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Empirical Study on Acceptability and Resistance to Feminization in STEM Fields at the Higher Education Level

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Abstract
The main objective of the study is to explore the acceptability and resistance to feminization in science, technology, engineering, and mathematics (STEM) fields at higher education levels. The number of females was lower in the STEM field. However, with time, females started taking an interest in science and technology subjects. As traditional gender roles are deeply rooted, STEM fields are still seen as a male domain in some countries. It is based on an exploratory qualitative research design grounded in an extensive review of research published documents on the topic of feminization in STEM education, acceptance, and resistance. A total of 82 research documents have been systematically extracted from well-reputed digital databases through the academic library, and the selection process has been continued until data saturation. Further, the thematic analysis technique has been employed to analyze the data qualitatively. The study findings reveal that momentous paces have been made in motivating and encouraging female participation in STEM fields, specifically in higher education. Precisely, higher education has been deeply embedded and interlinked with socio-cultural norms, gendered expectations, and institutional and structural barriers. Multiple factors often impede the inspiration, performance, career motivations, academic self-confidence, and job placement of female students in STEM fields.

Keyword: STEM Fields, Higher Education, Resistance, Feminization, Acceptability

Introduction

Historically, the number of females was lower in the science, technology, engineering, and mathematics (STEM) field (Shoaib & Zaman, 2025). However, with time, females started taking an interest in science and technology subjects (Redman, 2017). On the other hand, traditional gender roles are deeply rooted, and STEM fields are still seen as a male domain in some countries (Amirtham S & Kumar, 2023). Similarly, in certain areas, families select traditional roles for females over higher education and careers in STEM as compared to males (Shoaib, Waris, & Iqbal, 2025c). The successful females in STEM careers are the role models for other girls, and also help in breaking the stereotype (Shoaib, Waris, & Iqbal, 2025b). Girls get a chance to acquire transferable skills in STEM courses that will help them to compete in the job market and entrepreneurship (Shoaib, Waris, & Iqbal, 2025b). UNESCO's programme helps low-income countries in the education of females (Ogunniyi & Iwuanyanwu, 2024). Most of the females who have no permission to get an education in an institute are also getting education through the use of technology and online facilities (Shoaib, Waris, & Iqbal, 2025a). Female education has an impact on the cultural, environmental, societal, economic, and political factors of the country (Shoaib, Waris, & Iqbal, 2025a). Safety of girls in online education is also important and provides them with knowledge about the use of technology and online platforms (Rivera, 2022). Only education is not necessary; female students need job-specific skills that help them to enter the labor market and support their own self, family, and country as well (Shoaib, Tariq, Rasool, & Iqbal, 2025). At this time, the global employment sector is facing challenges that require employees with education and also having skills (Shoaib, Tariq, & Iqbal, 2025b). Most females do not get higher posts in the market due to a lack of critical and problem-solving skills (Shu & Huang, 2021). In most countries, the country's government starts a technical and vocational education for both males and females, which helps them in getting skill-based education (Shoaib, Tariq, & Iqbal, 2025a). In the agenda of sustainable development, males and females have equal access to STEM education (Shoaib, Shamsher, & Iqbal, 2025). Those females who are getting support from their parents and siblings perform well in the STEM subjects (Bissell, 2013). It is important that not only increase the quantity of females but also improve the quality of education

(Shoaib, Shamsher, & Iqbal, 2025). Many studies show that the behavior of teachers impacts the learning, skills, and behaviors of female students (Shoaib, Kausar, Ali, & Abdullah, 2025; Shoaib, Rasool, Kalsoom, & Ali, 2025). Cultural factors limit the performance of females in STEM subjects, and they feel excluded from this field (Croxford, 1997). Females require multiple career choices to ensure a bright and successful future (Shoaib, Iqbal, & Iftikhar, 2025). Many studies found that students need support to perform well in their education. With parental support, female students also need support from their institute and teachers (Shoaib, Ali, & Kausar, 2025; Garton, 2024). Parents provide female students with the necessary learning gadgets and motivate them to work hard.

Main Objective: The main objective of the study is to explore the acceptability and resistance to feminization in science, technology, engineering, and mathematics (STEM) fields at higher education levels.

The Data and Methods

It is based on an exploratory qualitative research design grounded in an extensive review of research published documents on the topic of feminization in STEM education, acceptance, and resistance. A total of 82 peer-reviewed research documents have been systematically extracted from reputable digital databases such as Taylor & Francis, SAGE, Google Scholar, Springer Nature, Web of Science, Emerald Insight, and other academic resources available through the university library. The published documents selection process has continued until the data saturation. The inclusion criteria of the study have required that selected studies explicitly address feminization of STEM education, be conducted within the context of higher education, and be published in well-recognized peer-reviewed national and international journals. Further, the thematic analysis technique has been employed to identify, infer patterns, and analyze across the data. The study findings have been presented and discussed qualitatively in the relevant sections of the study.

Results and Discussions

The study findings outlined that education was important for every individual and the basic rights of everyone (Phuthi & Mazarire, 2024). Similarly, the study findings examined historically female faces barriers in education, and in the past, females did not have the right to formal education (Petridou & Lao, 2024). Likewise, the analysis of the study reported that for the empowerment of females, it was important to promote education (Shoaib, Ali, Iqbal, & Abdullah, 2025). Comparably, the results of the study indicated that, for fulfilling the traditional roles, education was also important, and educated females manage their house duties in a better way. Correspondingly, the study findings showed that education increases the tolerance among the students and, in modernity, gives space to other matters a lot (Shoaib, 2025a). Furthermore, the argument of the study asserted that to reduce the conflict of genders, it was important to provide education to all and treat every gender equally. The conclusion of the research articulated that familiar poverty has been reducing easily if everyone contributes to it (Parsons, Miles, & Petersen, 2011). The study findings defined that policies for education, especially for females' education, need to change with the passage of time (Parson & Ozaki, 2018). In the same token, the study findings examined that females were also helpful in economic development, but space and chance were required. In addition, the argument of the study revealed that it was the responsibility of nations to ensure that every single girl gets an education and learn skills (Owusu et al., 2024).

The study findings outlined that females living in poor families face multiple barriers in education (Oon & Subramaniam, 2015). Similarly, the study findings examined that globally, there were a large number of females who were not enrolled in an educational institute (Olelewe, Dong, Abdullahi, & Nwangwu, 2023). Likewise, the analysis of the study reported that females who get a basic education are not allowed to pursue higher education due to the age of marriage (Ogunniyi & Iwuanyanwu, 2024). Comparably, the results of the study indicated that in most societies, people set the age of females for marriage, and after this age, they face stereotypes (Oforiwaa Gyamera, Animwaa Mireku, & Tsetse, 2024). Correspondingly, the study findings showed that poor families want child marriages when they cannot bear the expenses of their daughter. Furthermore, the argument of the study asserted that in most of the nation, females were present who were managing their careers with household responsibilities (Shoaib, 2025b). As the conclusion of the research articulated that female also supported their families by doing a job, education was important for them. The study findings defined that it was time to make efforts for the females' science and technology education for future development (Norman, 2011). In the same token, the study findings examined that most of the families who have low income prefer

boys' education with this income (Njifen, 2024). In addition, the argument of the study revealed that most of the females have no freedom in their families to perform outdoor activities.

The study findings outlined that higher education experience impacts the self-efficacy of the students and participation in other activities (Ali, Shoaib, & Kausar, 2025). Similarly, the study findings examined that societal myths related to the education needed to be removed from society. Likewise, the analysis of the study reported that in most of the areas, there was an important role of gender and power in the higher education of the students (Shoaib, Zaman, & Abbas, 2024). Comparably, the results of the study indicated that unpaid females were taking more time and were weak in decision-making (Shoaib, Shehzadi, & Abbas, 2024b). Correspondingly, the study findings showed that the Indian higher education system is also changing in different aspects (Shoaib, Shehzadi, & Abbas, 2024a). Furthermore, the argument of the study asserted that for the development of students, the development of academic staff was important (Shoaib, Ali, & Abbas, 2024). The conclusion of the research articulated that academic stress in students was impacting their mental health. The study findings defined that it was good to develop critical thinking in the students (Shoaib, 2024e). In the same vein, the study findings examined that provide leadership opportunities to females in the region. In addition, the argument of study revealed that higher education also increases the number of females in the workforce (Shoaib, 2024d).

The study findings outlined that policy-making always leads to betterment (Shoaib, 2024b). Similarly, the study findings examined that perceived support impacts the level of satisfaction in students. Likewise, the analysis of the study reported that promoting the teachers' training develops knowledge and provides cognitive support to the students (Shoaib, 2024c). Comparably, the results of the study indicated that at the time, artificial intelligence students were seeking help from it in their higher education (Shoaib, 2024a). Correspondingly, the study findings showed that the quality of higher education must be assured by teachers and students (Ali, Zaman, & Shoaib, 2024). Furthermore, the argument of the study asserted that research institutes of Malaysia were trying to find out the gap in policy making about education. The conclusion of the research articulated that every female in the STEM field has different experiences in a male-dominated field (Shoaib, Usmani, & Abdullah, 2023). The study findings defined that most of the students shift abroad for their higher education. In the same vein, the study findings examined that females in urban areas have a better experience compared to females in rural areas (Shoaib, Shehzadi, & Abbas, 2023). In addition, the argument of study revealed that higher education qualification and social support have an impact on the future of females (Shoaib, 2023b).

The study findings outlined that there was a gender disparity in enrollment for higher education in Malaysia. Similarly, the study findings examined that over the past few years, the enrollment of female students in higher education was improving (Shoaib, 2023a). Likewise, the analysis of the study reported that most of the countries are working on the gender gap in education (Shoaib, Usmani, & Ali, 2022). Comparably, the results of the study indicated that females still face problems in the STEM field. Correspondingly, the study findings showed that most of the subjects were present, which were considered only for males (Shoaib, Tariq, Shahzadi, & Ali, 2022). Furthermore, the argument of the study asserted that most of the time female has only a few resources to complete their education (Bartolic et al., 2022). As the conclusion of the research articulated, in societies, people expect traditional work from females (Bennett & Burke, 2018). The study findings defined that sometimes parents were unaware of the importance of education for everyone. In the same vein, the study findings examined that it was important that the government provide funding for the education of females (Shoaib & Ullah, 2021a). In addition, the argument of study revealed that female also start their career with the help of higher education (Shoaib & Ullah, 2021b).

The study findings outlined that getting a higher education was a challenge for females in Pakistan (Shoaib, Iqbal, & Tahira, 2021). Similarly, the study findings examined that there were a large number of challenges and barriers faced by females in higher education. Likewise, the analysis of the study reported that females face social challenges during their studies (Shoaib, Fatima, & Jamil, 2021). Comparably, the results of the study indicated that female also face economic and cultural challenges in their education. Correspondingly, the study findings showed that most of the females were dependent on their families (Shoaib, Ali, & Akbar, 2021). Furthermore, the argument of the study asserted that it was important to provide safety to the females in educational institutions. The conclusion of the research articulated that parents do not allow their females to get an education from male teachers (Shoaib, Ahmad, Ali, & Abdullah, 2021). The study findings defined that in Afghanistan, female students were facing challenges, but on the other hand, they had many opportunities. In the same vein, the study findings examined that STEM was a subject that was considered only for males (Shoaib, 2021). In addition, the argument of study revealed that female also has personal issues which occur as a barrier in their education (Burridge, Maree Payne, & Rahmani, 2016).

The study findings outlined that many students choose STEM courses for good jobs and a bright future. Similarly, the study findings examined in most of the developed and developing countries show that females were contributing to the science field (David, 2024). Likewise, the analysis of the study reported that it was important to provide benefits to females in STEM higher education. Comparably, the results of the study indicated that people ask the question about females choosing STEM courses. Correspondingly, the study findings showed that it was difficult for the females to adjust to the labor market and get a high position. Furthermore, the argument of the study asserted that many parents support their sons more compared to their daughters (Garay-Rondero et al., 2024). The conclusion of the research was that for the achievement and success of children, the education and knowledge of parents were important. The study findings defined that parental expectation of their sons and daughters helps them in decision making. In the same token, the study findings examined that the students who have less support from their parents drop out of the universities (Hanssen & Mathisen, 2018). In addition, the argument of the study revealed that there was a relation between higher education and female's empowerment (Harrop, Tattersall, & Goody, 2007)

The study findings outlined that friends played an important role in the life of females and their education (Hemmati, 2023). Similarly, the study findings examined that mostly American females were involved in online activities and online education (Hlatshwayo & Shawa, 2020). Likewise, the analysis of the study reported that every female student has their own experience in their peer group (Hou, 2024). Comparably, the results of the study indicated that parents support their girls to continue higher education. Correspondingly, the study findings showed that parents build confidence and self-esteem in daughters. Furthermore, the argument of the study asserted that most of the time, girls chose STEM subjects to support their families financially in the future. The conclusion of the research articulated that parents of female students tell them how to deal with the stereotypes (Shoaib, Abdullah, & Ali, 2021). The study findings defined that many societies considered that education was not necessary for females. In the same vein, the study findings examined that most of the girls get inspiration from their family members. In addition, the argument of study revealed that girls who belong to educated families easily perform well in the STEM field (Myburgh, Poggenpoel, & Hastings-Tolsma, 2017).

The study findings outlined that STEM was considered an expensive field (Ahmad, Shoaib, & Shaukat, 2021). Similarly, the study findings examined how female students get guidance from their parents and siblings. Likewise, the analysis of the study reported that it was important that family members trust in the abilities of their females. Furthermore, the argument of the study asserted that females who choose STEM courses were more confident and successful (Ahmad, Ahmad, Shoaib, & Shaukat, 2021). The conclusion of the research articulated that females who chose STEM were inspired by someone. The study findings defined that students need support from their family and friends to perform well. In the same vein, the study findings examined that it was important to raise awareness about the STEM courses. In addition, the argument of the study revealed that providing sufficient resources and labs for the STEM students is crucial. The study findings outlined that building separate institutions for females. Similarly, the study findings examined that encourage females and change their way of thinking (Snyman, 2022). Likewise, the analysis of the study reported that females have limited opportunities in most of the countries (Speight, Crawford, & Haddelsey, 2018). Comparably, the results of the study indicated that female role model helps other female students and motivate them (Tangenberg, 2013). Correspondingly, the study findings showed that peer groups of students shape the gender expectations of students (Tavares, 2017). Furthermore, the argument of the study asserted that it was important to change the ways for females. The conclusion of the research articulated that females who enrolled in STEM face multiple stereotypes from society. The study findings defined that students gain confidence when they get support from their parents and teachers. In the same token, the study findings examined in Saudi Arabia currently female workers in higher education and trying to pursue higher education. In addition, the argument of the study revealed that the culture of educational institutions was changing with time.

The study findings outlined that most of the female learners have the perception that the distance of the university impacts the learning process. Similarly, the study findings examined why females join the STEM courses for the food security of their family and the basic needs of the family. Likewise, the analysis of the study reported that it was important to change the perception and provide the motivation to females in science fields. Comparably, the results of the study indicated that there was a relation between social, institutional, and emotional support with the performance of female students. Correspondingly, the study findings showed that support from the family helps the students to perform well in their academic field (Azaola, 2020). Furthermore, the argument of the study asserted that decision-making was important for future security and achieving a bright future. As the conclusion of the research articulated, the institute and department make the policies

that support the students (Shoaib, Abdullah, & Ali, 2020; Shoaib & Ullah, 2019). The study findings defined that students move from one area to another to get higher education and face adjustment problems. In the same token, the study findings examined that teachers and leader members of the institute ensure the capacity building of the students (Cheng & Zhu, 2021). In addition, the argument of the study revealed that examining the structure of the institute impacts the satisfaction level of students.

Conclusion

The study conclusion asserts that the feminization in STEM higher education has been shaped by a multifaceted interplay of acceptability and resistance. The study findings disclose that momentous paces have been made in motivating and encouraging female participation in STEM fields, specifically in higher education. Specifically, higher education has been deeply embedded and interlinked with socio-cultural norms, gendered expectations, and institutional and structural barriers. It has an impact on the possibility of acceptance and resistance practiced by female students at tertiary levels. Correspondingly, the interlinked factors include gender based policies, gender sensitization, supportive family, peer influence, faculty members' networks, and increasing socio-cultural approachability, which have been contributing positively to the acceptability of females in STEM higher education. Similarly, parental and familial inspiration, personal motivation, community motivation, institutional initiatives, and structural support networks promoting inclusivity have also been found to boost female participation and retention in STEM fields. On the contrary, confrontation carries on in elusive and manifest forms, expressing through a lack of role models, specifically, gender stereotyping, peer biases, and apparent male supremacy in multiple technical fields in higher education. Numerous factors often obstruct the inspiration, performance, career determinations, academic self-confidence, and job positioning of female students in STEM fields.

Future Implications

The paper raised the need for a multiple aspect that addresses social, cultural, structural, personal, religious, communal, personal choices and options, and socio-psychological domains to enhance and feminize STEM fields and disciplines.

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