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Reflections on the Cultivation of Mathematics Normal Students Based on Mathematical Modeling Literacy

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Abstract: *Mathematical modeling literacy is one of the six core literacies of mathematics. Cultivating students' mathematical modeling literacy is an important work of middle school mathematics teaching which can develop students' innovation ability. As future middle school mathematics teachers, mathematics normal students need to have a high level of mathematical modeling literacy. In this paper, the measures that need to be taken in the teaching of mathematical modeling courses in universities are given, which focus on exploring the strategies of optimizing the teaching of mathematical modeling and constructing a new classroom teaching model that organically combines the traditional and innovative ones. The new teaching model can make classroom teaching full of vitality and improve students' mathematical modeling literacy and innovation ability. It is also necessary to pay attention to the improvement of students' ability to teach modeling content in middle school, while cultivating the mathematical modeling literacy of normal students.*

Keywords: *Mathematical modeling literacy, Mathematics normal students, Teaching ability*

1. Introduction

In February 2018, the Central Committee of the Communist Party of China and the State Council issued the “Opinions on Comprehensively Deepening the Reform of the Construction and Reform of the Teacher Team in the New Era”, which is a milestone policy document for the construction of the teacher team since the founding of the People's Republic of China. Colleges and universities shoulder the important task of cultivating all kinds of talents for the country and society. For the normal majors in colleges and universities, the main task is to train future teachers. The quality of normal students directly affects the quality of basic education in China. And the quality of mathematics normal students training is more prominent than other disciplines in today's rapid development of science and technology.

Mathematics, as a basic instrumental discipline in the natural sciences, has always played an important role in promoting the development of science and technology. In recent decades, with the development of computer technology, mathematics not only plays an important role in the fields of engineering technology and natural science, but also penetrates into new fields such as economics, management, finance, biology, and medicine with unprecedented breadth and depth.

When it comes to a practical problem that need to be solved by applying mathematical knowledge, what we should do first is to describe the essence of the problem in the language of mathematics, such as mathematical symbols, mathematical formulas, programs, etc., which is called mathematical models. This process of abstracting and refining mathematical models from practical problems is called mathematical modeling. Regardless of whether the research is in the field of science and technology or the problem in interdisciplinarity, the establishment of mathematical models for the actual problems studied is the primary and most critical task to solve problems with mathematical knowledge. Undoubtedly, cultivating students' mathematical modeling ability is not only a direct way to develop students' innovation, but also one of the basic objectives of education and teaching.

The 2011 edition of the Mathematics Curriculum Standards for Compulsory Education mentions that "In the mathematics curriculum, attention should be paid to the development of students' number sense, symbol awareness, spatial concept, geometric intuition, data analysis concept, calculation ability, reasoning ability and model thinking" [1]. Among them, the establishment of "model thinking" is the basic way to experience and understand the connection between mathematics and the external world, which is one of the significances for cultivating students' model thinking in the compulsory education stage.

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The 2017 edition of the high school mathematics curriculum standards clearly states that mathematical modeling literacy, mathematical abstraction, logical reasoning, mathematical operation, intuitive imagination, and data analysis are called the six core literacies of mathematics. Through the cultivation of mathematical modeling literacy, students can master the process of mathematical modeling, accumulate experience about expressing problems in mathematical language. All these can be benefit to improving students' application ability and innovation awareness. So, we should realize that we must pay attention to infiltrating mathematical modeling ideas as soon as possible, even in secondary school mathematics classrooms.

In December 2019, the Examination Center of the Ministry of Education released the "China College Entrance Examination Evaluation System", which determined the overall framework of "One Core, Four Layers and Four Wings". Then the transformation of the college entrance examination is realized that is from a simple examination evaluation to an important carrier of moral cultivation and quality education. Among them, the "Four Layers" are the examination content of the college entrance examination, that is, "Core Values, Discipline Literacy, Key Abilities, and Necessary Knowledge". The discipline literacy is one of the examination contents, which must be paid attention to. For the discipline of mathematics, the applicability is the ability to flexibly use the knowledge learned to solve practical problems, which is directly reflected in the students' mathematical modeling literacy. And the mathematical modeling process is also the process of comprehensive application of multidisciplinary knowledge, which plays a pivotal role in cultivating students' innovation.

2. The current situation of mathematical modeling teaching and the significance of the cultivation of mathematical modeling literacy among college mathematics normal students

2.1 Research status of mathematical modeling

In order to adapt to the development of science and technology and cultivate high-quality and high-level talents, mathematical modeling has been gradually carried out in university education all over the world. More and more universities have set up the courses of mathematical modeling and participated in some open mathematical modeling competitions. Meaning the while, much more importance to mathematical modeling teaching and competition as an important aspect of teaching reform and training of high-level scientific and technological talents are given in colleges and universities. For example, the National Mathematical Contest in Modeling, founded in 1992, has become the largest basic discipline competition in China, attracting the participation of many universities including Hong Kong, Macao and Taiwan. Many colleges and universities are combining mathematical modeling with teaching reform, striving to explore more effective mathematical modeling teaching methods and new ideas for cultivating talents for the 21st century. In addition, the American Collegiate Mathematical Contest in Modeling, sponsored by the American Federation of Mathematics and its Applications, is the only international mathematical modeling competition. It is also the most influential mathematical modeling competition in the world. The United States, Canada and other countries emphasize the applicability of mathematics in mathematics teaching. While the mathematical modeling can best reflect the applicability of mathematics. Generally, in these countries teachers have infiltrated mathematical modeling ideas in teaching since primary school, and students' mathematical modeling literacy is relatively high.

2.2 Problems and current situation in the teaching of mathematical modeling in secondary schools and universities

In order to cultivate the mathematical modeling ability of middle school students, teachers should not only have a high level of mathematical modeling literacy, but also be able to guide students to use modeling ideas to solve practical problems during the class.

Although the high school mathematics curriculum standards propose to carry out mathematics practical activities in middle school class, the middle school mathematics classroom is still mainly based on the traditional teaching mode, and few mathematical modeling activities are carried out. In addition, the current high school mathematics textbooks intersperse the content of mathematical modeling in various units, most of which exist in the form of mathematical application problems. Although this kind of curriculum design can enable students to achieve the purpose of consolidating their learning with the mathematical knowledge they have learned, there are many drawbacks, such as the content of mathematical modeling related mathematics courses is isolated, and students feel that they cannot use the knowledge learned in high school in real life. All these result in students' application awareness and

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application ability are relatively weak [2].

The number of teaching cases of mathematical modeling in high school is relatively small, and mature and effective modeling examples need to be developed urgently. At present, most of the domestic dramas focus on the theoretical research of mathematical modeling. Some studies are about the current situation of mathematical modeling ability in middle schools, but there are few studies on the teaching of mathematical modeling in the classroom and the measurement of its effect. Only through teaching practice can the abstract mathematics core literacy be implemented into the classroom, and the students' mathematics core literacy can be cultivated [3].

For many years, China's college entrance examination system is only a simple examination evaluation. And the traditional classroom teaching in middle schools has neglected the cultivation of students' innovation ability because of the one-legged requirements of the college entrance examination, which is manifested in the fact that students can only do questions and cannot flexibly apply the knowledge they have learned to solve real-life problems. That is, mathematical modeling literacy is lacking for most middle school students.

On the other side, most middle school teachers lack the training in mathematical modeling during their own study period. Their mathematical modeling literacy needs to be improved. they cannot fully carry out teaching, which has a great impact on the cultivation of middle school students' modeling ability. Definitely, this lack will affects the development of students' innovation ability in the long run. And it is not conducive to the cultivation of talents. According to the survey (Jinan City, for example), there are very few secondary schools that can offer mathematical modeling courses, except for a few key middle schools with high teacher qualifications. Even when mathematical modeling courses are offered, they are in the form of school-based classes, with very few hours in a semester. And some of them end up being mere formalities for various reasons.

In addition, as the cradle of training future middle school mathematics teachers, colleges and universities with mathematics teacher training majors have a profound impact on the quality of secondary school mathematics education in China. At present, the situation is that although colleges and universities (Shandong province for example) have mathematical modeling courses, most of them are set as elective courses. And some students do not realize the importance of mathematical modeling literacy cultivation and do not take this course. Furthermore, this course has less mathematical hours, generally one credit, about 18 class hours. Such a small class time cannot ensure that students have an in-depth understanding of mathematical modeling. Because there is no sufficient time for practical training, the effect on improving students' mathematical modeling literacy is not obvious.

For a long time, in the process of skill training for normal students, the selection of the content of the teaching trial lecture is basically the concept, nature, and theorem, which are mostly manifested in the other five literacies in addition to the mathematical modeling literacy. The selection of training content is not comprehensive, which leads to the neglect of students' teaching skills in mathematical modeling knowledge. This situation of lack of teaching skills training needs to be changed.

To sum up, the current college entrance examination evaluation system has taken students' mathematical modeling literacy as an important point of investigation in mathematics. And the new curriculum standards for middle schools also require teachers to have high mathematical modeling literacy. The understanding of cultivating normal students in cultivating students' modeling literacy needs to be further improved. There is still a lot of work to be done in this regard. And this problem will inevitably affect the talent training and education quality of our province if it is not solved.

2.3 The significance of the cultivation of mathematical modeling literacy for normal students

Among all the core literacy of all disciplines, the improvement of mathematics core literacy is of great significance. The new senior secondary curriculum standards point out that teachers should focus on improving students' core literacy in mathematics, stimulating students' enthusiasm for learning, providing students with opportunities to fully engage in mathematical activities, and helping them understand and master basic mathematical knowledge and skills, mathematical ideas and methods in the process of independent exploration and cooperative communication. Students can gain extensive experience in mathematical activities. Due to the influence of entrance examinations and traditional concepts and practices, there is still a great deal of shortcomings in mathematic class, such as not emphasis on students in teaching, students being in a passive state, and ignoring the cultivation of innovative consciousness, innovative spirit, and innovation ability [4].

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In this context, as a normal major for training future teachers, we start from the reality of teaching and the training of qualified teachers to strive to improve the comprehensive teaching ability of normal students through the research on the cultivation of mathematical modeling literacy of normal students, exploring the ideas and strategies of cultivating qualified normal students for primary and secondary schools. This is of great practical significance for improving the effectiveness of college mathematics curriculum reform, improving students' own quality, and promoting their professional development.

2.4 Measures taken by colleges and universities in the teaching of mathematical modelling

In order to improve the teaching ability of normal students, especially in cultivating the mathematical modeling ability of middle school students, we need to do the following work in a hierarchical manner.

Firstly, we should systematically cultivate students' mathematical modeling literacy, study how to ensure that students can systematically learn the basic knowledge of mathematical modeling in a limited number of hours. And we have to research what measures should we take, how to select teaching content, and how to reform teaching methods and methods.

Secondly, in the process of training conventional topics, we should pay attention to observing and thinking about what practical problems such as social life need to be solved in your own area. we will collect, analyze, and sort out these problems to form a case library, so as to improve students' enthusiasm for learning mathematical modeling through these topics closely related to reality. We not only let students participate more in the classroom, but also imperceptibly improve the mathematical modeling literacy of normal students. Let students experience the sense of achievement of applying what they have learned, and use what they have learned to serve the society. I believe the students will realize the educational goal of "cultivating people with virtue" finally [5].

Thirdly, according to the actual situation of our students, we should attach importance to the connection between the math models of college mathematics with the examples of middle school textbooks in the process of learning. Studying the teaching requirements of middle school mathematics for mathematical modeling courses, analyzing the teaching cases of mathematical modeling in middle school textbooks can be beneficial to improving teaching skills training of normal students. Paying attention to the connection with the teaching practice of middle school is not only improving the teaching ability of normal students, but also cultivating their own mathematical modeling ability [6][7].

Specifically, the following goals should be focused on in teaching mathematical modeling.

(1) Establishing the concept of "student development-oriented" and paying attention to improving the pertinence and effectiveness of mathematical modeling classroom teaching are necessary.

(2) Selecting classic problems so that these lessons can play a powerful role in cultivating students' mathematical ability and improving students' mathematical modeling literacy should be concerned.

(3) The research about comprehensively promoting an effective classroom teaching mode with the core of cultivating students' innovative spirit and improving students' modeling literacy could not be neglected.

(4) Teachers need to spend some time and energy to observe and think about the problems related to citizens' lives that need to be solved urgently, guiding students to use what they have learned to build mathematical models to solve practical problems and serve the society [8].

(5) Strengthening exchanges and cooperation with middle schools, studying the relevant content of middle school mathematics textbooks, improving students' teaching ability through skills training and educational practice opportunities to make every effort to cultivate high-quality talents to meet the needs of middle schools.

3. Conclusions

Through effective classroom teaching and analysis of typical cases, this paper aims to study the pertinent and effective teaching strategies for improving the mathematical modeling literacy of normal students. Mathe teachers should know about the requirements of middle school mathematics for the cultivation of students' mathematical modeling literacy. In addition, teachers should also see that the level of mathematical modeling literacy of mathematics normal students will have an impact on their teaching ability.

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It is suggested that the following aspects should be used in teaching work.

(1) Teachers should focus on the reform of university mathematics teaching, improving the pertinence and effectiveness of classroom teaching.

(2) The innovative "student-oriented" teaching method that combines in-class and extra-curricular teachings need to be constructed.

(3) The goal of improving students' professional ability, the strategy of improving students' mathematical modeling ability was studied should be taken seriously.

(4) It is one of the most important measures to cultivate innovative future teachers that studying the strategies to improve students' professional quality and improving students' teaching ability in combination with the actual teaching of mathematics in middle school.

In the research of this topic, it is suggested to focus on exploring the strategies of optimizing the teaching of mathematical modeling, and to construct a new classroom teaching model that organically combines tradition and innovation. All these measures can make classroom teaching full of vitality, improving students' mathematical modeling literacy and innovation ability. By the way of exploring the content and methods of teaching skills training, some strategies to improve the teaching ability of normal students on the basis of the improvement of mathematical modeling literacy [9] are gotten.

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References

[1] Ministry of Education of the People's Republic of China. (2018) Mathematics Curriculum Standards for General High Schools (2017 Edition). Beijing: People's Education Press.
[2] Huang Jianying. (2022) Construction and Practice of High School Mathematical Modeling Curriculum under Mathematics Core Literacy. Hainan: Master's Thesis of Hainan Normal University (Electronic Journal), 5, 1-18.
[3] Tan Wei. (2022) Research on the Influence of Inquiry-Based Teaching on High School Students' Mathematical Modelling Literacy. Shanghai: Master's Thesis of East China Normal University, 5, 5-10.
[4] Chen Yanfeng, Wang Mei. (2013) Mathematical Modelling and Discussion on the Teaching Reform of Mathematics in Colleges and Universities. Journal of Huadong Normal University (Natural Science), 34, 45-46.
[5] Zheng Qinggui. (2022) Educational Reform Leads Inquiry and Cultivates Mathematical Modeling Literacy [J]. Mathematics Learning and Research, 18, 126-128.
[6] Wang Meina, Yang Xiaobin. (2022) Exploration on the Cultivation of Mathematical Modeling Literacy Based on the Concept of "Three Teachings". Journal of Carey College, 40, 7-11.
[7] Wang Luyao. (2022) Research on the Implementation of Mathematical Modeling Literacy in High School Mathematics Teaching. Jinan: Master's Thesis of Shandong Normal University (Electronic Journal). 5, 10-16.
[8] Tang Feiying. (2021) A Study on the Relationship between High School Students' Experience in Basic Mathematics Activities and Core Literacy in Mathematical Modelling. Chinese Mathematical Bulletin, 60, 12-19.
[9] HE Ping. (2021) Performance Evaluation Design to Promote the Development of Mathematical Modelling Literacy. Textbook Teaching in Primary and Secondary Schools, 88, 51-56.