

Gender Inequality in STEM Education in Pakistan: A Case Study of Female Students

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Emphasis on STEM education has gained the attention of activists to promote gender equality in the education field in the last few years. The objectives of the present research paper are: Why is there a need to address gender inequalities in STEM education in Pakistan? The second objective of the research is to highlight the obstacles that restrict women's access to STEM education in Pakistan. This research is qualitative in nature and based on the interviews of students enrolled in the faculty of humanities at the BS level in AIOU. Research gives directions to policymakers on how to increase women's enrollment in science, technology, engineering, and mathematics (STEM).

Keywords: gender, inequality, women, STEM, education, Pakistan

INTRODUCTION

Gender inequality in the Science, Technology, Engineering, and Mathematics (STEM) field is considered a feminist issue in modern times because, overall, women are likely to enroll less in the STEM education field in comparison with men. Statistics show that forty-six percent of women are enrolled in the Humanities discipline in Pakistan whereas enrollment in scientific and technical subjects is comparatively low. Pakistan ranks at 145 positions out of 146 with a gender gap index of 0.057, which has decreased -3 points from last year. Educational attainment index is 0.836, ranking 139 out of 146 in 2024. The World Economic Forum reports significant gaps in enrolment across education levels in Pakistan. (WEF, 2024). Statistics from the World Economic Forum also confirm the fact that overall women are still struggling to access STEM education and facing barriers in the career because of gender stereotypes and prejudices about women's suitability for certain professions because of long working hours. Secondly, women are still considered to focus more on their role as responsibilities as a wife and mother.

The focus on STEM education started in the 1960s in Europe and America when it was realized that women's access to STEM education should be increased so that women should be able to have more chances to enter professions that were considered well-paid with more job benefits, ultimately improving the work conditions and lifestyle of women. It's a matter of concern for advocates that despite the emphasis on improving women's access to STEM education in the last six decades, women are still lagging men in STEM.

In Pakistan, the enrollment of women in STEM education is less than males. In Pakistan, the last fifteen years were crucial because it was encouraged by the government of Pakistan to improve women's access to STEM education at the tertiary level. The global education monitoring report 2024 shows that there is improvement in women's education in Pakistan. However, if statistics are compared from the data available

on the Higher Education Commission Pakistan, it shows that overall women's enrollment is still less than men. (HEC, 2024).

Statistics show that there is a need to address gender inequality in scientific and technological subjects in Pakistan. It is evident from secondary sources that there is significantly less enrollment of women in the scientific subjects when compared with arts and humanities subjects. This disparity has increased with time. In years 2017-2018, 26 percent of women were enrolled in territory-level education, which rose to 73% in 2018-2019 and then remained at 52%, respectively, for years 2019-2021. ICT field figures show nine percent women in 2017-2018, which drops to 2 percent from 2018-2019. There is a slight increase in five percent in 2019-2020 and six percent in 2020-2021. 16% in 2019-2020, and 12 percent from years 2018-2021. The worst decline can be seen in agriculture, with 2 percent of women in 2017-2018, which resulted in zero enrollment from 2018-2021. In natural sciences, women's enrollment increased from 20% in 2017 to 30% in 2019-2020 and 31% in 2020-2021. Girls from rural areas and less privileged backgrounds are at risk of less enrollment in STEM education at the territory level. Sociocultural norms affect less investment in expensive education for females.

The emphasis on STEM education has gained the attention of activists to promote gender equality in field education in the last few years in Pakistan. It is believed that the enrollment of girls and women will enable women to enter professions that help them to gain decent jobs, ultimately empowering them. This research was done with a feminist educationist perspective to address the issue of inequality in education and its implication on women's lives. The study reveals why it's beneficial for women to study science and technology-related subjects and how it can improve their lives and the country's development. This research will provide guidelines for policymakers on why there is a need to address gender inequality in territory education. Most of the research that is done on gender inequality in the education field is in the context of girl's access to STEM at the primary and secondary education levels.

LITERATURE REVIEW

The percentage of women studying STEM subjects has increased due to the introduction of all-girl institutions and the trend to invest in girl's education at the tertiary level for the professional skills and the demand of STEM subject graduates and better economic opportunities compared to humanities and social sciences students. Education in science, technology, engineering, and mathematics (STEM) is crucial to the overall empowerment of women and girls and the achievement of gender equality. As a growing nation, Pakistan must attain gender equality to improve the ranking of the gender equality index in terms of educational attainment in scientific subjects. Pakistani women frequently experience gender discrimination in STEM fields and are excluded from progresses made by men. Gender inequality in STEM education in Pakistan is a multifaceted issue that is deeply rooted in societal norms, cultural practices, and economic disparities. Several studies highlight the persistent gender disparities in education in Pakistan, particularly in the STEM fields. The influence of societal factors such as patriarchy, poverty, and cultural barriers contributes to the gender gap in education in Pakistan (Aftab, 2023). These factors, coupled with financial constraints and gender disparities, create significant obstacles for females seeking higher education in Pakistan (Ali et al., 2021).

Furthermore, structural barriers such as mentoring, networking, and gender equity issues impede women's career advancement in educational institutions (Zarif et al., 2019). The impact of gender inequality in education extends beyond individual opportunities to economic growth at the national level. Research suggests that addressing gender disparities in education is crucial for promoting economic growth and human capital accumulation in countries like Pakistan (Fatima, 2013). Moreover, gender disparities in education have been linked to income inequality, with factors such as age, gender, and education levels playing significant roles in perpetuating inequality across different regions in Pakistan (Islam et al., 2022).

The family creates obstacles in combining computer-related trainings, and it is often a transitional moment as parents begin to object to the daughter's career at a certain age. They worry that their daughter will have to spend more time in educational institutions. Which can risk their reputation. Engineering and computer-related fields for Pakistani women have also been taboo. Parents ensure they can shield the

daughters from adverse domestic criticism from their relatives and extended family. The option of taking distance learning classes has been given to parents and brought to the girls' attention. Science, technology, engineering, and mathematics (STEM) education is an important tool for achieving gender equality and women empowerment. As a developing country, Pakistan now requires achieving gender equality at the earliest to be at par with developed countries. Gender discrimination in STEM education is common for Pakistani women, and they are being kept away from professional development especially from lower middle-class families. This paper speaks of the causes that hinder women's advancement in STEM fields and the barriers for women in STEM fields in Pakistan.

In Pakistan previous research has not explored the elements of intersectionality that affect female engagement in STEM disciplines. Intersectionality examines how different facets of identity, including race, ethnicity, socioeconomic status, and disability, converge with gender to influence individuals' experiences. By neglecting these overlapping factors, the research might have missed crucial aspects of the challenges encountered by female engineering students. (Tahira et al., 2023). The results of the recent research highlight the necessity for increased support and encouragement for female faculty members within engineering academia to help them overcome the obstacles they encounter and progress in their careers. (Umar et al., 2024). The primary barriers which the educationist recognizes are challenges related to access, affordability, insufficient technological literacy, and sociocultural norms that hinder women from acquiring digital skills and engaging in the digital economy. The research show the impact of online education in closing the gender digital gap in Pakistan based on responses of key stakeholders in higher education in Pakistan, revealing that online education can serve as a vital resource in tackling this issue. (Nabi et al., 2022)

METHOD

This research relies on the qualitative approach. This research is qualitative in nature and based on the interviews of students enrolled in the faculty of humanities at the BS level at AIOU. Female students were selected for the research who completed grade 12, which is a high school degree world-wide, especially in the in the US, UK, Canada, Australia, New Zealand, etc. I have also used secondary data published by UNESCO and the Higher Education Commission. Completion of higher secondary education in Pakistan enables students to enter tertiary education. Primary data was collected through interviews of the students who were part of research, and a question was asked about the reason that led them to change their educational and career paths. Open-ended questions were asked of the students to know their decision to quit scientific studies and enroll in a humanities program. Previous research was conducted on STEM education within a quantitative research approach framework. This research is unique in a sense that it directly assesses the student's perspective, which resulted in their enrollment in non-scientific subjects. In contrast, their previous educational background was intended to pursue their education in scientific subjects. It is necessary to find out why a student spends twelve years of life in the scientific field and what pushes them back from pursuing education in the humanities field.

Five female students who were willing to participate in the research were selected. Student's educational background was those who completed high school studies in medical and engineering. Three students passed high school in medical, whereas two completed high school in engineering. The age group of the students was 18–22, and three of them were married with a child. Students were enrolled in a public sector distance education university. Data obtained through interviews was analyzed within the framework of liberal feminism. A thematic analysis approach was used to extract information from the data obtained through the interviews. Common themes emerged from the interview and were gained through carefully reading points jotted down in the personal diary. The interview was not recorded to make uncomfortable the interviewees and to maintain their confidentiality. Secondary data is analyzed through descriptive analysis of official data, reports of UNESCO and the Higher Education Commission, and academic research articles.

RESULTS

The result of primary data gathered through interviews was analyzed thoroughly. Common themes that emerged from the interviews are mentioned below.

Gender stereotypes put pressure on Pakistani women to share the burden of household work. Most of the girls in their student life are supposed to contribute the burden of household work, especially if they have large family members and house help is not available. It becomes difficult to manage the burden of household work and full-time studies of scientific and technological subjects because such subjects demand full-time dedication. These socio-cultural elements establish obstacles for women, hindering their ability to pursue education and engage in economic activities, adversely affecting the region's economic growth. Highlighting socio-cultural barriers, the study conducted in KPK Pakistan explains the socio-cultural elements that perpetuate gender inequality in education within the Malakand Division of Khyber Pakhtunkhwa, Pakistan, including domestic duties, marital commitments, patriarchy, the purdah system, and a feudal hierarchy (Umar et al., 2018).

Another main barrier that restricts women's access to STEM education is the geographical location of educational institutions and the lack of a safe and economical transportation system. It becomes nearly impossible if an educational institution is located more than 20 km one way. Most of the conservative families are not willing to send their daughters to the hostel because of financial and security concerns. Hostel environment is considered to negatively effect on the morals of women, and women are considered repositories of family honor in traditional families. Women who live in twin cities have more chances of enrollment in educational institutions.

Institutions that offer degrees in science and technology on average charge a tuition fee of 600-900 US dollars per semester, which is not affordable for all families to educate their daughters in science and technology subjects. Average household income in major cities of Pakistan is 395 USD (Shaik, 2024). Economic limitations can significantly shape gender roles, as households facing financial challenges may favor the education and growth of boys over girls, operating under the belief that boys are more likely to provide financial support to the family later.

Patriarchal mindset restricts investing in women's education at tertiary level because men are still considered breadwinners of the family and women are supposed to get married early because when it comes to marriage, young brides are sought by men's families because the more the young woman will, the more chances are that she is considered fertile for the offspring. When a young woman's family is approached for marriage, most families prefer the marriage of their daughter rather than investing in expensive education. Families prefer to marry their daughters with dowry instead of investing in education. The women's ultimate option is to enroll themselves in nonscientific subjects to compensate the deficiency of educational attainment by the women if their family is somewhat supportive.

The findings of the research reveal that the dominance of males within society serves as a significant obstacle to girls' education, as families frequently do not give priority to or advocate for educational opportunities for girls. The provision and accessibility of educational opportunities are frequently shaped by societal norms that favor boys' education over that of girls, resulting in considerable educational inequalities and curtailing girls' potential for personal growth and their ability to contribute to national advancement. In Balochistan and Khyber Pakhtunkhwa, girls are often restricted to their homes and are firmly prevented from making choices regarding their own lives, which encompasses decisions about their education. In numerous societies, cultural values and traditions significantly influence the formation of gender roles, typically establishing that men are the main decision-makers while women are relegated to domestic responsibilities, as is evident in Balochistan, Pakistan.

Secondary data from the international and national databases shows that it is true that women are less likely to enroll in STEM subjects at the tertiary level education because they don't have role models in their respective families. There is a strong link between social and academic support and the confidence of female engineering students in STEM; educational institutions can adopt specific strategies to offer mentorship, counseling, and academic resources. This assistance can enhance students' self-assurance in STEM areas and elevate their educational experiences. Through mentorship, institutions can foster a more supportive

environment that allows female students to excel in their engineering studies. The research results highlight the importance of tackling gender disparities and the lack of STEM confidence among female engineering students. Educational institutions and policymakers can leverage this knowledge to create targeted programs that inspire more women to enter STEM fields. This may include the introduction of outreach initiatives, scholarships, and support networks designed to attract and retain female students in engineering programs (Tahira et al., 2023).

DISCUSSION

Gender inequality within STEM sectors in Pakistan continues to be a prominent concern, even with the advancements made in recent times. Here are several important aspects to consider: Traditionally, girls in Pakistan have experienced lower enrollment rates in STEM education when compared to boys. This gap begins in primary education and persists into higher education. Deep-seated cultural norms frequently dissuade girls from seeking careers in STEM fields, perceiving them as more appropriate for males. This mindset restricts girls' access to both STEM education and career pathways. Among women who succeed in entering STEM fields, challenges such as workplace discrimination, insufficient support networks, and unequal compensation compared to their male peers remain prevalent. The Pakistani government has launched various initiatives to encourage girls' STEM education, including scholarships and focused educational outreach programs. Nevertheless, obstacles in implementation and prevailing societal attitudes continue to impede progress. Non-governmental organizations and global education experts have also taken an active role in fostering gender equality in education and STEM fields, offering support through advocacy, training, and financial assistance. There is an increasing awareness of the significance of gender diversity in STEM sectors among certain segments of Pakistani society. Initiatives to confront stereotypes and promote female role models in STEM are gradually making progress. Economic inequalities and inadequate infrastructure, and persistent security concerns in certain areas of Pakistan present further hurdles to achieving gender equality in STEM fields. Tackling gender inequality in STEM sectors in Pakistan necessitates unified efforts from various stakeholders, including the government, educational institutions, civil society, and the private sector. The long-term achievement will hinge on a sustained commitment to providing equal opportunities and transforming societal perceptions regarding gender roles and education.

Unfortunately, no study is available that highlights the factors influencing women's enrollment across various fields, including mathematics, computer science, biological sciences, chemical sciences, agricultural sciences, environmental sciences, etc. The research emphasizes that the government of Pakistan must implement special measures to enhance the inclusion of women. Gender inequality in Pakistan remains a critical issue and is particularly concerning in the realm of education. Gender disparities can be observed in areas such as enrollment ratios at the tertiary level. The circumstances are even more dire in the country's most rural and underdeveloped regions. In Pakistan, gender disparity persists significantly, with girls facing greater barriers to educational access compared to boys for a variety of identifiable reasons. Although gender inequalities in tertiary enrollment have decreased in Pakistan due to initiatives aimed at boosting female primary and secondary education, further efforts are necessary to elevate the proportion of girls pursuing higher education. The conditions for girls in rural locales and those hailing from impoverished families are notably worse. The limited access to education for girls is recognized as one of the gravest human rights challenges in Pakistan, and attaining gender parity remains an ongoing struggle for the nation. There is an urgent need to allocate more resources toward girls' education, and the government has demonstrated a commitment to this cause over the years.

CONCLUSION

It is concluded from the research conducted that women who did high school in STEM subjects but later changed their subjects while pursuing tertiary education in non-scientific fields are driven by the fact that there is a lack of support at the family level; either educational institution is located far away, which

restricts their access to education. The second major reason is that the level of family responsibility makes it difficult for them to pursue education in scientific subjects. Finally, the financial cost of studies in scientific subjects makes it difficult for them to continue their education in their desired field.

CONTRIBUTION & LIMITATION

Present research is beneficial for gender equality advocates, educators, and policymakers to focus on strategies to reduce gender parity and increase low enrollment of women in STEM education. Moreover, it will help to raise awareness about girls and women from less advantaged economic groups to find ways where they can sponsor their studies through scholarships available for them. Present research provides guidelines for future researchers as a baseline study to focus on lower enrollment of women in scientific and technical education. This research was focused on specifically female students. Cross-gender studies should be done to understand the lower enrollment of male students in the arts and humanities program. In the future, comparative research can be done to understand the underlying reasons for gender inequality in the STEM field. This research is based on limited data. Data should be gathered from a larger population to gain more insight about gender inequality in scientific and technical subjects.

RECOMMENDATIONS

- a) In order to increase the number of female students in scientific and technical subjects, the 100 percent tuition fee should be waived off on a merit basis.
- b) Infrastructure should be improved in already existing educational institutions.
- c) Female-centered educational institutions should be established to increase the number of students.
- d) The Ministry of Education and Social Welfare should organize awareness-raising programs in colleges to encourage female students at the tertiary level.
- e) A strong network should be established between public sector educational institutions and INGO's so that Territory education can be made more accessible for women by offering full-paid stipends.

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