An Empirical Insight into Acceptability and Resistance to Feminization in STEM Fields at the Higher Education Level

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ABSTRACT

This paper aims to explore the acceptability and resistance of females in science, technology, engineering, and mathematics (STEM) fields in higher education. Females are still facing challenges and different barriers in STEM education, which is why the number of females in STEM is low and is gradually changing with the passage of time. It has been based on an exploratory research design, i.e., qualitative, grounded in an extensive review of research published documents on the topic, i.e., feminization of STEM education, acceptance, and resistance. A total of 140 research documents have been systematically extracted from well-reputed digital databases and other academic resources available through the academic library, and the selection process has been continued until 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 journals. 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. Several factors often obstruct the motivation, performance, career ambitions, academic confidence, and job orientation of female students in STEM higher education.

Keywords: STEM Education, Higher Education, Acceptability, Resistance, Feminization

Introduction

Several challenges have been faced by females in science, technology, engineering, and mathematics (STEM) fields (Anning, 2024). These challenges include male-dominated subjects, reasoning-based subjects, daring subjects, and less glamorous subjects (Adikaram & Razik, 2023). Females are still facing challenges and different barriers in STEM education, which is why the number of females in STEM is low (Guy & Boards, 2019). However, the main challenge is that people think STEM courses are suited for males (Shoaib & Zaman, 2025). Females are less capable and not acceptable for these courses (Shoaib, Waris, & Iqbal, 2025c). In various parts of the world, girls have historically not had the right to access formal education (Shoaib, Waris, & Iqbal, 2025b). In places where education was available, girls were often directed towards subjects considered suitable for them, such as home economics or teaching, rather than STEM fields (Shu & Huang, 2021). In various cultures, traditional roles for females are domestic responsibilities and caregiving, which conflict with the demands of STEM careers (Yu & Jen, 2023). Females get less encouragement from the family, friends, and society, which works as a barrier in

pursuing STEM courses (Shoaib, Waris, & Iqbal, 2025b). Traditional gender roles and stereotypes restrict female students from doing science jobs, mostly in underdeveloped nations where patriarchal traditions are dominant (Adu-Marfo, Biney, & Asamoah, 2024). In lower-class families, girls are expected to help out around the house or start working early, while boys may receive priority education (Alrwaished, 2024). In most countries, there are no awareness campaigns to promote gender equality in the education field (Shoaib, Waris, & Iqbal, 2025a). Peer group and teacher bias discourage girls from participating in science classes, which lowers their confidence (Anning, 2024). STEM education not only helps females in their careers, but this knowledge also helps them in performing their traditional role of mother (Shoaib, Waris, & Iqbal, 2025a). STEM knowledge enhances the ability of critical thinking and wise decision making in females (Berdousis & Kordaki, 2018). Females face the challenge of the gender pay gap, which is solved when a large number of females take part in the market and get higher education (Shoaib, Tariq, Rasool, & Iqbal, 2025). Most of the females have a degree in STEM but are not pursuing their career in the STEM field due to societal and traditional norms (Shoaib, Tariq, & Iqbal, 2025b).

Main Objective: This paper aims to explore the acceptability and resistance of females in science, technology, engineering, and mathematics (STEM) fields in higher education.

The Data and Methods

This study has been based on an exploratory research design, i.e., qualitative, grounded in an extensive review of research published documents on the topic, i.e., feminization of STEM education, acceptance, and resistance. A total of 140 peer-reviewed research documents have been systematically extracted from reputable digital databases such as Emerald Insight, Web of Science, SAGE, Google Scholar, Springer Nature, Taylor & Francis, and other academic resources available through the academic library. The research documents selection process has been continued until 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 analyze, identify, and infer patterns 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 in multiple nations, education and subjects were dependent on the gender of the student (Kowasch, Oettel, Bauer, & Lapin, 2022). Similarly, the study findings examined that increasing the number of female teachers in universities positively impacts the number of females (Koudjom & Lokonon, 2023). Likewise, the analysis of the study reported that

the perspective of teachers on females in STEM also affects the thinking and choices of students (Kolne & Lindsay, 2020). Comparably, the results of the study indicated that females get less pay than males when they both have the same degree and experience level (Koh, Camiré, Lim Regina, & Soon, 2017). Correspondingly, the study findings showed that in most of the societies, people doubt the abilities of females and do not give them a chance (Abdullah & Nisar, 2024; Kinkopf & Dack, 2023). Furthermore, the argument of the study asserted that females perform well and best when they are motivated by their families and friends (Abdullah & Ullah, 2016; Kim, 2019). The conclusion of the research articulated that most of the students choose STEM subjects due to high-paying jobs in the future (Kim & Hamdan Alghamdi, 2023). The study findings defined that STEM courses have a bright future abroad (M. Kim & Hodge, 2024). In the same token, the study findings examined that in Pakistan, students who get a degree in STEM don't have practical skills in it (Abdullah & Ullah, 2022; Khoja-Moolji, 2014). In addition, the argument of the study revealed that it was important to make a change in teaching method and provide skills to the students (Khaokhajorn & Srisawasdi, 2024).

The study findings outlined that violent behavior and attacks on educational institutions also contribute to a smaller number of females in higher education (Shoaib, Tariq, & Iqbal, 2025a). Similarly, the study findings examined that a lack of awareness in parents impacts the choices of females in education (Shoaib, Shamsher, & Iqbal, 2025). Likewise, the analysis of the study reported that education of genders reduces the inequalities in societies and helps in making society stable (Shoaib, Shamsher, & Iqbal, 2025). Comparably, the results of the study indicated that due to cultural norms, females face challenges in education (Shoaib, Rasool, Kalsoom, & Ali, 2025). Correspondingly, the study findings showed that families provide support and motivation to the daughters that helps in academic achievement (Shoaib, Kausar, Ali, & Abdullah, 2025). Furthermore, the argument of the study asserted that most of the students depend on their friends for making decisions about their future (Shoaib, Iqbal, & Iftikhar, 2025). As the conclusion of the research articulated, most of the time, students want something else; they change their choices because of their parents (Shoaib, Ali, & Kausar, 2025; Abdullah, Matloob, & Malik, 2024). The study findings defined that females don't know about the hurdles faced by females during education in the past (Shoaib, Ali, Iqbal, & Abdullah, 2025). In the same token, the study findings examined that females choose STEM subjects to secure their future and the future of their family (Ifanti, Argyriou, & Kalofonos, 2011). In addition, the argument of the study revealed that in Pakistan, most of the universities provide insufficient resources to the students (Shoaib, 2025a).
The study findings outlined that the name was an important thing

that reflects your gender (Hunzai, 2009). Similarly, the study findings examined that it was difficult to modify or change the gender roles given by society (Hundie & Tulu, 2023). Likewise, the analysis of the study reported that most of the females did not continue their higher education due to family pressure for marriage (Huang, Erduran, Luo, Zhang, & Zheng, 2024; Abdullah et al., 2024). Comparably, the results of the study indicated that most of the females choose a traditional role over their career (Hourigan, O'Dwyer, Leavy, & Corry, 2022). Correspondingly, the study findings showed that it was difficult for the females to manage their traditional role and career together (Hojeij & Al Marzouqi, 2023). Furthermore, the argument of the study asserted that females face challenges in the workplace after completing their education (Abdullah, Nisar, & Malik, 2024; Henderson, 2018). The conclusion of the research articulated that only a few of the females who choose their career over families (Hayward, McVilly, & Stokes, 2018). The study findings defined that for females, family members were the main source of emotional support (Hasan, 2018). In the same token, the study findings examined that in most of the societies, females were considered dependent on the family (Harris, Samford, Mehus, & Zubatsky, 2013). In addition, the argument of study revealed that sometimes family practices and family traits occur as a barrier for females in education (Hapazari, 2019)

The study findings outlined that in most of the societies, your achievements and goals were decided based on your gender (Shoaib, 2025b). Similarly, the study findings examined that females also achieve well in the STEM field, which is important to provide awareness to them (Ali, Shoaib, & Kausar, 2025). Likewise, the analysis of the study reported that most of the students seek awareness and help from their elder siblings (Shoaib, Zaman, & Abbas, 2024). Comparably, the results of the study indicated that most of the time, females who want to get higher education face criticism from society (Shoaib, Shehzadi, & Abbas, 2024b). Correspondingly, the study findings showed that the education level of parents influences this career and education on STEM students (Abdullah, Nisar, & Ahmed, 2025; Shoaib, Shehzadi, & Abbas, 2024a). Furthermore, the argument of the study asserted that community participation and community awareness were necessary for female education (Shoaib, Ali, & Abbas, 2024). The conclusion of the research articulated that females who take a gap in education face difficulties in education and learn things (Shoaib, 2024e). The study findings defined that females need emotional support while completing their higher education (Shoaib, 2024d). In the same way, the study findings examined that female students were facing problems and challenges in higher education (Shoaib, 2024b). In addition, the argument of study revealed that the number of female students was improving not only in developed countries but also in developing countries (Shoaib, 2024c).

The study findings outlined that females were underrepresented in

the job market; they had fewer job opportunities (Fussy, Iddy, Amani, & Mkimbili, 2023). Similarly, the study findings examined in most of the countries are still considered as a male-dominated subject (Florence, 2016). Likewise, the analysis of the study reported that stereotypes have an impact on the decision-making of female students (Fitzallen & Brown, 2017). Comparably, the results of the study indicated that it was important to promote gender equity and gender equality (Fichtenbaum, 2006). Correspondingly, the study findings showed that the education of every single individual was important for the success of the country (Farahat, 2009). Furthermore, the argument of the study asserted that STEM was a subject that was not linked with gender (Elgar, 2004). The conclusion of the research articulated that it was important to provide awareness to the families of females (Dutta, 2009). The study findings defined that parents were performing a vital role in the education of their daughters (Dohn, 2022). In the same vein, the study findings examined that most of the parents think that the education of females was a waste of money and time (Din, Abbas, & Abdullah, 2023). In addition, the argument of study revealed that the most highlighted responsibility of the females was to manage the traditional roles (Dawson, 2014)

The study findings outlined that it has been considered that females were more expressive and emotional than males (Shoaib, 2024a). Similarly, the study findings examined that females were facing challenges in STEM in the past and struggle with it (Ali, Zaman, & Shoaib, 2024). Likewise, the analysis of the study reported that for the empowerment of females, it was important to give them opportunities in every field (Shoaib, Usmani, & Abdullah, 2023). Comparably, the results of the study indicated that by entering the STEM field, females gain skills and confidence in the future (Shoaib, Shehzadi, & Abbas, 2023). Correspondingly, the study findings showed that most of the females chose STEM subjects to support their family financially (Shoaib, 2023c). Furthermore, the argument of the study asserted that a lack of role models for females was the main issue for the smaller number of females in STEM (Shoaib, 2023b). The conclusion of the research articulated that females need to be encouraged and provided support for their education (Shoaib, 2023a). The study findings defined that mostly females were considered sensitive and polite, not suitable for the STEM hard courses (Johnson-Pynn & Johnson, 2005). In the same token, the study findings examined that STEM was a difficult and technical subject (Shoaib, Tariq, Shahzadi, & Ali, 2022). In addition, the argument of the study revealed that most people think that STEM subject has more job security (Shoaib & Ullah, 2021a).

The study findings outlined that most males get better grades in mathematics than females (Arellano, Denne, Hastings, & Hughes, 2019). Similarly, the study findings examined that men in STEM were more preferred for jobs, whereas females were more involved

in their traditional roles (Shoaib & Ullah, 2021b). Likewise, the analysis of the study reported that females who excel in the STEM subjects were not contributing to the economy of the countries (Barras & Jones, 2024). Comparably, the results of the study indicated that it was important to change the misconceptions of the societies regarding STEM (Boyd & Higgins, 2006). Correspondingly, the study findings showed that it was important to increase the confidence level of females (Burke, Sharp, Woods, & Paradis, 2024). Furthermore, the argument of the study asserted that in most countries, females were not selected for higher posts (Cai & Wong, 2024). The conclusion of the research articulated that females were mostly involved in lower-paying jobs and less authority jobs (Çetin & Demircan, 2023). The study findings defined that it was important to remove the gender gap in STEM education and improve the educational institutions (Cherng & Ho, 2018). In the same token, the study findings examined that policy making impacts on the solution of every problem (Daire et al., 2019). In addition, the argument of study revealed that it was important to understand that STEM abilities were not determined by birth (Đorđević, Glumbić, Memisevic, Brojčin, & Krstov, 2022)

The study findings outlined that the level of STEM decision-making and self-efficacy was lower in females compared to males (Gordon, Russell, & Finan, 2020). Similarly, the study findings examined that at this time of technology, the skill-based STEM education was important for females also (Greene, Jewell, Fuentes, & Smith, 2019). Likewise, the analysis of the study reported that most of the females were doing online jobs with their traditional roles (Houbrechts et al., 2023). Comparably, the results of the study indicated that it was important to trust in the abilities of the females and provide a safe environment (Hu, Zhou, & Li, 2017). Correspondingly, the study findings showed that friends provide encouragement and support, which matters for success (Jungert & Koestner, 2015). Furthermore, the argument of the study asserted that there were some attractions and barriers for females in higher education (Absher, 2009). In the same vein, the study findings examined that females face problems at the place of leadership (Alshdiefat, Lee, Sharif, Rana, & Abu Ghunmi, 2024). In addition, the argument of the study revealed that Ghana is trying to make a policy for female students in university (Ansah, Swanzy, & Langa, 2023).

The study outlined that tertiary education was linked with the mental health of the students (Shoaib, Iqbal, & Tahira, 2021). Similarly, the study findings examined that capacity building in students was important in education (Cheng & Zhu, 2021). Likewise, the analysis of the study reported that young adults need support and guidelines to make life (Shoaib, Fatima, & Jamil, 2021). Comparably, the results of the study indicated that addressing the problems and challenges faced by females was necessary to increase the number of females (Cole & Butcher, 2023).

Correspondingly, the study findings showed that there were multiple dynamics and impacts of curriculum on the learning process of students (David, 2024). Furthermore, the argument of the study asserted that students with poor and weak family backgrounds felt more hesitation (Shoaib, Ali, & Akbar, 2021). The conclusion of the research articulated that females not only need financial support from their parents, but they also require psychosocial support (Shoaib, Ahmad, Ali, & Abdullah, 2021). The study findings defined that it was necessary to make a competence-based assessment to examine the knowledge of students (Garay-Rondero et al., 2024). In the same token, the study findings examined that all individuals have their own characteristics and level of knowledge (Shoaib, Abdullah, & Ali, 2021). In addition, the argument of the study revealed that female students need more support in online education (Halkic & Arnold, 2019).

The study findings outlined that support in the study creates development in academic literacy (Shoaib, 2021; Hallett, 2013). Similarly, the study findings examined that institutional support helps students to become successful in their education (Ahmad, Shoaib, & Shaukat, 2021; Heagney & Benson, 2017). Likewise, the analysis of the study reported that Iran creates development in their higher education for science and medical students (Hemmati, 2023). Comparably, the results of the study indicated that teachers' perspective and training impact the learning process of the students (Ahmad, Ahmad, Shoaib, & Shaukat, 2021; Hlatshwayo & Shawa, 2020). Correspondingly, the studies showed that there was variance among the aspirations of city and village students (Shoaib & Ullah, 2019; Hou, 2024). Furthermore, the argument of the study asserted that to solve the problems of students, take help from the students and analyze what they want (Anwar, Shoaib, & Javed, 2013; Jansen et al., 2017). As the conclusion of the research articulated, it was important to give importance to the academic employees and work on the well-being of teachers (Jasson, Du Plessis, & Simons, 2022). The study findings defined that the academics' strong engagement was based on the attachment of students and teachers (Jiang & Tanaka, 2022). In the same token, the study findings examined that in Australia, parents have high expectations for their children's academic performance (Koshy, Dockery, & Seymour, 2019). In addition, the argument of the study revealed that creating a relationship with the students provides motivation to them (Leenknecht, Snijders, Wijnia, Rikers, & Loyens, 2023).

Theoretical Review

Biological Proponents: They state that biological differences between males and females have impacted the abilities, learning, and roles in society (Balmer, 2020). Similarly, different levels of interests among male and female students have been found in learning choices and habits (Su, Rounds, & Armstrong, 2009).
Hence, the biological differences between male and female students are linked with academic performance. The previous notion of

biological difference between male and female students had been linked with biological differences, the size of the brain, and other biological characteristics. The biological proponents argued that female students faced difficulties in studying STEM education compared to male students based on biological differences. Therefore, the biological differences were the main barrier to entering STEM education.

Psychological Proponents: According to the self-efficacy theory, students become successful and achieve their goals easily if they believe in their abilities and are confident (Weiss & Glenn, 1992). Students give up if they face negative stereotypes from multiple factors (Bastian & Haslam, 2007). The level of intrinsic and extrinsic motivation among females also impacts their choice and thinking (Goldman, Goodboy, & Weber, 2017). Females choose STEM fields, and they have good cognition with STEM from an early age (Bishara, 2021). It is necessary to build a comfortable, confident, and safe environment for the students to continue their STEM careers (Sofyan, Finefter-Rosenbluh, & Barnes).

Hence, the psychological proponents argued that female students only perform in arts and social science subjects. However, the reasoning skill has been linked with male students. Therefore, female students have fewer reasoning skills to enter STEM subjects. It is worth mentioning here that psychological proponents reject the notion of biological differences. They linked the psychological aspects of males and females to enter the STEM field rather than biological differences.

Sociological Proponents: In conflict with biological determinism, social constructivists state that differences between male and female students in STEM have been based on socialization, cultural opportunities, and institutional practices (Yamamoto, 2016). Different social drivers or factors impact the number of female students in the STEM field (Mills, 2023). It is argued that changes in culture, the number of role models, social institutions, and educational policies were considered as important factors to enter STEM education (Sharkey, 2008).

Hence, the social proponent argued that male students had a more supportive environment based on culture, role model, education environment, and patriarchal system of society in the STEM field. Therefore, female students still faced cultural barriers, role models, the education environment, and other social forces. Although female students enter STEM, they do not join the labor force in Pakistan.

Post-Structuralism: They reject the notion that male and female students have different abilities and levels of interest. It is argued that the difference between male and female students was socially constructed (Smith, 2016). It has been considered that STEM was hard sciences and males were perfect and more powerful (Smith, Lewis, Hawthorne, & Hodges, 2013).

Hence, the post-structuralist proponent rejects the notion of

psychological and biological proponents. They argued that gender has been socially and culturally constructed. In the social and cultural construction of gender roles, males have more compared to females in society, such as power, decision-making, resources, outdoor activities, education, and STEM education. In history, STEM education has been considered only for male students, and in the past, most scientists were male. However, female has less history in STEM education; therefore, males have been more represented in STEM education in the past.

Post-Feminist: According to this approach, the number of female students is increasing with the passage of time. This perspective also deals with the challenges that are still present for the girls in higher education (Ringrose, 2007). Post-feminist proponents argued that the number of female students is increasing because of a shift in the nomadic structure (Baker, 2010).

Hence, the post feminism argued that the situation is going to be changed in STEM subjects based on a change in the normative structure of society. Females are entering STEM, but still not joining the labor force in developing countries. However, the situation in the developed world has changed.

Conclusion

The overall conclusion of the study is that the feminization of STEM higher education has been shaped by a multifaceted interplay of acceptability and resistance. 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. It endures to impact the scope 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. Likewise, 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. Conversely, resistance 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. Several factors often obstruct the motivation, performance, career ambitions, academic confidence, and job orientation of female students in STEM higher education.

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. It comprises an amalgamation of gender equality and equity-based policies, developing comprehensive and inclusive learning environments, integrating gender based responsive tutoring, promoting mentorship programs, and leadership opportunities for females in STEM fields.

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