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Advancing Participation of Women in STEM Courses in the Higher Educational Institutions in India

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ABSTRACT: ***The higher education and research in universities and institutions of eminence are considered as key drivers for empowerment of society and social change. In this context, university institutions can play a pivotal role for promoting gender equality, diversity, justice, social inclusion. India is successfully moving forward towards closing the gender equality gap in its HEIs through policy interventions and good governance. The higher enrolment ratio of women enhances their living standards as well as decision-making powers in the society. While there is an increasing trend of enrolment of female students in STEM (Science, Technology, Engineering and Mathematics) courses are seen in India for the last few years, their participation in the workforce remains low. The secondary data from All India Survey on Higher Education (AISHE) conducted by the Government of India for the last 10 years from 2010-11 to 2019-20 has been used for analysis. The present study is aimed to examine the trends in enrolment of female students with a special reference to the fields of STEM. The paper will help the researchers and practitioners engaged in public policy or higher education in understanding the moving trends of society and its pace towards gender equality in India.***

KEYWORDS: Higher Education, STEM Course, Student Enrolment, Gender Disparity.

INTRODUCTION

Education has been the key of advancement and development for each and every group, class and social category. The group deprived from education is deprived from development. Education, centred in a particular category, group or class, becomes discriminatory for the rest of the society. Such discrimination prevents them to play their role in the development of society and country, consequently hampering the national development. This is also true with female. Female deprived from education means discrimination against them and subsequently their alienation from the participation in the processes of development. Education has been considered as a strong agent of social change also at individual as well as at societal level.

Significance of STEM courses

A World Bank report suggests that mere 18% female students were found enrolled at tertiary level education in the fields of STEM (Science, Technology, Engineering and Mathematics) as compared to 35% of male students. Women accounts for one thirds of the researchers, 22% of workforce engaged in AI/ML based jobs and about 28% of engineering studies.

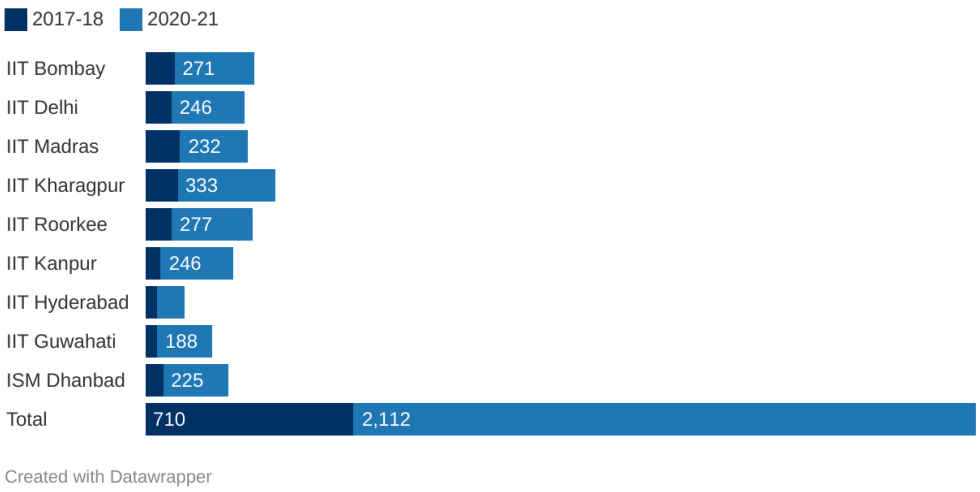
The scenario in India is encouraging one with nearly 43% female students enrolled in STEM courses as compared to 34% in United States, 31% Canada and 38% in United Kingdom. "Nevertheless, universities across the globe remain both gendered and gendering organizations [1][2]. Universities at global level strive to address this gender equality but it can be achieved through good public policies and governmental support. "World Bank data showed that in 107 of 114 economies, there are fewer female than male STEM graduates" [3].

In a study funded by UNESCO, 776 global universities on 18 indicators were studied recently and it was found that generally female students outnumber male students globally. The study also indicates that 54% students passed out in 2019 were female. Out of the total share of 54% of female students, only 30% students were able to pursue science, technology, engineering and Mathematics (STEM) programmes. But a significant 'human bias' was observed as "universities are more focused on measuring women's access to HEIs than tracking their outcomes and success rates". The remaining 24% of female students had undertaken arts, humanities and social sciences (AHSS) degrees. The study indicates that India shows a particularly large STEM bias of 25 percentage points on average [4]. The study shows that "not all STEM subjects show female underrepresentation, while males tend to be underrepresented in life sciences, psychology and education. Universities from all world regions are more likely to focus on providing access and support to women than on measuring their progress and success" [4]. The AISHE Survey data presented before the upper house of the Indian Parliament by the Educational Minister shows that about 20 million female students were enrolled in STEM courses in India between the academic years 2015-16 and 2019-20. The state of Tamil Nadu saw a maximum number of increased intakes of female students to the extent of 3 million.

Encouraging Participation of Women in STEM Courses in India

The Government of India, Department of Science and Technology (DST) has launched a pilot project called "Gender Advancement for Transforming Institutions (GATI)' with the objective of promoting gender equity in STEM courses in India. The project was formally launched by on 28th Feb 2020 on the occasion of National Science Day. GATI is aimed "to create an enabling environment for equal participation of women in science, technology, engineering, medicine and mathematics disciplines at all levels, addressing deep-rooted problems. It envisages a fresh perspective on not just measures for increasing retention and recruitment but the progression of women throughout their professional journey" [5].

Table 1: Female students admitted in top ranking IITs in 2017-18 & 2020-21



The admission data of India's premier STEM institutions - Indian Institute of Technology (IITs) indicates that there is almost 20% increase in enrolments of female students from 2017-18 onwards. The enrolment of female students in these IITs was 995 in 2017-18 which increased to 2990 students in 2021-22 viz. three times [6]. The admission data of female students of few IITs for the last four years viz. 2017-18 to 2020-21 is mention in Table 1.

All India Survey on Higher Education Reports

According to the All-India Survey on Higher Education Report, 2019-20, maximum students are enrolled in traditional undergraduate Arts/Humanities/Social Science programmes (32.7%) in HEIs, followed by science (16%) and Commerce (14.9%) based programmes. The enrollment in Engineering and Technology is 12.6%. The data indicates that 79% of the total students enrolled in 10 popular programmes. Student enrolment in Science and Engineering & Technology constitutes 28.6%. Still the share of female students is lowest in Institutions of National Importance viz. IITs/NITs/IISERs etc., deemed to be universities as well as Private Universities established under the State Legislature Act.

The GER of women in higher education had increased from 17.9 in the year 2010-2011 to 27.3 in the year 2019-2020. The GER of women in higher education has surpassed men in the age group of 18 to 23 in the year 2018-2019 and 2019-20, the GER for male is 26.9 and for female it is 27.3. The percentage of female enrolment was increasing from 43.76% (2010-11) to 49.03% (2019-20), the Gender Disparity Rate (GDR) is also decreasing from 12.49% to 1.95% and Gender Parity Index (GPI) is increasing from 0.78 to 0.96. Since GDR is decreasing it indicates that enrolment of female student is increasing and GPI is increasing which means disparity in enrolment was in favour of female.

DATA COLLECTION AND RESEARCH METHODOLOGY

Data Collection

The study is primarily based on secondary data and covers all types of Higher Education Institutions (HEIs) in India. Secondary data from the All-India Survey on Higher Education (AISHE) from 2010-11 to 2019-2020 on students' enrolment in HEIs, undertaken and published by the Government of India, Ministry of Education, Department of Education Higher Education [7].

Data Coverage

The level of programmes covered in this study includes undergraduate, postgraduate, integrated course leading to professional degrees or Postgraduate and Research degrees, M.Phil, PhD, postgraduate diploma, diploma or certificate courses offered at university or colleges level.

Research Methodology

This is a descriptive study that has taken into consideration the analysis of secondary data, following methodology has been used for the analysis of the data:

(i) Growth Rate represents in percentage (%): The growth rate is also called as Percentage of Increase and while calculating growth rate annually it is called as Annual Growth Rate (AGR).
Annual Growth Rate = (New Value-Old Value/Old value) × 100

(ii) Compound Annual Growth Rate (CAGR): specific term for the geometric progression ratio that provides a constant rate of growth over the time period

$$CAGR = \left(\frac{V_{final}}{V_{begin}} \right)^{1/t} - 1 \qquad where$$

V_{begin} = Beginning value; V_{final} = Final value; t = Time in years;

(iii) Gender Gap or Gender Disparity Rate (GDR) represent in percentage (%): It measures the gap or disparity between the male and female literacy rates. If the gap is negative, it indicates the disparity in favour of female. If the gap is positive, it indicates the disparity in favour of the male.
GDR (%) = % Male - % Female

(iv) Gender Parity Index (GPI): Is a socio-economic index usually designed to measure the relative access to education of males and females. It indicates the ratio between the female (F) and male (M) literacy rates (F/M).
GPI= Percentage of Female/Percentage of Male

- GPI = 1 indicates parity between male and female.
- GPI <1 means disparity in favour of male
- GPI >1 indicates the disparity in favour of female

RESULTS AND INTERPRETATIONS

During the period of survey in 2019-20, there were 1043 universities, the various types of universities are 48 Central Universities, one National Open University, 386 State Public Universities, 327 State Private Universities, 14 State Open University, 1 State Private Open University, 36 Deemed University-Government, 10 Deemed University-Govt. Aided, 80 Deemed University-Private, 135 Institutes of National Importance established through Central legislation and 5 established through State legislation. The number of students enrolled in the higher education institutions (all types of Universities, Colleges, Stand Alone Institutions) has increased steadily in the past one decade from 2010-11 to 2019-20. The students' enrolment at the beginning of 2010-11 was 27.50 million which rose to 38.54 million in 2019-20, registering a growth of 1.4 times with 3.4 % and 3.84% of AAGR. The total growth rate is 40% at the end of the study period i.e. 2019-20 with a steady increase from 6.13% in 2011-12.

Programme wise student enrolments and progressions

Table 2: Programme wise student enrolment in HEIs enrolment (in %) from 2010-11 to 2019-20.

	Ph.D	M.Phil	Post Graduate	Under Graduate	PG Diploma	Diploma	Certificate	Integrated
2010-11	0.28	0.09	11.89	79.9	0.51	6.59	0.52	0.21
2011-12	0.28	0.12	11.54	79.41	0.67	7.1	0.63	0.25
2012-13	0.32	0.1	11.44	79.23	0.64	7.32	0.64	0.31
2013-14	0.33	0.1	11.82	78.86	0.86	7.07	0.58	0.39
2014-15	0.34	0.1	11.26	79.42	0.63	7.33	0.5	0.41
2015-16	0.37	0.12	11.33	79.28	0.66	7.37	0.42	0.45
2016-17	0.39	0.12	11.22	79.39	0.6	7.32	0.47	0.49
2017-18	0.44	0.09	11.23	79.19	0.64	7.39	0.48	0.53
2018-19	0.45	0.08	10.81	79.76	0.6	7.22	0.44	0.64
2019-20	0.53	0.06	11.19	79.53	0.56	6.94	0.41	0.78

Created with Datawrapper

Table 2 shows the programme wise student enrolment in the Universities and colleges (Higher Educational Institutions) from 2010-11 to 2019-20 (10 years period). Level-wise student enrolment from 2010-11 to 2019-20 reveals that the majority of students both regular or distance mode enrolled for a variety of courses at the under-graduate level which alone constitutes about 80% of the total number of students in colleges and universities put together. The percentage of students enrolled for Master's level courses (Post Graduate) registered at 11%, followed by Diploma with 7% and with 1.5% in PG Diploma, Certificate and Integrated courses. A very small proportion i.e. 0.5% of the total number of students were enrolled for research Degrees i.e. PhD & M.Phil. Further the effective measures are therefore needed to motivate female students to take admission in diploma programmes (gender gap 30%) of higher education; gender inequality in education in India is still one of the areas of concern.

Trends in gender disparity

Table 3 shows the gender-wise enrolment pattern observed during the study period 2010-11 to 2019-20.

Table 3: Gender-wise enrolment pattern in Higher Education in India between the period 2010-11 to 2019-20.

	Male	Female	%Male	%Female
2010-11	15,466,559	12,033,190	56.24	43.76
2011-12	16,173,473	13,010,858	55.42	44.58
2012-13	16,617,294	13,535,123	55.11	44.89
2013-14	17,495,394	14,840,840	54.1	45.9
2014-15	18,488,619	15,723,018	54.04	45.96
2015-16	18,594,723	15,990,058	53.77	46.23
2016-17	18,980,595	16,725,310	53.16	46.84
2017-18	19,204,675	17,437,703	52.41	47.59
2018-19	19,209,888	18,189,500	51.36	48.64
2019-20	19,643,747	18,892,612	50.97	49.03

Created with Datawrapper

As may be seen from the table-3, the gender parity is slowly reducing. The percentage of male students at the beginning of the study period 2010-11 was 56.24% which is decreased to 50.97% in 2019-20. Similarly, the enrolment of female students at the beginning of the study period was 43.76% which increased gradually to 49.03% with 1.6-fold increase in 2019-20. However, there is an increasing trend of enrolments noticed both the male and female students. There was about 1.3 times increase observed in the case of male students. In the case of female students, the increase was 1.6 times resulting into increased share of female students at the end of the study period. The female enrolment during 2019-20 is very close to male enrolment the difference (1.95%) is very less as compare to previous years.

The GER in higher education in India during 2019-20 is 27.1 percent which is calculated for 18-23 years of age group. GER for male population is 26.9 percent and for females it is 27.3 percent. GER of higher education in India saw a jump from 19.4 in 2010-11 to 27.1 in 2019-20. The GER of female students has surpassed that of male students in the two years 2018-2019 and 2019-2020. During 2019-20 the GER (Male 26.9 and Female 27.3) the gap is 0.4% and the gender parity index is also highest 0.96, it appears that female enrolment is increasing.

Student enrolment at undergraduate level is 50.78% male and 49.22% female. Diploma has a skewed distribution with 65.14% males and 34.86% females. Ph.D level has 55.02% male and 44.98% female. Integrated levels have 56.17% male and 43.83% female. PG Diploma student enrolment is 53.55% male students and 46.45% female students. Further, the enrolment of female students are highest share of enrolment are in M.Phil (62.22%) followed by Post-Graduate (56.87%) and Certificate (53.61%).

Trend in Gender Parity Index

Table 4 and Figure 1 show the gender parity index of female students enrolled in different programmes in universities and colleges (HEIs) during the last 10 years of study period from 2010-11 to 2019-20 [8].

Table 4: Gender Parity Index of female students enrolled in different programmes in HEIs in the period 2010-11 to 2019-20.

Year	*Ph.D*	*M.Phil*	*P.G.*	*U.G.*	*PG Diploma*	*Diploma*	*Certificate*	*Integrated*	*Overall*
2010-11	0.62	1.00	0.80	0.81	0.55	0.42	1.15	0.58	0.78
2011-12	0.65	1.15	0.90	0.84	0.34	0.43	1.07	0.61	0.80
2012-13	0.71	1.29	0.95	0.85	0.36	0.40	1.20	0.60	0.81
2013-14	0.67	1.30	1.02	0.88	0.80	0.40	1.13	0.59	0.85
2014-15	0.69	1.37	1.06	0.88	0.78	0.40	1.29	0.63	0.85
2015-16	0.70	1.43	1.15	0.88	0.86	0.42	1.28	0.68	0.86
2016-17	0.72	1.63	1.20	0.90	0.76	0.43	0.99	0.70	0.88
2017-18	0.74	1.78	1.18	0.93	0.85	0.47	1.30	0.71	0.91
2018-19	0.78	1.64	1.30	0.96	0.85	0.50	1.17	0.74	0.95
2019-20	0.82	1.65	1.32	0.97	0.87	0.54	1.16	0.78	0.96

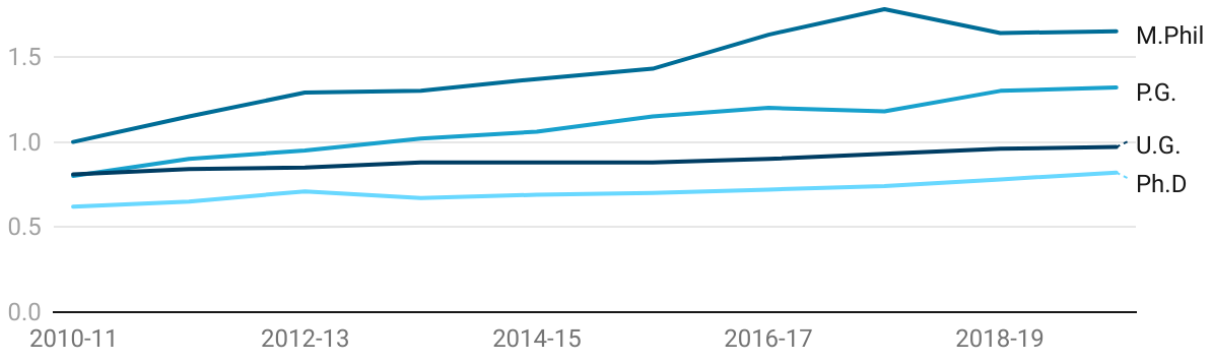


Figure 1: Shows gender parity index of women students enrolled in different programmes in HEIs in the duration 2010-11 and 2019-20.

As may be seen from the table and graph, there is an increase in Gender Parity Index (GPI) for (overall enrolment) as shown in the graph. It has increased during the last 10 years, from 0.78 in 2010-11 to 0.96 in 2019-20 but always less than one which means the female enrolment is significantly higher but less than male enrolment. The gender parity index is greater than one

(>1), which means disparity in enrolment was in favour of female. The GPI is always greater than 1 for the programmes (M.Phil and Certificate) which means the female enrolment is significantly higher. It is obvious from table that the gender parity index is increasing and greater than one (>=1) in all the years from the 2010-11 to 2019-20, which means disparity in enrolment was in favour of female. For post graduate programmes has also increased marginally from 0.80 to 1.32. It is obvious from table that gender parity index has always less than one (<1) across all in 10 years from 2010-11 to 2019-20 for the programmes (Ph.D, Undergraduate, PG Diploma, Diploma and Integrated), which means disparity in enrolment was in favour of male, the female enrolment are less as compare to males.

DISCUSSION AND CONCLUSION

The issue of gender adds a new dimension to gender inequality in education. Equity and equality in education is the single and one powerful tool for achieving gender equality. The female enrolment is significantly increasing as compared to male, but it always remained less than male enrolment across all the years from 2010-11 to 2019-20. On the other hand, the GER of women in higher education has surpassed that of men in the year 2018-2019 (Male 26.3, Female 26.4 the gap is 0.1%) & 2019-20 (Male 26.9, Female 27.3 the gap is 0.4%). It is only in the under-graduate programmes that the enrolment of male students was 5.67% higher than female students. AISHE report 2019-20 shows that now the female students constitute 49.03 percent by reducing the gender gap to 1.95%. From the analysis during 2019-20 it is observed the enrolment pattern in under-graduate programmes the gender gap is less (1.56%) in participation of male and female. There is a good sign that the enrolment of female student enrolment was 14% and 7% higher than the female students in postgraduate and certificate programmes respectively. As more girl students pursue higher studies, the numbers of degree colleges for girls have steadily increased in the past 10 years from 3982 to 5973.

The low percentage at the post-graduate level indicates that lesser academic progression of undergraduate students passing out colleges or universities because of socio-economic conditions and opportunity costs to offer higher level degree programmes in universities. The trend could change in the future because of opening up online digital education at professional and postgraduate level programmes by the regulatory bodies. Several working populations could avail such online digital education for upward mobility in their careers. The higher percentage indicates that more women are transiting from Under-Graduate to the next higher-level courses. The Survey indicates that the female student enrolment in the institutions of national importance is very low at 17.67% at the base year of 2011-12, and there was an improvement of around 2% in the year 2014-15. The percentage of female students was 46.11% in 2014-15 compared to 44.69% at the end of the nine-year review period 2019-20. However, the total number of female students enrolled in the year 2014-15 was 3.10 lakh as against 5.22 lakh in the year 2019-20.

The public policy in India is always aimed to make India a 100 percent literate society with scientific temper. The premier IIT institutions were set up for the purpose of developing a skilled workforce to support the economic and social development of the country in the post-independence. It has been always a priority for the successive governments in India to improve the enrolment of girl students in the schools and institutions of higher learning. These initiatives have started yielding results in general education in higher education but only limited to non-STEM courses till some years back. While the trend in the number of female students may go up further in the coming years, sustained efforts are needed by the policy makers involved in

the higher education to further improve the enrolment of women students in STEM based courses. Such efforts would give a major push to women empowerment and economic growth.

REFERENCES

[1] Rodrigo Rosa & Sara Clavero, "Gender equality in higher education and research", Journal of Gender Studies, 31:1, 1-7, 2020, DOI: 10.1080/09589236.2022.2007446

[2] Rosa, R., Drew, E., & Canavan, S., "An overview of gender inequality in EU universities". In D. Eileen & S. Canavan (Eds.), The gender-sensitive university. A contradiction in terms?, 2022, pp. 1–15. London: Routledge.

[3] The International Bank for Reconstruction and Development / The World Bank *World Bank Report: The Equality Equation: Advancing the Participation of Women and Girls in STEM*, 2020. Available at: https://documents.worldbank.org/en/publication/documents-reports/documentdetail/789951595308672516/main-report

[4] Times Higher Education and UNESCO International Institute of Higher Education in Latin America and the Caribbean, "Gender Equality: How Global Universities are Performing, Part-2", 2022. Available at: https://www.iesalc.unesco.org/en/2022/05/19/unesco-iesalc-and-time-higher-education-launch-report-on-universities-contribution-to-gender-equality-and-womens-empowerment-part-2/

[5] Department of Science & Technology, Govt. of India: "Call for Expression of Interest to Participate in Pilot of GATI", 2020. Available at: https://dst.gov.in/sites/default/files/Gati%20detailed%20advertisement_0.pdf; *https://www.iesalc.unesco.org/wp-content/uploads/2022/03/SDG5_Gender_Report-2.pdf*

[6] The Times of India, Mumbai Edition, "Four years on, 20% women's quota fully filled", 20 August 2022. Available at: https://timesofindia.indiatimes.com/india/four-years-on-20-womens-quota-fully-filled-in-most-iits/articleshow/93668336.cms

[7] All India Survey on Higher Education Reports (AISHE) 2010-11 to 2019-2020, Ministry of Education, Department of Higher Education New Delhi.

[8] Sikandar, M. A., Rahaman, P. F., Ahmad, A., & Sikandar, Anita, "Managing Higher Education Institutions in India: A Study on Gross Enrolment Ratio and Financing" Vidyabharati International Interdisciplinary Research Journal, Special Issue on Emerging Techniques in Interdisciplinary Sciences, Oct. 2021, pp. 3274-3286.