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Professions Beyond STEM Education: Analyzing the Gendered Influence of Parents and Teachers on the Educational Paths and Career Goals of Indian High School Students in STEM and Non-STEM Professions

Original research article

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Abstract

This study examines the gender disparity within STEM education and the societal pressure to prioritize careers in STEM over the Arts and Humanities. The primary aim of this study is to identify gender disparities in STEM classrooms, analyze students' awareness of courses offered in Arts and Humanities in higher education, awareness of STEAM education and examine how social agents influence students' career choices in relation to their gender, because according to Albert Bandura, social agents as role models influence the students to make decisions. Utilizing a quantitative methodology, the research collects data from a sample of 350 high school students in grades 8 to 10 (ages 13 to 16) in Tamil Nadu, India. This investigation aligns with Sustainable Development Goal 4, which seeks to guarantee that all girls and boys receive equitable and quality high school education, irrespective of gender and external influences from social agents. The study advocates for the integration of Arts into STEM education, thinking beyond STEM at the high school level, by promoting the implementation of Science, Technology, Engineering, Arts, and Mathematics (STEAM) education to foster an inclusive and equitable environment.

Keywords: *Gender, High school, Parents, STEM, Students, Teachers*

The domains of STEM are increasingly acknowledged as pivotal in shaping the trajectory of global development and innovation. In recent years, there has been a shift among students to pursue STEM disciplines, especially science and engineering, over the arts and humanities. To get a better financial life and status, students tend to choose STEM (Meu Labs, 2024). The term STEM was introduced by Ramaley and he addressed STEM as an integrated educational approach to enhance learning and

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problem solving, and cultivate creativity and innovation.

Sustainable Development Goal 4 addresses inclusive and equitable quality education, promoting lifelong learning opportunities for all (United Nations, 2015). It acknowledges education as a fundamental human right and a catalyst for sustainable development, gender equality, and economic growth. A primary target within SDG 4 (Target 4.5) is the elimination of gender disparities in education and ensuring inclusive and equitable quality education and promoting lifelong learning opportunities for all" (Saini, M. et al., 2022).

To improve the quality of students in science and technology, India initiated STEM education at the school level. It focuses on fostering critical thinking, creativity, innovation, and problem-solving skills, for preparing learners for the dynamic needs of the 21st-century workforce (Larson, L. C., and Miller, T. N., 2011). In India, the relevance of STEM education has gained prominence due to rapid technological advancements and the growing demand for a skilled workforce in high-tech sectors. The Indian government and private sectors have undertaken numerous initiatives to promote STEM education, particularly at the school level. The Atal Tinkering Labs (ATLs) under the Atal Innovation Mission and Rastriya Avishkar Abhiyan are steps toward integrating experiential learning and scientific inquiry into the curriculum. Promoting STEM education among Indian youth is crucial for achieving self-reliance in science and technology. It aims to bridge the gap between theoretical knowledge and real-world applications through project-based, hands-on learning experiences. Additionally, STEM initiatives strive to ensure equitable access across gender, socio-economic strata, and geographic regions. By nurturing curiosity, collaboration, and computational thinking, STEM education envisions creating a generation of problem solvers, entrepreneurs, and future leaders in science and technology. STEM education prepares students for diverse careers in engineering, research, biotechnology, environmental science, IT, and education, among others. Moreover, initiatives like Coding Literacy in Schools, inclusion of AI modules in the CBSE curriculum, and partnerships with organizations like Google, IBM, and Intel are broadening access to STEM learning. Significant emphasis is being placed on enhancing female participation in STEM fields, addressing gender disparities, and fostering inclusivity within science education. At the tertiary education level, leading institutions such as the IITs, IISc, and NITs are at the forefront of STEM research and innovation. The New Education Policy 2020 further bolsters interdisciplinary learning, encouraging students to integrate STEM with the arts and humanities, thereby advancing STEAM (Science, Technology, Engineering, Arts, Mathematics) education. This focus on STEAM is intended to facilitate an understanding of life from a social perspective.

Although STEM education aims to provide equitable opportunities, it may inadvertently reinforce gender biases if not implemented with a gender-inclusive approach. Research has highlighted that unconscious bias of educators and students, and gendered expectations, are a potential reason for the gender gap in STEM education (Dasgupta and Stout, 2014). In India, deeply rooted cultural norms and gender stereotypes continue to influence the education and career of a person. Families often encourage boys to choose high-paying professions like engineering and medicine, and careers like teaching and nursing for girls (Chakravarty and Somanathan, 2019). To bring a positive change in educational and career choice, STEAM education was introduced by adding Arts into STEM. It nurtures holistic learning and social values, and encourages the students to think beyond STEM. It bridges classroom knowledge with rustic culture, history, and community issues to create meaningful education.

Tamil Nadu has initiated several projects to establish equitable education and create a brighter generation, including STEM to STEAM integration and Illam Thedi Kalvi scheme. This study analyzes the gender gap in STEM education with a particular focus on the roles of parents and teachers in shaping students' educational and career choices from a gendered perspective, as well as students' awareness of STEAM education and Arts and Humanities opportunities in higher studies in Tamil Nadu, which is closely associated with the objective of SDG 4. This research advances SDG 4 by identifying systemic barriers within educational and career

achievements that impede equitable access to STEM education. By highlighting how gendered expectations influence students' academic and career paths, the study highlights the need for gender-sensitive pedagogy and career counselling, and advocates for policy interventions to promote inclusive and equitable quality education, as outlined in SDG 4.

Literature Review

Many studies have been conducted globally to address the complex relationship between gender and participation in STEM education. Beibei Lv et al. (2022) highlighted that in China, parents and teachers influenced male students more than female students in STEM career expectations. Similarly, Card David et al. (2021) discovered that gender disparities at the university level in STEM originate from high school course selections, where female students are less inclined to pursue mathematics and science, thereby affecting their STEM preparedness. Supporting this, Lloyd et al. (2018) observed that over 90% of parents of STEM-aspiring students in the UK desired their children to attend university, underscoring parental aspirations as a significant determinant. Research by Makola, Z., and Tabane, R. (2023) and Mau et al. (2020) further highlights the critical role of early influences parental support, cultural context, primary school experiences, and self-efficacy, in shaping girls' interests in STEM. Mau's findings notably emphasize cultural differences, with gender disparities being more pronounced in collectivist societies. Corrigan et al. (2023) described that although female enrollment in high school STEM courses has increased, gender disparities persist in specific subjects such as physics. At a systemic level, Hussénius (2020) and Davies et al. (2024) critiqued structural gender biases and symbolic barriers within STEM education, advocating for feminist interventions. Eshetu et al. (2025) reported significant female underperformance in national exams in Ethiopia, calling for tailored strategies to bridge the performance gap. In New Zealand, Smith and Evans (2024) found that girls in single-gender schools outperformed those in co-educational settings in STEM, particularly from low socio-economic backgrounds, due to reduced stereotype threats. In the Middle East and North Africa, EL-Deghaidy et al. (2025) identified socio-cultural and institutional barriers affecting women's participation in STEM, reflecting a "leaky pipeline." Similarly, Chirinda et al. (2025) documented the challenges faced by rural and female students in Zimbabwe despite curriculum reforms. In India, studies by Bochare (2025), Amirtham and Kumar (2021) observed increasing female participation in STEM, especially at postgraduate levels. However, social norms continue to influence enrollment in male-dominated disciplines such as mechanical and civil engineering. Shaju et al. (2024) further emphasized the necessity of closing educational gender gaps to address occupational disparities, citing unequal opportunities in leadership and research output. Research focusing on younger age groups, such as that by Harnischfeger and Stahl (2025) highlighted the impact of gender norms and self-perception on students' STEM identities, advocating for early educational interventions to counter gendered stereotypes. Recent research underscores the integration of arts and technology within inclusive STEM/STEAM education frameworks. Zhang and Jia (2024) have highlighted the role of visual arts in fostering creativity and critical thinking through VA-STEAM. Aghasafari, Needles, and Malloy (2025) demonstrated that multimedia arts enhance engagement and problem-solving skills among special education students. Furthermore, Xiao et al. (2024) reported that the integration of facial and posture recognition technologies in STEAM education achieved an accuracy rate exceeding 94% in recognizing children's emotions. Álvarez Ariza and Hernández Hernández (2025) conducted a review of 39 interventions, emphasizing the benefits of robotics and coding, while also identifying existing research gaps.

In the Indian perspective, Amirtham S, N and Kumar, A. (2021) identified there was gender parity in overall disciplines at undergraduate, post-graduation, and M.Phil. levels by analyzing all India Survey on higher education. Sindhu et al. (2025) noted parity in overall enrollments but highlighted the underrepresentation of women in physical sciences and engineering. Mukherjee and Sharma (2022) associated poverty and traditional values with STEM exclusion, aligning with socioeconomic and regional

inequalities as determinants of access. Furthermore, Maji et al. (2023) revealed problems exist in organizational gendering within elite research environments. These studies emphasize that gender disparity in STEM is influenced by a variety of social, institutional, and psychological factors across regions and educational levels. Unfortunately, there is a paucity of studies on promoting STEAM and the Arts and Humanities in higher education within the Indian context.

Sustainable Development Goal 4 (SDG 4)

Sustainable Development Goal 4 (SDG 4), which seeks to ensure inclusive and equitable quality education for all, has become an important framework for addressing gender disparities in STEM education. Ocampo Cantillo and Lazaro (2024) examined the evolution of SDG 4, emphasizing the shifting priorities in global governance, such as digital literacy, basic learning, and education financing in the post-2020 era. India's SDG 4 implementation using data mining techniques, uncovering strong interrelations among key indicators that can inform more effective education policy and gender-focused reforms. Wulff (2024) analyzed global mechanisms like the Transforming Education Summit for their limited accountability, advocating for enhanced evaluation methods and stakeholder responsibility to genuinely advance SDG 4. Concurrently, Unterhalter (2024) investigated the application of "soft power" in global education governance, identifying four key strategies for integrating gender into SDG 4: partnership building, gender mainstreaming, activism, and feminist contestation. Her study underscored the necessity of institutional grounding of feminist politics in global education to address persistent inequalities. Collectively, these reviews focused on SDG 4 to highlight the importance of aligning national and international education initiatives with gender equity goals in STEM. They also emphasize the need for more accountable, data-driven, and feminist-informed governance mechanisms to address systemic educational disparities and ensure no learner is left behind. The study's findings are particularly significant when considered in the context of the United Nations Sustainable Development Goal 4 (SDG 4): Quality Education. SDG 4 evaluates the importance of inclusive and equitable education that fosters lifelong learning opportunities for all individuals. The observed disparities, ranging from limited awareness of non-STEM disciplines to gendered barriers in career choice, highlight challenges to the objective of ensuring that all learners acquire the knowledge and skills necessary for full societal participation. The existing research hasn't explicitly addressed the issues in STEM through the eyes of SDG 4. The present study analyses the data and evaluates findings by connecting the SDG 4 goals.

Purpose of the Present Study

This study focuses on Tamil Nadu, India, to address a significant research gap in gender disparity in the existing literature on STEM education. Limited studies have examined persistent gender disparities observed in classroom settings, students' awareness and interest in STEM, and their understanding of the scope and future opportunities within STEM disciplines. The study also aims to uncover how parents and teachers impact students' aspirations. Moreover, there is inadequate research exploring students' awareness of Arts and Humanities as viable higher education pathways. By integrating all these critical elements, this study offers a comprehensive perspective that is largely missing in prior research on assessing students' understanding of STEAM education. This research stands as a distinct contribution to gender-neutral teaching practices and policies that promote equal opportunities in STEM for all students and provides a strong foundation for future scholars and researchers in the field.

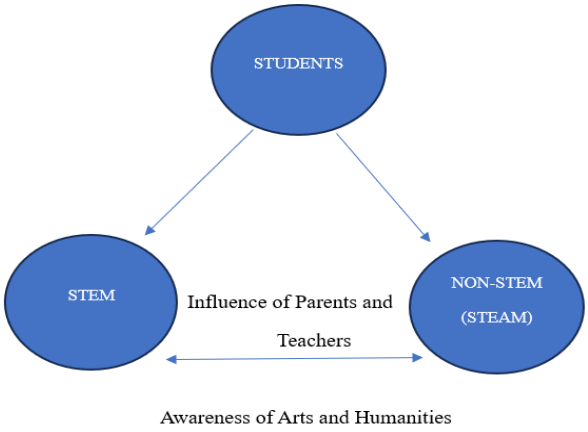
Method

Participants and Procedures

This study addresses gender disparity in STEM education, focusing on high school students' awareness and influence on educational pursuits and career choices in rural Tamil Nadu. To analyze the objectives, a sample of 350 participants was selected from Grades VII to IX in Tamil Nadu, Thanjavur district. The study uses a questionnaire survey and distributes a hard copy to the participants. The questionnaire was structured around three central objectives. The first set of questions

addressed STEM awareness and interest, assessing whether students understood the scope of STEM disciplines (Objective 1), gender disparity in the classroom and students' awareness of Arts and Humanities as an option for higher studies (Objective 2). The second set of questions investigated the influence of parents and teachers on students' academic and career trajectories and students' awareness of STEAM education (Objective 3).

Figure 1.
The Hypothesized Model of the Present Study



In rural contexts, parents and teachers play a decisive role in guiding students toward particular educational pathways. Teachers' encouragement in classrooms, as well as parental aspirations rooted in economic stability and societal recognition, often significantly contribute to whether a child chooses STEM or non-STEM fields (Figure 1). For instance, parents may prioritize careers in engineering, medicine, or computer science for their male child despite his ambition and non-STEM career for their daughters due to their perceived gender role stereotypes and lack of awareness (Figure 1). Similarly, teachers may either inspire students to engage deeply with STEM subjects or, conversely, unintentionally discourage participation due to gender stereotypes or limited resources (Figure 1). Students were asked about the subjects they wished to pursue in the future and whether they were aware of alternatives outside the STEM stream connected to non-STEM. Notably, the survey also investigated students' awareness of STEAM education and awareness of Arts and Humanities as options for higher education (Figure 1). This dimension was critical, as rural schools often emphasize science and technology pathways, leaving limited exposure to liberal arts disciplines. Exploring this awareness helps assess whether students view Arts and Humanities as viable and respectable career options or whether such fields are marginalized within their educational imagination. The significance of this study lies in its contribution to understanding educational aspirations in rural India, particularly how social and institutional factors shape students' choices connected to their gender (male or female). In contexts where STEM is increasingly promoted as a national development priority, it becomes vital to examine whether students themselves are interested in STEM or whether their aspirations are primarily shaped by external pressures. The data collected from this study not only reveal patterns of awareness and interest but also highlight the degree to which rural students are informed about diverse career pathways.

Table 1.
Demographic Details of the Participants

Age	Male	Female	Total
13	100	110	210
14	71	46	117
15	12	10	22
16	1	0	1
Total	184	166	350
Percentage	52.57%	47.43%	100%

Table 1 shows the demographic details of the participants, highlighting their gender and age. The study focuses on students from the age group 13 to 16 (between early and mid-adolescence). The 13-year-old cohort is the most represented, comprising 210 individuals (100 males, 110 females), thereby constituting a significant majority of the total sample. The 14-year-old group includes 117 individuals (71 males, 46 females), the 15-year-old group comprises only 22 individuals (12 males, 10 females), and the 16-year-old category is particularly small. In aggregate, male participants total 184, while female participants total 166. When considering percentages, males constitute 52.57% and females 47.43% of the population, indicating a slight male predominance yet a generally balanced gender representation. The overall sample size is 350 participants, ensuring statistical relevance for analyses based on age and gender stratification.

STEM Understanding and Awareness of Students and Influence of Parents and Teachers

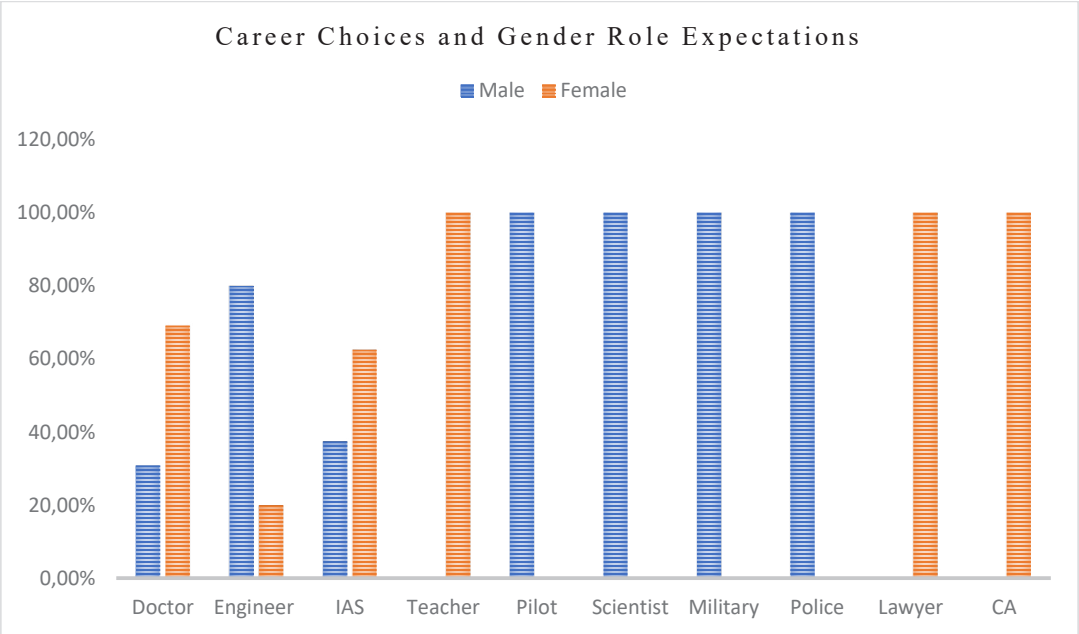
A series of questions was posed to evaluate the participants' comprehension and awareness of STEM education. This evaluation encompasses understanding the aims and objectives of STEM education, the influence of parental pressure to pursue STEM fields, gender disparity within the classroom, the implementation of gender-inclusive examples in educational settings, and perspectives on the current curriculum's incorporation of gender-neutral elements.

Table 2.
Awareness of STEM Education Objectives, Pressure to Pursue STEM, Perception of Gender Disparity, Use of Gender-Inclusive Instructional Examples, Curriculum Gender Neutrality

Question	Gender	No	Yes	Total
Are you aware of the aims and objectives of STEM education?	Female	56	110	166
	Male	67	117	184
	Total	123	227	350
Do you experience any pressure from your family or teachers to pursue STEM?	Female	151	15	166
	Male	88	96	184
	Total	239	111	350
Do you observe any gender, disparity in the classroom?	Female	53	111	164
	Male	98	86	179
	Total	151	197	350
Are teachers using gender-inclusive examples during instruction?	Female	57	107	164
	Male	71	113	179
	Total	128	220	350
Is your school curriculum gender-neutral?	Female	110	55	164
	Male	103	82	179
	Total	213	137	350

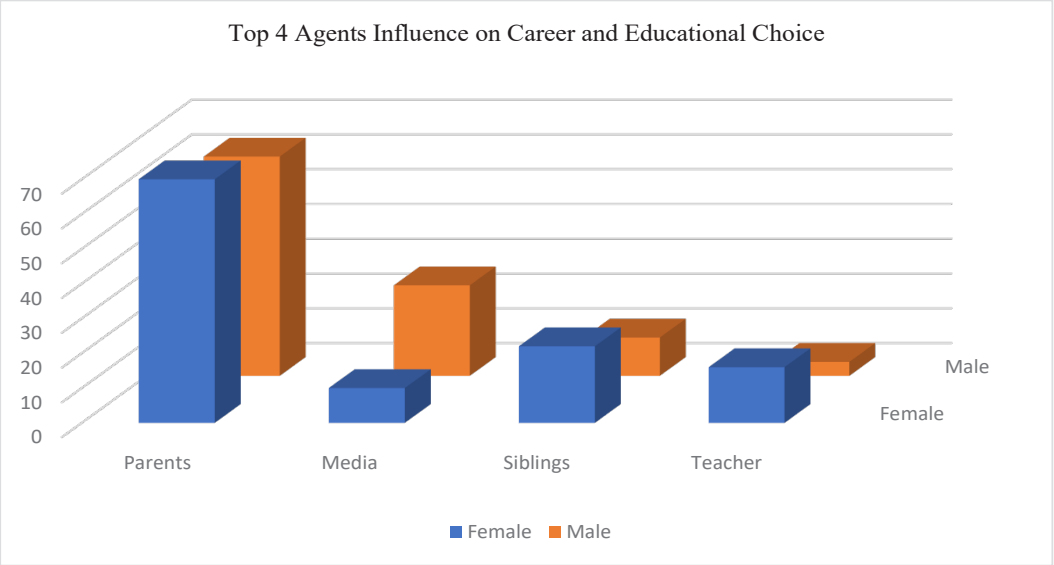
Table 2 reveals important patterns regarding gender role expectations and disparities within the context of STEM education. A notable majority of both female (66.3%) and male (63.6%) participants reported being aware of the aims and objectives of STEM education, reflecting successful dissemination of information attributed to the efforts of the organization providing STEM kits (Objective 1). However, responses about pressure to pursue STEM indicate gender difference: while only 9% of female participants reported experiencing such pressure from family or teachers, more than half of the male participants (52.2%) felt compelled in this direction. This disparity suggests that prevailing gender role expectations may position STEM fields as more suitable or expected for males, perpetuating traditional stereotypes and impacting students differently based on gender. (Objective 3) Furthermore, perceptions of classroom gender disparity remain prevalent, with 67.7% of females and 48.0% of males acknowledging its existence, highlighting that female participants are more likely to recognize or be affected by inequities in classroom interactions or opportunities. On a more positive note, 65.2% of females and 63.1% of males agreed that teachers use gender-inclusive instructional examples, indicating progressive steps toward combating ingrained biases through pedagogical practice. Yet, only 33.5% of female and 45.8% of male respondents consider their school curriculum to be gender-neutral, exposing continued structural imbalances (Objective 2). Collectively, these findings underscore the persistence of gender-based expectations and experiences. Males more frequently report pressure to participate in STEM, while females more acutely observe and are possibly affected by gender disparities despite active organizational and instructional efforts to foster a more inclusive and equitable STEM educational environment. Table 2 highlights the need of an awareness class for parents and teachers to create an inclusive, gender-neutral classroom.

Figure 2.
Top Ten Professions Influenced by Gender by Parents and Teachers (Male /Female)



The chart illustrates the gender distribution among students' top ten preferred professions, highlighting the associations between particular career choices and gender role expectations influenced by parents and teachers (Objective 3). A critical evaluation reveals how social agents' traditional notions of masculinity and femininity continue to shape students' vocational aspirations, reflecting deeply rooted societal norms. A striking trend is evident in professions like doctor, where a significantly greater proportion of females (69.1%) express aspiration compared to males (30.9%). Conversely, the field of engineering is overwhelmingly preferred by males (80%) with minimal female representation (20%). Similarly, IAS a leadership-oriented civil service role is more popular among females (62.5%) than males (37.5%). The teaching profession is exclusively selected by females (100%), reinforcing the enduring cultural view of teaching as a nurturing, feminine occupation. On the other hand, roles such as pilot, scientist, military, and police are chosen solely by males (100%), manifesting perceptions of these careers as masculine, requiring traits stereotypically associated with men, such as physical strength, bravery, and technical prowess. Professions like lawyers are entirely male-dominated in this sample, while CA (Chartered Accountant) presents a rare instance of exclusive female preference (100%). These data points reflect the persistent impact of gender role expectations on career choices. Females move towards professions traditionally aligned with empathy, care, and social responsibility, like doctors, teachers, IAS, and CA. Males are drawn to occupations linked with authority, innovation, risk, like defense, engineering, pilot, scientist, military, and police. The data suggest that interventions promoting awareness of gender-neutral professions and professions beyond science and technology will encourage students to choose their education and career and bring societal progress toward gender parity and a change in the perpetuation of outdated gender norms.

Figure 3.
Who Influences the Career of a High School Student, Gender Wise Report

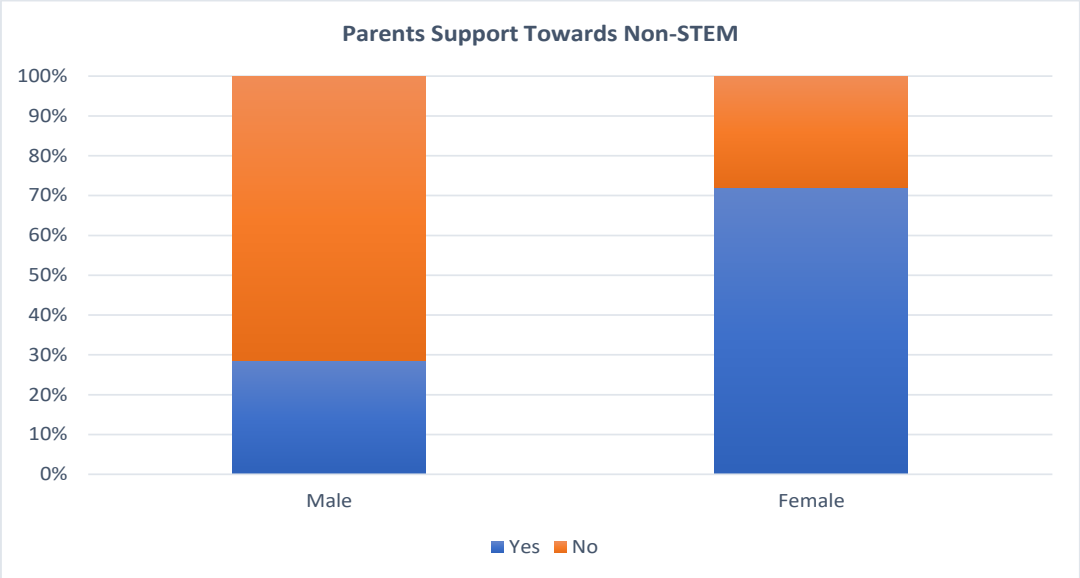


The bar chart underscores the substantial impact of various social agents like parents, media, siblings, and teachers on students' career and educational choices, revealing nuanced gender differences in sources of influence (Objective 3). When considered alongside the previous data (Figure 2) on the gendered distribution of the top ten preferred professions, the interplay between social influence and gender role expectations becomes apparent. Parents emerge as the most prominent influencers for both females (70) and males (63), which attests to the powerful role of family in shaping career aspirations. This dominant influence aligns with observed preferences for gender-stereotyped professions in the earlier chart, where females heavily favor nurturing roles such as doctor and teacher, and males gravitate toward positions culturally coded as masculine, including engineer, pilot, scientist, and police. Such patterns can be attributed to parental reinforcement of traditional gender norms and expectations regarding appropriate career trajectories for sons and daughters. Media exhibits a particularly gendered influence, impacting more males (26) than females (10). This may reflect greater male exposure or receptivity to digital portrayals of high-status, technical, or adventurous professions in movies, consistent with their higher representation in engineering and STEM-oriented fields. Siblings and teachers play comparatively secondary roles, with sibling influence higher for females (22) than males (11), and teacher influence notably more significant for females (16) than males (4). For girls, these agents may provide relatable models or encouragement, supporting aspirations toward professions like doctor, IAS, or teacher, as seen in the profession chart. Teacher influence for females can also be interpreted as a supportive mechanism, potentially encouraging entry into fields where women are underrepresented, though the overall numbers suggest stronger familial than educational intervention in breaking gender role boundaries.

Taken together, these findings illustrate that career and educational choices are not made in isolation but are continually shaped by a network of socializing agents. The prevalence of parental influence, in particular, reinforces traditional gender divides in occupational preferences, as evidenced by the sharp gender splits in professional aspirations from the previous chart (Figure 2). The findings strongly support the necessity of an awareness class for parents and students on gender neutral professions and the scope of higher education beyond STEM. To foster gender equity in academic and professional pathways, targeted interventions are required, not only in classrooms but also at the familial and media levels, to expand students' visions of what is possible beyond the constraints of traditional gender role expectations.

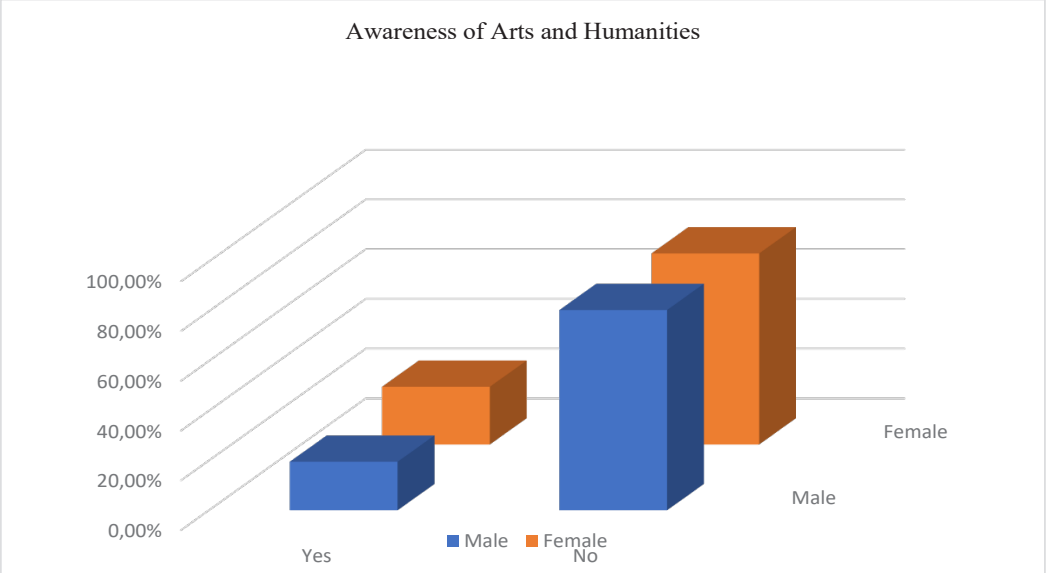
Figure 4.

Are Parents Supportive of Taking Non-STEM for Higher Studies?



The chart vividly depicts parental interest in encouraging their children, differentiated by gender to pursue non-STEM fields in higher studies (Objective 3). A critical evaluation reveals significant disparities influenced by the gender of the student, which have important implications for gender equality in academic and occupational outcomes. A substantial 71.4% of parents of male students do not support the pursuit of non-STEM fields, indicating a pronounced preference for their sons to continue in STEM disciplines. Only 28.6% of parents of male students express willingness for their sons to pursue non-STEM careers. This collective attitude reflects entrenched societal beliefs associating masculinity with STEM professional fields often perceived as more lucrative, prestigious, or aligned with traits traditionally assigned to men, such as technological aptitude, analytical ability, and leadership. In sharp contrast, a markedly higher 72.1% of parents of female students express support for their daughters pursuing non-STEM fields, while only 27.9% resist this trajectory. This pattern suggests that parents are significantly more open to, or even encouraging of, non-STEM paths for females, further reinforcing traditional gender roles that associate women with humanities, education, arts, and care-related professions rather than science, technology, engineering, and mathematics. These divergent parental expectations have a profound impact on gender equality. By steering boys toward STEM and girls toward non-STEM, parents unconsciously perpetuate occupational segregation: boys are directed toward fields with higher earning potential and social status, while girls are confined to domains historically undervalued in economic and cultural terms. Figure 4 supports the vision of awareness class for parents to think beyond STEM. For true gender equality to materialize in higher education choices and professional outcomes, parental attitudes must become more supportive of non-traditional pathways for both genders, empowering students to pursue fields aligned with their interests and talents rather than those limited by conventional gender expectations.

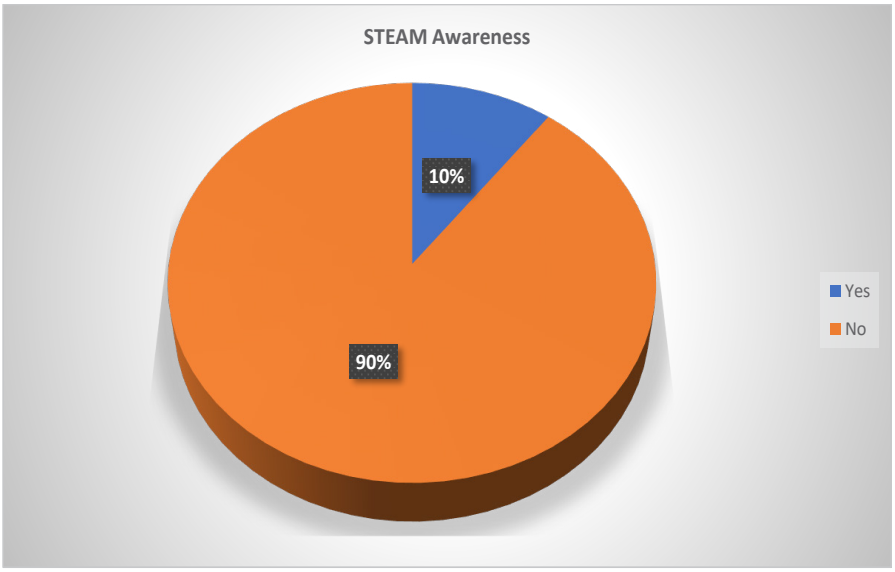
Figure 5.
Students' Awareness of Arts and Humanities as a Higher Studies Option



The bar chart titled "Arts and Humanities Awareness" offers a clear depiction of students' awareness of arts and humanities as viable options for higher education, disaggregated by gender (Objective 2). The findings indicate a strikingly low level of awareness among both male and female students, albeit with subtle gender differences. Only 19.5% of male students reported awareness of arts and humanities pathways, while a significant majority, 80.5%, indicated a lack of awareness. This pronounced deficit underscores a possible marginalization or underpromotion of arts and humanities within educational guidance for male students. Culturally ingrained stereotypes reinforcing STEM as the preferred domain for males may result in limited exposure and endorsement of arts-related academic pursuits. Among female students, the scenario is marginally better: 23.2% demonstrate awareness of arts and humanities avenues, whereas 76.8% lack such awareness.

Although this proportion surpasses that of male students, it still reflects an educational context where arts and humanities are notably overshadowed by alternative streams, even for females who have been traditionally associated with these fields. The data suggests that, contrary to expectations of higher awareness among girls, the recognition of arts and humanities as legitimate and valuable realms for higher studies remains limited. The overall diminished awareness across genders has significant ramifications for diversified educational choices and informed decision-making. Limited familiarity with arts and humanities restricts students' ability to fully consider, appreciate, or pursue these disciplines, ultimately narrowing the talent pool and perpetuating hierarchies that favor STEM and professional courses. To promote a holistic and balanced academic ecosystem, it is imperative that arts and humanities receive greater emphasis within career counselling, curricular design, and parental encouragement, thereby broadening students' perspectives and opportunities in higher education.

Figure 6.
Students' Awareness of STEAM Education



The pie chart depicting "STEAM Awareness" presents a revealing snapshot of students' knowledge concerning STEAM education, which integrates Science, Technology, Engineering, Arts, and Mathematics (Objective 3). The data shows a profound lack of awareness among the surveyed cohort. Out of the total respondents, a mere 36 students indicated awareness of STEAM education, while a striking majority, 314 students, reported no familiarity with the concept. This amounts to only about 10% of students being aware, with the overwhelming 90% remaining

unaware. Such a considerable gap underscores a critical deficiency in exposure to or engagement with STEAM as a holistic educational paradigm. The minimal awareness level suggests that the integration of the arts into traditional STEM curricula is not widely recognized or adopted within the learning environment sampled. This lack of knowledge risks inhibiting the development of essential interdisciplinary skills such as creativity, critical thinking, and innovation that STEAM education intends to foster. Furthermore, without adequate dissemination or advocacy, students are less likely to pursue learning opportunities that bridge technical and creative disciplines, potentially narrowing their academic and professional prospects.

Table 3.
Students Who Wish to Pursue Non-STEM Subjects in the Future

Question	Gender	No	Yes	Total
Do you wish to pursue STEM - related subjects in the future?	Female	67	98	164
	Male	44	139	179
	Total	111	237	350

The table presents a notable preference among students for STEM-related subjects in their future academic pursuits, with 237 out of 350 respondents expressing this wish comprising 139 males and a considerable 98 females. This strong inclination towards STEM can be critically connected to the previously observed deficiency in awareness regarding arts and humanities and the integration of STEAM education. The earlier data indicated that the vast majority of students lack awareness of arts and humanities as viable higher education pathways, with only 19.5% of males and 23.2% of females considering these disciplines (Figure 5). Likewise, awareness of STEAM, which intentionally embeds the arts within STEM fields, was alarmingly low, at just 10.3% overall. This restricted exposure directly influences students' attitudes and decisions, orienting them almost exclusively towards STEM subjects and thereby narrowing the perceived spectrum of legitimate academic and professional choices. In educational settings where arts and humanities and interdisciplinary models like STEAM are underrepresented in information campaigns, curricular design, and parental or teacher guidance, students naturally gravitate toward the more familiar and frequently promoted STEM fields. This pattern perpetuates existing academic hierarchies and may limit the holistic development of students' creative and critical thinking capacities. Furthermore, the data reveals that both males and females exhibit significant interest in STEM, reflecting not only universal branding of STEM as essential for modern careers but also the failure to provide competing narratives that champion creativity, social inquiry, and cultural studies. The findings elucidate the need for educational stakeholders' awareness and a comprehensive understanding of arts, humanities, and STEAM education.

Discussion and Recommendation

The data presented above explicates a multifaceted analysis of gender-neutral representation in STEM education. It addresses gender disparities within the classroom, the awareness of Arts and Humanities and STEAM among students, and the influence of social agents such as teachers and parents in determining a student's educational and career trajectory. The study reveals that students encounter gender disparities in the classroom, with male students experiencing parental pressure to pursue STEM-related subjects (Table 2). Parents and teachers consistently serve as influential figures in a student's life, acting as catalysts in shaping their academic pursuits (Figure 3) and guiding them towards professions aligned with societal gender norms (Figure 2). The findings further underscore the significance of awareness regarding Arts and Humanities and STEAM education (Figures 5&6). Notably, nearly 80% of boys and 76% of girls lack awareness

of the future scope of Arts and Humanities. This deficiency in awareness contributes to unsuitable academic and professional trajectories, thereby challenging the aims and objectives of SDG 4. Regrettably, parents exhibit a lack of interest in encouraging their children to pursue non-STEM environments. Most parents of girls are inclined to motivate their daughters to pursue careers in non-STEM fields, whereas parents of boys tend to do the opposite (Table 3). Parents of boys believe their sons should secure employment immediately after graduation to fulfill societal gender role expectations as breadwinners, while girls are more encouraged towards non-STEM fields to possess a degree for matchmaking purposes. The study emphasizes the urgent need for action to render STEM education more gender-neutral by providing equal and equitable opportunities and raising awareness of academic and professional options beyond STEM. It also highlights the need for policy reformation to bridge Arts, Science and Technology in one page to bring a bright and unbiased generation.

Based on the findings and discussion, several initiatives should be implemented and executed meticulously to bring about a positive change and bridge the gap. Through the study, the recommendations and suggestions are highlighted below:

To enhance the academic and professional awareness of Arts and Humanities, educational institutions should extend career guidance beyond STEM education to include STEAM education, thereby fostering an equitable learning environment (SDG4). To promote gender inclusivity and neutral perspectives among students, programs aimed at increasing parental awareness and involvement should be introduced. These programs should educate parents on the importance of supporting and encouraging their children to pursue careers beyond science and technology. They should be engaged in workshops and campaigns to promote egalitarian parenting, thereby creating a gender-inclusive and equitable environment. Table 2 elucidates the necessity for curriculum reform. The curriculum should be restructured to incorporate gender-neutral illustrations and provide educational and career guidance for Arts and Humanities, alongside science and technology. In addition to curriculum changes, teachers should be trained to counsel students to achieve gender parity in all aspects of life. Since media significantly influences and motivates adults, social agents should address both positive and negative influences from media and the community. Sarah Arnold and Izzy, in their research, addressed the rising misogyny among boys, influenced by social influencer Andrew Tate (Sarah Arnold, 2025). Therefore, students must receive classes on the positive and negative impacts of media and be guided to make informed choices. The research also recommends policy interventions to effectively close the gender gap, aligning with SDG 4 and cultivating empowered learners.

Scope for Future Research

The present study addresses gender disparity in STEM education at high school level. The major objectives of the study are to address STEM awareness and interest, assessing whether students understand the scope of STEM disciplines, gender disparity in the classroom. It also elucidates students' awareness of Arts and Humanities as an option for higher studies and the influence of parents and teachers on students' academic and career trajectories and students' awareness of STEAM education. Since the study is limited to Indian students, especially Tamil Nadu, future researchers can expand the study to the national and international level, or conduct a comparative study of South India vs North India to evaluate the differences and challenges. Additionally, researchers focusing on educational polices and programs can get insights from this research and design career guidance programs beyond STEM to bring inclusivity and avoid bias in students to decide their educational and career options.

Conclusion

The study on gender disparity in STEM education elucidates the potential gender gap, encompassing disparities in the classroom, and the influence of parents and teachers in directing students towards STEM-related subjects. It also highlights a lack of awareness regarding STEAM education and the Arts and Humanities as viable higher education options. The findings of this study are aligned with Sustainable Development

Goal 4, which emphasizes quality and equitable education. The study identifies that STEM education predominantly focuses on science and technology, thereby indirectly encouraging students to pursue courses aligned with these fields. Through a series of questions, the study highlights the often-overlooked gender gap, where students are motivated to pursue careers such as engineering and medicine (Figure 2). The professions chosen by participants align with traditional social gender roles, and Figure 3 illustrates the influence of social agents, such as parents and teachers. Additionally, the study underscores the role of media as a significant influence in students' lives. Comparatively, parents tend to encourage their sons to pursue science and technology, aiming for early career establishment as dictated by societal norms, whereas daughters are often advised to pursue non-STEM subjects and are given less priority. Students develop cognitive learning through observational learning, by selecting social agents as role models and emulating them, as posited by Albert Bandura. (McLeod, 2025). Consequently, students often follow their role models and enter into careers expected by these models. To counteract this trend, educational institutions and policymakers should implement effective strategies.

This study proposes several recommendations to bridge the gender gap and contribute to SDG 4, including raising awareness of academic and professional pursuits, promoting STEAM education, highlighting the scope of Arts and Humanities, implementing parental involvement programs, and developing gender-neutral curricula and policy interventions. These recommendations promise to promote gender parity and enhance social progress, fostering an egalitarian ecosystem. This study serves as a pertinent example of the gender gap in STEM education within the Indian context, specifically through the lens of Tamil Nadu. It proposes a systematic restructuring of STEM education to enhance the lives of students in Tamil Nadu, making them brighter and more prosperous.

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