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GENDER DIFFERENCES IN PHYSICS LEARNING FOR JUNIOR HIGH SCHOOL STUDENTS

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Abstract- *There is gender differences in the learning process of science courses. We have investigated the differences in physics learning between male and female students while taking junior high physics courses. We used physics test scores to analyze gender differences in physics learning, and designed a simple questionnaire to investigate the physics learning of boys and girls. The results demonstrated that the gender difference of junior high school students is existed, but the gap is not very big.*

Keywords- Gender Differences; Questionnaire; Physics learning; Junior high school students

I. INTRODUCTION

Physics is an experimental-based science. Physics studies the most basic physical structures, the most common interactions of substances and the most general laws of motion. Physics has become one of the most basic subjects in the natural sciences, and it is closely related to many other natural sciences, such as mathematics, chemistry, biology and so on. The knowledge of physics comes from daily life and experiments. However, it has obvious differences from other disciplines. Physics is more theoretical, experimental and logical than other disciplines.

In 1974, Maccoby and Jacklin, who are psychologists of Stanford University, published the book, *The Psychology of Sex Differences*. This book presented an unparalleled synthesis of research findings on gender differences in development [1]. It said that men and women behave more similarly than had been previously supposed. They also proposed that children have much power over what gender role they grow into, whether by choosing which parent to imitate, or doing activities such as playing with action figures or dolls. In the literature on mathematics and science education, inequalities between genders are often defined as lower levels of secondary mathematics and lower enrolment of girls and retention rates for science courses and girls' enrollment and university physics science courses [2]. Numerous studies have investigated the gender gap on these concept inventories and other measures in physics [3-8]. These studies are mainly aimed at college students.

In the course of physics teaching, more teachers find that there are obvious differences between male and female students in physics knowledge and experimental application. These results demonstrated that males have a greater advantage in direct visual spatial perception, while females have a greater hearing ability [6]. Therefore, female students have less spatial cognition and analysis ability to physical movement than male students. In terms of memory ability, male students have better abstract memory and understanding memory than female students. In the physics learning process, female students are more likely to remember mechanical and graphic knowledge, while male students more tend to master practical skills [9,10].

Although gender difference is not the root cause of the difference in students' learn of physics, but it is an indisputable fact that there is a difference in boys' and girls' study. Therefore, we should carefully analyze the cause of the differences, and fundamentally eliminate these differences, in order to fundamentally eliminate the excuses of most of the students, and make them set up confidence in physics learning from source. In this paper, we used physics examination scores to analyze whether male and female students have differences in physics learning, and designed a simple questionnaire to investigate the physics learning of boys and girls. The results demonstrated that the gender difference of junior high school students is universal in physics achievement, but the gap is not very big.

II. THE CONNOTATION OF GENDER DIFFERENCE OF JUNIOR HIGH SCHOOL STUDENTS

Junior high school is the beginning of students' puberty, and the development of secondary sex and the estrangement between the two sexes also appear, so teachers should guide students to correctly view the relationship between the gender relationships. Students' aesthetics, rational thinking and spatial thinking are established and developed in junior high school period, and these abilities are very important and significant for the guidance of the students in learning methods and personal future development.

In terms of sensory perception, women are more sensitive, and they have better sense of touch and smell, and their



hearing ability is also stronger than men. Men, on the other hand, perform better in visual skills. Therefore, when receiving external information, the male's strong visual ability makes up for other deficiencies. Because of the strong visual spatial ability, men can use strong representational ability when receiving foreign objects.

In terms of memory, the female's appropriate memory way is mechanical memory and image memory, and they do not deeply understand the meaning of the memory content, but they just have better efficiency in a short time. Therefore, in the long run, their breadth of knowledge will be worse than boys. But for boys, they usually don't like rote, but they like comprehending and memorizing, and they often cannot accurately memorize the content which needs to be fully memorized, such as Chinese text, so boys and girls have more obvious differences in the memory.

When it comes to attention, the biggest difference between men and women is whether it aims at objects or human. Women pay more attention to people, and they are more sensitive to people's emotional feelings and are vulnerable to be influenced by others' emotions. Therefore, teachers can pay more attention to this aspect in class. Men pay more attention to the objects. Although their attention is easy to disperse, their ability to explore the relationship between objects is stronger. In addition, men are easily distracted in class, so teachers should also pay more attention to this problem, so as to improve their attention through new class method.

In terms of thinking quality, the main differences between male and female students are different types of thinking. Men have stronger abstract thinking ability, and they used to judge, reason, deduce and conclude, while women perform a good image thinking ability, and they have rich imagination, but lack flexibility. In terms of thinking mode, males are accustomed to independent thinking and comprehensive thinking, but they don't pay enough attention to details, while females pay attention to details, but lack the ability to take the overall situation into consideration.

In terms of operating skills, men tend to "objects", and they toys are mostly vehicles, weapons, tools and so on. They like to disassemble and install them so that they can be modified. Therefore, men have strong physical practice ability, and they like to design and operate by themselves, and at the same time, they have a strong creativity. Women, on the other hand, tend to "characters", and they like to animate toys and lack interest in inanimate objects. Therefore, women have poor operating ability, and they are more suitable for verification experiments.

Due to the above differences between male and female students, they have different performance in thought, space, experiment and understanding, but physics learning just needs these capabilities, so their physics learning ability is not the same. In addition, girls are mature one to two years than boys. In elementary school, the teaching material is simple, and the demand is not high, because girls have strong memory ability

and reciting ability, and their development of thinking is ignored. Then by junior high, various subjects need higher and higher thinking ability, and boys are energetic. Although their memory ability is inferior to girls, their analysis induction ability is stronger, so it is easier for them to understand science and engineering subjects. Generally speaking, girls are better than boys in terms of carefulness, seriousness, persistence, etc, but they are less than boys in terms of stubbornness, control, emotional stability, confidence, independence, etc, and these personality traits are very important to solve the difficult problems in physics. Therefore, as the grade increases, the difficulty of learning becomes more and more difficult, and the gap between male students and female students in physics learning becomes larger and larger.

III. ANALYSIS OF GENDER DIFFERENCE IN JUNIOR HIGH SCHOOL PHYSICS LEARNING BETWEEN MALE AND FEMALE STUDENTS

Teachers should fully understand the gender differences between male and female students and start from various aspects to make use of the students' characteristics to improve their learning ability. In order to grasp the status quo of students' physics learning, we used the test scores and questionnaires to analyze the current situation of physics learning of junior high school students.

A. Analysis results of grade table

The monthly test results of grade 7 in an experimental middle school are analyzed, as shown in Table 1. There are 4 classes and 283 students in grade 7, including 159 boys and 124 girls.

Table 1 Average score of physics

	Class 1	Class 2	Class 3	Class 4
Class average score	76.70	74.25	75.18	75.68
Average score of boys	76.11	73.91	75.21	73.31
Average score of girls	77.41	74.67	75.03	78.55
Difference in average score of male and female students	-1.3	-0.76	0.28	-5.24

According to the data in Table 1, the average score of physics in class 3 is quite special, that is, the boys' score is higher than that of girls, and in the other classes, the fact is opposite. The table shows that the gender difference of junior high school students is universal in physics achievement, but the gap is not very big.

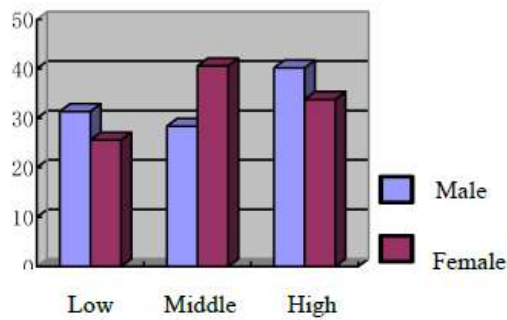


Fig. 1. Scores of boys and girls in different grades

As can be seen from Figure 1, there are fewer girls with high score than boys. (low score section: 1-50, middle score section: 50-85, high score section: 85-100)

B. Questionnaire analysis results

According to the characteristics of gender differences in physics learning among junior middle school students, we designed a questionnaire for 283 students from 4 classes in grade 7 of an experimental middle school. The number of questionnaires issued is 283, and the number of recovered copies is 267. The number of valid questionnaires is 249, including 136 for boys and 113 for girls. The content of the questionnaire is about the influence of junior middle school students' cognitive strategy and gender stereotype of learning motivation, learning style and gender difference on junior middle school students in physics learning.

Question 1: Do you think it will be more difficult for girls to learn physics than for boys? The results of the questionnaire are shown in the Figure 2. Students who chose "yes" and "a bit" are more than boys, so we can draw the conclusion: girls have a more serious sex stereotype about the problem that "girls are more difficult than boys when learning physics".

Question 2: Do physics teachers think it will be more difficult for girls to learn physics than for boys? As shown in the Figure 3, the number of male and female students who chose "yes" and "a little bit" is larger than that of "no", which indicates that the gender stereotype of physics teachers does exist.

Question 3: What is the best time to learn physics in a day? As shown in the Figure 4, both boys and girls chose evening as the best time to learn physics. Early morning and morning came next.

Question 4: What type of physics learning style do you think you are? The results are shown in the Figure 5, The male students' are more likely auditory type and kinesthetic type learning style, and it larger than that of visual type. For female students, the proportion of visual type and kinesthetic type is smaller than the other. Therefore, it is concluded that boys tend to be auditory and kinesthetic, while girls tend to be auditory. This conclusion is consistent with the known research conclusions.

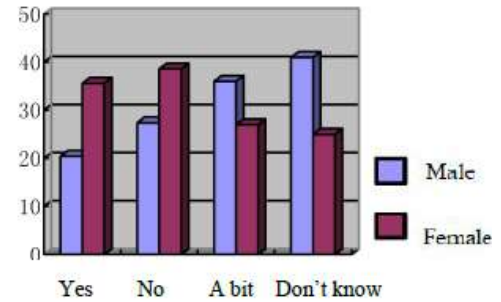


Fig. 2. Students' judgment of gender differences in physics learning difficulties

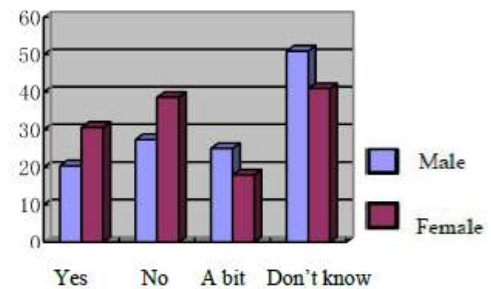


Fig. 3. Teacher's gender difference in students' physics learning difficulties

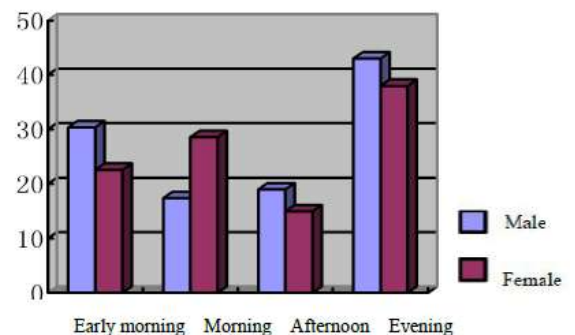


Fig. 4. Student's physics learn time

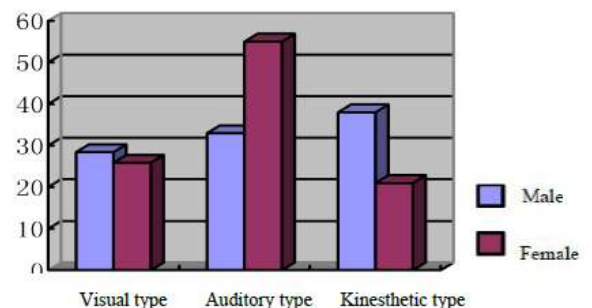


Fig. 5. Student's physics learning style



IV. TEACHING STRATEGIES FOR GENDER DIFFERENCES
IN PHYSICS LEARNING OF JUNIOR MIDDLE SCHOOL
STUDENTS

**A. Overcome the negative effect of gender stereotypes
and help girls improve their confidence and eliminate
inferiority**

First of all, physics teachers themselves should correct the traditional gender bias, and educate students without discrimination, and hold the philosophy that everyone is equal in class, and provide girls and academically poor students with same opportunities to answer questions, so as to let each student be able to obtain learning feedback and help some students establish self-confidence. Therefore, to overcome the negative effect of gender stereotypes, physics teachers should first correct their traditional negative gender bias and gender conception.

Secondly, physics teachers should help girls eliminate inferiority feeling. In the teaching process, physics teachers should actively guide girls to ask questions and solve problems, and introduce some successful achievements of female scientists and politicians consciously, so as to let students know that women are no less attractive and talented than men. Everyone is an independent individual with the capability of will.

Then appropriately and gently communicate with students, and discuss and analyze the reasons for failure, trying to not to make mistakes next time. Then they should point out that although they are not as smart as others, but as long as they work hard, nothing is impossible. Through reasoning and analyzing reasons, the sense of trust of middle school students on teachers is established, so that the students can psychologically resonate and be in an "excited state", and have a tendency to try. Meanwhile, it also helps to foster non-intelligence factors, so as to let them play a leading role in the independent innovation, independence, strong will, perseverance and other creative activities.

Teachers should guide students to correct learning attribution. In the process of physics learning, teachers should focus on students' learning motivation and attribution of success and failure, help students improve their learning motivation, and guide them to establish correct attribution model. Teachers should give students positive attention, arouse their enthusiasm for learning physics, guide them to analyze and summarize the cause of the success or failure of physics learning. If a student thinks that no matter how difficult it is, he must fail, then he will be at a very low level of motivation. At this time, it is necessary for teachers to master the correct grading standards, so as to let students feel it is possible to achieve good grades, but they also need to work hard.

**B. Teaching according to the learning characteristics of
students' different learning styles and cognitive styles**

The knowledge of learners' learning styles may be utilized in many ways to enhance learning and teaching [11, 12]. Students can use their learning styles to help them become better learners, as teachers vary their instructional approach to engage a range of learning styles [13].

In view of the survey results, the best time for middle school students to learn physics is at night, so self-learn at night should be increased, so that the students can learn efficiently. According to the results of perceptual learning style, boys are good at auditory learning style and kinesthetic learning style, and they are accustomed to acquire knowledge by means of hands and ears. Boys like to receive information through television programs, discussions and other forms of spoken language. They usually listen attentively and finish their homework on time, but their disadvantage is that they don't know how to comprehend by analogy, which sometimes may affect them to give full play to potentials.

Kinesthetic learners like to learn through hands and body movements, such as taking notes, marking text books and doing manual work. They don't like to quietly listen to the teachers, and they are not good at speaking, but this kind of students performs well in physical education and extra-curricular activities, and these learners tend to be more reliable. If they focus on one thing, they will get good grades in the matter. But because they are emotionally unstable, cold, energetic and enthusiastic about things, they tend to dissipate their energy and achieve nothing. According to the above situation, teachers should pay attention to the following several aspects:

In teaching process, teachers should pay attention to cultivating girls' ability to solve problems and deal with problems independently, as well as the habit of asking questions and thinking positively.

Most girls learn by ears. In the teaching process, teachers should pay attention to cultivate students' ability to independently solve problems and deal with problems, and ask them to consider more about their own ideas rather than asking others when meeting problems that they do not understand or cannot solve, or they should seek answers through looking up information and the network. Only when they really can't solve the problems can they ask others for help.

At the same time, teachers should also pay attention to the questions put forward by students and cultivating their diligent and positive thinking habits. Loose and equal classroom atmosphere is conducive to students' learning, and teachers should create a good classroom atmosphere in the classroom teaching, so as to guide students to actively think, and provide students with sufficient opportunities to put forward and solve problems through a variety of ways to let the students fully involve in the classroom. Therefore, the learning difficulties encountered by the students can be timely solved, in order to avoid the accumulation of problems.



Attention should be paid to the cultivation of boys' attention quality in teaching process. Boys are the majority among kinesthetic learners, who tend to have poor attention quality. Therefore, teachers should pay attention to cultivating students' attention in teaching process. In the classroom teaching, teachers should pay attention to students' attitude towards learning, and take advantage of a variety of ways to motivate the students' interest, in order to make students improve concentration for the sake of interest and then improve their academic performance. In addition, in classroom teaching, teachers should pay attention to improving the fun and applicability of the class, so as to maintain students' long-term attention and help to cultivate their habit of "sitting well".

C. Strengthen the teaching of physics experiments, improve students' learning confidence

According to the characteristics of perceptual learning style and the theoretic analysis of field independence and field dependence cognitive style, it is found that female students have better image thinking, while male students have better abstract thinking. Because female students lack physical situation guiding physics learning, they feel it is difficult to learn physics, and thus lose the confidence to learn physics.

In the physics teaching process, teachers should create a variety of reasonable physical situations as far as possible, so as to make the students especially female students be able to set up a corresponding scenarios in their mind, understand the nature of things with the image of the things, and connect the abstract concepts, laws and physical process with specific things. Through the life phenomenon displayed by multimedia, the abstract content is materialized, so that the female students can feel and experience and easily master physical laws in the physical situation.

D. Teaching strategies based on pre-concept

Learning a new knowledge is to integrate the old knowledge in the mind into the new knowledge, which is also the theoretical understanding of constructivism.

Female students' ability to accept new things is weaker than male students, and their abstract thinking ability is also not as strong as male students. Some abstract concepts in the high school physics, such as density, inertia, specific heat capacity, heat value and so on are difficult to understand. Therefore, physics learning should let the students fully penetrate into the real life and let them accumulate experience in life. In addition, teachers should guide students to build new knowledge structure on the basis of original experience and form scientific concepts. In other words, students should follow the law of age when learning scientific knowledge.

Girls are more imaginative when analyzing and solving problems and they are often influenced by inertial thinking. Fixed thinking has both positive and negative effects, and it makes us easy to establish a rigid, mechanical, monotonous habit of solving problems. Therefore, if teachers want to make

students get rid of this mistake, they must guide them to practice divergent thinking.

E. Cooperative learning strategies for male and female students

In modern society, cooperative learning has become a teaching method which is widely used in all subjects' classroom teaching. Due to the characteristics of physical teaching materials, there are many kinds of experimental inquiry, so cooperative learning can play a greater role. A growing number of teachers also begin to focus on group collaborative learning methods based on gender. How to explore the advantages of cooperative learning between male and female students from the perspective of gender will bring new ideas to reducing the physical and physiological differences between male and female students.

V. CONCLUSION

The requirements of physics itself make male and female students have bigger differences in physics learning. We used physics examination scores and questionnaire to analyze the gender differences in physics learning. These results demonstrated that the gender difference of junior high school students is universal in physics achievement, but the gap is not very big. As we have studied, there are gender differences in the physics learning process between boys and girls. If students want to learn science subjects such as physics well, they are required to have certain logic thinking, be able to analyze and judge problems with reasoning experimental methods, and have a certain spatial thinking and abstract thinking ability. The abilities are the foundation of learning physics well, and the students are required to have and be able to use these abilities, and in physics learning process, due to the physiological characteristics of female students, and their abstract logical thinking is not mature, so they cannot fully understand and master corresponding knowledge in the physics learning process. In the process of physics teaching, according to the physiological and cognitive characteristics of boys and girls, various effective teaching strategies can be adopted to narrow the difference in physical learning between boys and girls.

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