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On the Moral Education of High School Students in Mathematics Teaching from the Perspective of Mathematics Culture

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Abstract **– Whether students have good moral character is an important factor in their success, so the task of school is not only to teach knowledge, but also to attach importance to the moral education of students. Mathematics is an important course in subject teaching. Mathematics teachers should maximize the moral qualities, thoughts and emotions covered in mathematics. Use mathematics to educate students on moral education. However, mathematics culture runs through the whole system of Chinese high school mathematics education, which contains rich educational thoughts. Therefore, this paper sets out from the following two connotations of mathematical culture given in the 2017 edition of general senior high school mathematics curriculum standards in China: The first is the thought, spirit, language, method, viewpoint of mathematics, and their formation and development; Second is the contribution and significance of mathematics in human life, science and technology, and social development, as well as the humanities activities related to mathematics. This paper puts forward the ways of cultivating moral education in Chinese high school mathematics teaching from many angles.**

Keywords **– Moral Education, Mathematical Culture, High School Mathematics, Mathematical Thought, Mathematical Activity.**

I. Mathematical Culture and Moral Education

Moral education in schools refers to the purposeful and planned education of students in ideological, political, moral and psychological aspects [1].

The new encyclopedia britannica, published in the 1980s, divided human cultural knowledge into six categories: logic, mathematics, science, history, the humanities and philosophy [2]. The current state of basic education is that math has become the science we learn the longest. Everyone cannot do without mathematics [2]. Mathematics, as a natural and separate discipline, has become "common sense" that is closely related to life and surrounds us.

According to the general senior high school mathematics curriculum standards published by China in 2017, one of the basic concepts of math education in high schools is that “to develop students talents and morality, and improve literacy.” That is: “High school mathematics curriculum is based on the development of students, the implementation of the basic task of moral education, the cultivation of scientific spirit and innovative consciousness, and enhances the core literacy of mathematics.” This tells the majority of high school mathematics educators: at this stage, China not only to cultivate high knowledge of talent, more is to focus on students both moral and ability. It is impossible for teachers to teach students all kinds of knowledge they need in their lifetime, and many knowledge and life skills need to be explored and discovered by students themselves. Therefore, it is necessary for teachers to pay attention to and attach importance to the moral education of students and have the consciousness of cultivating people by moral education. After enabling students to have virtue, they can use virtue to aid their studies and become high-quality, high-level talents required by the country and society. It can be seen from the above that the moral education of students is very important and urgent. Therefore, teachers can integrate

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moral education into mathematics education and cultivate students' formation and development of moral education through mathematics imperceptibly. This is also the basic requirement for the 2017 edition of the Chinese general senior high school mathematics curriculum standard.

In mathematics education, the majority of mathematics educators in China have done a lot of research on the methods and ways to improve students' moral education and put forward different strategies. Through searching and reading related literature, it is found that most authors either base on the content of textbooks or study the promotion and cultivation of moral education in mathematics teaching from the perspective of teaching practice. Or study the importance, significance, and value of mathematical culture. However, it is rare to combine the two to improve students' moral education from the perspective of mathematical culture. Therefore, this paper will discuss the moral education of high school students from the perspective of mathematical culture.

In the 2017 edition of the general senior high school mathematics curriculum standard, Chinese mathematics courses are divided into compulsory courses, optional compulsory courses, and elective courses. The content of the senior high school mathematics curriculum highlights the four main lines of functions, geometry and algebra, probability and statistics, mathematical modeling activities, and mathematical inquiry activities, which run through the compulsory, selective compulsory, and elective courses. And pointed out: the mathematical culture is integrated into the curriculum content. It gives the specific explanation of mathematical culture: mathematical culture is the thought, spirit, language, method, viewpoint of exponential science, as well as their formation and development; it also includes the contribution and significance of mathematics in human life, science and technology, and social development, as well as human activities related to mathematics. The integration of mathematics culture into the content of the curriculum means that although the mathematics culture has not been separated into lines, it has consistently implemented the entire high school curriculum, which is an important part that cannot be underestimated. This also reflects the importance of mathematical culture from another aspect. Therefore, it is reasonable to improve students' moral education from the perspective of mathematical culture.

The following describes the cultivation of students' moral education from two aspects of mathematical culture: the mathematical and spiritual perspective of mathematics, and the contribution of mathematics to human life, science and technology, and social development.

II. Improving Students' Moral Education From Mathematical Thoughts And Spirits

The so-called mathematical thought "refers to the result that the spatial form and quantitative relationship of the real world are reflected in people's consciousness and produced through thinking activities". The so-called mathematical spirit "not only refers to the concentrated representation of the intentionality such as thinking mode, behavioral norms, value orientation and ideal pursuit of human beings in mathematical activities, but also refers to the product of continuous generalization and internalization of human beings' mathematical experience, mathematical knowledge, mathematical methods, mathematical thoughts, mathematical consciousness and mathematical concepts. It can be seen from above that mathematical thought is not only the thought in mathematics, but also an important part of human thought. Good thinking is an important embodiment of one person's behavior and emotional methods, and plays a positive role in promoting the development of people. The spirit of mathematics is not only the spirit related to mathematics. The correct use of mathematical spirit can also

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develop other spiritual aspects of humankind. For example, the spirit of mathematics helps to the formation of people's values and concepts of right and wrong; Help people see and solve problems from a mathematical perspective; Set up the world feelings and national consciousness; Innovative thinking and strong character. In short, both mathematical thinking and mathematical spirit provide us with a more flexible way of doing things and a more responsible attitude. For students who are still studying, high school stage is the key period for them to form their moral character and emotional attitude. The process of using mathematical thoughts to promote students' moral education is a problem of moral education in Chinese school education. Therefore, teachers can start to improve students' moral education from the perspective of mathematical thought and spirit. Specifically in teaching, students are teacher-oriented. In the same way, the wonderful anecdotes between those famous mathematicians and mathematics as well as the development process of mathematics have certain guidance to the development of moral education of Chinese students. Specifically in content, as an aspect of mathematical culture, mathematical thought and spirit are largely embodied by the history of mathematics in practical content.

The history of mathematics, in short, is the history of the development of mathematics. It is the history of the basic law of the generation, transformation and development of mathematical knowledge [3]. To be specific, it is to trace back the production, transformation and development of mathematical knowledge and explore the influencing factors that produce these processes. And the impact of mathematical development on human historical civilization [3]. Therefore, the history of mathematics contains a large number of mathematical ideas, spirits, methods and opinions. The famous Japanese mathematics educator Miyama Kokura once pointed out in "The Spirit, Thoughts, and Methods of Mathematics": "Teach students mathematical knowledge, and students' memory of mathematical knowledge cannot be used for life, but the spirit of mathematics is engraved in students' minds. And applying the logic of mathematical thinking, methods, and reasoning to various fields of study is the real performance of benefiting for life." [4]

A. *Moral Education in "After-Class" Content*

What is referred to here as "after class" content is not collected by students themselves after class, but refers to the part of the textbook after the explanation of the knowledge, before the summary and the content of the exercises. Taking the high school mathematics textbook published by the People's Education Press of China as an example, there are many small mathematical stories in the book. They are the embodiment of the history of mathematics, with the column of "Reading and Thinking" as the carrier, running through the whole set of textbooks. The editor hopes to inspire the students' interest in learning mathematics through such a small case of invention and creation by mathematician, or a history of mathematics related to the generation and origin of knowledge. Through the power of role models, students can realize the value of life, and at the same time inspire their patriotic feelings and self-reliance. In actual teaching, the "Reading and Thinking" behind these books is not paid enough attention, and often even ignored by teachers, resulting in these contents not playing their due role. Therefore, teachers should first pay attention to these "after-class" content, and then talk about the correct use of these mathematical stories behind the book. In fact, these contents can not only advocate the correct values, help improve the personality quality, improve the noble emotional attitude, but also expand students' knowledge horizon. No matter from any aspect, it is the cultivation and promotion of students' moral education.

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Table 1. The Number of "Reading and Thinking" in the Compulsory Series of Senior High School Mathematics Textbooks Published by China People's Education Press.

Series	Number of "Reading and Thinking"
Compulsory one	four
Compulsory two	four
Compulsory three	eight
Compulsory four	four
Compulsory five	four
Total	twenty four

According to the above table, most of the "Reading and Thinking" in Chinese textbooks are small mathematical stories between mathematicians and the generation and development of related knowledge. Of course, there are also a few mathematical stories that are closely related to the needs of actual life development. Although these contents are after the knowledge of mathematics, teachers can use 2-3 minutes after speaking the knowledge points in the class to simply read and share their insights with the students. We often say that now is an era with students as the main body, and we can't "cramming education". Therefore, teachers should try to allow students to learn independently and summarize by themselves; Digest knowledge in its own way, understand and use it; Leave more "blank" time in class for students to think, instead of talking too much and telling them everything. Therefore, in the classroom teaching, if we can end the teaching with such extended reading that is full of exploration and guidance, it will not only stimulate students' enthusiasm and longing for learning mathematics, but also leave more space for students. After acquiring knowledge, students can sublimate their moral character: Let students understand the philosophy of life, perfect their own concepts, gain profound inspiration, and shape good qualities through different mathematical stories; Let the students fly freely in the broad sky of mathematics, finally eager to look forward to the arrival of the next math class.

Another example is the famous sayings interspersed in Chinese mathematics books, which can also bring students unlimited ideological power and help them to grow healthily in ideology. For example, when learning geometric sequence, zhuangzi's sentence in "Zhuangzi-The world" is used in the textbooks published by the People's Education Press of China: "a hammer of one foot can be used half of it every day, and it will never be exhausted." to inspire students. This sentence means to take half a foot of wood every day and never finish it. This dialectic point of view, which covers the infinite in the finite, corresponds to the limit thought in mathematics, which makes students realize the wisdom and greatness of the Chinese nation. Provide opportunities to further cultivate their arduous, industrious and brave, unremitting self-improvement of the national spirit [5].

B. *Using Mathematical Masters to do Moral Education after Class*

In China, although there are many interesting and touching stories about mathematics in math books, there are still many famous mathematicians and their deeds are not detailed or mentioned. These stories can also inspire and enlighten students. They have important educational functions for students and cannot be ignored. Therefore, teachers can ask students to collect the relevant parts of some famous mathematics masters in math books by themselves after class. Share and supplement each other with 2-3 minutes before class to achieve the purpose of

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moral education.

Mathematicians have different growth paths for studying and studying mathematics. Almost every student can find his own growth shadow from the biography of mathematicians [2]. The power of role models is endless, and "people-oriented" can exert the greatest benefits from this [2]. For example, from the achievements of ancient Chinese mathematician Gauss and his skill of adding and summing in reverse order, we can understand the mystery and symmetrical beauty of mathematics. Stimulate students' divergent thinking, and experience things from both positive and negative perspectives; We can also teach the poem "combination of Numbers and shapes" by Luogeng Hua, a famous Chinese mathematician, or the story of Shuang Zhao, a mathematician of the three Kingdoms period in ancient China, who skillfully proved the Pythagorean theorem by using "string diagram", or the combination of Yang Hui triangle and binomial theorem to help students understand the idea of "combination of Numbers and shapes" and solve problems; By introducing the "Goldbach Conjecture" proof method of Jingrun Chen, a well-known mathematician in China, to stimulate students' interest in mathematics and to appreciate the wisdom and talent of Chinese mathematicians in mathematics [5]. Let students use the fine traditions and great deeds of historical figures as a benchmark for establishing their own moral cultivation, so as to build the Chinese nation's pride and awe in mathematics. Moral education is not a cramming indoctrination for students, nor to establish the code of conduct for students, but to carry out ideological education for students [6]. Therefore, teachers can take advantage of the growth experience and learning process of mathematicians in our country to make students adore mathematicians and scientists. Let students understand that everything is difficult and achievement is not easy. Only by earnest study and hard work can you make a difference. Tell students to respect the hard work results of others and develop good living and learning habits. It is also necessary to develop good qualities that have perseverance and are not afraid of hardships. Let students courageously look for the direction of life.

III. Promoting Moral Education of Students from the Contribution of Mathematics in Human Life, Science and Technology and Social Development

Mathematics plays an important role in actual production and life. It is an important foundation for the development of science and technology, and it is also the backbone of the progress of our country and society. Therefore, mathematics is closely related to social production. As a major social group, human beings in the environment of social development are always in contact with all kinds of things that are closely related to mathematics, and it is also the use of mathematics to transform the world. Therefore, teachers can look for the important application and main contribution of mathematics in science and technology and life, and use the close relationship between mathematics and life to improve students' moral education. Let students have the great desire and spiritual quality to change the world for the Chinese society and strive for the great rejuvenation of the Chinese nation.

A. *Using the Content Related to Reality in Textbooks to Carry Out Moral Education*

In the high school mathematics textbook of the People's Education Press of China, the quotations at the beginning of some chapters are usually related to human life and social development, and some examples to consolidate knowledge are often closely related to science, technology and practical situations. This shows that Chinese mathematics education attaches great importance to linking mathematics with actual life. Therefore, mathematics teachers cannot break and isolate mathematics teaching content from life. Teachers should

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understand the editor's intentions, and use practical situations to cultivate the spirit of applying what they have learned in order to reflect the scientific, applied, and cultural values of mathematics. Not only that, in China's college entrance examination questions in recent years, the situational and life-based questions related to historical changes and human civilization have also increased significantly, and the proportion of scores has been rising. The change in the design intention of the test questions reflects the difference between “exam-oriented education” and quality-oriented education. This is also the transition from “exam-oriented education” to quality-oriented education in China, and it is the country that makes a difference. Therefore, teachers should be clear about the national education and training plan, and pay attention to the use of situational examples in books to cultivate students' moral feelings and cultivate young persons with morality.

For example, the quotation of first chapter-solving triangle, which is in compulsory five of the mathematics textbook for senior high school mathematics published by People’s Education Press of China, the textbook editors use example of Change to go to the moon to guide students to think about the distance between the earth and the moon; Introducing practical issues such as land height measurement and sea island measurement from navigation and astronomy topics. And all of these things can actually be solved by solving triangles. And all of these things can actually be solved by solving triangles. The editor not only connects mathematics with science, but also realizes the intersections of various disciplines through chapter head quotations. Effectively cultivate students’ consciousness of using mathematics to solve problems encountered in life and the spirit of assiduous study in order to solve problems.

Other examples in Chinese textbooks are as follows: Designing examples with tax rate problem when learning the sequence; Designing examples with computer problem when learning algorithm; Designing examples with the lowest cost and the nearest route when learning maximum and extreme value; Designing examples with winning and losing problem when learning probability; Using waiting time of marine cargo as background to design examples when learning linear programming, etc. Such situational problems can also enable students to experience the culture of mathematics, and effectively promote the formation and development of Chinese students’ moral education.

B. *Using Mathematics Extracurricular Activities to Carry Out Moral Education*

Many mathematical knowledge, such as the generation of negative numbers and complex numbers, the origin of probability, and so on are due to the needs of life and production at the time, and people were forced to use it to create it. First of all, it requires a certain life experience; secondly, it also requires a certain ability to find problems, and the self-confidence and creativity to solve problems. Teachers can actively organize some mathematics extracurricular activities suitable for Chinese students to participate in, so that students can discover mathematical materials from real life, in order to cultivate students’ social practice ability and communication skills. At the same time of forming good moral quality, we can also cultivate the “Four Abilities” and “Three Can” of the students mentioned in the 2017 curriculum standard through extracurricular activities. That is, to improve the ability to find and put forward problems, analyze and solve problems from a mathematical perspective. Can use mathematical vision to observe the world; Can use mathematical thinking to think about the world; Can use mathematical language to express the world. The emergence of all new things begins with questioning. As long as we have the courage to break the routine and the spirit of earnest verification, we can become builders and promoters of national development and social progress in the new era and contribute to China’s future. This kind

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of ability is also one aspect of moral quality, so this process is actually the cultivation of moral education for students.

After performing extracurricular activities in mathematics, teachers can let students write social practice reports, or after explaining math knowledge with educational significance, teachers can let students write small mathematical essays such as mathematical diaries and popular science reports. While writing, students make their own understanding and value selection of the spiritual civilization and material civilization, which is also an important way to improve students' moral education.

IV. Conclusion

China's "Middle School Outline for Moral Education" states that "moral education is the responsibility of each teacher in the teaching content and process of various subjects." As an important course in all disciplines, mathematics is an important way to train students' moral development. The new curriculum standard requires teachers to carry out effective moral education penetration in the course of senior high school mathematics teaching [7]. This also points out that in China, mathematics teachers are duty-bound to cultivate students' moral education. As for the numerous ways to cultivate moral education in senior high school mathematics education, this paper mainly talks about how to cultivate moral education for students from the two perspectives of mathematical culture proposed in the 2017 version of the general senior high school mathematics curriculum standards in China. Textbooks are the main and important carrier for transferring mathematical knowledge. Therefore, teachers should be good at using textbooks to convey excellent ideological qualities and moral sentiments to students. Carrying out ideological, spiritual, and civilized construction for students, rooting the good morals of mathematicians who love the motherland, self-improvement, and dedication in their minds, forming a model force. It is also very important for the practice of mathematical life outside textbooks. These activities can train students' will and character, study spirit and mathematical thinking ability. And having strong mathematical thinking is also one of the important characters for students to succeed in the future.

To sum up, mathematical culture can effectively carry out moral education for students. Mathematics teachers in China should be good at using the mathematics culture that runs through the high school mathematics system to promote the development of students' moral education.

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