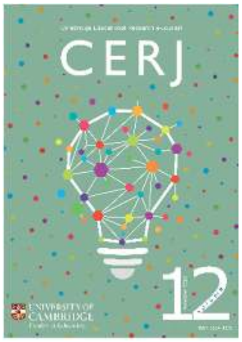

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Gender Inequality and Female Underrepresentation in Chinese STEM Education: A Study of Experiences, Challenges, and Recommendations

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ABSTRACT

Gender inequality remains a persistent challenge in higher education, with particularly stark disparities in the participation of women within Science, Technology, Engineering, and Mathematics (STEM) disciplines in China. Drawing on qualitative interviews with female undergraduates from leading Chinese universities, this research examines both the structural barriers that restrict women's access to social capital (Bourdieu, 1985; Lin, 2001) and the absence of visible female role models who might inspire and guide their academic trajectories (Etzkowitz et al., 2000; Xu, 2008). In doing so, the study provides a nuanced understanding of the mechanisms through which gender inequality is sustained in STEM education and underscores the critical role of representation and mentorship in shaping women's participation and aspirations (Hill et al., 2010). Adopting a qualitative research approach, this study conducted in-depth, one-to-one interviews with eight female undergraduate STEM students across a range of Chinese universities. These interviews serve as the primary source of data, enabling a comprehensive exploration of participants' lived experiences, their motivations to pursue scientific fields, their encounters within male-dominated academic environments, and their perceptions of gender-based inequities within the Chinese higher education system (Li & Koedel, 2017). The findings reveal two central issues in relation to gender inequality in Chinese STEM education. First, despite formal equality in curricula and teaching resources, female STEM students continue to lack access to crucial forms of social capital, such as informal networks and mentorship (Chen et al., 2020). Second, institutional support remains inadequate, with professors—particularly female faculty—often unable or unwilling to provide equitable guidance and role modelling (Shen, 2013; UNESCO, 2017). This further limits female students' academic and professional development. Together, these findings illuminate the persistent structural and relational barriers shaping the educational trajectories of women in STEM and contribute to broader discussions of gender equity in Chinese higher education (Marginson, 2016).

KEYWORDS

STEM education, women in STEM, gender inequality, feminist studies, higher education

Introduction

Attaining gender equality and enhancing empowerment for all women and girls constitutes a pivotal objective within the United Nations' 2030 Agenda for Sustainable Development (United Nations, 2015). However, persistent gender disparities have been documented across science, technology, engineering, and mathematics (STEM) disciplines on a global scale. Prior studies have demonstrated that female students in STEM face disadvantages due to entrenched gendered structures in higher education (e.g., Wang & Degol, 2017; Xu, 2008). In China, even though women comprised 53.74 % of all undergraduate students in 2018, more than 60 % of these female students were concentrated in non-STEM majors, highlighting subject segregation (Wang, 2015). These patterns show that while overall access to higher education has improved for women in China, gender-based discrimination and structural barriers still discourage their full participation in

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science and engineering fields.

The fact that many women withdraw from pursuing education and career paths in STEM due to a variety of obstacles underscores the substantial underutilisation of potential talent (Shen, 2013). According to the *Report on the Development of Science and Technology Human Resources in China: Total Quantity, Structure, and Flow of Scientific and Technological Personnel* (2018), women constitute approximately 40% of China's science and technology human resources.

Furthermore, Gu (2021) highlighted that a significant proportion of these women occupy lower-tier positions, with relatively few progressing to higher academic or research echelons. Wang (Ibid.), a senior researcher at the Chinese Academy of Social Sciences, observed that "there are a significant number of women scientists, but a substantial portion of them find themselves in lower-level positions, primarily engaged in basic or supportive work". Similarly, the *Fourth National Survey on the Status of Scientific and Technological Workers* (National Academy of Innovation Strategy, 2017) reported that approximately 33.3% of female scientific and technological workers experienced a lack of recognition, while 31.7% reported gender discrimination. Moreover, the proportion of women indicating insufficient opportunities for professional development far exceeded that of their male counterparts.

The absence or underrepresentation of women in STEM represents significant losses both from the perspective of women individually and from the standpoint of broader societal development. In this context, advocacy for gender equality should be recognised as a pivotal mechanism for fostering sustained excellence in science and technology. Society as a whole must endeavour to dismantle biases and prejudices, cultivating an environment in which women are acknowledged as an indispensable driving force for the expansion of STEM talent.

In this research, two themes have been identified as key contributors to gender inequalities and the challenges faced by women in STEM fields: (a) the unequal distribution of social capital due to the underrepresentation of female STEM students, and (b) the dearth of female role models in STEM.

As such, the primary research questions driving this study are as follows:

1. What is the key factor that contribute to gender inequalities and challenges faced by female students in STEM fields in China?
2. How does role model affect young female STEM students in their pursuits of science?

Literature Review

STEM, Gender, and Higher Education in China

STEM education has played a central role in China's nation-building and modernisation since the mid-20th century. Following the founding of the People's Republic in 1949, the state prioritised science and technology as key drivers of industrialisation, national defence, and self-reliance. This emphasis on cultivating scientific talent was further reinforced in the reform era of 1949–1978. As Suttmeier (1980) observed, China sought to integrate into the global economy and enhance its competitiveness through technological innovation. This policy orientation was consolidated in 1988, when Deng Xiaoping declared that "science and technology are primary productive forces," elevating STEM to the core of China's modernisation discourse. In 1995, the state formally launched the "Revitalise the Country through Science and Education" strategy, which explicitly positioned education and technological innovation as twin engines of development.

To implement this vision, a series of higher education initiatives were introduced: Project 211 (1995), designed to strengthen around 100 key universities; Project 985 (1998), which aimed to foster world-class institutions; and, more recently, the "Double First-Class" plan initiated in 2015 to further enhance global competitiveness (Gao & Tisdell, 2004). Beyond higher education, the government extended its focus to the pipeline of talent by issuing the *STEM Education Action Plan 2029* in 2018, which sought to increase participation across both K–12 and tertiary levels. Collectively, these reforms illustrate how STEM education has been systematically elevated as a national priority, embedded within broader strategies of economic growth, global integration, and technological leadership. Today, STEM fields remain at the centre of China's development agenda, shaping higher education policies, funding allocations, and institutional reforms. Universities have expanded STEM programmes at an unprecedented scale—China's undergraduate engineering offerings now exceed 23,000 programmes, with more than 6.7 million students majoring in engineering (Xinhua, 2023)—producing large cohorts of graduates who contribute to the country's rapid advancement in the technology industry.

However, the growth of STEM education has not translated into equitable participation across genders. While women in China have made notable progress in gaining access to higher education overall, their representation in STEM disciplines remains disproportionately low, particularly in engineering, computer science, and physics. For instance, although women accounted for about 53.7% of undergraduate students in 2018, more than 60% were concentrated in non-STEM disciplines, indicating a marked gendered pattern in subject choice (Yu & Zou, 2023). In research and professional pathways, the imbalance is even more pronounced. According to the *China Statistical Yearbook on Science and Technology* (2021), women made up only 26.3% of the national R&D workforce. A study of National Natural Science Foundation projects between 2010 and 2015 also revealed that women researchers were significantly less likely to obtain funding compared with men (Zhang, 2025).

Scholars have identified several factors shaping these patterns. Some emphasise gender socialisation and achievement motivation, suggesting that girls in China are less encouraged to pursue STEM pathways due to early expectations about gender roles (Wang & Li, 2019). Others highlight the role of structural and cultural barriers in higher education: teacher and parental biases, unequal resource allocation in schools, limited female role models, and the persistence of stereotypes that frame STEM as a "male domain" (Chen, 2021).

This imbalance also highlights a broader paradox within China's educational system: while the state relies heavily on STEM talent to fuel innovation, it has not adequately addressed the systemic barriers that hinder women's full inclusion. Female students often encounter limited mentorship, fewer networking opportunities, and bias in academic hiring and promotion, which collectively restrict their long-term participation in STEM research and industry. These challenges point to the need for a more nuanced understanding of how gender intersects with educational structures in China, and how addressing these inequalities is essential for realising the country's ambition for scientific and technological leadership.

Negative Stereotype Theory

Negative stereotype theory, often conceptualised through the lens of stereotype threat, provides a useful framework for explaining persistent gender disparities in STEM. Stereotype threat posits that when individuals are aware of negative stereotypes about their social identity, this awareness can generate anxiety and self-doubt that hinder performance, thereby reinforcing the very stereotypes they attempt to disprove (Steele & Aronson, 1995).

In China, empirical studies have shown that both parents and teachers often perceive boys as more capable in mathematics and science, a belief that shapes girls' academic self-concept and influences their educational choices (Tsui, 2007; OECD, 2015). These stereotypes not only perpetuate a confidence gap—with men internalising beliefs in superior logical reasoning and women internalising a sense of inferiority—but also constrain women's academic pathways, leading them to opt out of STEM subjects at higher levels of education (Rudman & Fairchild, 2004). Moreover, entrenched patriarchal norms and the "boys' club" culture of science exacerbate exclusion, undermining women's sense of belonging in male-dominated fields (Corbett & Hill, 2015; Rosa & Mensah, 2016). Empirical studies have further shown that women may even experience a greater fear of success than men in such contexts, reflecting the long-term psychological burden of stereotype threat (Fogliati & Bussey, 2013; Steele et al., 2010).

Taken together, these findings illustrate how negative stereotypes not only undermine women's performance in STEM but also restrict their long-term participation by shaping educational aspirations, self-perception, and access to inclusive learning environments.

Role Model Effect

The underrepresentation of women in STEM fields in China has resulted in a significant scarcity of female role models compared with their male counterparts. This imbalance is particularly visible at the highest levels of the academic hierarchy. For instance, women constitute only about 5.5% of the members of the Chinese Academy of Sciences and the Chinese Academy of Engineering, two of the nation's most prestigious scientific bodies, reflecting a striking gender disparity in recognition and leadership. Although China has produced renowned female scientists—such as Tu Youyou, the first Chinese woman to receive a Nobel Prize in 2015 for the discovery of artemisinin, a groundbreaking antimalarial drug, as well as pioneering figures like Yan Ning, a structural biologist and professor at Princeton—these individuals remain exceptions rather than the norm. The limited visibility of such trailblazers underscores the persistence of gender imbalance across the broader STEM landscape. Consequently, young women entering STEM fields often lack accessible role models whose careers they can realistically aspire to, which in turn perpetuates the cycle of underrepresentation and limits the motivational and mentoring resources available to female students.

Role models play a critical role in inspiring and motivating students to pursue STEM fields. A role model is an individual who possesses greater experience, knowledge, and a willingness to provide personal or professional support to others (Ruiz-Cantisani, 2021). In educational settings, Young et al. (2013) demonstrated the effectiveness of same-gender role models, such as female STEM professors, in attracting young women to STEM disciplines. The influence of female professors and scientists as role models can be conceptualised across three interrelated levels: visibility, educational mentorship, and institutional transformation.

At the first level—visibility motivation—representation is essential. The oft-cited phrase, “you cannot be what you cannot see,” captures how the presence of women in positions of scientific authority disrupts gender stereotypes and broadens students’ horizons of possibility. According to Social Identity Theory, individuals derive self-concept from group membership, meaning that female students who see women professors in STEM are more likely to envision themselves as belonging in those fields (Tajfel & Turner, 1986). The “possible selves” framework further suggests that exposure to diverse role models provides students with concrete images of their potential futures (Markus & Nurius, 1986). In the context of China, where long-standing gender norms frame science as a masculine domain (Tsui, 2007), the visibility of female scientists offers a powerful counter-narrative. Empirical evidence indicates that even brief exposure to female role models can improve women’s performance and reduce anxiety in STEM tasks, thereby mitigating stereotype threat (Stout et al., 2011).

At the second level—direct educational and career support—female professors and scientists extend their impact through mentorship. Mentorship functions not only as academic guidance but also as psychosocial support that enhances persistence in male-dominated fields (Crisp & Cruz, 2009). Studies have shown that female students with access to female mentors report higher self-efficacy, greater research productivity, and stronger aspirations to pursue graduate study in STEM (Dennehy & Dasgupta, 2017). In higher education, mentoring relationships improve women’s likelihood of publishing, securing competitive fellowships, and building professional networks—crucial advantages in systems where women are often excluded from informal “old boys’ networks.” In China’s competitive STEM landscape, such guidance is particularly important in navigating high-stakes transitions, such as preparing for postgraduate entrance exams or applying for national funding, where women remain underrepresented (Li et al., 2025). Thus, mentorship serves both as a buffer against structural disadvantage and as a bridge to opportunities otherwise inaccessible.

At the third level—institutional and cultural transformation—the presence of women in senior academic and scientific positions challenges entrenched gender hierarchies. While the “glass ceiling” remains a persistent barrier in Chinese academia—evident in the low proportion of female full professors and academy members (Wang et al., 2023)—women leaders play a critical role in redefining institutional cultures. By participating in admissions decisions, grant review committees, and hiring panels, female faculty can influence how resources and recognition are distributed. Research in organisational studies suggests that gender diversity in leadership correlates with more inclusive policies, higher retention of women, and even improved organisational innovation (Ely & Meyerson, 2000; Morley, 2013). In STEM academia, this translates into a gradual reconfiguration of the “boys’ club” culture (Rosa & Mensah, 2016), fostering environments where female students are not merely “tokens” but active participants. The symbolic significance of women breaking the glass ceiling thus extends beyond individual achievement: it signals to younger generations that systemic barriers can be overcome and that women have a rightful place in shaping scientific knowledge.

Taken together, these three levels illustrate that the role of female professors and scientists is not incidental but foundational to addressing gender inequality in STEM. Their presence provides students with psychological affirmation, their mentorship equips women with tangible skills and networks, and their institutional leadership paves the way for structural change. To fully realise gender equity in STEM education, particularly in contexts such as China where patriarchal norms remain influential, strengthening the pipeline of female role models is not optional but essential.

Methodology

The purpose of this study is to investigate the experiences of Chinese female STEM students in male-dominated academic fields and to examine how they navigate and overcome potential gender discrimination within Chinese university education. Using a qualitative research design, this study conducted interviews with Chinese female STEM students from different universities and academic backgrounds in order to explore gender inequality in the context of Chinese higher education.

One-on-One Interviews

This study employed one-on-one, semi-structured interviews as the primary method of data collection. Semi-structured interviews are widely recognised as a valuable qualitative research tool because they balance structure with flexibility, allowing researchers to elicit participants' lived experiences while still ensuring comparability across cases (Galletta, 2013; Kvale & Brinkmann, 2009). They enable participants to express their perspectives in their own terms and to emphasise issues they perceive as most significant (Bryman, 2016).

The one-on-one format was particularly appropriate for this study, which investigated the experiences of Chinese female students in STEM disciplines. Previous research has shown that sensitive topics—such as gender discrimination, self-doubt, or experiences of marginalisation—are more effectively explored in private, confidential interview settings (Rubin & Rubin, 2012). The assurance of anonymity and confidentiality reduces the likelihood of self-censorship, while the conversational nature of semi-structured interviewing fosters trust and openness (Cohen, Manion, & Morrison, 2018). Importantly, by avoiding leading questions and maintaining a non-judgemental stance, the researcher minimised social desirability bias and allowed participants' narratives to emerge authentically (Patton, 2015). Given that Chinese female students' perspectives on STEM are shaped not only by individual aspirations but also by cultural, institutional, and familial expectations, the semi-structured interview format provided the flexibility to probe more deeply into context-specific issues as they arose (Seidman, 2013). The researcher was also able to follow up on unexpected but relevant themes—such as the influence of role models, perceptions of gender stereotypes, or coping strategies in male-dominated classrooms—that may not have been anticipated in a structured questionnaire.

In summary, the decision to employ one-on-one semi-structured interviews was guided by both methodological and ethical considerations. This approach ensured a respectful and confidential environment in which participants could articulate their challenges and aspirations, while also enabling the researcher to generate a rich, nuanced understanding of the systemic and personal factors underlying gender disparities in STEM education. By prioritising depth over breadth, the method aligns with the broader goals of qualitative inquiry: to illuminate lived experiences and to provide insights that can inform both theory and practice in gender and education research.

Data Collection and Analysis Procedures

Sampling and Participants

Female undergraduate students were recruited for this study, comprising eight women enrolled in STEM majors at five leading universities in China. These institutions were selected because they are widely recognised for the strength of their STEM provision, access to resources such as laboratories and research funding, and their reputation for attracting high-achieving students. Admission to these universities is based primarily on performance in the *Gaokao* (the national college entrance examination), ensuring that participants come from highly competitive academic backgrounds.

The eight participants ranged in age from 18 to 25 years and were enrolled as undergraduates (first- to fourth-year students) in STEM fields. To maximise disciplinary variation within STEM, we sought students from computer science, biological sciences, mathematics, and programming/data-science-related programmes.

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Eligibility criteria required that participants: (1) were currently enrolled as undergraduates; (2) were 18 years of age or older; (3) had declared a STEM major; and (4) had completed and signed an informed consent form.

Recruitment

Recruitment took place from May to July 2023 and targeted participants across leading Chinese universities known for strong STEM provision. The researcher disseminated a digital invitation (study purpose, eligibility, time commitment, confidentiality, and researcher contact) via: (a) posts in university-affiliated WeChat groups; (b) personal academic networks (peer-to-peer forwarding by enrolled students); and (c) faculty referrals (advisers circulated the invitation to eligible students). Interested individuals completed a brief screening form (year of study, major, age, university, gender, and contact details) and indicated permission to be contacted.

Data Collection

The researcher then scheduled one-to-one interviews, emailed the participant information sheet and consent form in advance, and reconfirmed consent at the start of each session. No identifying information was collected beyond what was necessary for scheduling; pseudonyms were assigned upon enrolment. Recruitment ceased when the target sample (n = 8) had been reached and thematic/code redundancy was observed across interviews (i.e., no substantively new issues were emerging that would alter the thematic structure).

Data were collected between May and July 2023 through one-to-one, semi-structured interviews conducted online via Zoom or Tencent Meeting. This format was chosen to maximise accessibility for students across different locations while maintaining confidentiality and comfort. Each interview lasted between 45 and 60 minutes. With participants' consent, interviews were audio-recorded, transcribed verbatim, and supplemented with field notes taken during the sessions.

The interview protocol explored a range of themes, including: (a) early academic experiences and factors shaping the decision to pursue STEM majors; (b) learning opportunities and resources associated with social capital (e.g., access to extracurricular activities, academic competitions, or professional networks); (c) sources of support and motivation from family, peers, teachers, and mentors; (d) experiences of gender inequity, discrimination, or bias within educational spaces (classrooms, laboratories, or internships); and (e) forms of resistance, experiences of isolation, and coping strategies within academic settings. This breadth of topics enabled the researcher to capture both individual experiences and broader patterns of gendered opportunity in STEM education.

Data Analysis

Transcription and analysis began immediately after data collection to ensure an iterative process of reflection and refinement. The data were analysed using Braun and Clarke's (2006) thematic analysis framework, which involves six phases: familiarisation, coding, generating themes, reviewing themes, defining and naming themes, and producing the report. NVivo software was employed to assist with data management and coding. Initial open codes were developed inductively from the transcripts, then grouped into broader categories. These categories were refined into overarching themes that captured both commonalities and differences across participants.

The final thematic structure reflected several key areas: (1) early academic influences and secondary-school experiences shaping entry into STEM; (2) informal learning activities and their role in sustaining interest in STEM; (3) support systems provided by family, teachers, and peers; (4) inequities and gender-based challenges encountered in university STEM contexts; and (5) resistance, isolation, and strategies for coping with stereotypes and cultural barriers. This process ensured that the analysis was both systematic and sensitive to the nuanced lived experiences of Chinese female students.

By triangulating insights from diverse participants and maintaining methodological rigour throughout data collection and analysis, the study generated a comprehensive understanding of the complex social, cultural, and institutional factors that influence women's participation in STEM disciplines in China.

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Table 1
Participants' Information

List	Participants Pseudonym	University	Study Major
1	Ji	Nanjing University	Information Science & Technology
2	Xiao	Tsinghua University	Computer Science
3	Luo	Tsinghua University	Computer Science (High-Performance Computing)
4	Zeng	Nanjing University	Biology
5	Estrella	Tongji University	Biomedical Science
6	Duoduo	Tsinghua University	Mathematics
7	Shi Qianlin	Beijing Normal University	Pharmacology
8	Cathy	Peking University	Computer Science

Findings and Discussion

Social Capital Inequality

This study identifies two major factors contributing to gender inequality in Chinese STEM education: (a) the unequal access to social capital among underrepresented female students and (b) the lack of visible female role models in STEM. Social capital—defined as networks and interpersonal relationships that provide access to resources and opportunities—is widely recognised as a key determinant of educational and professional success (Casad et al., 2021; Collins & Steffen, 2019; Korte & Lin, 2013). Drawing on Bourdieu's (1985) theory of social, cultural, and economic capital, the findings illustrate how restricted social capital constrains women's ability to cultivate strong academic relationships, secure research opportunities, and benefit from institutional privileges (Florin et al., 2003; Seibert et al., 2001).

Interviews with eight female STEM undergraduates across five leading Chinese universities (see Table 1) revealed that five participants perceived clear gendered disparities in their access to social capital. These disparities emerged primarily from two interrelated dynamics: numerical underrepresentation and gendered communication gaps. First, the severe underrepresentation of women in STEM contributes to social and academic isolation. Participants reported striking gender ratios in their programmes, such as 30:200 in Computer Science at Tsinghua University, 10:33 in Biology at Tongji University, and 21:79 in Biomedical Science at Nanjing University. Such imbalances hinder women's participation in informal networks and academic circles. One participant responded by creating a "girls-only" chat group to share class information and provide mutual support, underscoring both the marginalisation of female students and the necessity of alternative networking spaces. This lack of integration restricts students' sense of belonging and limits exposure to valuable academic and professional opportunities.

Second, information asymmetry further compounds these inequalities. All eight participants observed that students tend to share resources more freely within same-gender groups, which reinforces gender boundaries. Several female students noted difficulty in forming cross-gender networks and described how they maintained formal, distant interactions with male peers. This limited exchange of informal knowledge left female students at a disadvantage in accessing opportunities such as research projects, internships, and competitions.

Reduced social capital also affected interactions with lecturers and supervisors. Some participants reported feeling overlooked in the allocation of academic tasks and extracurricular opportunities. For example, one student described how her lecturer consistently assigned experimental work to a male classmate with whom he appeared to have a closer rapport. Such patterns of perceived favouritism not only restricted women's practical learning experiences but also undermined their confidence and sense of engagement in the academic environment.

Overall, these findings confirm that gender-based disparities in social capital are pervasive within

Chinese STEM education. Experiences of isolation, limited information exchange, and weak mentoring relationships all reinforce structural inequality and constrain the academic and professional trajectories of female students. Addressing these barriers requires more than equal access to formal resources; it necessitates institutional and cultural changes that promote inclusive networking, equitable mentoring, and visible support from female faculty. Developing peer-support systems, facilitating mixed-gender collaboration, and redistributing access to social capital are essential steps towards building a more inclusive and gender-equitable STEM culture in Chinese higher education.

The Lack of Female Role Models in STEM Education

The absence of female role models emerged as a recurring theme across all eight interviews, underscoring its profound influence on women's experiences in STEM fields. Most participants highlighted a striking scarcity of relatable female figures in their disciplines. While one biomedical science student credited a family friend with inspiring her interest in medicine, the majority could not identify any influential women in academia or industry who had shaped their aspirations.

Young women entering STEM often find themselves without access to the same networks and mentorships available to their male peers. Participants described how senior male students and professors tended to support and prioritise younger male students for internships, laboratory assistant roles, and coding competitions. One participant noted that senior male students frequently recommended their male peers for prestigious opportunities, reinforcing a cycle of exclusion for women. This pattern is consistent with findings that women are often excluded from informal professional networks, which provide access to critical opportunities (Ibarra, 1993; Van den Brink & Benschop, 2014). The limited presence of female mentors—whether senior students or faculty—further restricted the guidance and inspiration available to aspiring female scientists, leaving them uncertain about their future career paths.

However, when asked about their preference for more female mentors, most participants did not articulate a strong desire for female professors per se; instead, they emphasised a wish for greater fairness and support from the faculty already present in their academic environments. This suggests that many students may not yet fully recognise how the absence of women in senior academic positions shapes their experiences and opportunities. Rather than demanding structural change in the form of more female representation, participants often framed their needs in more immediate, interpersonal terms. This lack of awareness reflects the broader invisibility of women in STEM leadership and underscores how systemic underrepresentation can operate subtly, limiting students' ability to imagine alternative forms of mentorship and role modelling (Etzkowitz et al., 2000; Morley, 2013).

Another reason for the limited desire for more female mentors was revealed when participants noted a generational and experiential disconnect between themselves and older female professors. Several students perceived that senior women in their departments did not display empathy or encouragement. One participant recounted being dismissed by a female professor after sustaining an injury during an experiment; the professor responded by referencing her own hardships studying abroad and leading laboratories, implying that resilience required emotional detachment. This illustrates how prolonged immersion in male-dominated academic cultures can lead some women to assimilate "masculine" norms of independence and competitiveness while distancing themselves from qualities such as empathy or relational support (Lester, 2008; Acker, 1990).

Interestingly, while senior female role models were largely absent, participants reported that peer influence played a more meaningful and motivating role in their development. Accomplished classmates who secured prestigious graduate placements or launched independent projects often served as powerful sources of encouragement. Research confirms that peer mentoring can be an especially effective form of support in higher education, enhancing students' confidence, persistence, and sense of belonging (Terrion & Leonard, 2007; Dennehy & Dasgupta, 2017). In this sense, peer relationships emerged as more accessible and relatable sources of support compared with distant or less engaged senior female figures.

The findings suggest a wider cultural problem in STEM, where traits associated with masculinity are privileged, while other leadership and mentoring styles—such as collaboration and empathy—are overlooked and discouraged. This aligns with broader critiques of the "masculinised" culture of science, which continues to devalue relational and inclusive leadership practices (van den Brink & Benschop, 2012; Ely & Meyerson, 2000). As a result, many senior women may resist expressions of vulnerability or feminine identity, further weakening the potential for intergenerational solidarity among women in STEM.

STEM disciplines must not be viewed as inherently male or governed exclusively by masculine traits. The ongoing absence of female role models—both in institutional leadership and in informal support systems—contributes to a sense of disorientation and exclusion among female students. Participants often described navigating STEM spaces "like headless flies," lacking direction or encouragement. Addressing this issue requires more than simply increasing the number of women in STEM. Structural and cultural transformation is necessary to ensure that women in senior positions are empowered to mentor across generations, challenge dominant masculine norms, and model inclusive forms of leadership. While peer support remains valuable, it must be complemented by accessible and empathetic mentorship from senior women. Through such changes, STEM disciplines can evolve into environments where young women not only thrive but also become the role models that future generations urgently need.

Conclusion

This study has examined the persistent gender inequalities experienced by female students in Chinese STEM education, foregrounding two critical and interconnected issues: the unequal distribution of social capital and the profound absence of female role models. Through in-depth qualitative interviews with eight female undergraduate students across five prestigious Chinese universities, the research sheds light on the nuanced, lived realities that continue to shape—and constrain—women's participation in STEM fields.

Firstly, despite surface-level equality in access to courses and institutional resources, female students remain disadvantaged in terms of informal support structures. Their exclusion from male-dominated networks limits opportunities for academic collaboration, research involvement, and professional development. This lack of social capital is not simply a matter of personal disposition or isolated incidents, but a structural issue deeply embedded in the gendered culture of STEM education. Prior studies have similarly shown that social capital—informal networks, mentorship, and resource sharing—plays a decisive role in shaping academic outcomes, and that women in STEM often face barriers to accessing these networks (Bourdieu, 1985; Lin, 2000; Seibert et al., 2001). The isolation and information asymmetry experienced by participants contribute to a sense of marginalisation and weaken their ability to fully participate in the academic community (Casad et al., 2021).

Secondly, the research underscores a striking absence of female role models in STEM, particularly in leadership positions or visible academic roles. While participants reported drawing inspiration from peers and classmates, the lack of mentorship and guidance from senior female figures reinforced feelings of uncertainty and disconnection. Previous scholarship has emphasised that role models and mentors are vital in counteracting stereotype threat and supporting women's persistence in male-dominated fields (Dasgupta, 2011; Stout et al., 2011). Some participants even noted that older female professors appeared distant or unempathetic, suggesting a generational and cultural divide shaped by internalised masculine norms within the field. Instead of fostering solidarity, these figures may inadvertently perpetuate exclusion by failing to support more emotionally open or vulnerable expressions of female student identity (Lester, 2008).

Together, these findings point to a broader pattern of gendered exclusion that operates not only through policy and representation but also through everyday interactions and informal structures. Addressing these challenges requires more than increasing female enrolment in STEM programmes; it calls for a fundamental cultural transformation—one that reimagines what it means to be a scientist, a leader, and a mentor. Universities and institutions must take active steps to dismantle the hidden hierarchies that govern social capital distribution, foster inclusive peer and faculty networks, and promote empathetic, diverse forms of mentorship (Corbett & Hill, 2015; Morley, 2013).

Ultimately, this research argues that the future of STEM in China must be built not only on technical excellence but also on inclusion, representation, and relational equity. Empowering female students means ensuring that they are not merely present in STEM spaces, but that they are genuinely seen, heard, supported, and connected. Only then can we begin to envision a more just and equitable academic environment—one where gender no longer predicts the depth of one's belonging or the height of one's ambition.

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