

Gender Equity in Subject Education in Compulsory Education under the Perspective of Ecological System Theory: Take STEM Teaching as an Example

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Abstract. Against the backdrop of an essentially equal gender ratio in China's tertiary education enrollment, males still account for the majority of certain subjects and perform better in academic achievements. The researcher found that gender equity in Chinese education has not been fundamentally realized. Therefore did a series of studies on different genders in subject education in higher education, but actually, the focus of the study should be converted more to the compulsory education stage for more effective propelling. By using literature review method, this paper studies gender equity in subject education in compulsory education stage, taking STEM teaching as an example. The study finds that the gender achievement gap in subject education is not genetically backward, but more a result of individual, school, family, social and national influences. From individual perspective, female students in compulsory education stage are likely to suffer from stereotypes, secular perceptions and lack of subject confidence. For environment perspective, with the help of Ecological Systems Theory, this study analyzes involved factors in terms of Chronosystem, Macrosystem and Macrosystem. Therefore, as China's social structure changes, subject education and employment choices should not be tied tightly to social roles and expectations, but should be made available and flexible to students according to their academic interests and personality cs, to fully develop students' specialties, and to tailor education to students' needs, provide individualized educational options for them, hereby greatly contributing to the country's innovation-driven capacity.

Keywords: Gender equity; Subject education; Compulsory education; STEM Teaching; Ecological System Theory.

1. Introduction

Since the reform and opening up of China, economic level has rose greatly. The support of education policies and the sprouting of a sense of gender equity, women in China have increasingly empowered to receive higher education. The proportion of women attending universities in China has risen from 23.4% in 1980 [1] to continually over 50% in the past three years [2]. Enrolment rate in tertiary education is, to some extent, the most visible manifestation of gender equity in education. Since higher education is based on pre-school and compulsory education, the gender ratio of enrolment in higher education is a good indicator of the profile of gender education at these two stages.

It seems that gender equity in education has been achieved in terms of data, but the fact is that many social deviations and gender inequities have not been substantially resolved to date. Examples include diverse educational expectations for different genders, the phenomenon of "gender segregation" in higher education, and the emergence of "female subjects" and "male subjects". This phenomenon is not entirely attributable to historical legacies and social ideologies. From a historical perspective, the patriarchal social system and culture that predominated throughout the world have always formed a social ideology that limits the existence of women in the social position of the second sex in the development of the gender system. The social relations of rights, social and cultural awareness in society were as a whole, which has resulted in the existence of blatant and de facto gender inequality between men and women in their participial roles [3]. And from the perspective of social ideology, some societies also discriminate against women in various aspects, such as differences in physical

characteristics, social and workplace discrimination, as well as gender stereotypes. Taking China as an example, since ancient times, China has had the idea that men were superior to women, and women have gradually become accustomed to the fact that all kinds of resources are tilted in favor of men in social discipline, so women's status and rights have never been truly guaranteed. There are gender stereotypes of women in education, and some ancient thinking holds that "There is no use for girls to study so much, they will have to marry sooner or later." "Girls are better than boys only because they are better behaved in the lower education stage. As long as boys make an effort in junior and senior high school, they will soon catch up with girls." "Girls can't learn STEM subjects well. They are just good at liberal arts." "It's good for a girl to be a teacher in the future. There is no need for girls to study far away because you don't need to earn a lot of money." Girls of all ages, both former and current, are constantly imprisoned and poisoned by these words. One of the root factors is that society's expectations of women are very different from those of men, and this has resulted in different expectations, objectives and rates of return for women's education.

Therefore, this essay will mainly study gender equity in subject education with the help of examples of STEM teaching in compulsory education, and at the same time, the author will analyze the current situation from international comparative perspective in a more far-reaching way, and put forward some suggestions for the future development of the phases of law.

In the face of the seriousness of the current situation, it is fortunate that related research has been conducted and measures have been implemented internationally, from which China can learn from and refer to. In this section, the author mainly chose two studies related to subject education of different genders in Kenya and Finland to conduct a comparative study and ultimately be able to derive lessons and measures that can be learned from them.

And there is not a lot of research and discussion on this issue in China at the moment, the vast majority of which also focuses on the differences in disciplines between genders at the higher education level. However, this thesis will focus on the compulsory education stage, since the author believes that in order to solve this problem at its root, it is necessary to analyze it from this stage. To account for the switch of the concentration, in the Chinese education system, students' expectations and confidence values for different subjects are cultivated from elementary school, and it is the subjects that students study in high school that ultimately determine their choice of major in the university. Therefore this essay will analyze gender differences in STEM teaching in compulsory schools in three terms - mathematics, physics and chemistry by using the literature review methodology and examples, thus filling the gap of insufficient research and attention to this issue at the compulsory education level in China. Additionally, this paper will analysis gender unfairness concerning this situation based on Urie Brofenbrenner's Ecological Systems Theory in three aspects - Chronosystem, Microsystem and Macrosystem [4]. Lastly, by analogizing with similar situations from an international view, integrating and analyzing existing recommendations and measures, the paper will provide suggestions for promoting gender equity in subject education for China.

This study hopes that the author's analysis will lead to a more in-depth understanding and consideration of this phenomenon, and the author hopes to give some directional suggestions that will ultimately lead to the promotion of gender equity in education, as well as the hope that in the future, female students from every parts of the world will be able to receive truly equal educational resources, which are not inferior to male students', and make good use of the resources. Ultimately students will achieve the results of resource transformation to their own academic performance and achievements in the field, in which this gender may be considered wouldn't do well.

2. Gender Differences in STEM Teaching in Compulsory Schools of China

2.1. Gender Differences in Mathematics Performance and Causes

From this case, it can be known that female students in compulsory education are affected by stereotypes and therefore are not able to perform at a normal level in mathematics, which will continue to generate negative feedback for students in the process of learning mathematics, which will ultimately result in the loss of female students in the subject of mathematics.

In this society, most people believe that men are better at logical thinking than women, and therefore men are better suited to study math. Therefore, it is hoped that this study will help students, parents and teachers to better analyze their learning ability and development potential, avoid the interference of stereotypes, choose majors suitable for students according to their interests and abilities, as well as promote the healthy development of adolescents.

It begins by introducing two concepts, the first one is Stereotype Threat Theory [5]. They believe that when stereotypes are recognized as self-representations that have negative effects, they will be destructive. These negative effects include potential benefits for the other party. In this study, it refers to the fact that girls who identify with a high level of stereotypes about math perform poorly in math, and then boys become potential beneficiaries. For example, the study mentions that Muzzatti studied children in Italy and found that in elementary school, boys and girls developed differences in attitudes toward math learning arise as early as third grade, and this math-gender stereotype can also have a deleterious effect on girls by the time they reach middle school. The second concept is self-concept. According to the study, self-concept refers to a person's knowledge, understanding and opinions about aspects of himself or herself, which may be correct or incorrect [6].

This case shows that there was no relationship between boys' mathematical gender stereotype identity and their mathematical self-concept [7]. Whereas, math gender stereotypes had a significant effect on girls' self-concept and were negatively correlated. Through comparative analysis, the study found that negative stereotypes had a greater impact on middle school students. According to the stereotype threat theory, it can be seen that when the research subjects are affected by negative stereotypes, their performance in a certain area will be affected and cannot reach the normal level.

It can be learned from this paper that gender stereotypes as a pathological social norms have a greater negative impact on girls than on boys in math. In a situation where girls' self-concept is generally lower than that of boys, this effect will not benefit girls' learning of mathematics in compulsory education, but will continue to erode their self-confidence in learning mathematics, thus leading to a vicious circle.

2.2. Gender Differences in Physics Performance and Causes

Although it cannot be seen from this case whether there is a skewing of educational resources received by different genders in subject education. However, it can be found that most of the reasons for gender subject preference in high school course selection lie in their own secular perceptions and lack of subject confidence.

The study used Ma City High School as an example and found that [8] firstly, Girls care less about the subject interest factor in the subject selection process compared to boys. Secondly, Gender categorization of high school students significantly and negatively affects employment prospects. Girls are less concerned with the confidence factor of learning to do well in the subject selection process than boys. Thirdly, Compared to boys, girls are more likely to suffer the conflict of future employment and their favorite subjects during the subject selection process. So from the paper it can be concluded that among the troubles faced by high school students taking physics subjects, most of the troubles arising from individual attributes are mainly focused on students' gender categorization.

In other words, female students generally care more than male students about external objective factors, such as employment prospects, social expectations, etc. However, they seldom consider their

own academic interest, subject confidence, and future career plans. This is the opposite of what boys show. The reason for this is that, under the original social structure, the social roles assumed by women are different from those of men. As a result, the social ideology derived from this also transfers more benefits to men, while at the same time, women assume the role of giving up part of their rights to take care of the other gender. Apart from the historical perspective, more societal reasons are involved. Society is generally less friendly and more demanding of women than men, and this is especially true in jobs that correspond to STEM disciplines. When men and women are equally competent, the qualification and promotion opportunities of a job are always unilaterally channeled to men. If a woman wants to pursue a career in a male field, she is forced to take more risks (unemployment, layoffs, unpromotable possibility, etc.), which may serve as one of the reasons that why girls tend to consider more external objective factors. Therefore, if this problem is to be solved, gender discrimination in the workplace should be improved first, which will enhance the treatment of women to a certain extent. The problem of gender equity in subject education can also be improved consequently.

2.3. Gender Differences in Chemistry Performance and Causes

In this case, it can mainly be perceived that learning self-efficacy plays a vital role in students' subject learning. Students of different genders actually do not differ much in terms of their ability and aptitude in the subjects.

The concept introduced in this case is self-efficacy, which refers to students' judgment of their own abilities in learning a subject or in accomplishing a subject's learning tasks. Some scholars in China have found that boys' self-efficacy is higher than girls'. Meanwhile, self-efficacy is positively correlated with students' performance in chemistry [9].

The study found that boys are more interested in chemistry than girls in relation to their state of mind, motivation and engagement, and are more inclined to tackle difficult problems. Girls who were interviewed believed that boys mostly performed better than girls in chemistry. The authors of the case found that boys' level of self-efficacy in chemistry and the mean values of all dimensions were higher than girls'. The dimensions that showed the greatest difference in chemistry self-efficacy levels between genders were "Learning and problem solving efficacy" and "Self-confidence", and the dimension that showed the least difference was "Experimental ability".

Therefore, from this study people can find that in fact there is no significant difference between boys and girls in their ability to learn chemistry, but the biggest difference lies in the female students' distrust of their own abilities. There are only two ways to describe the source of this mistrust, either internal, i.e. genetically, or external, i.e. the influence of the bad situation and the people the student comes into contact with on her. The former factor cannot be discussed in this study for the time being, but the latter factor has been studied by a large number of scholars in our country. From the perspective of gender, there is a big difference between the two sexes in terms of social rights and together, so the family, school, and even society's educational expectations for women are different from those of men, and this is the main contradiction that causes gender inequality in education.

2.4. Problem Analysis Section

In general, combining these three studies and the data from them, the problem of gender equity in subject education is mainly attributed to the following aspects:

On an individual level, there is a certain bias in students' personal gender consciousness. The concepts and beliefs of students in compulsory education are still in the process of being shaped, so it is normal to have some deviations. What is even more frightening is that in most cases this is not just a phenomenon, but an inevitable one. Male students always aspire to be more competitive and technical, while female students are more family-oriented and would favor being managerial. For them, jobs that are more relaxed and easy to fulfill both career and family are more preferred. People also find

that female students are more easily influenced by others and tend to satisfy other needs, and have less confidence and awareness of their own ability to learn STEM subjects.

In terms of schools, studies have pointed out that some teachers unconsciously instill gender stereotypes in their students. Textbooks and extracurricular books portray gender stereotypes in some subjects [7]. These stereotypes are perpetuated for students. Therefore, both teachers and textbook compilers are suspected of deepening gender segregation in subjects.

From the social point of view, first of all, the job market of certain specialties has a certain gender discrimination against women. The above studies have already pointed out that female students are more worried about their employment prospects. In the job market, the trend of some enterprises to recruit only male students has marginalized women in this field, and they are forced to change their jobs in the end. Secondly, there are social norms and stereotypes about women, the latter of which are more likely to lead to a loss of confidence in the discipline. Education for gender equity is a matter of urgency.

3. Analysis Gender unfairness in STEM Teaching Based on Urie Brofenbrenner' s Ecological Systems Theory

3.1. Involved Factors in the Chronosystem

From this dimension, in the long run, in the process of long-term historical development, in the world generally patriarchal society. As a result, the social ideology that men are the dominant and women are the subordinate has been formed. For a long time, men have taken charge of most of the resources (including educational resources, economic resources, etc.), so this social structure has not been fundamentally changed, and therefore the real equity between the two sexes in education cannot be realized. However, in recent years, along with the increasing awareness of women, the low fertility rate and aging have increased the burden on society, and the demographic structure of China has changed significantly, so women are gradually able to choose their own subjects. However, many women are still confined by societal concepts of gender discrimination, so that women have not achieved true freedom in their choice of disciplines.

In the short run, it can be found that neither changes in family structure, address, nor parental job changes have a significant effect on subject choice and education across gender.

3.2. Involved Factors in the Macrosystem

By interpreting and understanding the macrosystem, the author concludes that for the purpose of this study, the system mainly refers to the social ideology, the political system as well as the economic system.

The authors found that social ideology generally instills in students, parents, teachers and other stakeholders the unproven and uncertain notion that boys are better than girls in STEM subjects, both in terms of students' subject or choice of subjects and in terms of subject education. At the same time, social ideology constrains girls to make subject choices based on their own subject interests, and constrains girls to compete for performance and resources, which leads them to believe that they are not doing well academically, and ultimately to lose confidence in STEM subjects. At the same time, it has emerged throughout the world that social stereotypes assign certain social roles to female students, expecting them to fill such roles and take on a specific social division of labor. However, the education of students should be diversified and multidirectional, which is in conflict with China's current educational philosophy.

3.3. Involved Factors in the Microsystem

Involved factors in this system various, from the most direct surroundings like school, home to the closest people that are related to them, such as teachers, family members, peers and so on. But the environment and the person are never separate, so the paper will analyze one place at a time.

First of all, the school. In terms of teachers, there should be balanced ratio of male to female teachers of STEM subjects. If it is not balanced, is it likely to aggravate the gender stereotypes of the subject among students. Secondly, in terms of teachers' teaching philosophy and teaching process, there shouldn't be any educator thinking that boys must be better than girls in studying different subjects. In addition, teachers are not supposed to put a lot of pressure on boys in the subject that they are expected to learn well by the biased standard and norm, so that the school won't make girls prejudge the subject and classify it as a male subject, thus ultimately losing their interest and confidence in the subject. Other departments in the school are advisable to provide appropriate guidance on subject selection and careers for students in compulsory education. These guides should be tailored to the students' personalities and academic interest, rather than to meet the expectations of others or to play a social role. Potential gender stereotypes and sexist portrayals of subjects in the textbooks need to avoid as much as possible. Teachers should always pay attention when subject gender stereotypes are likely to appear in the classroom. Girls who are good at STEM subjects in the class should receive the same praise and rewards as boys do.

Secondly, in the family, parents are not expected to have different academic and employment expectations for children of different genders. Also, they should respect children's individual development and their academic development. Considering the family situation, if it necessary for students to consider employment, it is not advisable to let siblings' choice of employment affect students of different gender to choose their subjects or majors.

4. Suggestions for Promoting Gender Equity Based on International Comparisons

4.1. Measures Drawing on Similar Situations from worldview

From the papers related to education in different gendered subjects in Kenya, it can first be found out that there is this awareness to promote the development of knowledge economy and education and training in STEM subjects in Kenya [10]. The current curriculum piloted nationally in the Republic of Kenya from 2018 aims to encourage girls to excel in these subjects from the early stages of education.

Although most developing countries, including Kenya, have achieved gender parity in enrolment and completion rates, girls' performance and academic achievement in science, technology, engineering and mathematics disciplines is much lower than that of boys. There are two main conclusions from this piece of research.

One is that there are generally no gender differences in boys' and girls' ability to learn math; in other words, the differences in average math achievement between boys and girls resulting from qualification endowments are not significant. This paper also draws the same conclusion. The second is that boys and girls are treated differently in education due to a number of factors, such as the belief that it is economically more advantageous for boys to be educated than for girls to be educated, that there may be differences in social norms between men and women, and also that teachers may expect more from boys than from girls in the process of socialization.

However, the focus of Kenya's education policy continues to be on equity in gender-specific educational opportunities. The paper argues that attempts such as controlling the gender ratio of teachers can be implemented based on the results of the research, but for the Kenyan government, it needs further research to develop concrete measures to address gender equity in subject education [11].

Another piece interviews young Finns about the gendered educational choices they make. The study found that boys were less influenced by outside influences, but girls were more susceptible to the influence of others. This paper also concludes the same. One of the interviewees in the study would naturally refer to her sister's career, nursing, when considering subject choices and career plans, and her sister's career choices were made to conform to the expectations of family members and counselors. In fact then there is a continuum butterfly effect here. It will ultimately result in a status quo for society as a whole [12].

4.2. Advice and Educational Priorities better Suited to Today's China

For teachers, they should not consciously or unconsciously inculcate subject gender stereotypes into students, thereby affecting students' perceptions, interest and confidence in certain subjects. Teachers are also not advised to give students inappropriate advice on academic and career planning based on experience and the current employment situation in the society. Individual teachers need to revise erroneous gender stereotypes of subjects. During lessons, it is recommended to praise girls who are good at STEM subjects or boys who are good at arts subjects, so as to correct the gender inequity in subject education. In the course of daily classroom management, teachers can also consciously introduce great women in STEM subjects, mathematicians, engineers, etc. to give girls sufficient confidence to learn STEM subjects well. In addition, schools can also organize lectures on gender equity in subject education or provide students with relevant guidance on subject selection and employment to convey the correct concepts of education and employment. When educators compile books, they should try to be as diversified as possible when describing the occupations of the characters in the books, and it is also recommended that some genders take up atypical occupations, so as to increase the activity, self-confidence and self-efficacy of students in compulsory education in the study of academic subjects.

For parents, the educational philosophy should also be corrected. A scientific approach to education is to let students make choices according to their own interests in the subject, while parents try to support them as much as they can. For example, if a girl wants to learn programming, it is wrong for parents to think that girls can't learn programming, which is a move to curb the development of the child's interest and ability in the subject. Especially in the current world situation, innovation is the power source of a country. So no matter what gender, STEM subjects should be a part of a student's academic goals to consider. At the same time, parents need to work together with the school to communicate with their students in a timely manner so as to create a better learning and living environment for them.

5. Conclusion

In this paper, in the international perspective, girls in compulsory education have a low proportion of choices. Through the study, it is found that they have a low sense of identity, confidence and interest in STEM subjects due to the influence of personal, family, school, social and national factors. It is therefore concluded that gender equity in subject education has not been fully realized, and that it is still at the level of equity in the gender ratio in education, but that in individual subjects, such as STEM subjects, the gap in academic achievement and future employment rewards between the genders is still enormous. At the same time, women are plagued by such ideologies, which are not conducive to the development of the discipline, the development of innovative capacity for all, and also increase disciplinary segregation. The main contribution of this study is to shift the inappropriate focus of gender inequity in academic education in the country from the higher education level to the compulsory education level, which is conducive to exploring the root causes of gender equity in academic subject education. At the same time, the authors fill the gaps in the data of this part of the study. However, the current study is not based on a large number of samples, which may be subject to chance, and does not take into account China's regionality and culture, and the conclusions given are not very rigorous. Future research could be based on the premise of conducting regional education and culture research by visiting a large number of samples in the field to conduct in-depth research.

It is also necessary to take into account the fact that competition education belongs to academic education in some regions and to discuss it in a categorized way according to the actual situation in China.

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