth. Moreover, higher education is considered key instruments for empowerment and social change as it produces a wide variety of externalities which go beyond the productivity (Filmer & Rogers, 2019; Dreze & Sen, 1996). The pioneering research of Theodore Schultz (1961), followed by a substantial expansion of studies in the Economics of Education, has firmly established that education is not merely a consumption activity but primarily an investment. This investment results in the formation of human capital, akin to physical capital, which significantly contributes to economic growth (Tilak, 2007).

Following the pioneering work of Theodore W. Schultz, numerous researchers have quantified the significant returns on investment associated with educational attainment. Their findings show that private returns, the individual's financial gains for secondary and tertiary education, are substantially higher than those for primary education (Psacharopoulos & Patrinos, 2018). This translates to higher-level education being a profitable investment for individuals. This economic reality has fuelled a global trend of nations striving for a more rapid expansion of their education systems, particularly focusing on higher secondary and university education.

The benefits of education extend beyond individual and national development. There are significant external benefits associated with female education in particular. Studies have shown that advancing female education associated with lower fertility rates, decreased child mortality, and improved education for the next

generation. These factors collectively contribute positively to economic growth and societal well-being. Therefore, gender disparities in education not only limit the potential of women themselves but also diminish the societal advantages of high female education (Galor & Weil, 1993; Klasen & Lamanna, 2009).

Studies suggest that many countries have achieved success in global markets by leveraging women-intensive, export-oriented manufacturing industries (Seguino & Floro, 2003). For these competitive export industries to thrive, it is essential that women are educated and face no barriers to employment in these sectors. Gender inequality in access to education hinders countries' ability to capitalize on these opportunities. Consequently, discrimination against women in education and employment not only harms the affected women but also imposes a burden on society as a whole (Klasen & Lamanna, 2009).

The above discussion presents a critical opportunity for a developing country like India, with its vast and growing young population, to promote higher education. This is especially the case in the modern era because economic growth and social development depend more on human capital than the availability of natural resources owing to the development of new information technologies. While recent years have seen significant progress in access to higher education for females in India, the journey towards true inclusivity is far from complete. The literature in this field suggests that gender gap exists across disciplines/ courses, with certain fields remaining dominated by one gender or the other. This uneven distribution raises questions about whether equal access translates to equal opportunities for girls to pursue their full potential within higher education.

Since higher education plays a crucial role in the economic, socio-cultural, and human development of any country, it should be accessible to all citizens, regardless of gender. Theoretical literature on gender inequality in education posits that gender disparity diminishes the overall level of human capital in a society, thereby negatively impacting economic performance. This occurs because the talent pool for education is limited by excluding highly qualified girls and favouring less qualified boys (Dollar and Gatti, 1999). Additionally, if there are diminishing marginal returns to education, prioritizing boys' education over girls' means the marginal return on educating girls is higher, which would enhance overall economic performance (King & Mason, 2001; Avin, 2006).

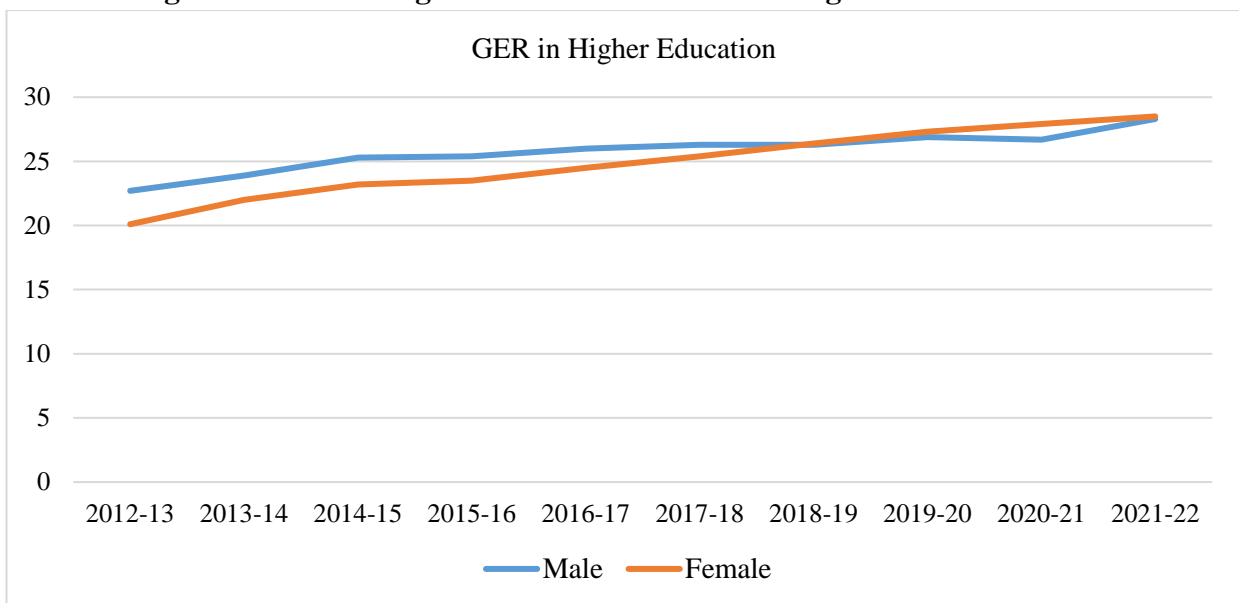
Seeing a significant rise in Gross Enrolment Ratio (GER) across school education levels in India (100.13% for Elementary, 79.56% for Secondary, and 57.6% for Higher Secondary in 2021-22), the higher education system now faces a surging demand, particularly among girls. India's higher education system places a strong emphasis on undergraduate education, with 78.91% of students enrolled in undergraduate programs, while only 12.06% pursue postgraduate studies, and 0.49% enrolled in Ph.D. programs (AISHE Report 2021-22). The remaining students are enrolled in diploma and certificate programmes. This enrolment data highlights the significant gap in enrolment between undergraduate and postgraduate programs in India's higher education system. As postgraduate studies allow individuals to specialize in a field, fuelling innovation and technological advancement crucial for economic growth, ensuring equitable access for girls in these programs is essential. This study delves into the status of representation of female students in postgraduate (PG) and doctoral (Ph.D.) programs.

In view of the above context, this article delves into the trend of girls' enrolment in higher education over the past decade. Specifically, it examines the growth in postgraduate (PG) and doctoral (Ph.D.) programs, and explores the potential factors driving this increasing demand for advanced degrees among females. To achieve a comprehensive understanding, the study utilizes data from the All-India Survey on Higher Education (AISHE) reports, an important resource providing official statistics on enrolment trends across different demographics and educational levels in India.

ACCESS TO HIGHER EDUCATION IN INDIA

Access to higher education is measured in terms of the Gross Enrolment Ratio (GER), which is calculated as the ratio of persons enrolled in higher education institutions to the total population of persons in the age group of 18 to 23 years. According to All India Survey on Higher Education (AISHE) report, GER for higher education for male population has improved from 22.7 percent in 2012-13 to 28.3 percent in 2021-22 and for female population from 20.1 percent to 28.5 percent at all India level during the same period. Due to the significant increase in GER in last decade, female students became higher than that of male students for the first time in 2019-20. It is relevant to mention here that higher education refers to the formal education pursued after completing 12 years of schooling which includes various programs including diploma, certificate, undergraduate, postgraduate, and doctoral courses/programs. Further, the aforesaid GER in India provides the overall participation in higher education. AISHE reports doesn't provide a breakdown of the GER for different types of programs within higher education (i.e., diploma, UG, PG, Ph.D.). The trend of GER during the last ten years is as below.

Figure 1: GER in Higher Education in India during 2012-13 to 2021-22.



Source: AISHE Reports of Various years, Ministry of Education, GoI

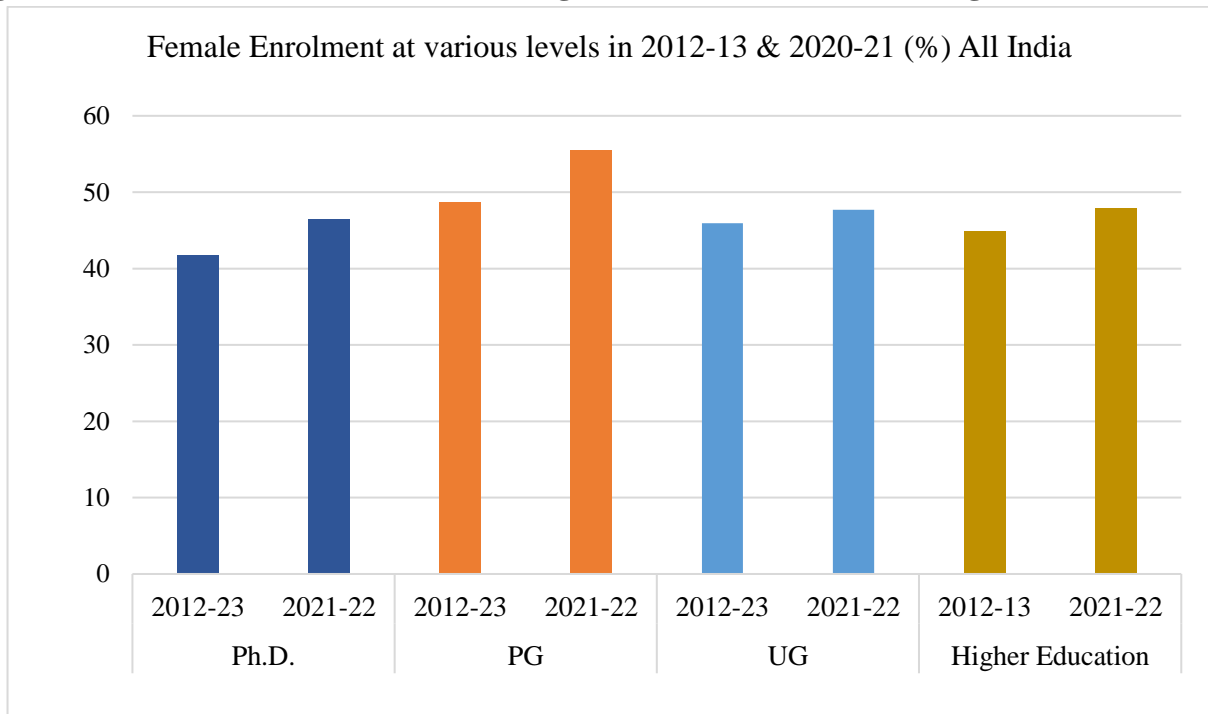
The above figure shows that there has been higher increase in female enrolment as compared to male in last decade. In 2012-13, the GER for males was 22.7% and for females was 20.1%, culminating in a total GER of 21.5%. By 2021-22, these figures had risen to 28.3% for males and 28.5% for females indicating near gender parity in higher education enrolment. Thus, the GER data mentioned above gives a positive picture overall.

GER helps to understand the proportion of the population of the relevant age group (18-23 years) that is enrolled in higher education. It indicates how effectively the higher education system is serving its primary target group. Since the focus is on PG and Ph.D. enrolment of females, total enrolment captures the absolute number of students in higher education, including non-traditional students (those outside the typical age range of 18-23 years), providing a complete picture of higher education access.

Further, GER looks at total enrolment, so it doesn't differentiate between students enrolled in undergraduate programs, postgraduate programs (PG), or Ph.D. programs. If the focus is on PG and Ph.D. enrolment,

particularly for females, a more specific metric might be needed. Thus, the following paragraphs discuss the situation of female enrolment in higher education in India. The figure below provides progress of female enrolment at various levels of courses in higher education from 2012-13 to 2021-22.

Figure 2: Status of Female Enrolment in Higher Education in India during 2012-13 to 2021-22.



Source: AISHE Reports of Various years, Ministry of Education, GoI

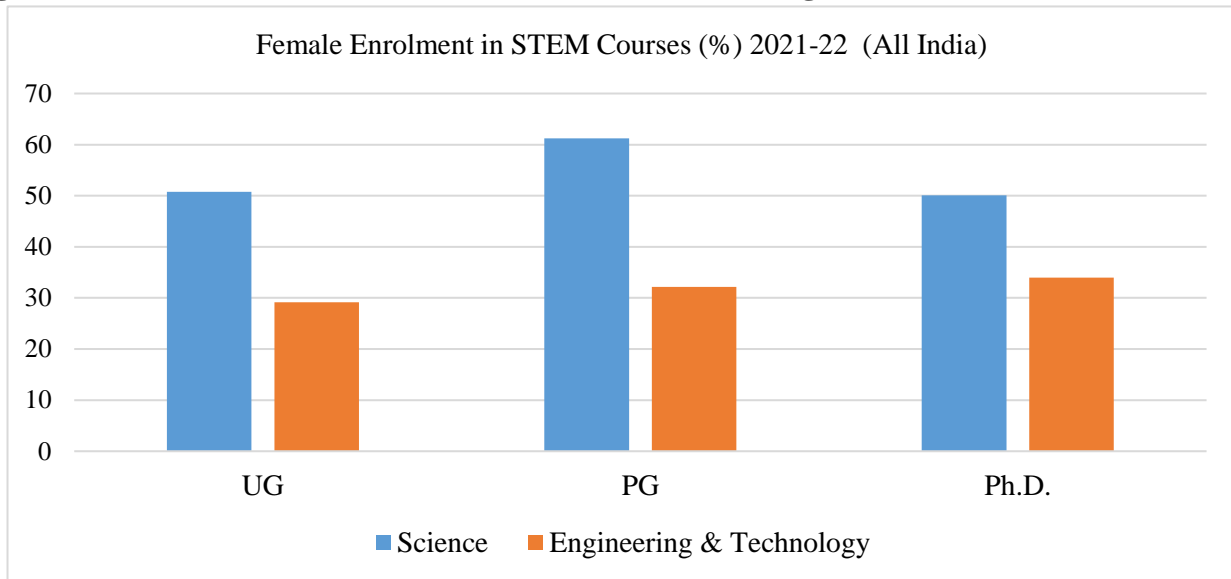
The above figure provides a positive picture for female enrolment in India in different level of courses. There's been a significant increase of 4.72% in female students pursuing higher education compared to the academic year 2012-2013. This means nearly half (47.82%) of all students enrolled in higher education in India are now women.

The trend is particularly encouraging in postgraduate programs, where female enrolment has jumped by 6.75%. This suggests a growing number of women are opting for specialized studies after their undergraduate degrees. While undergraduate programs also show an increase, it's slightly lower at 1.78%.

Doctoral programs are also witnessing a surge in female participation, with a 4.72% rise in enrolment. This indicates a growing ambition among women to pursue research and contribute to their chosen fields. Overall, the data highlights a positive trend towards gender equality in Indian higher education.

It is important to mention here that these statistics represent country averages and do not account for gender disparities across different levels of courses of higher education like UG, PG and Ph.D. The reports on higher education indicates that gender distribution is notably uneven, particularly evident in STEM disciplines (science, technology, engineering, and mathematics), where female students are significantly underrepresented in most countries including India. The following figure gives detail about female enrolment in STEM subjects in higher education.

Figure 3: Status of Female Enrolment in STEM courses in Higher Education in India in 2021-22



Source: AISHE Reports of Various years, Ministry of Education, GoI

The figure illustrates female enrolment percentages in STEM courses across different higher education levels in India for 2021-22. At the undergraduate level, 50.76% of science students are female, compared to 29.14% in engineering and technology. At the postgraduate level, female enrolment rises to 61.23% in science and 32.17% in engineering and technology. For Ph.D. programs, 50.09% of science students and 34.00% of engineering and technology students are female. Overall, female participation is higher in science than in engineering and technology at all levels, with the highest percentage in postgraduate science courses.

Above data suggests that there is a gender disparity in STEM enrolment in India, with science courses having a higher percentage of female students compared to engineering and technology at all educational levels. This suggests that there might be some underlying factors affecting female enrolment in engineering and technology programs. One significant factor contributing to this gender gap is the portrayal of men primarily as science professionals and women mainly as teachers, which perpetuates stereotypes and reinforces societal gender expectations. These psychosocial differences are believed to contribute significantly to the differing interests and career aspirations observed between girls and boys in STEM fields (Hammond, 2020).

Further, the availability of academic courses and women's ability to enrol in them are not directly linked, nor are they solely dependent on women's academic performance¹ (UNESCO, 2017). For example, in India, results of Central Board of Secondary Education (CBSE) indicates that girls generally perform at par or better than boys in school. However, upon entering college, they may not necessarily pursue their preferred subjects. Many girls face constraints on their freedom of choice, such as familial discouragement from studying certain subjects like science or attending high-quality private schools, etc. Additionally, after completing school, they may lack financial support for coaching or tuition for entrance exams, like IIT and Medical. These limitation on disciplinary choices will also have implication on participation of women in the job market also.

The literature also highlights the educational-gender-equality paradox which means that countries with high gender equality surprisingly have some of the widest gaps in STEM education in higher education. Conversely, countries with lower gender equality have relatively more women among STEM graduates

¹ <https://unesdoc.unesco.org/ark:/48223/pf0000253479>

compared to more gender-equal countries. For example, Finland, which ranks high on the gender equality index and educational standards, unexpectedly has one of the world's largest gaps in STEM subjects in college degrees, with fewer than 25% of graduates being women. Similarly, Norway and Sweden, known for their gender equality, also face significant gender disparities in STEM higher education (Stoet & Geary, 2018). Whereas, the countries which has relatively lower gender equality index like Azerbaijan, Thailand, Kazakhstan, Georgia, Armenia, Kuwait, Bolivia, Venezuela, Trinidad & Tobago, Guatemala, Argentina have relatively higher enrolment in STEM courses (UNESCO, 2018).

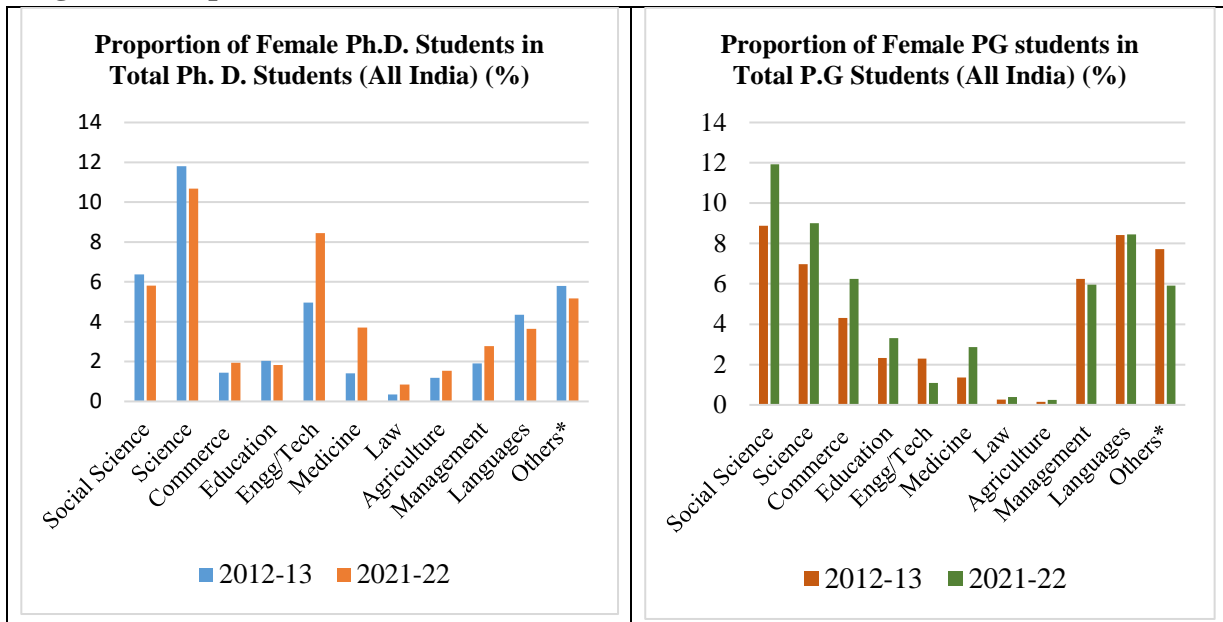
Globally, a phenomenon known as the 'leaky pipeline' describes the consistent decrease in the proportion of women as they progress through education and careers. While girls show interest in science during school and comprise the majority of science graduates at the bachelor's and master's levels, their representation significantly drops at the Ph.D. level. This disparity becomes even more pronounced among researchers (Thornton, 2019). While research into biological factors like brain structure and hormones has not revealed inherent limitations for women in STEM, it has highlighted the brain's remarkable ability to learn and adapt. This suggests that educational experiences and targeted interventions can significantly impact achievement in STEM subjects (UNESCO, 2017). Several factors contribute to this phenomenon, including societal expectations of motherhood, lingering gender stereotypes, implicit or explicit sexism, requirements for geographical mobility, and limitations in established academic networks (Osterloh et al. 2023).

The above discussion indicates that there is no single explanation for the STEM gender gap. However, the two economic concepts help shed light on it: utility and comparative advantage. Utility refers to the enjoyment or satisfaction from an activity. A Canadian study found that boys report higher self-efficacy and a broader interest in science than girls. This influences their study as well as career choices. Comparative advantage suggests individuals should specialize in the work they are most productive at, as supported by economic theory. This principle appears to be evident in the current STEM landscape (Hango, 2013).

GENDER DISTRIBUTION IN HIGHER EDUCATION COURSES IN INDIA

The proportion of female students in total students versus the proportion of female students within each course or subject can provide insights into gender representation across different fields of study. Proportion of female students in total represents the percentage of female students compared to the total number of students enrolled in all courses or subjects combined at a particular level (e.g., PG or Ph.D.). It gives a broad overview of gender distribution across all fields without specific focus on individual subjects. Whereas proportion of female students within each course/subject provides a detailed view of gender representation within each field, highlighting where women are more or less represented compared to men. The figure below provides proportion of female students in total students at Ph.D. and PG level courses.

Figure 4: Proportion of female students in total students at Ph.D. and PG level courses.



Source: AISHE Reports of Various years, Ministry of Education, GoI

Note: For each subject (i), proportion of Female Ph.D. Students in Total Ph.D. students has been calculated as below: $P_i = (\text{number of female PhD students in subject } i) / (\text{total number of PhD students across all subjects.})$

An analysis of female enrolment data from 2012-13 to 2021-22 reveals a fascinating interplay between disciplines and educational levels. In 2021-22, at the postgraduate (PG) level, Social Sciences lead with the highest proportion of female students (11.93%), followed by Science (9%), Languages (8.45%), Commerce (6.24%), and Management (5.97%). Interestingly, the Ph.D. level shows a different picture, with Science boasting the highest proportion (10.68%), followed by Engineering/Technology (8.44%) and Social Sciences (5.82%).

These contrasting trends of enrolment in PG and Ph.D. courses highlight a complex dynamic. While fields like Social Sciences attract more women at the PG level, Science and Engineering/Technology see a larger female presence at the Ph.D. level (possibly reflecting career aspirations or research opportunities). Importantly, the overall proportion of female Ph.D. students has increased by 4.79% from 2012-13, suggesting a positive shift towards higher female participation in research.

At the Ph.D. level, Science shows the highest proportion of female students, comprising 10.68% of all female Ph.D. students in 2021-22, followed by Engineering/Technology with 8.44%, and Social Science with 5.82%. Whereas, at the PG level, Social Science has the highest proportion of female students, accounting for 11.93% of all female students in 2021-22. Science follows with 9%, Languages with 8.45%, Commerce with 6.24%, and Management with 5.97%.

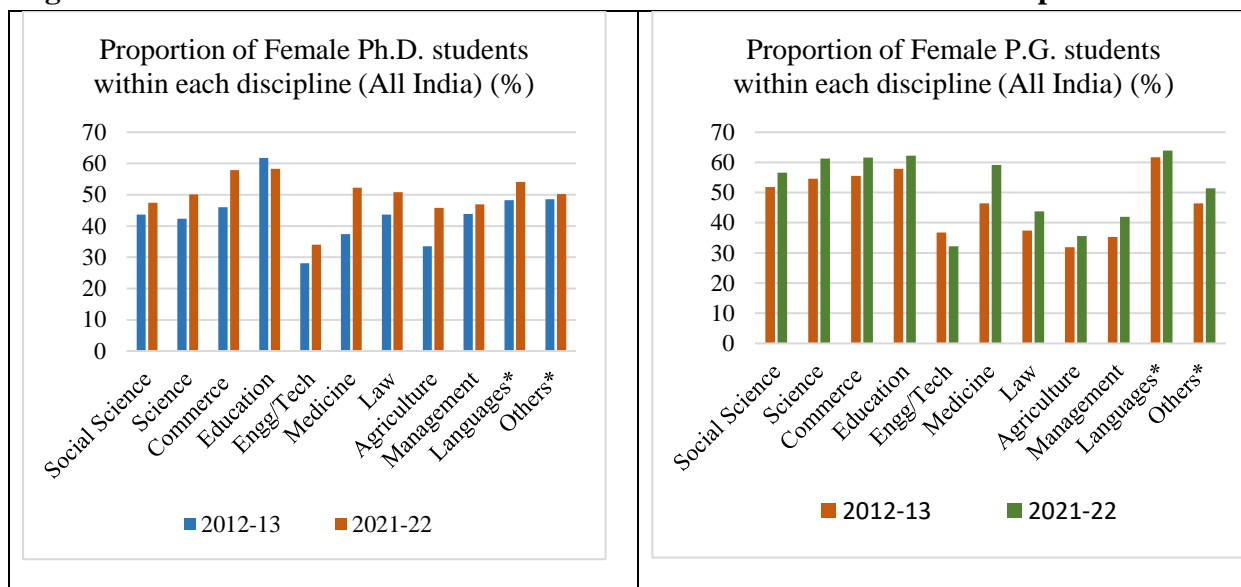
If we compare the enrolment data of 2012-13 with 2022-23, Engineering/Technology, Medicine, Law, and Management have seen an increase in the proportion of female students pursuing Ph.D. degrees. This suggests a positive trend towards higher female participation in traditionally male-dominated fields like Engineering/Technology, Medicine and Law. At the PG level, Social Science, Science, Commerce, and Education have observed an increase in the proportion of female students. This trend suggests a growing interest and participation of female students in these fields at the postgraduate level, possibly influenced

by broader societal changes, educational opportunities, and career prospects. It is relevant to mention here that at aggregate level, in Ph.D. course the proportion of female students was 41.62 % in 2012-13 which increased to 46.41 % in 2021-22.

The opposite trends in female enrolment between PG and Ph.D. levels in India in different disciplines underscore the evolving landscape of higher education and career opportunities for women. While societal norms and initial career choices at the PG level may vary, factors such as institutional policies, research opportunities, and the availability of support systems increasingly shape decisions at the Ph.D. level. As these factors continue to evolve, they play a pivotal role in shaping the educational and professional trajectories of female students in India. Understanding the real reasons behind these trends is crucial to ensure that higher education caters to diverse aspirations and contributes effectively to national development.

In order to have better picture of gender inclusivity in higher education courses, the paragraph below analysis proportion of female students within each subject/ discipline.

Figure 5: Female Enrolment in PG and Ph.D. courses within different disciplines in India



Source: AISHE Reports of Various years, Ministry of Education, GoI

Note: Proportion (P_i) of female Ph.D. students within each subject (i) is calculated using the formula: $P_i = (\text{number of female PhD students in subject } i) / (\text{number of total PhD students in subject } i)$

Over the past decade, India has witnessed a positive trend in girls' enrolment in postgraduate (PG) courses, particularly in Science, Commerce, Education, Social Sciences, and Languages, where female students now comprise over 50% of enrolments in 2021-22. This surge suggests greater access to education and a growing interest in diverse fields. Interestingly, traditionally male-dominated fields like Medicine (from 46.46% to 59.13%), Law, and Management have also seen significant increases in female enrolment (over 5% each) during this period. This shift reflects changing societal perceptions and potentially aligns with evolving career opportunities.

However, a closer look reveals a persisting gap in Engineering/Technology, where female enrolment has dipped slightly (from 36.80% to 32.17%). Similarly, Social Sciences in Ph.D. programs show a female enrolment rate below 50% in 2021-22. Further research is needed to understand the reasons behind these

discrepancies. Nonetheless, the overall increase in female participation across various disciplines, particularly at the Ph.D. level, is encouraging. Continued efforts to dismantle gender stereotypes and provide targeted support programs can further bridge these gaps and empower women to pursue their academic aspirations in all fields.

If we analyse the changes during the last ten years, Engineering/Technology discipline saw a decrease from 36.80% to 32.17%. Whereas Medicine had a notable increase from 46.46% to 59.13%. The disciplines of Law and Management also experienced more than 5 % increase in last decade. Thus, fields traditionally dominated by male enrolment, such as Engineering/Technology, are seeing a decrease in the gap between male and female enrolments. Whereas, fields like Medicine, Law, and Management are showing increasing female participation, possibly reflecting changing societal trends and educational opportunities.

In Ph.D. courses, there is an increase in the proportion of female students across all disciplines. Similar to PG enrolments, fields like Medicine, Commerce, Languages, have continued to see female enrolment surpass 50% in Ph.D. programs. However, in Social Science percent of girl enrolment is less than 50 percent in Ph.D. course in 2021-22.

CONCLUSION:

Indian higher education is seeing a rise in female enrolment, with a positive trend at both PG and Ph.D. levels. The analysis reveals interesting differences across disciplines. Social Sciences lead in PG enrolment, while Science takes the top spot for Ph.D. Traditionally male-dominated fields like Medicine, Law, and Management are witnessing a surge in female students at the PG level. However, a closer look reveals a persisting gap in Engineering/Technology, where female enrolment has dipped slightly (from 36.80 % to 32.17%) in the last decade for PG programs. Similarly, Social Sciences in Ph.D. programs show a female enrolment rate below 50% in 2021-22, despite a higher rate at the PG level.

Promoting gender equality is particularly important in the fields of science, technology, and engineering. Historically, various factors, including societal stereotypes and biases, have resulted in significant underrepresentation of women in these areas. Supporting and encouraging women's involvement is essential for scientific progress and innovation. The Department of Science and Technology, Government of India, has introduced a specialized scheme called "Women in Science and Engineering-KIRAN" to support women in research. Similarly, the Vigyan Jyoti scheme aims to provide support and interventions from Class IX through to the PhD level to encourage girls to pursue careers in underrepresented areas of STEM.

Government of India as well as State Governments have implemented several policies to encourage girls' participation in higher education, including financial assistance schemes, scholarships for disadvantaged girls. Additionally, initiatives like reservation for women in universities and dedicated women's institutions aim to improve access and create a supportive learning environment. However, societal norms and safety concerns can still discourage girls, and ensuring quality education, particularly in rural areas.

Overall, the data suggests a positive shift towards more women pursuing higher education in India, particularly in research (Ph.D.). Improved access to primary and secondary education for girls, coupled with growing awareness of the benefits of higher education, likely plays a role in this trend. Continued efforts are needed to address societal norms and provide targeted support, such as mentorship programs, to further empower women to pursue diverse educational and professional paths, especially in fields like engineering/technology where female participation remains lower.

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