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REVIEWARTICLE

AN ANALYSIS OF FEMALE PARTICIPATION IN INDIAN ENGINEERING EDUCATION WITH SPECIAL REFERENCE TO PUNJAB

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ABSTRACT

The economic prosperity of nations like Japan, China, etc. springs ample evidence that there exists positive relationship between educational development and economic development of a nation. To achieve the much emphasized objective of technological self-reliance since independence, Indian economy witnessed a massive growth of institutions providing technical education. Among the various streams of technical education, the growth of institutions providing engineering education is extremely applauded. As a consequence, the enrolment in the institutions of engineering education has increased over the years. In this respect, examining the female participation in Indian Engineering Education with special reference to Punjab is the thrust area of this study.

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INTRODUCTION

Economists right from Adam Smith have realised that education plays an important role, among the other factors that contribute to economic development. Marshall also regarded education as a national investment. According to Seren (2001), Education investment can contribute to economic growth via two ways. First, the human capital can directly participate in the productive process as a production factor and second, human capital can also contribute to rise in technical progress as education leads to new innovations, diffusions and adoption of new technologies. Where, the former is called level effect and the latter is called rate effect. It has been proved beyond doubt that the educational development of a country is the most important factor in its economic development. Japan has cent percent literacy and it has high technological know-how. Even China is forging ahead on account of the knowledge in science and technology. Therefore, it can be concluded with a reasonable degree of certainty that there is a positive correlation between educational development and economic development of a country. Barrow (1991) by examining the data of 98 countries from 1960-1985 found a positive relationship between human capital and growth rate of real per capita GDP.

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As per the provisions of All India Council of Technical Education (AICTE), technical education means programmes of education, research and training in the field of Engineering and Technology, Architecture, Hotel Management and Catering Technology, Town Planning and Management, Pharmacy and Applied Arts and Crafts, Such other programmes or areas as the central government may declare in consultation with the council by a gazette notification.

Section I

India's Policy Emphasis on Technical Education

Since independence, India's development strategy of attaining economic self-reliance had its moorings in building technological power. It was clearly envisaged by the planners that to achieve economic self-reliance, technological self-reliance was indispensible. It was evidently visualised that self-reliance would be unattainable unless based on domestically groomed workforce and skill (Chadha *et al*., 2013). Unless India grooms its home grown technically skilled and professionally trained manpower to sustain its productive sectors, it would be impossible to sustain rising production and productivity. Accordingly, India's economic ills were sought to be overcome through a process of industrialisation which required a well-developed system of technical education making it a vital preamble to the country's prosperity. Driven by the renowned emphasis on knowledge and human

capabilities in the new growth theory, the economic reforms spurring the diffusion of FDI inflows and the new ICT based knowledge industry, put a revered premium on technical education and spurt in demand for technical manpower. Therefore, for achieving high rate of economic growth, the generation of skilled pool of scientific and technical manpower becomes even more imperative. To respond to such a demand, a huge infrastructure providing technical education was established and as a result, there has been massive growth of technical education in India over the years especially since economic reforms of 1991. In this regard, the emphasis of this study is to analyse the status of female participation in Indian engineering education with special reference to Punjab.

Database, Scope and Methodology of the Study

The data for the present study are taken from various secondary sources like Statistics of Higher and Technical Education, Analysis of Budgeted Expenditure on Education published by Ministry of Human Resource Development, Research and Development Statistics published by Ministry of Science and Technology and Statistical Abstract of Punjab published by Economic and Statistical Organisation, Government of Punjab. The scope of the study pertains to the engineering stream of technical education and the period of the study spans from 1991 to 2012. For analysing the data, percentage shares and compound annual growth rates have been calculated.

Section II

1.Engineering Education in India

In consonance with the country's development strategy of attaining technological self-reliance by growing home based technical manpower and keeping in view the growing demand for technically skilled personnel in the country, special emphasis has been laid on the development of institutions providing technical education since independence. Engineering education in India has seen tremendous growth over the past decades, both in number of students and number of colleges (Varshney, 2006). The engineering and technology colleges in India have grown from just 279 in 1991 to 3393 in 2012 growing at a rate of 13.85 percent, therefore, supplying more and more engineering graduates to meet the growing needs of the economy. However, the recent large scale expansion in engineering education has come at the cost of quality (Choudhary, 2012). The affiliating university system, out dated curricula, inadequate infrastructure, shortage of qualified teachers, poor teaching/ learning process have all contributed in different degrees to the lowering of standard of the educational offerings of engineering colleges in our country (Biswas *et al*., 2010).

a.Growth of Enrolment of Female Students in Engineering and Technology Colleges in India

Table 1 divulges the enrolment of female in engineering and technology over the years. The table shows that the enrolment of female in engineering/technology was 17.1 thousand in 1990-91 which rose to 131.8 thousand in 2001-02 and in 2011-12 the number has risen to 959.1 thousand. In terms of percentage of total enrolment in engineering and technology, the share of women has increased to 29.4. This shows that the enrolment of female in engineering and technology has increased over the years, yet it is around 30 percent of total enrolment. Therefore it is obvious that female enrolment needs to be induced in the field of engineering and technology as well.

Table 1. Growth of Female Enrolment in Engineering and Technology

Year	Enrolment of female (in thousand)	Total enrolment (Male+Female) (in thousand)	Female enrolment (percentage of total)
1991-92	18.3	258.2	8.1
1996-97	27.6	331.0	8.3
2001-02	131.8	510.5	21.3
2006-07	185.8	837.2	22.2
2011-12	959.1	3261.6	29.4
CAGR	20.7	12.1	-

Source: Government of India (Various Issues), *Research and Development Statistics*, New Delhi: Ministry of Science and Technology

b.Gender Perspective of Enrolment in Indian Engineering Institutes

The World Economic Forum's Gender Gap Index (which comprises economic, political, educational and health parameters) for the year 2007, ranks India 114th among 128countries. India has overall 59.4 per cent Gender Inequality (NAWO, 2008). Table 2 shows the gender perspective as far as enrolment is concerned in technical institutions in India for Post Graduate Degree and Under Graduate Degree in 2009-10. Table shows that in all the states boys have outnumbered girls. In State/UTs like Manipur, Nagaland, Andaman and Nicobar, Daman and Diu, Dadra and Nagar Haveli, Lakshadweep, there is no enrolment at all. In Bihar, the enrolment of boys in percentage is maximum i.e. 100 per cent. In other words, the percentage of girls is minimum i.e. 0 per cent. Among all the States/UTs, the maximum enrolment in post graduate degree is in Tamil Nadu i.e. 19562 and minimum in Bihar i.e. 3. Whereas Lakshadweep, Daman and Diu, Dadra and Nagar Haveli, Andaman and Nicobar Islands, Nagaland and Manipur have zero enrolment in post graduate degree programmes.

However as far as under-graduate degree is concerned, the enrolment is quite high i.e. 1928998 in 2009-10. The table shows that in all the States/UTs, boys have outnumbered girls. However in Bihar state the percentage share of boy enrolment is maximum i.e. 89.18 and the lowest share is of Goa where it is 61.38 per cent. In other words, girl enrolment is the least in percentage share in Bihar and it is highest in Goa. However, there are certain States/UTs like Mizoram, Nagaland, Dadra and Nagar Haveli, Daman and Diu, Lakshadweep, where there is zero enrolment in 2009-10 because there is no technical institute in these states.

2. Engineering Education in Punjab

Earlier, Punjab had fragile facilities for training technical manpower, such as engineering colleges. Therefore, Punjabi students had to go to the distant southern states in India for engineering education. Following the path of national strategy

to grow home groom technical manpower, Punjab too laid stress on the growth of engineering education which resulted in huge growth of engineering colleges in Punjab. Earlier in 1991 there were only 4 colleges of engineering and technology in Punjab which rose to 84 colleges in 2012 growing at a rate of 17.06 percent.

in Punjab. As the number of engineering colleges has grown from 4 in 1991 to 84 in 2012, the number of students enrolled has also increased from 2245 in 1991 to 52309 in 2012. In the percentage form, the same has decreased from 91.2 in 1991 to 73.9 in 2012 in case of males and increased from 8.8 in 1991 to 26.1 in 2012 in case of females, respectively.

Table 2. Gender Wise Enrolment in Technical Institutions in India

State/ Union territory	Post graduate degree					Under graduate degree				
	Boys	Boys (in %)	Girls	Girls (in %)	Total	Boys	Boys(in %)	Girls	Girls (in %)	Total
Andhra Pradesh	2028	68.1	947	31.8	2975	264578	67.1	129608	32.8	394186
Arunachal Pradesh	1019	74.9	340	25.0	1359	1332	72.9	494	27.1	1826
Assam	332	75.1	110	24.8	442	6672	77.9	1884	22.0	8556
Bihar	3	100	0	0	3	7920	89.1	960	10.8	8880
Chhattisgarh	326	61.6	203	38.3	529	43041	78.2	11965	21.7	55006
Goa	58	61.0	37	38.9	95	2121	61.3	1334	38.6	3455
Gujarat	4532	64.3	2514	35.6	7046	82204	83.1	16618	16.8	98822
Haryana	243	57.8	177	42.1	420	83835	74.1	29183	25.8	113018
Himachal Pradesh	232	68.6	106	31.3	338	9370	76.4	2888	23.5	12258
Jammu &Kashmir	42	70.0	18	30.0	60	2840	72.5	1072	27.4	3912
Jharkhand	1188	80.3	291	19.6	1479	8235	80.0	2058	19.9	10293
Karnataka	2745	80.7	653	19.2	3398	107434	60.2	70998	39.7	178432
Kerala	1326	60.1	877	39.8	2203	65356	65.9	33715	34.0	99071
Madhya Pradesh	628	55.1	510	44.8	1138	37374	75.9	11813	24.0	49187
Maharashtra	6403	80.8	1517	19.1	7920	195640	71.7	77043	28.2	272683
Manipur	0	-	0	-	0	344	69.6	150	30.3	494
Meghalaya	85	77.2	25	22.7	110	315	77.0	94	22.9	409
Mizoram	50	65.7	26	34.2	76	0	-	0	-	0
Nagaland	0	-	0	-	0	0	-	0	-	0
Odisha	1352	74.3	467	25.6	1819	90440	80.7	21508	19.2	111948
Punjab	4284	65.8	2218	34.1	6502	35407	74.5	12092	25.4	47499
Rajasthan	710	67.8	336	32.1	1046	77958	82.1	17003	17.9	94961
Sikkim	10	90.9	1	9.1	11	1390	66.1	712	33.8	2102
Tamil Nadu	12914	66.0	6648	33.9	19562	120363	67.8	57058	32.1	177421
Tripura	53	81.5	12	18.4	65	1897	78.5	519	21.4	2416
Uttar Pradesh	2460	81.5	558	18.4	3018	58669	63.0	34384	36.9	93053
Uttarakhand	844	88.5	109	11.4	953	4819	86.4	758	13.5	5577
West Bengal	5228	75.3	1711	24.6	6939	43232	77.1	12769	22.8	56001
Andaman &Nicobar Islands	0	-	0	-	0	63	64.9	34	35.0	97
Chandigarh	129	80.1	32	19.8	161	1944	77.9	550	22.0	2494
Dadra &Nagar Haveli	0	-	0	-	0	0	-	0	-	0
Daman &Diu	0	-	0	-	0	0	-	0	-	0
Delhi	5327	79.0	1416	20.9	6743	12772	83.2	2572	16.7	15344
Lakshadweep	0	-	0	-	0	0	-	0	-	0
Puducherry	120	72.7	45	27.2	165	6486	67.5	3111	32.4	9597
Grand Total	54661	71.3	21904	28.6	76565	1374051	71.2	554947	28.7	1928998

Source: Government of India (2009-10), *Statistics of Higher and Technical Education*, New Delhi: Ministry of Human Resource Department

a.Enrolment of Female Students in Engineering Education in Punjab

The number of students enrolled in technical institutes in Punjab is also on the increase with the number of boy students being more than the girls students (Chadha *et al*., 2013). According to Upadhyay (2007), despite some improvement in enrolment rates over the decades at the end of 2002 hardly 9.28 per cent of boys and 6.71 per cent of girls belonging to the relevant age group population in the country has been enrolled in higher education institutions. Table 3 shows the number of students enrolled in Engineering, Technology and Architecture

Table 3. Female Students in Engineering and Technology Education of Punjab

Year	Boys	Boys (in %)	Girls	Girls (in %)	Total
1991	2048	91.2	197	8.8	2245
1996	3876	85.8	642	14.2	4518
2001	11022	80.1	2730	19.9	13752
2006	20232	79.9	5095	20.1	25327
2012	38678	73.9	13631	26.1	52309
CAGR	16.33	-	22.58	-	17.39

Source: Government of Punjab (2013), *Statistical Abstract of Punjab*, Chandigarh: Economic and Statistical Organisation

This almost two decade analysis shows that in all the years males have outnumbered female students. In other words, the male enrolment in the stream of technical education is thrice as that of female enrolment.

b.District Wise Analysis of Female Enrolment in Engineering/ TechnologyColleges of Punjab

The district wise analysis of female participation in engineering and technology colleges of Punjab for the year 2012 is given in Table 4. The table shows that for all the districts males have outnumbered the female students. The highest percentage of girls enrolment in engineering/technology colleges of Punjab is in Hoshiarpur district (76.89) followed by Rupnagar (33.84), whereas the lowest is seen in case of S.B.S Nagar (14.80) followed by Sangrur (17.05).

Table 4. District Wise Enrolment of Female Students in Engineering and Technology Education of Punjab

District	Boys	Boys (in %)	Girls	Girls (in %)	Total
Gurdaspur	2614	75.4	850	24.5	3464
Pathankot	-	-	-	-	-
Amritsar	1132	74.4	388	25.5	1520
Tarn Taran	-	-	-	-	-
Kapurthala	3346	81.8	740	18.1	4086
Jalandhar	1577	68.8	712	31.1	2289
S.B.S Nagar	1946	85.2	338	14.8	2284
Hoshiarpur	394	23.1	1311	76.8	1705
Rupnagar	1797	66.1	919	33.8	2716
S.A.S Nagar	5850	73.6	2095	26.3	7945
Ludhiana	3904	77.9	1105	22.0	5009
Ferozpur	726	81.6	163	18.3	889
Fazilka	-	-	-	-	-
Faridkot	936	75.4	304	24.5	1240
Muktsar	2574	80.1	638	19.8	3212
Moga	1173	78.0	330	21.9	1503
Bathinda	1237	70.6	513	29.3	1750
Mansa	-	-	-	-	-
Sangrur	2185	82.9	449	17.0	2634
Barnala	-	-	-	-	-
Patiala	3774	74.4	1293	25.5	5067
Fatehgarh Sahib	3513	70.3	1483	29.6	4996
Total	38678	73.9	13631	26.0	52309

Source: Government of Punjab (Various Issues), *Statistical Abstract of Punjab*, Chandigarh: Economic and Statistical Organisation

c. Female Faculty in Engineering Education of Punjab

For having a qualitative stock of skilled manpower, good quality of teachers plays a very important role. As the number of institutions providing technical education is increasing, the number of teachers is also growing. But there are certain institutions where there is a dearth of qualified teachers. Table 5 shows the number of teachers in technical institutions in Punjab. The table shows that in total the number of teachers has increased from 270 in 1991 to 5084 in 2012. In case of males, the number has increased from 252 in 1991 to 2910 in 2012 and increase of females, the number has increased from 18 in 1991 to 2174 in 2012. In percentage share, the male teachers have decreased from 93.3 per cent to 57.2 per cent in 2012 and females have increased from 6.7 per cent in 1991 to 42.8 per cent in 2012. This shows that although in case of teachers, the women participation has increased tremendously however in case of students, the increase in women participation is just marginal.

Table 5. Female Faculty in Engineering and Technology Colleges in Punjab

Year	Male	Male (in %)	Female	Female (in %)	Total
1991	252	93.3	18	6.7	270
1996	528	86.0	86	14.0	614
2001	967	81.4	221	18.6	1188
2006	1246	64.1	699	35.9	1945
2012	2910	57.2	2174	42.8	5084
CAGR	12.06	-	25.58	-	15.16

Source: Government of Punjab (Various Issues), *Statistical Abstract of Punjab*, Chandigarh: Economic and Statistical Organisation

d.District Wise Analysis of Female Faculty in Engineering/ Technology Colleges of Punjab

The district wise analysis of female faculty in engineering and technology institutions in Punjab is given in Table 6. The table shows that contrary the case of students, the female faculty participation in total faculty of the colleges is quite high. It is highest in S.A.S Nagar (55.64) followed by Rupnagar (54.14), whereas the lowest participation is in Sangrur (14.10) followed by Ferozpur (21.88).

Table 6. District Wise Analysis of Female Faculty in Engineering and Technology Colleges in Punjab

District	Male	Male (in%)	Female	Female (in %)	Total
Gurdaspur	200	67.3	97	32.6	297
Pathankot	-	-	-	-	-
Amritsar	158	61.2	100	38.7	258
TarnTaran	-	-	-	-	-
Kapurthala	268	63.6	153	36.3	421
Jalandhar	185	77.4	54	22.5	239
S.B.S Nagar	134	48.5	142	51.4	276
Hoshiarpur	64	52.0	59	47.9	123
Rupnagar	155	45.8	183	54.1	338
S.A.S Nagar	409	44.3	513	55.6	922
Ludhiana	266	62.4	160	37.5	426
Ferozpur	50	78.1	14	21.8	64
Fazilka	-	-	-	-	-
Faridkot	68	59.1	47	40.8	115
Muktsar	178	66.9	88	33.0	266
Moga	75	51.0	72	48.9	147
Bathinda	83	73.4	30	26.5	113
Mansa	-	-	-	-	-
Sangrur	134	85.9	22	14.1	156
Barnala	-	-	-	-	-
Patiala	275	48.5	291	51.4	566
Fatehgarh Sahib	208	58.2	149	41.7	357
Total	2910	57.2	2174	42.7	5084

Source: Government of Punjab (Various Issues), *Statistical Abstract of Punjab*, Chandigarh: Economic and Statistical Organisation

Conclusion

The study shows that there has been massive growth in institutions providing Engineering/Technology Education in India in the post reform period. The enrolment has increased stupendously. However, almost in all the years and states males have outnumbered females. For Punjab as well, the female participation is less as compare to the male participation in

engineering and technology colleges. The district wise analysis shows that only in case of Hoshiarpur district females have outnumbered male students. Further, the study depicts that as far as female faculty in engineering and technology colleges of Punjab is concerned, the scenario is better than the case with the students. The female faculty participation in total faculty of the colleges is quite high. It is highest in S.A.S Nagar followed by Rupnagar. Thus, the study concludes with emphasizing the importance to be given to the female participation in engineering education to have a balanced growth of the society.

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