



# Gender Equity in STEM Education

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**Abstract.** The strength and contributions of women are significant for all industries, including both STEM majors and non-STEM majors. Based on this background, this paper examines the reasons for the gender inequity experienced by Chinese women in STEM majors, hoping to provide informative comments to support the development of women in STEM majors and improve the status of women in STEM education so as to make more contributions to society. This paper uses the Internet to break through geographical restrictions, and selects samples from various cities in China, distributes questionnaires, and concludes through subsequent interviews that the causes of gender disparity in STEM education for women are stereotypes and gender inequality in employment.

**Keywords:** Horizontal Gender Segregation, Gender Equity, STEM Education, Stereotype, Employment Disparities.

## 1 Introduction

The issue of gender equity in education has received considerable attention from educational scholars and governments around the world since the last century and has improved significantly in the last decade. DiPrete and Buchmann note that the number of female university students in the United States has already exceeded that of males since 2010 and predict that the number of female university students enrolled and graduating will continue to grow in the next decade[1]. Despite the improvement, the status of women in STEM education is still not optimistic.

Ma, You, Xiong, Dong, Wang & Kou analyze data from 85 colleges and universities in mainland China and conclude that a much higher percentage of Chinese male students chose engineering majors than female students when selecting their college majors[2]. American scholars Ganley, George, Cimpian & Makowski also point out that women are underrepresented compared to men in many STEM majors and even a few non-STEM majors in U.S. universities and combine this with previous literature to suggest that gender stereotypes may be the main reason for this inequity[3]. CohenMiller, Saniyazova, Sandygulova & Izenkova argue that women are discouraged from STEM education in Kazakhstan mainly due to cultural and historical factors and also the lack of female instructors in STEM majors in schools[4]. Summarizing the previous literature, many studies have concluded that women are experiencing disparities in STEM education, but few studies have identified the causes and solutions. This paper will take

China as an example to conduct a qualitative study on the causes of the inequities experienced by women in STEM education, to explore the visible or underlying constraints to Chinese women's choice of STEM majors as well as how to resolve them, and to provide pathways to promote gender equity in education further. This study makes use of the Internet to facilitate the collection of samples of students from various provinces and cities in China, which avoids the influence of the wealth gap and regional and cultural differences on the outcomes of the study. Through questionnaires and interviews, the study concludes that Chinese women are treated inequitably in STEM education and proposes the following solutions: educational institutions reinforce gender equity education among both teachers and students, media promote the equal capabilities of men and women in STEM learning, and technology and science companies provide certain support for the employment of female STEM scholars. This study identifies the causes of disparities in female STEM education and gives three suggestions on measures to support female STEM education in terms of education, society, and employment to help women gain equal status and achieve greater success in STEM fields.

## 2 Introduction to Related Background

### 2.1 STEM Education

STEM is often considered an overall term for science, technology, engineering, and mathematics education. However, many organizations and institutions around the world have different definitions of what exactly is considered to be STEM. The International Technology Education Association defines science as all those subjects that explore the natural world, and technology as those subjects that use materials from the natural world to meet human needs (ITEA/ITEEA, 2000/2002/2007)[5]. This study will combine the International Technology Education Association's definition with the common division of disciplines in China to conduct the surveys and interviews with the participants of the study.

### 2.2 Gender Segregation

**Vertical Gender Segregation.** The importance of gender equity in education has been studied for decades. According to the data from UNESCO, female students in higher education increased from 41% to 51% globally from 1970 to 2018. Furthermore, according to statistics from the Ministry of Education of China website, the proportion of females in higher education began to exceed that of males in 2019. By 2019, there were 15,679,000 female undergraduate and professional students, 51.72% of the total, and 1,448,000 female master students, 50.56% of the total. The data indicates that the vertical gender segregation in education suffered by women in China and all over the world has improved significantly in recent years.

**Horizontal Gender Segregation.** However, horizontal gender segregation, which means gender differences in the choice of field of study[6], still exists. Horizontal segregation in STEM education in China is mainly reflected in two stages: the choice of arts and science in high school and the choice of undergraduate majors. Nearly 80% of male students choose science subjects in high school, and only half of the female students choose science subjects; also, the proportion of female students choosing humanities majors in university is higher than that of male students. Therefore, this paper qualitatively investigates whether gender inequity exists in STEM education in China, as well as the causes of the inequity. This research contributes to the field by identifying the causes of gender inequity in STEM education in China.

### 3 Methodology

#### 3.1 Questionnaires and in-depth interviews

This survey focuses on female scholars who have completed their elementary, secondary, and higher education in China. Some of them come from first-tier cities, some from second-tier cities, and some from poor areas or minority regions. By using a comprehensive sample, this study avoids the influence of the economic and cultural level of the area on the study results. Furthermore, this study chose female scholars who have completed higher education mainly because of their greater accessibility to the Internet, which can avoid the geographical limitations of this study and investigate the obstacles faced by female scholars in as many different areas as possible. A total of 36 questionnaires were sent out via WeChat, and 30 questionnaires were returned. The response rate was 83%. Three participants were selected for interviews in this study after receiving the questionnaires. The data collection methods consisted of questionnaires and in-depth interviews. In addition, data analysis was done by analyzing the data. The survey consisted of 15 questions, focusing on four sections: basic information; the division of arts and science in secondary school; choice of undergraduate major; further education; and career development. In the basic information section, the questionnaire contains the city of residence, family income, parents' education level, etc. In the latter three sections, the questionnaire required participants to recall their interests before choosing a subject, their final choice, and whether they received encouragement or discouragement from teachers, classmates, parents, etc. After the survey, four participants from different cities were interviewed, in which the participants recalled in more detail their experiences when choosing their subjects.

#### 3.2 Results and Discussion

In this research, 30 questionnaires were returned through WeChat and the following results were found based on the responses. The results suggest that there is gender disparity in STEM education in China. From the causes behind it, this study concludes the following two explanations based on in-depth interviews.

**Results.** The results of the survey show that 40% of the participants are STEM majors and 60% are humanities majors. Among them, 56% of scholars majoring in humanities said they had thought of majoring in STEM, but gave up due to the discouragement of people around them and some gender bias. When classifying the results of the survey according to city and income level in the basic information, it was found that these two variables did not have a significant effect on the results of the latter sections. However, in both the secondary and undergraduate sections, although there were some participants who persisted in their interest despite being discouraged, almost all participants who were interested in STEM but chose humanity majors had received objections or discouragement from others. This suggests that there is gender disparity in STEM education in China.

**Reasons.** To further explore the reasons for gender inequity in STEM education, this study conducted interviews with four participants. The discouragement described by all four participants was basically caused by several of the following three reasons.

*General inequality.* In the interview, one participant mentioned that she has a younger brother in her family, and her parents' idea of preferring boys over girls tilted the family's resources toward her younger brother, and her parents thought she should study humanities, which is easier for girls, and get a stable job. Therefore, she gave up her interest in physics and chose finance instead. From the description of this participant, it is clear that the general gender inequality, the bias that male and female talents differ in STEM education, and the gender inequality in STEM employment all contributed to her decision not to follow her interest in studying STEM subjects.

*Stereotypes.* During the interviews, one of the participants mentioned that her high school physics teacher talked with all the girls in the year to persuade them not to choose science subjects when they were divided into arts and science subjects. Another participant mentioned that she had received comments that girls would struggle to learn science when making her choice of undergraduate major. Fortunately, both participants eventually adhered to their interests and made solid achievements in the fields they chose. But these stereotypes still largely contribute to the horizontal segregation in education that Chinese female students experience.

*Employment Disparities.* In the interviews, all three STEM major scholars mentioned that when looking for jobs in China, some STEM companies specified in their job advertisements that they would only accept men, especially for engineering jobs. This inequality also led some female STEM scholars to switch to humanity majors at the master's level. One participant who came to the U.S. for her master's degree after her undergraduate degree mentioned that women are even better employed than men in STEM companies in the U.S. and that many companies have programs to support female STEM scholars. This is a very good way to deal with the inequity problem women face in STEM majors. Buchmann, C., DiPrete, T. A., & McDaniel, A. have also pointed out that a clear pathway to getting employment can help students organize their plans and thus be motivated to complete their education[7].

## 4 Solutions

After identifying the causes of disparities in female STEM education, this paper gives three suggestions on measures to support female STEM education in terms of education, society, and employment to help women gain equal status and achieve greater success in STEM fields.

### 4.1 Education

Schools and educational institutions should reinforce gender equality education among both teachers and students. It is evident from the interview that the words and attitudes of teachers and classmates have a great impact on students. With such trust from students, teachers who hold gender bias on one hand betray the trust of students and, on the other hand, are more likely to lead to students' suspicion of themselves. Therefore, better education on gender equality for both teachers and students is the best way to maintain equity.

### 4.2 Society

The media should promote the equal ability of men and women in STEM learning. There is a general bias in Chinese society against women's talents in STEM subjects, or, in other words, against men's talents in the humanities as well. The media should take the social responsibility to promote gender equity in education so that people understand that it is a reasonable thing for boys to be talented in the humanities and for girls to be talented in STEM subjects.

### 4.3 Employment

Technology companies should provide certain support for female employment. Many STEM companies are discriminating against women in hiring, which is illegal. In a context where women in STEM fields are disadvantaged by gender bias in school and at work, this study argues that STEM companies should provide support programs for female employment to promote gender equity. Many scholars from various countries have identified employment equity as a very effective way to approach gender equity in education. Thomas, R. E. suggested in a study of India that one solution to the problem of female educational equity is to increase employment opportunities[8]. Bukhari, M. A. H. S., Gaho, M. G. M., & Soomro, M. K. H. studied the situation in Pakistan and concluded that the government and companies should ensure female equal status and treatment with males in the work environment[9].

## 5 Conclusion

The strength and contributions of women are significant for all industries, including both STEM majors and non-STEM majors. Based on this background, this paper examines the reasons for the gender inequity experienced by Chinese women in STEM majors, hoping to provide informative comments to support the development of women in STEM majors and improve the status of women in STEM education so as to make more contributions to society. This paper uses the Internet to break through geographical restrictions and selects samples from various cities in China, distributes questionnaires, and concludes through subsequent interviews that the causes of gender disparity in STEM education for women are stereotypes and gender inequality in employment. There are also some weaknesses in this paper. Due to the time and geographical constraints, the amount of sample in this paper is relatively small, so the analysis and recommendations in this paper may have some limitations. Future research can conduct fieldwork to gain more authentic and comprehensive statistics.

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