Gender Issues in Mathematical Textbooks of Primary Schools

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Education is one of the main factors that results in the impression that males are more talented in learning mathematics. Mathematical textbooks have been conveying this concept either implicitly or explicitly in the process of selecting and organizing teaching content. By analyzing mathematical textbooks of primary schools published by Beijing Normal University Press, which is in accordance with the National Standard of Mathematics Curriculum, we find that it pays more attention to gender equality compared with the edition of 2000, but there is still inequality of gender and some stereotypes. To improve this bias, textbbooks firstly should reflect the difficulties encountered by women in learning mathematics. Secondly, gender roles of adults should be handled equivalently and described based on their substantial features instead of stereotypes.

Key words: *curriculum reform in compulsory education, mathematical textbooks, gender issues, comparison.*

Introduction

The new round of curriculum reform emphasizes the development of each student. But "in people's subconsciousness, mathematics seems to be a natural field for males, and gradually a traditional stereotype came into being." (Li, 2001) Does it reflect the real situation? Compared with the research in China, gender issues in Western mathematics education are much more emphasized. "International Research Institutions of Females and Mathematics Education " is one of the five affiliated research groups in the International Mathematics Education Committee (ICMI).

The existing research has different findings on whether there are gender differences in mathematical learning. Some researchers think males have the

superiority in mathematics learning (Maeeoby & Carol, 1974; Brandell, Leder, & Nystrom, 2007); others believe that males and females have their respective advantages (Benbow, 1992; Hyde, Fennema, & Lamonj, 1990). Nevertheless, the apparent consensus is that gender is an important factor in mathematics learning (Zhang, 2006). However, the causes of gender differences also fall into two camps. Some researchers believe that gender differences in mathematics can be mainly attributed to physical, mental and other factors (Kimball, 1989; Geary, Sauzts, & Liu, 2000); others suggest that external factors like social and cultural factors are dominant causes of the gender differences (Fan & Li,,2008). ICMI (1992) proposed a basic conclusion: Women have no obstacles in participating in mathematics in physical and mental aspects (Li, 2001). That is, the gender differences in mathematics learning are mainly caused by social and cultural factors, particularly school education which plays an important role in children's gender socialization.

In the view of the internal elements of mathematics education, mathematical knowledge learning is one of the main tasks of mathematics education. Mathematical knowledge is often considered to be culture free and pure rational knowledge, and traditional mathematics education is always complying with this teaching concept. However, the sociology of knowledge posits that, "knowledge, including subject knowledge, is 'not only knowledge, but also a social practice'. It is the refined cultural and symbolic system that is selectively constructed by people which 'includes the theoretical premise and ideology beneficial to these in charge (Shi, 2004). Much research on ethnomathematics and multicultural mathematics supports this view. That is, mathematics textbooks inevitably attach and deliver a specific gender perception in selecting and organizing mathematical knowledge either implicitly or explicitly. Based on the above understanding, we think it is very important to analyze the gender concepts in mathematical textbooks.

Methods

We compared "Primary School Mathematics Textbook Based on Curriculum Standard" (MTCS), which was published by the Beijing Normal University (BNU) with "Mathematics Textbook Based on Syllabus" (MTS), which was published by the Beijing Normal University in 2000. We want to reflect the perfection course of gender equality in textbooks, also further reveal the gender equality problems in MTCS. It should be explained that the selection of the textbooks published by BNU does not mean that only this

version has related problems, but that the editions are one of the typical materials of the new curriculum, and have a certain influence. In the specific analysis, we selected four textbooks from MTCS by interval sampling: the final volume of the first grade (2005), the first volume of the third grade (2006), the final volume of the fourth grade (2005), and the first volume of the sixth grade (2006).

We analyzed gender from the frequency and activities of characters which appeared in the textbook illustrations and the role of adults. There are often more than one character in an illustration. At this time, we used individuals as a statistical analysis unit. However, when characters in an illustration have equal status, then they are counted as one, such as the illustration of "long jump" on page 15 in the fourth grade MTCS, the boys or girls are only counted as one person. In addition, as activities appear in the form of illustrations, we analyze activities based on the gender roles of the characters, which we divide into "the pure male", "the pure female", and "the mixed type". "The mixed type" is again divided into three categories according to the main characters, namely "no gender difference", "male dominant" and "female dominant". It needs to be explained that, "no gender differences" is concluded when "the mixed type" mainly results from different age groups. For example, in the illustration of "Female teachers guide students to take a bus" on page 7 in the third grade of MTCS, although female teachers is the leader, it is still classified as "no gender difference".

Status of Gender Issues in Primary School Mathematical Textbooks

A High Frequency of Male Appearance in the Textbooks

There are 931 people in the four volumes of MTCS, among them 515 people are male, which accounts for 55.3% (Table 1). The frequency of the male appearance is obviously higher than that of female (x^2=10.53, p <0.01). Moreover, male characters in various volumes separately account for 52.9%, 54.3%, 56.4%, 58.6%. Obviously, there are not remarkable difference between the ratio of male in various volumes of the textbooks and the four volumes in total (x^2=0.73, p >0.05), which indicates that the phenomenon of "male more than female" are in conformity with various volumes of the textbooks, and becomes more remarkable along with the higher grade. But compared with the data from MTS (Shi,, 2004), MTCS had distinct improvement.

Table 1

The Frequency of Male Appearance and Female in MTCS

	the final of first volume the grade	the first of third volume the grade	the final of fourth volume the grade	the first of sixth volume the grade	Sum	x^2	P
Male	144 (52.9%)	132 (54.3%)	123 (56.4%)	116 (58.6%)	515 (55.3%)		
Female	128 (47.1%)	111 (45.7%)	95 (43.6%)	82 (41.4%)	416 (44.7%)	10.53	P＜0.01
Sum	272	243	218	198	931		

Different Gender Characteristics in Activity Forms

Taking the characters' action as an analysis unit, we analyzed the MTCS and found (Table2): it was obvious that male is present more than female, male dominates female. If we take "the pure male" and "male dominant" as "the male–dominant activity", and take "the pure female" and "female dominant " as "the female–dominant activity", then in four volumes of textbooks, there are 190 illustrations of "the male–dominant activity", and only 97 illustrations are "the female–dominant activity". So, the illustrations of "the male–dominant activity" are obviously more than "the female – dominant activity" (x^2=30.14, P<0.01). Moreover, in various volumes of MTCS, the ratio of "the male–dominant activity" illustrations to "the female– dominant activity" illustrations are respectively 1.72, 2.19, 2.53, 1.67. Therefore, the phenomenon of "male more than female" displayed the uniformity in various volumes of MTCS. Moreover, if we only compare the data of "male dominant" and "female dominant", we would also find that the former was more than the latter (x^2=6.58, P<0.05), and the male dominate female.

Table 2
The Action Forms of Male and Female in MTCS

		the final volume of the first grade	the first volume of the third grade	the final volume of the fourth grade	the first volume of the sixth grade	Sum
	the pure male	31	36	28	35	130
	the pure female	16	20	7	19	62
the	no gender difference	45	39	54	42	180
mixed	male dominant	24	21	10	5	60

| type | female dominant | 16 | 6 | 8 | 5 | 35 |

The Existence of Adult Gender Role Stereotypes

The most direct influences on the socialization of children's gender roles are the grown-ups' family roles and the professional roles. From the analysis of the MTCS, we found that the gender role stereotypes of adult males and females still exist. First, the males and females' traditional family roles have not been broken through, which are specifically demonstrated in the activities of "father", "mother" and other family members engaged in. In the illustrations which appear in the form of family (besides the illustrations using "height", "age" and other data as question backgrounds), the masculine family roles mainly appear in traveling (2) (the digit in parenthesis presents number of people), dividing the inheritance (1), making dumplings (1), and shopping (1); However, the feminine family roles mainly appears in shopping (3), feeding chickens (2), traveling (2), accompanying child at home (1), and making dumplings (1). Obviously, the frequency of male appearance in the illustrations is less than that of the female. Moreover, the feminine actions such as shopping, accompanying child at home are consistent with the traditional concepts.

Next, the distribution range of masculine social roles is broad. The statistics show that in MTCS, from most to least, the masculine social role in turn is sapiential old men (41), mathematicians (5), sales clerks (5), country leaders (4), personnel related to sports (4), drivers (3), scientists (2), teachers (3), farmers (3), ancient celebrities (2), chefs (2), workers (2), ordinary citizens (2), astronauts (1) and bank staff (1). However, from most to least, the feminine social role is teachers (22), sales clerks (15), personnel related to sports (6), ticket sellers (3), television hosts (3), on-stage hotel servants (1), librarians (1), technical personnel (1) and ordinary citizens (1).

So, the masculine role displays more intellectual and technical tendency. For instance, there are mathematicians and scientists who create knowledge directly, and also sapiential persons and so on. There are also drivers, chefs and so on whose positions need professional skills. The feminine roles, however display more of a service tendency. If we take sales clerks, ticket sellers, on-stage servants of hotels and librarians as service personnel, then the service personnel of female amounts to 20 people, occupying 38.5% of the feminine roles, but the corresponding data of males is only 6.3%.

Suggestions to Promote Gender Equality in Mathematical Textbooks

After analyzing the textbooks, we found that the authors of mathematical textbooks have paid close attention to gender equality in China, but there are also some gender role stereotypes as a whole. For instance, sapiential old persons, young doctors and so on who are through out the whole set of textbooks appear in masculine image, which conforms to the social value orientation. It maybe the reflection of the gender roles which exist generally in people's subconsciousness and are conveyed through textbooks to the next generation. Therefore, the improvement of elementary school textbooks' gender roles is very important. We believe that we may improve the above phenomenon through the following aspects.

Reflecting the Difficulty of Females in Learning Mathematics

The mathematicians introduced in the elementary school mathematical textbooks are only males, which will cause the students to think that mathematics is created by males and females are not worthy of mentioning, as well as believing that females are inferior to males in mathematical ability . Although in mathematical history female mathematicians are truly very few, education should not just tell students the fact. More importantly, we should make students understand the social reasons for fewer female mathematicians. In history, females suffered more resistance in studying and researching mathematics than males. Hypatia (370-415), the first female mathematician in the world, was ripped by frantic Christians. In ancient times, females are framed more as "the good wife and loving mother", and in ancient China, people believed that "female incapacity is virtue". Feminine mathematical talent was neglected by the feudal values that "Females are inferior to males". Therefore, females were denied the access to learning mathematics. We learn from the related documents that the history of allowing females to enter higher institutions to study mathematics is only 130 years old. This reality caused females to lose the opportunity to studying advanced mathematics, which then created gender differences in mathematics (Ling,S.,2006) that we see today. Therefore, textbooks should not only increase the content of the feminine mathematicians' contribution directly, but also introduce particular difficulties of females during studying and researching mathematics in history.

Balanced Treatment of Adult Gender Roles in Textbooks

Gender roles are a social cultural production, and are extended by longitudinal dissemination in identical cultures. Namely, in a macroscopic view, the formation of the gender role idea is a circulation from the individual

cultural unconsciousness to the collective cultural unconsciousness and then the individual cultural unconsciousness again. Through such cyclic processes, people are used to the phenomenon of "men and women are materially not equal" (for instance very few people ponder "why in our impression sapiential old people are always male"). In a microcosmic view, students firstly feel the gender division of the adult world from their life, and by imitating their parents and other adults' behavioral patterns they obtain approvals; then such experience is strengthened in schools through teacher's behaviors, the textbooks' implications and finally students form the gender roles in a specific culture. Therefore, textbooks should arrange adults' gender roles in balance and consciously. In fact, along with many endeavors which work on the equality of the genders in China, numerous talented females emerge in various trades and occupations. Even in the mathematical domain, there are also renowned female mathematicians like Yangzhi Gao, Ruiyun Xu and Hesheng Hu and so on.

Changing Character Roles from Stereotypes to Substantial Roles

Examples are an important medium in study. The children's roles which are similar to the students do more than just make abstract boring mathematics familiar. Moreover, these roles may also show the process of learning mathematics. MTCS presents many children's roles and sets two student roles named "mischievous" (male) and smiling (female) thoughout the whole textbook. Unfortunately, the two names "mischievous" and "smiling" have the mechanical gender impression. More importantly, readers cannot find their substantive, continuous mathematics activities in the textbook, and also their special thought characteristics are not manifested. Two aspects of endeavors are in need if we want examples in textbooks to have essential functions. First, from the longitudinal aspect, character roles need to have the respective mathematical characteristics, and maintain their thought characteristics consistently. For instance, some students are accustomed to studying mathematics by computing and inferencing while other students are used to studying mathematics by operating intuitively. Therefore, textbooks may also hypothesize two kinds of character roles of these different study methods. Of course we should avoid conscious gender differentiation in different learning methods in this process. For example, we must avoid assuming that female students fit into operating intuitively, while male students favor computing and inferencing. Besides, from the horizontal perspective, we must give students the opportunities to experience different functions of various methods

in solving identical problems. Meanwhile, we must unfold the situation that students learn from other students to make up their own insufficiency.

In brief, the gender equality is one of the important aspects of educational fairness, and education is the primary factor in forming children's gender roles. Therefore, we need to cultivate an educational environment for students which convey gender equality. The most important thing is that mathematics teachers and textbook editors should pay attention and reflect gender issues in the current textbooks.

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