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Factors Influencing Women's Underrepresentation in China's STEM Higher Education and Corresponding Intervention Strategies

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Abstract: This study investigates women's underrepresentation in STEM subjects in Chinese higher education, focusing on contributing factors and improvement strategies. Adopting an interpretivist paradigm, it uses qualitative secondary data analysis via extended literature review (ELR) and thematic analysis (TA) to examine 13 peer-reviewed articles (2015–2025) across education, sociology, and gender studies. Three interrelated factors are identified: cultural/gender stereotypes, structural barriers, and psychological/ academic self-perception, which interact to create cumulative disadvantages. Corresponding teaching-level strategies include informal STEM activities, STEM-arts integration, and cooperative learning including gender pairing. Future research should incorporate Chinese-language journals, focus on specific educational stages, and explore the long-term effectiveness of systemic interventions.

Keywords: Women in STEM; Underrepresentation; Chinese higher education; Contributing factors; Improvement strategies; Qualitative analysis

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1. Introduction

1.1. Research background

In order to meet the needs of rapidly changing industries and cultivate high-quality STEM talents, many countries have introduced a number of policies to improve their STEM education systems. Although countries continue to implement policies to promote gender diversity and inclusiveness, the problem of women's underrepresentation in STEM has become a long-term problem related to educational equity. Therefore, in order to deeply understand this issue, it is necessary to examine the participation of women in the STEM field in combination with the specific cultural, institutional and policy environment.

China's higher education system provides a representative example for examining gender underrepresentation and inequality in STEM fields. Gender imbalance still exists in STEM higher education in China, and women are still underrepresented [1].

At the same time, the exam-oriented education model often highlights the competitive and rational characteristics in mathematics and science learning, which are often highly related to men.

1.2. Research objectives and contributions

This study aims to systematically sort out and deeply analyze the existing empirical research literature, reveal the key factors affecting women's entry into the STEM field, and put forward feasible strategies to solve the underrepresentation of this group and promote gender equity. To this end, this study focuses on the following two core research issues:

(1) In the STEM field of higher education in China, what are the key factors that lead to the low proportion of women's attendance and participation?

(2) In China, what effective strategies can be adopted to improve the underrepresentation of women in the STEM field of higher education and promote gender equity in this field?

This study is significant as it provides a systematic, locally-contextualized understanding of the issue, offering theoretical and empirical references for policymaking and institutional practice in Chinese higher education.

1.3. Key definitions and the scope of research

"STEM" includes Science, Technology, Engineering, and Mathematics disciplines in higher education [2]. The research is scoped to Chinese higher education, excluding primary and secondary levels, though studies on senior high school or STEM career women may be referenced where relevant. Due to contextual differences, Western data are not included, but studies from East Asian countries (e.g., Japan, South Korea) may serve as supplementary references.

2. Research methodology

2.1. Data search method

2.1.1. Keywords and database

A structured search strategy was developed to ensure comprehensive coverage of the relevant literature. Boolean operators (AND, OR), truncation and phrase searching were employed to capture variations in terminology [3]. **Figure 1** displays the complete string. To account for variations in wording across studies, keywords were organized into thematic categories along with their alternative terms.

("women" OR "female" OR "gender") AND ("STEM" OR "science" OR "technology" OR "engineering" OR "mathematics") AND ("higher education" OR "university" OR "college") AND ("China" OR "Chinese") AND ("underrepresentation" OR "representation" OR "participation" OR "gender equity" OR "gender equality" OR "gender inclusion" OR "gender gap" OR "gender differences" OR "gender disparities")

Figure 1. Search string.

In order to ensure the breadth and depth of literature coverage, this study carried out retrieval in several mainstream academic databases. The retrieved databases include comprehensive databases such as Web of Science, Scopus, ProQuest and JSTOR Digital Library, as well as databases of ERIC (education), SAGE Journals, Taylor & Francis Online, Wiley

Online Library and other professional fields or publishers.

2.1.2. Screening process

The screening process followed the PRISMA 2020 guidelines to ensure methodological transparency and reproducibility [4]. It was conducted in three main stages:

(1) Initial identification

A preliminary keyword search was carried out in the selected database, and a total of 327 document records were obtained. These records include English and Chinese research, including peer-reviewed journal papers, gray literature and institutional reports.

(2) Deduplication and preliminary screening

After using the reference management software EndNote to delete duplicate records, 298 independent documents were obtained. Subsequently, the titles and abstracts were screened according to the inclusion and exclusion criteria described in section 2.5, and finally the number of literatures was reduced to 46 studies with potential relevance.

(3) Full-text review and final selection

Obtain the full text of the above 46 studies and make a detailed evaluation of their applicability. At this stage, if the research method is opaque, beyond the specified time range, or does not directly discuss the problem of underrepresentation of women in the STEM field in higher education in China, it will be excluded. The final literature data set contains 13 peer-reviewed journal papers published between 2015 and 2025.

2.1.3. Data extraction

Before formally extracting information, two sample documents were used to pilot and refine the extraction fields. A standardized extraction form captured study characteristics, methods, key findings, and proposed interventions. Pilot tests confirmed that the framework effectively covered key information and ensured data integrity and comparability.

2.2. Inclusion and exclusion criteria

To guarantee the relevance, quality, and analytical merit of the chosen literature, this study established the subsequent inclusion criteria:

(1) Articles should be published between 2015 and 2025, as studies in recent years can reflect the current trends and challenges of gender equality issues in STEM fields in China in a timelier manner [3];

(2) The research object should focus on the underrepresentation of women in higher education in China;

(3) The contents of the literature should cover the relevant influencing factors (such as gender stereotypes, institutional obstacles, psychological factors, etc.), or the countermeasures and solutions to promote gender equality;

(4) In order to ensure the rigor of research methods and the credibility of research results, only peer-reviewed journal papers are included;

(5) Literature should be written in English in order to be in line with international academic research.

2.3. Data analysis

This study used Thematic Analysis (TA) as the data analysis method, which is a method of analyzing qualitative data, referring to a process of identifying, analyzing, organizing, describing and reporting recurring ideas (known as themes) in a dataset [5].

TA is suitable for secondary qualitative data analysis, such as ELR. TA is a flexible yet rigorous method suitable for synthesizing diverse qualitative and quantitative research findings in secondary studies, providing a rich, detailed and complex description of the data, as well as generating rich and detailed research insights.

The six-step TA process was used in this study as follows [5]:

(1) Familiarization with the data
Researchers repeatedly read the abstracts and full texts of the extracted documents to deeply understand the contents.

(2) Generate initial coding
The researcher systematically combs the data set, pays full and equal attention to each data, and identifies the effective content related to the research question.

(3) Search for themes
Classify related codes into a broader concept category (axial coding), and sort out the relationship between influencing factors, coping strategies and broader social and institutional environment.

(4) Review the themes
Check the subject against the extracted data to ensure that it can accurately reflect the results of many studies; Merge overlapping or redundant topics, and clearly define vague categories.

(5) Define and name themes
Further refine the axial code to form a more general theme and sub-theme, which respectively correspond to research question 1 (causes of women's under-representation) and research question 2 (countermeasures and solutions).

(6) Generate the report
Make a clear, coherent and logically rigorous explanation of the topics and their internal relations, while ensuring that the words are concise and vivid and avoid repetition.

3. Literature review part 1

This chapter focuses on the gender differences in STEM higher education, the influence of gendered environment such as "cold atmosphere", and two core theoretical frameworks: Social Cognitive Career Theory (SCCT) and Gender Schema Theory (GST). This chapter also discusses the influence of Chinese Confucian cultural tradition on gender norms and educational experience.

3.1. Gender

Manstead et al. defines gender stereotype as people's inherent views on their respective characteristics, which are related to different personality traits [6]. Specifically, the traditional concept holds that men are ambitious, clear-cut, decisive and powerful leaders. But these qualities are not treated equally. Greenwald and Banaji pointed out that people will unconsciously associate a certain gender with a specific subject or ability [7].

Research shows that when parents or teachers think that boys are good at science and engineering and girls are good at language subjects, they often treat students differently. This will reduce students' self-efficacy in specific fields, and then limit their future academic and career choices [8].

3.2. Gender and STEM

3.2.1. STEM in higher education

Since its launch, STEM education has spread rapidly around the world, with fruitful research results, and academic attention to this field has also continued to rise [9]. In the higher education stage, STEM covers the course contents and teaching methods of various science and engineering disciplines, aiming at cultivating students' critical thinking, problem-solving ability and practical application ability.

3.2.2. The relationship between gender and STEM

The underrepresentation of women in the STEM field is a global phenomenon [10]. In the higher education stage, there is a significant gender gap in STEM-related majors, and more women choose to quit the STEM field than men in all aspects such as further study, employment transformation and career development.

Gender stereotype is one of the key factors that cause gender differences in STEM field, especially the inherent concept that STEM belongs to male domain [11]. The influence of this prejudice will continue to the higher education stage. In China, there is also an obvious gender gap in STEM majors in higher education: in 2022, the proportion of women enrolled in engineering and technology majors is only about 30%, and that of computer science majors is less than 20%. In addition, influenced by gender stereotypes, lack of resources and career expectations, many women switch to non-STEM majors before graduation, or give up related occupations after graduation [12]. These phenomena show that, despite the continuous promotion of education equity policy, China still faces structural problems and unique obstacles originating from local systems and cultures in the STEM field.

3.2.3. 'Chilly climate' in STEM

The term "chilly climate" was put forward by Hall and Sandler to describe the indifference and hostility that women feel in male-dominated fields due to implicit prejudice, stereotypes, social exclusion or nonverbal signals [13]. Therefore, "chilly climate" is used to summarize the unequal treatment mode in educational activities. This chilly climate is also widely regarded as one of the important reasons that prevent women from studying for STEM degrees or engaging in related occupations. In the STEM field of higher education in China, this kind of "chilly climate" phenomenon has been fully studied and recorded.

3.3. Theoretical frameworks

3.3.1. Lent et al.'s social cognitive career theory (SCCT)

This theory emphasizes that an individual's career choice is determined by a series of interrelated factors, including learning experience, self-efficacy, outcome expectation and career interest, which can explain how people form their academic and career interests, make choices and stick to them in related fields [14].

First of all, achievement performance refers to the direct experience gained by individuals through completing tasks [15]. Secondly, the vicarious experience comes from indirect learning by observing others (especially people with similar gender, background or ability) to complete tasks [15]. Social persuasion, including encouragement and constructive feedback from teachers, parents and peers, can help individuals to keep going despite setbacks [14]. Finally, emotional arousal refers to the individual's physiological and emotional response before or during the task.

3.3.2. Bem's gender schema theory

Although the Social Cognitive Career Theory (SCCT) provides a solid framework for analyzing how personal beliefs, situational support and obstacles and behavior choices jointly affect women's participation in the STEM field, it fails to fully explain how gender itself, as a cognitive schema, affects individuals' self-cognition, academic interests and career choices. This study also adopts the gender schema theory [16].

In STEM education, GST is very important to understand how early gender socialization shapes students' self-concept, academic interest and career choice.

Combining SCCT with GST, we can analyze the factors that affect self-efficacy and career choice from the cultural level and individual cognitive level. Therefore, this study will use these two theories at the same time to systematically analyze the causes of underrepresentation of women in STEM majors in higher education in China from a dual perspective, and provide theoretical support for proposing educational intervention strategies.

3.4. Cultural and educational context in China

In China, the Confucian cultural values, the tradition of exam-oriented education and the social expectation with gender color have shaped the interest and self-awareness of male and female students in the field of STEM since childhood [17].

Under the cultural background of China, the gender difference in STEM field of higher education is the result of the joint action of Confucian traditional values, exam-oriented education system and mainstream gender norms. From this point of view, Confucian culture emphasizes the different division of labor between men and women in society, and often binds the field of science and technology with male characteristics, while classifying parenting and service roles as female characteristics.

4. Literature review part 2

Research question 1: In the selected literature, there are 10 empirical studies directly around this theme. Through the theme analysis of its research conclusions, three core themes are finally extracted, and the specific content will be explained in detail in the following chapters.

4.1. Cultural and gender stereotypes

4.1.1. Gendered perceptions of STEM ability

A number of studies have consistently shown that deep-rooted cultural traditions and gender stereotypes significantly affect women's cognition of their abilities in STEM. In addition, some studies have pointed out that teachers often attribute girls' success in mathematics to hard work rather than talent, which further strengthens the concept that their achievements are more due to diligence than ability.

Similarly, in interviews with six female high school students in Tangshan, Hebei Province, highlighted the substantial impact of gender stereotypes on perceived STEM competence [18].

Quantitative data show that although female college students are more involved in engineering major, they are relatively reluctant to engage in related occupations in engineering field after graduation. The interview data further shows that this gap is closely related to the deep-rooted gender norms in Confucian culture. Affected by this, engineering occupations are often regarded as male-dominated fields, while women are considered to lack technical ability. Therefore, women usually choose or are arranged to engage in administrative and civilian jobs in the job market, rather than core technical positions.

4.1.2. Teacher reinforcement of stereotypes

A number of studies have highlighted the crucial role that teachers play in perpetuating gendered stereotypes in STEM learning environments, based on the topic of gendered perceptions of STEM competency in the preceding section [19]. Teachers are important figures in education, and their expectations, interactions, and job assignments can have an intended or inadvertent impact on students' career choices and academic self-perceptions. The study found that teachers' actions, such as doubting female students' accomplishments in STEM or keeping them out of male-dominated activities, can progressively erode the students' interest and self-confidence and subsequently have a long-lasting impact on their educational route.

This study showed that teachers frequently reinforce traditional gender role distinctions in their teaching approaches by unintentionally communicating gendered expectations to their students.

4.1.3. Low expectations of parents and traditional roles

Following the discussion on teachers in the previous section, another key factor that appears repeatedly in the literature is the influence of parents' expectations and traditional gender roles. Several studies show that parents' expectations and traditional gender stereotypes significantly affect female students' education and career choice in the STEM field.

The results show that the mother's traditional concept of gender role has a much greater influence on her daughter than her son. In particular, this influence is found to indirectly reduce the possibility of daughters entering the STEM field by weakening their self-esteem, lowering their math scores and increasing their risk aversion.

In order to solve the limitation of quantitative data, He et al. conducted a semi-structured interview with six female high school students from two high schools in Tangshan, China, as part of a multi-case qualitative study, aiming to explore why female high school students do not engage in STEM-related disciplines or related occupations [18]. Research shows that participants' views on ideal jobs and their own identity are closely related to their parents' expectations. Compared with STEM jobs, most parents prefer stable and well-paid jobs, such as teachers, nurses or civil servants. Combining the advantages of the two methods, McNeill and Wei conducted a questionnaire survey among 747 STEM students from two universities in Scotland and China, followed by a semi-structured interview with 14 female students [20]. The results show that, compared with Scottish women, China women are discriminated against more in the family. Most of the respondents in China said that their families were not very supportive of their choices, and they were more willing to encourage them to pursue stable and low-risk careers. This is because, in Chinese society, people generally think that STEM is not suitable for women because of its fierce professional competition, and it is difficult for women to compete with men for promotion. At the same time, in more traditional families in China and other places, marriage and childbirth are regarded as the most important goals in women's life, which marginalizes their career development and limits their choices.

4.2. Structural and institutional barriers

4.2.1. Discrimination in the workplace and negative career prospects

Several studies have found that gender discrimination and institutional inequality in the workplace are the key factors that hinder women's development in science, technology, engineering and mathematics. The research shows that gender discrimination poses a huge structural obstacle for women to enter STEM career, especially in the male-dominated working [21,22]. In these environments, women often face recruitment bias, difficulties in integrating into the workplace culture and limited promotion opportunities, thus promoting their transition to non-science, technology, engineering and mathematics fields [23].

The survey results show that almost all female participants in China are aware of women's weak position in the STEM labor market and widespread gender discrimination, including discriminatory questions about marriage or family planning, gender wage gap and 'mother punishment' after maternity leave. These factors make it difficult for women to obtain equal career development opportunities with men, which further aggravates the marginalization of women in the field of STEM. Some participants mentioned that despite their qualifications and potential, the gender structure of the engineering industry and its patriarchal culture led them to actively or passively choose to leave this career path.

4.2.2. Lack of female role models

In addition to discrimination in the workplace, another structural obstacle is the lack of visible and accessible female role models, which has been found in many previous studies. Participants in China generally expressed their desire to see female role models who can balance their career, family and personal life. Similar findings were also observed in studies conducted in South Korea.

4.3. Psychological and academic self-awareness

Research question 2: The focus of research question 2 is to determine the strategies and solutions that can effectively solve the problem of insufficient female representation in STEM higher education in China, and promote gender equality in these fields. In the selected literature, there are four empirical studies directly related to this topic. According to the thematic analysis of their findings, only one central theme emerged, which will be explained in more detail in the next section.

4.3.1. Low self-efficacy and confidence in STEM

Several studies show that girls' academic self-efficacy and self-confidence in STEM subjects are often lower than boys'. This kind of education limits students' participation, makes them doubt their scientific ability, affects their self-efficacy and long-term willingness to learn STEM subjects, and inhibits girls' confidence and motivation to learn science.

4.3.2. Gender marginalization and lack of sense of belonging

In addition to the decrease in self-efficacy, the decrease in the sense of belonging to social experience in the academic environment has also had a major impact on women's participation, which often prevents them from continuing to participate in these fields. They found that many participants gradually lost their sense of purpose and belonging because of their alienation from the environment during their academic or professional development. This lack of a sense of belonging ultimately destroyed her desire to pursue an engineering career after graduation.

4.3.3. Synthesis and evaluation

Regarding research question 1, the literature shows that the underrepresentation of China women in the STEM field of higher education stems from the interaction of cultural, structural and psychological factors. Culturally, the gender norms formed by Confucian tradition have influenced the expectations of families, teachers and society for women; Structurally, institutional obstacles, including gender-biased admission and recruitment mechanism, classroom assignment and lack of female role models, limit women's participation in STEM field; Psychologically, these internal factors further weaken women's self-efficacy, academic confidence and sense of belonging, and reduce their long-term motivation to pursue the field of STEM. Therefore, this study holds that the underrepresentation of women in STEM subjects is not the result of mental deficiency, but the comprehensive influence of cultural norms, institutional obstacles and psychological influence.

4.4. Diversified education strategy (RQ2)

4.4.1. Informal STEM learning experience

Previous studies have found that informal STEM learning experiences play an important role in shaping female students' interest, identity and career aspirations in STEM field. The results show that there is a significant positive correlation between the frequency of informal learning experiences (such as joining STEM clubs, visiting museums and science centers, participating in competitions, field trips, etc.) and the future STEM professional or career intentions of female high school students. Therefore, this study shows that this experience plays a key role in stimulating students' initial interest in STEM and shaping their subsequent academic preferences.

4.4.2. Interdisciplinary integration of STEM and art

Integrating art into the interdisciplinary model of STEM curriculum has proved to be an effective strategy. This study shows that the introduction of artistic elements into academic and vocational STEM subjects significantly improves the effectiveness of female STEM education. The results of focus group discussions with female students further show that girls attribute their improvement in grades to the enhancement of self-confidence, which is enhanced by winning design competitions and showing their aesthetic achievements, thus consolidating their STEM identity.

4.4.3. Paired learning/cooperative learning

More and more studies have emphasized the potential of cooperative learning strategies to offset gender-based barriers in STEM education. The results show that in the environment of high stereotype threat, women's performance in the cooperative environment is obviously better than that in the competitive environment. However, in the low threat situation, there is no difference between the cooperative situation and the competitive situation. This study shows that in male-dominated fields, such as mathematics, cultivating cooperative relationships can reduce the negative impact of stereotype threat and improve women's performance and self-confidence in this field.

The results show that participatory learning significantly improves girls' learning input and self-confidence, which is higher than that of boys. In terms of project quality, male-female couples are better than female couples.

5. Discussion and analysis

5.1. Research question 1

5.1.1. Cultural and gender stereotypes

As for the factors of cultural and gender stereotypes, the research results show that under the social and cultural background of China, deep-rooted traditional attitudes and gender stereotypes continue to influence women's judgment on their STEM subject ability. This in turn limits their confidence and participation in related disciplines. This phenomenon can be explained by Bem's gender schema theory [16]. This theory holds that individuals internalize social norms, expectations and gender evaluation criteria through the cognitive structure of 'gender schema'. These schemas not only affect information processing, but also shape self-concept and value orientation, and guide individuals to choose behaviors and paths according to gender roles defined by culture [16]. Although modern China advocates gender equality, these cultural values still exert a subtle influence on education and career choice.

At the same time, this study also found that teachers' implicit expectations based on gender and differentiated interaction in the classroom strengthened students' perception of gender differences in ability. This differential treatment further deepens the self-doubt of girls in the process of STEM learning and enhances their marginalized experience in this field. Therefore, even if teachers don't explicitly express sexism in class, different feedback modes may imply gender differences in STEM ability, such as favoring boys to complete technical tasks, but praising girls' efforts and attitudes more [24]. This further strengthens the gender stereotype that science, technology, engineering and mathematics are male fields, thus affecting women's representation and participation in this field.

Parents' educational expectations and gender stereotypes in China families have a similar significant impact on women's representation and lack of participation in the STEM field. This can be explained by the deep-rooted Confucian cultural tradition, which has been paid attention to in China to maintain a patriarchal society, as described in the third chapter [17].

This cultural framework lays the foundation for the intergenerational transmission of gendered academic expectations. In the long run, the educational model formed by the intersection of filial piety culture and gender role concept strengthens the marginalized position of women in the field of STEM.

5.1.2. Structural and institutional barriers

Regarding the factors of structural and institutional barriers, the study found that structural barriers and workplace inequality have a profound impact on women's career development and their continuous participation in science, technology, engineering and mathematics.

Lack of female role models will also have a negative impact on women's career choices in STEM and their future career development. Through the lens of SCCT, role models, as an important source of 'alternative learning experience', shape individual self-efficacy and result expectation [14]. In other words, when female students see women's success in STEM career, they are more likely to believe that this career path is achievable and worth pursuing, thus promoting more effective alternative learning [15]. In the context of China, due to the long-term influence of the above social and cultural factors (such as the division of Confucian gender roles and family education expectations), the proportion of women entering the STEM field has been relatively low. This situation further aggravates the scarcity of female role models.

5.1.3. Psychological and academic self-awareness

In terms of psychological and academic self-cognition, the study found that women generally showed a low sense of academic self-efficacy in STEM courses. This kind of psychological cognition directly limits their academic participation level and their ability to form career aspirations. As time goes by, low self-efficacy will aggravate the underrepresentation of women in STEM higher education.

In addition, this study found that in the male-dominated STEM academic environment, the scarcity of female peers, limited opportunities for classroom interaction and gender discrimination often make women feel "outsiders" [20].

Three levels of influence were identified: culture, structure and system, and psychology. These findings further enriched the experience base of GST, SCCT and "cold climate" in the field of female STEM in China [14,16]. In addition to confirming and enriching these theories, this study has also produced new discoveries.

5.2. Research question 2: Diversified educational strategies

The results show that diversified educational strategies, such as informal STEM learning activities, interdisciplinary learning combining STEM with art and cooperative learning between men and women, can solve the problem of an insufficient number of women in the STEM field in higher education.

The study found that there is a positive correlation between the frequency of girls' participation in informal STEM learning activities and their interest and ambition in the STEM field.

Cooperative learning not only helps to reduce the negative impact of stereotypes in male-dominated fields, but also effectively improves the confidence of girls in STEM fields. In addition, cooperative learning with members of the opposite sex can improve girls' performance and confidence in STEM subjects more effectively than cooperative learning with members of the same sex. This is mainly because, in a cooperative environment, students of different sexes work towards a common goal.

6. Conclusion

6.1. Main findings

This extended literature review aims to discuss the underrepresentation of women in STEM higher education in China, and deeply analyze the key influencing factors and coping strategies behind it. Therefore, this study solved two research problems:

(1) What are the key factors that lead to the underrepresentation of Chinese women in STEM higher education?

(2) What strategies can effectively solve this under-representation problem and promote gender equality in the STEM field?

In order to answer these questions, this study conducted an ELR on the domestic and foreign literature related to female STEM education in China, and finally screened and analyzed 13 representative empirical research papers. The thematic analysis of ten studies on the first research question summarizes three main influencing factors:

(1) Cultural and gender stereotypes

(2) Structural obstacles and institutional defects

(3) Psychological and academic self-cognition

Together, these themes reveal the external social and cultural pressure, internal structural exclusion and the complex dilemma of personal psychology faced by women in the process of STEM learning. Aiming at the second research question, we screened four studies. The thematic analysis shows that diversified educational strategies, such as informal STEM learning activities, interdisciplinary integration of STEM and art, and cooperative learning, have been verified by empirical research and are highly related to the current Chinese background. These strategies aim to broaden the learning style of Chinese women in the field of STEM and stimulate their interest.

6.2. Meaning

Higher education institutions play a vital role in promoting gender equality in STEM education. At present, many universities in China lack sufficient gender sensitivity in their courses, learning support systems and campus culture. In order to break the long-standing gender stereotype in STEM field, universities can incorporate the contributions and opinions of female scientists into curriculum design, teaching materials and educational concepts. For example, adding case studies of female scientists such as Tu Youyou and Wu Jianxiong to engineering courses can not only show women's important contributions in the field of science, but also stimulate students' academic interest and career confidence. In order to solve the problem of a lack of female role models, they can set up a tutor program to show the future of STEM disciplines to female students and provide guidance on academic and career development in these fields. At the same time, some female students may find it difficult to adapt to the teaching methods of STEM subjects, because they have the study habit of taking exams since high school. In order to solve this problem, we should encourage interdisciplinary courses and diversified teaching methods, such as school-enterprise cooperation and cooperative learning projects in STEM learning activities, so as to broaden women's learning ways and stimulate their interest in STEM subjects.

In addition, higher education institutions should take active measures to cultivate an inclusive academic environment. In order to cope with the phenomenon of "cold climate", universities can take targeted institutional measures, such as providing gender equality training, formulating clear anti-discrimination policies, and encouraging inclusive participation in the classroom. These measures help to ensure that girls' views are recognized and valued, thus strengthening their sense of belonging and participation in STEM learning.

6.3. Limitations

This review has several limitations. First, the included literature is limited to articles from selected databases, and only 13 empirical studies were included. Second, only English-language international journals were included, excluding relevant Chinese-language studies. Third, some included studies involve high school students or women who have left STEM fields, which may introduce bias when applying findings to female university students in STEM majors.

6.4. Future direction

Based on the findings and limitations of this study, we can expand the literature review in the following fields. First of all, more relevant research from different subject databases and academic journals in China can be included to improve the representativeness and local relevance of the data and solve the problem of the limited sample range at present. Secondly, once enough literature sources are determined, the focus can be completely shifted to the specific education stage, especially the female college students in higher education. This targeted method will help to avoid the applicability deviation in the mixed education stage, and can more accurately understand the specific challenges and needs faced by this group in the STEM field.

Disclosure statement

The author declares no conflict of interest.

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