Experiences of Women in STEM Research in Mizoram, India

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Abstract

The aim of the present study is to explore the experiences of women in STEM research in Mizoram. It aims to study the influence of socio-economic, cultural and familial factors among women in Mizoram pursuing STEM research. The empirical research includes a sample of 32 doctoral research women from various STEM disciplines in the state of Mizoram, India. The study reveals that the experiences of women in STEM research in Mizoram were indeed positive. The influence of family and society were contributing positively in women's entry into STEM disciplines at different levels of higher education among women in Mizoram. However, traces of patriarchy influencing performances and experiences of female researchers were nevertheless visible. The results show that women experience burden in STEM research due to responsibilities in household chores and taking care of the family members.

Keywords: *Higher Education, Mizoram, STEM, and Women.*

Introduction

The contribution of Science, Technology, Engineering and Mathematics (STEM) education is well recognised in global, national and regional development. Recent past has seen tremendous growth in enrolment in higher education across the countries and there is improvement in representations of different former underrepresented groups including women. However, STEM fields is still challenging for women. In Indian context every citizen has the right to education constitutionally. However, there are still certain cases where the existence of patrifocal influence in the decision of women's education is found (Subrahmanyan, 1995). The traditional societal gender roles continue to influence women's participation in information technology and engineering and neither contributes to the enhancement of political and socio-economic status of women, nor to the equal participation in the information technology sector (Patel & Parmentier, 2005). Changes in the socio-cultural and economic context of the society

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bring about changes in the relationship between gender and technology (Gupta, 2020). The present study attempts to understand women in STEM higher education in Mizoram.

Women in STEM Higher Education in India

In terms of enrollment, according to All India Survey on Higher Education (MHRD, 2020-2021), female enrollment exceeded male enrollment in science since 2018-2019while male enrollment is much higher in engineering and technology with above 70% in the last five years.The Enrolment in STEM (at U.G., P.G., M.Phil. and Ph.D. levels) is 94,69,022 out of which 53,74,237 (56.8%) are males and 40,94,785 (43.2%) females. A total of 55,48,809 students were enrolled in Science at UG, PG, M. Phil, Ph.D., in which females (53.1%) outnumber males. A total of 39,20,213 students were enrolled in Engineering and Technology at UG, PG, M. Phil and Ph.D., in which males (71%) outnumber females. In the field of Engineering and Technology, improvements in women enrollment were found in computer engineering, information technology and electronics engineering while male enrollment outnumbers female enrollment in mechanical engineering, Civil engineering and electrical engineering (Amirtham & Kumar, 2021). The enrolment of women in Science and Technology courses and occupations are increasing but not yet satisfactorily. The gendered norms and social stereotypes show impact on students in doctoral research in science and engineering (Gupta, 2007) and also economic conditions and influences of family are linked with gender related issues in India (Vindhya, 2007). The influence of socio-economic, cultural and familial factors of the society largely contributes to the gender gap and differences in experiences in STEM disciplines. Reasons for women falling out of STEM courses include familial decisions, economic factors, gender stereotyping, society, lack of role models and male dominated situations (Gupta, 2019). Isolation in the working environment due to lack of informal communication; conflict of gender role stereotyping between being feminine to being a scientist are often posing as career threats adding to the stress of women scientists. Dual role, which is the ability to manage and balance both their families and career is often required for women scientists to be considered successful, resulting in stress and exhaustion, where the same role is not expected from their male colleagues (Gupta and Sharma, 2002). Family structure, lack of mentoring and line experiences is the barriers for Indian professional women in their career advancement (Buddhapriya, 2009). Opposing to findings that a modest increase in the number of minorities will result in improved conditions, the minorities themselves must attain power in order to overcome resistance, which is the key to change (Etzkowitz et al, 1994).Improvements in women enrollment in science can be seen over the years in India while improvements in enrollment of women in the field of engineering and technology is still to be achieved. Economic conditions of the family, societal norms, educational environment, dual role of women, school teachings and mentoring can have strong impact on the choice of discipline for higher education.

STEM Higher Education in Mizoram and Representation of Women

Mizoram, meaning Land of the Mizo's is one among the 28 states in India, located on the north eastern part of the country. Mizo society has been patriarchal in nature since the

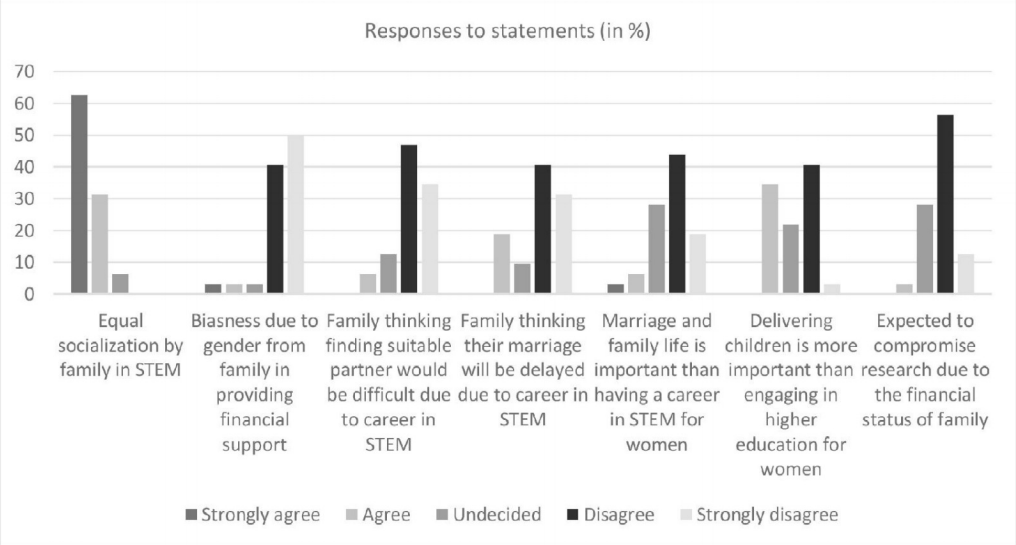
pre-colonial period and which continued after colonialisation; the introduction of Christianity brought in with it only some changes in its form and nature of patriarchy (Lalsangkimi,2016). Education in Mizoram was initiated by the British missionaries in 1894. The introduction of secondary education in 1945 was the beginning of science education in Mizoram. Science education began to gain its proper form since then, beginning with the divisions of science to life sciences and physical sciences. Science, Technology, Engineering and Mathematics (STEM) is an umbrella term used to group together different disciplines of science, technology, engineering and mathematics. Public higher educational institutions are more prevalent in the state of Mizoram. Undergraduate course for science educationwas first opened in 1973 at Pachhunga University College.Various central and state government institutions offer STEM higher education courses in Mizoram. There are presently six colleges offering science education at undergraduate level and two institutions offering undergraduate courses in Engineering in Mizoram. Postgraduate courses in STEM is currently offered at Mizoram University and National Institute of Technology, Mizoram. Doctor of philosophy courses in STEM are offered by Mizoram University and National Institute of Technology, Mizoram (MZU annual report, 2012-2022 & NIT portal).

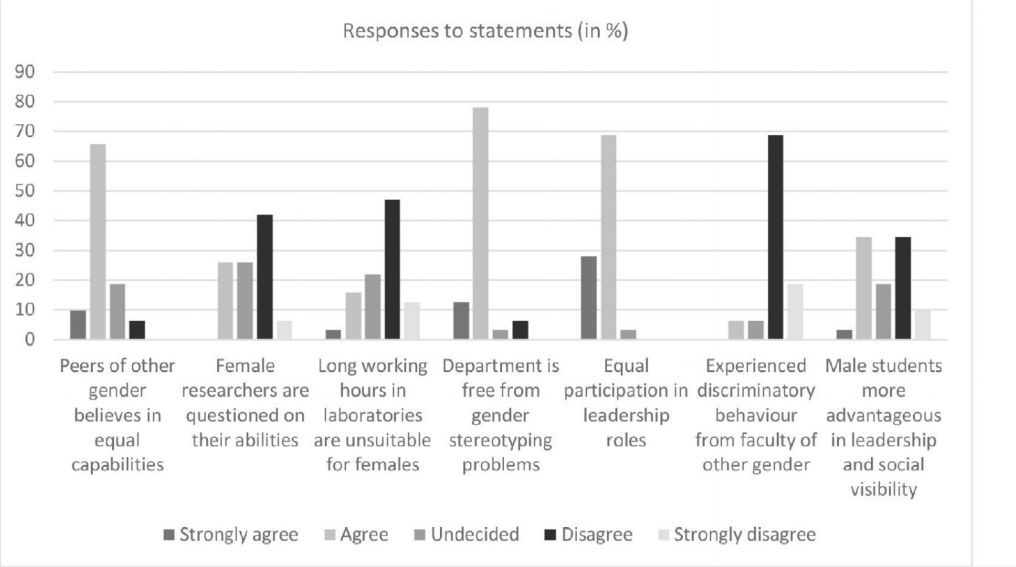
94.43% of population in Mizoram is under the scheduled tribe category of India (Ministry of Home Affairs, 2011).By 2011, Mizoram stood third in literacy ranking of states and union territories with a total literacy rate of 91.33% (Male- 93.35%; Female- 89.27%) (Directorate of economics and statistics, Government of Mizoram, 2022). With high percentage of literacy rate, all genders in Mizoram are encouraged to pursue education. Participation of all genders in higher education are also encouraged in all disciplines, still the differences persist especially in STEM disciplines. In a study conducted by the authors, enrollment of male postgraduate and doctoral research scholars outnumber female in STEM disciplines in Mizoram, while improvements were seen in female Ph.D. enrollment in life sciences between the years 2014-2019. Engineering and Technology was found to be more male dominated throughout in both postgraduate and Ph.D. courses. Hence, objective of the study is to explore the experiences of women in STEM research and also the influence of socio-economic, cultural and familial factors among women in STEM in Mizoram.

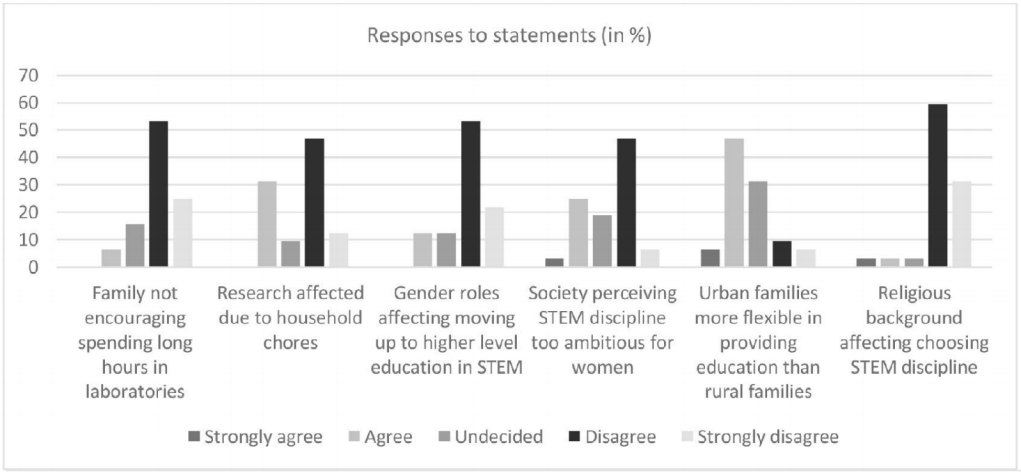
Methodology

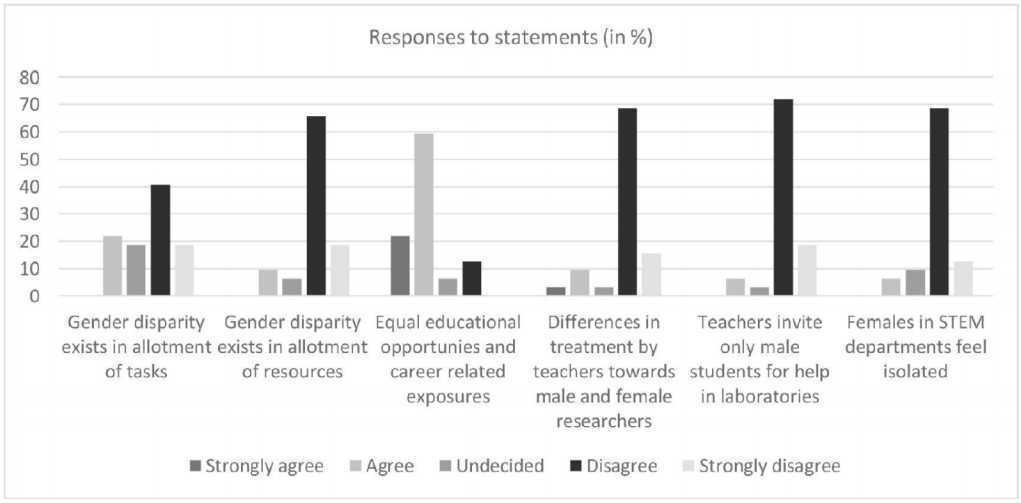
The empirical research includes a sample of 32 female doctoral researchers from various STEM disciplines from Mizoram University. Purposive sampling is used to select participants for the study. Respondents were selected from school of physical sciences, life sciences, earth science and natural resources management, and engineering and technology. Questionnaire prepared by the researcher is used for collecting the data. The Cronbach's alpha reliability of the questionnaire is 0.844 and the validity is 0.918. Five-point Likert scale ranging from strongly agree to strongly disagree was used to measure the response towards the given statements where strongly agree was scored as 5, agree as 4, undecided as 3, disagree as 2 and strongly disagree as 1. The questionnaire consists of 66 statements on three dimensions such as gender-role socialization, societal perception towards gender and socio-economic, cultural and familial factors.

Findings


Responses to statements (in %)
70
60
50
40
30
20
10
0
Equal socialization by family in STEM
Biasness due to gender from family in providing financial support
Family thinking finding suitable partner would be difficult due to career in STEM
Family thinking their marriage will be delayed due to career in STEM
Marriage and family life is important than having a career in STEM for women
Delivering children is more important than engaging in higher education for women
Expected to compromise research due to the financial status of family
Strongly agree
Agree
Undecided
Disagree
Strongly disagree


Responses to statements (in %)
90
80
70
60
50
40
30
20
10
0
Peers of other gender believes in equal capabilities
Female researchers are questioned on their abilities
Long working hours in laboratories are unsuitable for females
Department is free from gender stereotyping problems
Equal participation in leadership roles
Experienced discriminatory behaviour from faculty of other gender
Male students more advantageous in leadership and social visibility
Strongly agree
Agree
Undecided
Disagree
Strongly disagree





Influence of Socio-Economic, Cultural and Familial Factors

In terms of being equally socialize with male siblings for STEM discipline, 62.5% of the respondents 'strongly agree' and 31.3% 'agree' on being equally socialize with male siblings for STEM discipline by their family. 78.1% of the respondents agree and strongly agree to a statement, **"**Male children were given toys trucks and cars and females were given dolls and kitchen sets during my childhood for play" while 6.3% 'disagree' with 15.6% respond to 'undecided'. When respondents were asked whether they experience any biasness from their family in financial support of male and female children in studying STEM higher education, a striking 90.6% responds to experiencing no bias treatment from their family while pursuing higher level STEM courses.

Majority of the respondent's fathers completed their undergraduation while only 12.5% of the respondent's mothers were undergraduate. 84.4% of the mothers and 62.5% of the fathers have no background in tertiary level STEM education. Among the 29 unmarried respondents, 81.3% respond that their families do not think getting a suitable life partner would be difficult for the researcher if they choose a career in STEM. When asked whether their families think their marriage will be delayed if they choose a career in STEM, 71.9% respond that their family did not think that way. In response to the statement "Marriage and family life is important than having a career in STEM for women in my society", 62.6% respond to 'disagree' and 'strongly disagree', 28.1% respond to 'undecided' while 9.4% agrees and strongly agreed to the statement.34.4% of the respondents agreed that in their society, the ability of women to deliver children is considered a greater contribution than engaging in higher education in STEM while 43.7% disagrees to the statement.

The monthly income of the families of 59.4% of the respondents was found to be more than Rs.50,000. It was found that 68.8% of the subjects were not expected to compromise their research due to the financial status of their family. Only two respondent's family have a problem with them staying long hours in the laboratory. 31.3% agree that their performance in research is affected due to their household chores while 59.4% respondents are not affected by their household chores. Among the respondents, 53.1% do not think that moving on to higher level in education would be difficult due to gender roles in the society.

28 respondents hail from Mizoram, while 4 respondents were from other north-eastern states of Indiapursuing research in Mizoram. 28.1% of the respondents agree and strongly agree to the fact that their society perceives higher education and career in STEM disciplines too ambitious for women. Another 53.2% disagree to the statement. 53.2% respondents agree that families living in urban areas are much flexible in providing educational opportunities for their children in STEM disciplines than rural areas irrespective of gender. A strong 90.6% respond that the religious backgrounds of their families do not pose as hurdles for them to choose STEM discipline in higher education due to their gender.

Experiences in Educational Institution

With regard to equal allotment of tasks in the Department, 59.4% of the respondents agree to having equal tasks with male researchers. In response to equal allotment of resources, 84.4% respondents agree to having equal allotment of resources with the male researchers. In the equal provision of higher educational and career related exposures and opportunities inside and outside the campus to male and female researchers, 81.3% respond to agreeing to equal provisions. Questions were also raised as to whether professors provide equal treatment to both male and female researchers and whether there was gender discrimination from the professors in asking for assistance in the laboratory. The findings reveal only 12.5% of the respondents agreeing to unequal treatment of male and female researchers by the professors and a small 6.3% respondents agreeing to the existence of gender discrimination from the professors in asking for assistance in the laboratory.

A small percentage of 9.4 respondents respond to feeling isolated due to their gender in the department while 68.8% 'disagrees' and 12.5% 'strongly disagrees' to female researchers being isolated in the department. In response to a statement, "My peers of other gender believe that men and women have equal capabilities in STEM research", 75% respondents agree and strongly agree to the statement. While majority were found to not being questioned due to their gender on their abilities in STEM research, one fourth of the respondents admit to their abilities being questioned due to their gender. No female researchers thought that working long hours in the laboratory is unsuitable for females. 78.1% responded that their department is free from gender stereotyping problems and all respondents agree that they can equally participate in leadership roles along with male researchers. 87.6% have not experienced discriminatory behavior due to gender from faculty of other gender in the department. But when respondents were asked to rate their departments in terms of gender sensitivity approach, 12.5 % gave a 'satisfactory' rating, 59.4% gave a 'less than satisfactory' rating and 21.8% gave a 'poor' rating. In the opinion relating to male researchers being more advantageous in STEM in terms of leadership and social visibility, responses quite differ. 37.6% agrees to male researchers being more advantageous, 43.3 disagree while 18.8% responded 'undecided'.

Discussion

With regards to receiving financial assistance and support from their family, women in STEM research do not experience biasness between male and female children. The finding in this regard is quite notable considering the trend of male child preference in India as a whole. Majority of the respondent's parents were educated though their levels of degrees differed. However, only a few of them have background in STEM disciplines. In spite of parents having less experience in STEM disciplines, it was found that male and female children in their families are equally encouraged to select STEM disciplines in higher education. In line to this, the findings also suggest that female researchers socialize equally for STEM discipline with their male siblings. It was found that while the female researchers perceive themselves as being equally socialized in their family, they were victims of gender stereotyping in their childhood plays in the form of playsets made available to them.

In a tribal Mizo society, women are easily referred to as 'Nula senior' (Nula-lady, Senior-old) if they remain unmarried after 30 years of age. If a woman desires to complete her Ph.D. course before getting married, she has a good chance of being referred to as 'Nula senior' which is kind of an insulting reference. The study however found that 71.9% of the respondent's families do not think their marriage will be delayed due to a career in STEM. 81.3% of the respondent's families also do not consider getting a suitable life partner for the female researcher would be difficult due to a career in STEM. The dual responsibilities, i.e., family life and career responsibilities, often pose a dilemma among women in higher studies. The studies found that majority of female researchers who have entered higher studies do not consider marriage and family life more important than having a career in STEM.

Female STEM researchers in Mizoram are not expected to compromise their research due to the financial status of their family. Though semester fees in each department vary, it

can be taken as an average of Rs.7,000 per semester. Majority of female STEM researchers were also found to have received fellowships which vary from Rs 8,000- Rs 37,000 per month from the university or other central agencies. With regard to spending late hours in the laboratories, it was found that most parents of women researchers in Mizoram do not have a problem with their child staying long hours in the laboratory. Mizos have been known to be a patriarchal society since the earliest times. Before the age of education and technology, men were responsible for earning the livelihood of their family while women were in charge of household chores. This practice is still found to be prevalent in modern Mizo society. Women are expected to take care of all the household chores whether or not they contribute in earning to their family's livelihood.

The study reveals that the responsibility of female researchers in their household chores was found to take a toll on the research performance of 31.3% respondents. But female researchers are rather challenged by gender roles in the society and do not believe that moving on to higher level in education would be difficult for women due to ascribed gender roles. Mizo society has always perceived STEM discipline as a more dominant subject when compared to other disciplines such as arts and humanities. As a result, the authors hypothesized that the society of the respondents would consider research and career in STEM discipline to be too ambitious for women. The results however show that 53% of the respondents do not feel that their society considered it to be too ambitious for women. Findings also reveal that majority of the respondents do not feel that the expectation of the society for women to deliver children is considered a greater contribution than engaging in higher education in STEM. However, the existence of such beliefs was still seen to exist in certain areas of the society.

It is also to be noted that while majority of respondents were from Mizoram, few of them were from other north eastern states of India. While private institutions attract more students at school level in Mizoram, public institutions are more prevalent at higher studies. The availability and quality of educational institutions in Mizoram between rural and urban areas quite differ. This is relevant particularly to STEM higher education. Educational institutions offering STEM courses at U.G, P.G, and Ph.D. level are only found in Aizawl city and four other towns of Mizoram. The study found that families living in urban areas are believed to be more flexible in providing educational opportunities for their children in STEM disciplines than rural areas irrespective of gender. Religion wise, 90.6% of the respondents follow Christianity, 3.1% follow Hinduism and 6.3% responds under 'Others'. Findings reveal that the religious background of vast majority of female STEM researchers are not posing treats or hurdle to their choice of engaging in STEM research.

Male and female STEM researchers in Mizoram are given equal educational and career related exposures and opportunities inside and outside of the campus based on the findings. The findings also suggest that there is equal allotment of tasks and resources in the department among the male and female STEM researchers in Mizoram. According to a study conducted by Gupta and Sharma (2003), some teachers show favor to male students while they discriminate against women students. As opposed to this finding, the authors found that

majority of the female STEM researchers agree to the provision of equal treatment to male and female by professors and being called for assistance by their professors in the laboratory irrespective of their gender. Existence of discriminatory behaviour due to gender from faculty of other gender was also not found among women researchers in Mizoram. While many Indian researches reveal that women feel isolated in their working environment, 81.3% disagree to women in STEM feeling isolated in the departments, indicating a healthy informal environment among research scholars in STEM departments in Mizoram.

It was also found that women researchers in Mizoram were feeling rather safe when working long hours in the science laboratories. Majority of the respondent's other gender peers believe that men and women have equal capabilities indicating an equal treatment by male peers in their research related works. Most women in STEM research in Mizoram also believe that their department is free of gender stereotyping problems and that female researchers can equally participate in leadership roles with male researchers. While females in STEM research are not being degraded and ridiculed in their departments, the problem of female researchers being questioned on their abilities due to their gender was found to exist among some departments. While majority of the respondents agree to male and female researchers having equal educational and career related exposures, it was found that quite a number of female researchers perceive male peers as being more advantageous in leadership and social visibility. While most of the questions in terms of gender equality in various spheres were given positive responses, the result took a turn when respondents rate their departments in terms of gender sensitivity approach. It was found that more than half of the respondents were not satisfied with their departments in terms of gender sensitivity approach.

Conclusion

Studies on women in STEM were conducted only since the 1970s in India. A study on women scientists in Mizoram has recently emerged as a result of increasing awareness and interest in women participation in higher education. The study reveals that the experiences of women in STEM research in Mizoram were indeed positive. However, traces of patriarchy influencing performances and experiences of female researchers were nevertheless visible. It was found that there still exist women who are experiencing burden in their research due to responsibilities in household chores and taking care of the family members. While the nature of problems faced by women in the informal environment of doctoral level science education is more or less similar to the problems faced by women in the West, the specific type of discrimination is shaped by one's culture (Gupta 2007). Compared to the other gender studies conducted on STEM field in India, the experiences of women researchers in Mizoram were found to be more satisfactory and unbiased. The author concludes that based on the findings, there is still need for more policy initiatives in providing supportive environment to women in higher education and changing the perceptions of the society towards women to bring gender equity in STEM higher education.

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