

Research on Gender Differences of Mathematics Achievement from the Views of Gender Socialization

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(Received May 19, 2010 Revised August 22, 2010 Accepted August 24, 2010)

The gender differences of mathematics achievement exists in many counties in the world. Some Chinese scholars think that the differences also exist in China. The researchers explain the gender differences of mathematics learning mainly from the individual psychology and education. This paper, firstly, introduces an investigation of the gender differences of mathematics achievement in grade 1–9 in three areas (Hefei urban area, Cuozen area, and Chenji area) of Hefei in China. The investigation found that the gender differences of mathematics achievement exist but are different in these areas. Then, the results are explained from the theory of the gender socialization.

Keywords: gender differences, society and culture, gender socialization, mathematics achievement

MESC Classification: C60

MSC2010 Classification: 97A40

INTRODUCTION

Research on gender differences has always been topic from mid-1970s until now in the international mathematics education community. Although, some researches indicated that the gaps between boys' mathematics achievement and girls' are becoming smaller and even do not exist in some countries (such as the United States and the United Kingdom)(Lim,2008), but some important international mathematics education investigations in recent years showed that the world-wide gender differences of mathematics achievement remain indispensable. For example, all of the PISA's results showed that the gender differences of mathematics achievement exist obviously in many countries. PISA 2000's results showed that boys' mathematics achievement are higher than girls' significantly in more than half of participating countries. PISA 2003's results showed that boys' mathematics achievement are higher than girls' significantly in 27 of 41 participating countries,

and girls' mathematics achievement are higher than boys' significantly just only one country (Iceland)(OECD,2004). In recent PISA 2006, the gender differences still exist evidently in 35 of 57 participating countries (OECD, 2007).

In order to explain the gender differences of mathematics achievement, researchers have proposed a variety of models and found the reasons which lead to the gender differences from different angles. Some scholars explain why girls are not so good at mathematics as boys from the relationships between the features of mathematics and the female biological characteristics; some scholars explain it from boys' and girls' different epistemological characteristics; and others explain it from mathematics teaching contents, methods and assessments. In recent years, that some scholars research the gender differences of mathematics learning from the socio-cultural views has caused people's attention extensively (Xu Yan-li & Cui Chun-xia, 2007). It is to be noted here that, because the gender differences of mathematics education generally referring to girls being inferior to boys in various aspects of mathematics learning, such as achievement, interest and self-confidence, some researchers who hold feminist perspectives do a lot of works in this field (Boaler,1997). Conclusively, existing explains on the gender differences of mathematics achievement can be divided into two categories. One is internal reasons, which explain the gender differences from the cognitive and biological views; the other is external reasons, which explain the gender differences from mathematics curriculum, teachers' behaviours, families, and social and cultural conditions, etc.

In China, the gender differences of mathematics achievement also attract some mathematics education researchers; they generally think that the gender differences of mathematics achievement exist in China. Most researchers explain the gender differences from psychology, and some explain it from education. Although a few researchers point that social and cultural factors are important reasons leading to the gender differences of mathematics learning, "but, their social-cultural and institutional analysis often are vague and lack of concreteness (Zhang, 2006)." So, the research on the gender differences of mathematics achievement from the social-cultural views is very weak in mathematics education research in China.

In this paper, I firstly describe the investigation of the gender differences of mathematics achievement in grade 1-8 in Hefei, Anhui Province, China, then, the results are explained from the gender socialization.

AN INVESTIGATION OF THE GENDER DIFFERENCES OF MATHEMATICS ACHIEVEMENT IN GRADE 1-9

In 2008, the author made an investigation of the gender differences of grade1-8 ma-

thematics achievement in Hefei. Hefei is the capital of Anhui province, located between Yangtze River and Huaihe River. Its area is 7029.48 square kilometers, and the population is 486.74 million. In recent years, Hefei's economic development is fast, the GDP is 1334.2 billion RMB in 2007(1 dollar is about 6.8 RMB). But the development is imbalance; there is still a national level poor county in the region.

The objects of the investigation

The first step of the investigation was to choose objects of the investigation. The author of this paper, based on consultation with some province services departments, divides Hefei into underdeveloped area, developing area, and developed area (Hefei urban area).

For underdeveloped area and developing area, Chenji area and Cuozen area were determined by a random selection. In Chenji area, there is just one junior high school (the Chenji Junior High School), so it was chosen as the investigated high school. The Chenji Center Primary School is near the Chenji Junior High School, because students' number of other village primary schools in Chenji area small, so it also was chosen as the investigated primary school. There are two high schools in Cuozen area; they are the Cuozen First High School and the Cuozen Second High School. By random selection, the Cuozen Second School was chosen as the investigated high school. Considered the students' number of schools, Like Chenji area, the Cuozen Center Primary School, near the Cuozen Second School, was chosen as the investigated primary school.

For developed area, Hefei urban area, based on consultation with the relevant departments, all common high schools in the area, which take out the best and worst high schools in quality from all high schools, were identified. Then, by random selection, the High School Affiliated to Hefei Technology University was chosen as the investigated high school. For convenience, the Primary School Affiliated to Hefei Technology University was chosen as the investigated primary school, because the Primary School Affiliated to Hefei Technology University is near the High School Affiliated to Hefei Technology University, meanwhile, the author consulted the relevant departments to identify the Primary School Affiliated to Hefei Technology University as common primary school in quality in Hefei urban area.

After choosing the investigated schools, the investigated classes were chosen. One class of every grade in every chosen investigated school was chosen by random selection. The chosen classes and their students' number and girls' number are in Table 1. There were 516 students participating in the investigation in Chenji area, which included 247 girls; there were 502 students participating in the investigation in Cuozen area, which included 241 girls; there were 528 students participating in the investigation in Hefei

urban area, which included 245 girls. There were 1546 students participating in the investigation totally, the number of girls participating was 733.

Table 1. Numbers of Students Participating in the Investigation

Chenji area		Cuozhen area		Hefei urban area	
Grade (class)	Number (girl number)	Class	Number (girl number)	Class	Number (girl number)
1 (1)	54 (25)	1 (1)	48 (19)	1 (1)	55 (27)
2 (2)	59 (20)	2 (2)	57 (28)	2 (2)	54 (24)
3 (1)	75 (25)	3 (1)	57 (25)	3 (4)	61 (29)
4 (1)	48 (19)	4 (2)	60 (32)	4 (2)	59 (27)
5 (2)	60 (27)	5 (3)	57 (32)	5 (5)	59 (20)
6 (1)	68 (33)	6 (3)	62 (28)	6 (1)	63 (29)
7 (3)	46 (38)	7 (1)	53 (28)	7 (1)	60 (34)
8 (1)	60 (34)	8 (2)	55 (25)	8 (3)	59 (28)
9 (4)	46 (26)	9 (4)	53 (24)	9 (3)	58 (27)

The method of the investigation

When the investigation began, the schools in Hefei just were in mid-term exam. For convenience, the investigation adopted the results of the mathematics mid-term exam of first term of 2008/09 school years. After the investigated classes' mathematics teachers marked the exam papers and checked carefully, the author computed the average achievement of boys and girls of every investigated class, and computed the differences, which are served as the indexes of the gender differences, between the average achievement of boys and those of girls. If the average achievement of boys is higher than those of girls in a class, the gender differences are positive. Reversely, if the average achievement of girls is higher than those of boys in a class, the gender differences are negative.

Table 2. The Differences of Boy's and Girls' average achievement

Grade	Chenji area	Cuozhen area	Hefei urban area
1	-8	1.42	-0.21
2	-0.2	3.49	-0.86
3	5.1	0.47	-1.71
4	12.97	2.44	0.19
5	9.89	-0.38	-0.94
6	14.81	-2.4	-3.62
7	11.33	2.68	-0.33
8	23.13	4.78	2.39
9	19.15	8.11	2.54

The bigger the differences' absolute values, the bigger the gender differences of mathematics achievement. The gender differences of three areas are in Table 2, and Figure 1 is its line graph.

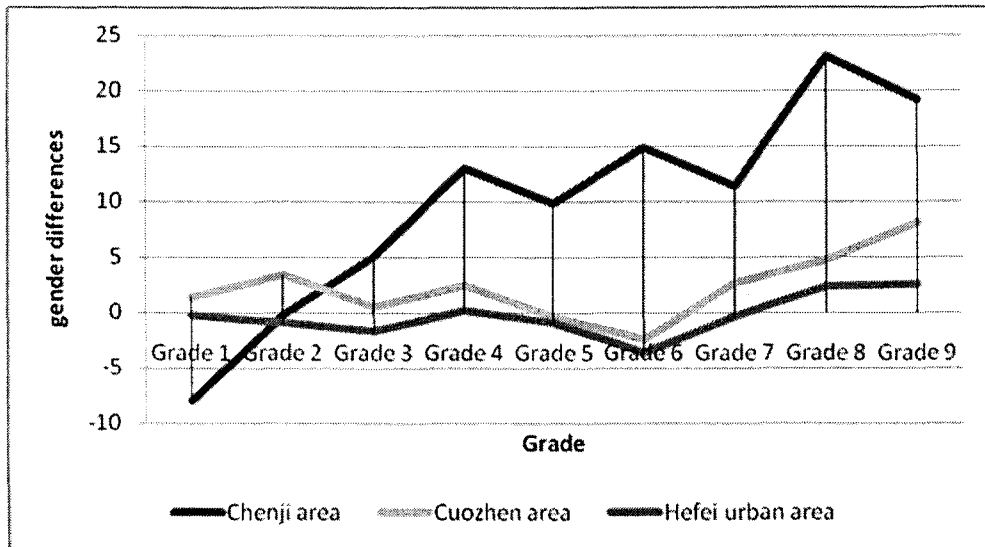


Figure 1. The Line Graph of the Gender Differences of Three Areas

The results of the investigation

The results of the investigation can get from the line graph above, two results are obvious.

First, the mathematics achievement differences of boys and girls of Chenji area become bigger and bigger along with grades increasing. The average achievement of girls are higher than those of boys in grade 1 and 2. From grade 3, the average achievement of boys are higher than those of girls, and the differences between boys and girls are bigger and bigger along with grade increasing on the whole. At grade 8 and 9, the average achievement of boys are higher 20 points or so than those of girls. The gender differences of mathematics achievement in all grades 1–9 are very small in Hefei urban area. From the line graph, the absolute value of the gender differences of mathematics achievement at grade 1 to 7, except grade 3 and 6, is smaller than one, and the girls' mathematics achievement are slightly higher than boys' except grade 4. In grade 8 and 9, although the boys' average achievement higher than girls', but the differences are smaller than 3. Although, the gender differences of mathematics achievement in primary and junior high school stages in Cuozen area are higher than those of Hefei urban area, are smaller significantly than those of Chenji area. From grade 1 to 6, the gender differences fluctuate.

In grade 3 and 6, the absolute values of the gender differences of mathematics achievement even are less than 0.5. In grade 5 and 6, the girls' average achievement are higher than boys'. Only in grade 7, 8, and 9, the boys' average achievement progressively are higher than girls', and the gender difference of mathematics achievement reach the maximum value 8.11 in grade 9.

Second, as for same grade's mathematics achievement, except a few grades, the gender differences are biggest in Chenji area, are smallest in Hefei urban area. The gender differences of the students' mathematics achievement in Cuozen area are between in Chenji and Hefei urban area, but closer to in Hefei urban area. The Figure 2 is the line graph of the every grade's gender differences' differences in the three areas, it is easy to see visually the gender differences' differences among Chenji, Cuozen, and Hefei urban area. From the figure, the gender differences' differences are smaller between Hefei urban area and Cuozen area, and are bigger between Chenji area and Hefei urban area and Cuozen area and Chenji area.

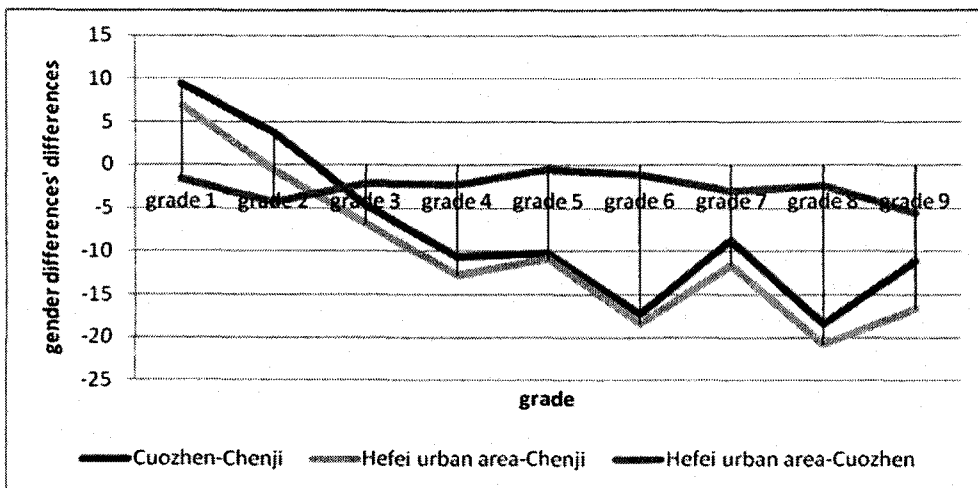


Figure 2. The Line Graph of Gender Differences' Difference in Three Areas

UNDERSTANDING THE RESULTS OF THE INVESTIGATION FROM THE GENDER SOCIALIZATION

From the results of the investigation, like many countries in the world, the gender differences of mathematics achievement exist in China, and it is similar to the results of many Chinese scholars' studies. Then, how do we understand the results of the investigation?

The traditional research on the gender differences of mathematics achievement mainly

take the method of the individual psychology, which emphasized the cognitive processes of mathematics learning, its typical mode is “deficit mode”(Forgasz & Leder, 2001) . This mode thinks that girls are innate “insufficient” in mathematics learning compared with boys. But the socio-cultural views in mathematics education research appearing recently think that the problems and phenomena of mathematics education cannot find answers just from the inside of mathematics education, the mathematics education in certain socio-cultural situation inevitably is effected by socio-cultural factors, to find the answers from the society and culture is a very important way in mathematics education research. So, from the socio-cultural views, to some extent, the gender differences of mathematics achievement are affected by the society and culture.

Chenji area is located at the northeast corner of Hefei, about 80km from Hefei urban area. Its population is about 29.000 in 2007. There are many hills in this area, so, the traffic is relative blocked, and the people’s earning mainly is from the agriculture. Here people are simple and honest, and the traditional Chinese culture is kept very well. Many traditional views, such as “regarding men as superior to women” and “men working outside while women staying at home”, still are recognized by most people. Some mathematics teachers of the Chenji Junior High School made a survey to some parents about gender and learning about two years ago. The results were that the parents thought widely girls maybe get good achievement in some subjects such as Chinese, history, and politics, but are not good at in mathematics. So, the parents’ expectations to girls in mathematics learning are low.

Cuozen area is located in the east of Hefei, just about 20km from the urban area. The population is about 95.000 in 2007. Recently, the development of industry in Cuozen area is relatively fast, there are three industrial districts now. The traffic is convenient, the urban’ public buses can arrive here. Comparing to Chenji area, because of economic development and urban area’s affects, people are more open-minded here. The traditional views, such as “regarding men as superior to women”, have been weakened greatly. Many women work in a variety of vocations confidently.

The economic and cultural development is very fast in recent years in Hefei urban area. Comparing to Cuozen, people here are more open-minded. Women here play the important roles in from government agencies to a variety of enterprises and institutions. “Regarding men as superior to woman” has been given up by overwhelming majority of people.

Children gender socialization is one of most important parts of children socialization. It refers to children forming appropriate man’s (woman’s) value, views, personality traits and behavioral attitudes gradually in children’s growth processes, in which children interact with parents, teachers, other adults, and peers. So, the society and culture in which children live play important roles in children’s gender socialization. The society

and culture affect children by the mediation of parents, teachers, and peers, etc, make the children internalize the demands of the society and culture. To different gender, the society and culture have different demand. To use the language of gender schema theory, the gender socialization of children is to form a schema of about gender views and expectations gradually (Gan, 2007), which affects directly individual thinking and behavior, and makes the different gender individual become the individual the society desires.

From the history, the cultural tradition of man's mathematics learning outperforming woman even can be traced back to the ancient Greece. In the western countries, the mathematics has been thought as men's activities. The western mathematics went into China in the late Qing Dynasty (about in 1900), and the stereotype view of man's mathematics learning outperforming woman came into China with the western mathematics. The view of "superiority of men and inferiority of women" in the Chinese traditional culture enhances the stereotype view of man's mathematics learning outperforming women.

To the children of different areas, such as Chenji area, Cuozen area, and Hefei urban area in this research, they are affected by the views of relationships between gender and mathematics learning in the society and culture around them in the processes of gender socialization. The views will become children's views gradually in the processes of interaction between the children and others, including adult (especially parents and teachers) and peers. Under affected by the views, children will form the corresponding thinking and behavior habits. In one area, if the traditional view of "boys being better than girls" in mathematics learning are recognized by most people of this society, then, the gender socialization will make the girls in this society be more inclined to think that boys are better at mathematics than herself, it will lead to her lack the motivation and confidence to learning mathematics well. If a student lacks the motivation and confidence to learning mathematics well, it is difficult for him/her to get high achievement in mathematics. Contrarily, because of boys forming the view of boys' superior to girls in mathematics learning in his process of gender socialization, it will enhance his motivation and confidence to learning mathematics well, and the motivation and confidence to learning mathematics will affect positively his mathematics learning. From the introduction to Chenji area above, that boys' mathematics learning superior to girls is still the stereotype view of most people in the society and culture of this area. It is not difficult to understand why the boys' mathematics achievement are higher than girls in this area. Inversely, in another area, where the traditional view of boys' superior to girls don't be eliminated but no longer be recognized by most people, the students are not inclined to form gender sense of inferiority and superiority in mathematics learning under such socio-cultural background, then, the factors that decide students' mathematics achieve-

ment are others such as genius, learning methods and extent of working hard, etc. So, the gender differences of mathematics achievement are not obvious under normal condition, this can explain the mathematics achievement of boys and girls in Hefei urban area. There is the third area between above two kinds of areas. In such area, the traditional view of boys being superior to girls in mathematics learning is not a strong culture in the local society but exists to some extent and is accepted by some people. Obviously, Cuozen area has such characteristics. So, it is easy to understand that the gender differences of mathematics achievement in Cuozen area exist but are not striking like in Chenji, but bigger comparing to Hefei urban area.

The gender socialization is a gradual process; the extent of gender socialization is gradual increasing with children ages' increasing. In this process, boys and girls recognize gradually their gender and form special gender characteristics certain society and culture demand, so, their gender socio-cultural characteristics increase gradually. Therefore, even in the socio-cultural situation where boys are thought being superior to girls in mathematics learning, the gender differences maybe are not obvious in primary low grades even in whole primary. But, with grade increasing, up to the primary high grades let alone junior high school stage even senior high school stage, the gender differences of mathematics achievement are obvious more and more. As for when the gender differences of mathematics learning showing obviously, maybe, it mainly depends on holding degree of the stereotype view of boys being superior to girls in mathematics learning by people in the society. So, it is easy to understand that the gender differences of mathematics achievement show obviously in primary stage in Chenji area, that the differences gradually increase from grade 7 in Cuozen area, and that the differences show obviously up to grade 8 in Hefei urban area.

The reasons that lead to the gender differences of mathematics achievement are complex, so, in order to understand completely the gender differences of mathematics learning, it is necessary to research from different angles. Just as some researcher said that all existing gender differences theories of mathematics learning cannot explain the gender differences phenomena completely (Gallagher & Kaufman, 2005). In this research, although, it can explain the gender differences of mathematics achievement better in three areas from the gender socialization, but the explanation is also not completely. For example, it cannot explain reasonably the fluctuation of the gender differences in different grades in three areas. Although the gender socialization theory is not perfect, but the author believes that it can provide a good framework to research the gender differences of mathematics learning, it can help understand the gender differences of mathematics learning more comprehensively and more deeply.

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