Research on Higher Algebra and Middle School Mathematics under the Thought of Reduction

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ABSTRACT. Higher Algebra courses are the inheritance and development of middle school mathematics in terms of Mathematical thinking. One of the important thoughts of mathematics in the course is the thought of reduction, which embodies the close connection and contrast between advanced algebra and middle school mathematics on the thought of Reduction. Using the reduction theory of middle school mathematics to analyze some practical problems related to higher algebra can effectively reduce the learning cost and difficulty of higher algebra courses, and has a guiding role in training a new generation of middle school mathematics innovative teachers, which also promotes China Teaching reform and practice of new mathematics curriculum in middle school.

KEYWORDS: The thought of reduction, Higher algebra, Middle school mathematics

1. Introduction

1.1 Study the Reasons for Reduced Thought

First of all, mathematical thinking is a tool, which not only effectively promotes the organic combination of mathematical practice and practical application of mathematical theory but also is more conducive to the theoretical research of mathematics. Secondly, the thought of reduction is one of the most basic ideas in China's modern mathematics. It is dedicated to achieving the standardization of problem solving in the transformation of migration. Among many mathematical ideas, most are permeated with the thought of naturalization, such as the combining the numbers and shapes, the problem of "shape" can be transformed into the problem of "number", and the problem of "number" can also be transformed into the problem of "shape", combining the idea of function and equation can transform the problem of inequality. It is a problem of equations and functions, and vice versa. Classify, discuss ideas, and the transform the overall problem into partial ones. Solve local problems before solving the whole problem and then set out to mathematical transformation ideas, mathematical analysis ideas, mathematical counter-evidence ideas, undetermined coefficient ideas, structural ideas, etc. These are all considered as an important means of transformation of mathematical ideas. The thought of reduction is in everywhere, and it reveals both the theoretical basis of various mathematical ideas and the spiritual soul of various mathematical ideas. Therefore, this idea of conversion is also called the "conventional problem-solving" thought".

1.2 The Middle School Mathematics Textbook Contains the Thought of Reduction

The various aspects of mathematics textbook compilation, content selection, mathematics question answering methods, and the selection and configuration of mathematics learning questions in high school are a combination of mathematical knowledge and basic mathematical ideas. The analysis of the entire middle school mathematics textbook runs through these two main lines, one is the mathematical thinking method, and the other is the specific teaching content that carries the thinking method, that is, the related concepts, formulas, rules, applications, etc. The two complement each other. The basic knowledge of mathematics is an obvious line, written directly in the textbook in text form, reflecting the vertical relationship between knowledge. Mathematical thinking methods are unobvious lines, reflecting the horizontal connection between knowledge, often hidden behind the basic knowledge, which need to be analyzed and refined by teachers in teaching to make them appear. [1]

1.3 Infiltrate the Thought of Reduction into the Application of Higher Algebra in Middle School Mathematics

The professionalism of mathematics education requires mathematics teachers to master certain mathematics

knowledge and proficiency in a variety of applied mathematics. At the same time, it also requires them to understand the scientific of mathematics education theory and possess strong mathematics education practical skills. Therefore, in addition to offering middle school mathematics teaching courses, the mathematics departments of colleges and universities also set up basic courses of advanced mathematics, such as "Higher Algebra". However, in the long-term teaching practice of higher algebra courses, the author found that there are two problems in this mathematics teaching. On the one hand, due to the difficulty of linking middle school mathematics with higher algebra, many freshmen have a bored psychology when they are initially exposed to advanced algebra courses; on the other hand, because of the theoretical basis of higher algebra, a certain disconnection with middle school mathematics appeared in teaching practice, which has made many college graduates of mathematics education feel confused when discussing how to use higher algebra theory to guide the teaching of middle school mathematics. In order to better solve the mentioned problems in mathematics teaching, the author believes that using the method of reduced thought can fully analyze and explore the connection between higher algebra and the mathematics of middle school mathematics, which is an active and effective mathematics teaching measure.

In this way, the difficulty of student directly learning higher algebra will be significantly reduced, and the role of higher algebra in training middle school mathematics teachers will be greatly enhanced.

2. The Thought of Reduction

2.1 The Meaning of "Reduction Thought"

"Reduction thought" literally means to standardize and model the process by transforming and resolving known problems. The general model is the process of transforming the problem to be solved, then the original problem is reduced to the problem that has been solved or easy to solve, and finally the correct answer of the original problem is obtained. Simply put, "reduction" is to turn unfamiliar and unknown problems into familiar and known problems, so that the problem can be solved fundamentally.

A scholar who engaged in mathematical research and education once asked such a mathematical question: "Assuming there have a kettle, gas stove and faucet, what should you do if you want to boil a pot of water?" Someone answered, he said: "Pour water into the pot, put the pot on the gas stove, and finally light the gas." The scholar quickly agreed with the questioner's answer, but he continued to ask: "If none of the above conditions have changed. It is just that there is already water in the kettle. What should you do now? "So, the questioner quickly replied with physical confidence:" Just put the kettle on the gas stove and light the gas. "However, the questioner is unsatisfied with such an answer. He said," Only physicists will do this, but mathematicians will dump the water in the pot, so the latter will be transformed to the former. " This kind of metaphor may be a bit too exaggerated, but it points out the essential feature that the mathematical problem is combined into a reduction, that is, when we encounter a relatively complex mathematical problem, we should not directly look for the correct answer to the problem, but Boldly think of a better way to face The problem into a mathematical problem specification in order to apply the theory and methods of what we already know, the mathematical problem can be effectively found and resolved.

2.2 The Meaning of "Reduction Thought"

By reviewing the history of the development of mathematical thought, we can know that "reduction thought" is widely used in the basic research of mathematics to deal with a variety of mathematical problems. It is also one of the important way people look for mathematical truth and discover scientific truth. In 1614, John Napier invented the logarithm, which transforms the complex problems in the mathematical operation process into simple addition and subtraction problems, and also promotes a major revolution in mathematics calculation methods. In the book "Methodology for Better Guiding Reasoning and Seeking Scientific Truth" published in 1637, the mathematician Descartes first proposed the universal method: ① any problem can be reduced to a mathematical problem; ② any mathematical problem It can be reduced to an algebraic problem; ③ any algebraic problem can be reduced to an equation solving problem. Obviously, although such a universal method does not really exist, it can still solve some problems well. Because this "omnipotent mode" can be regarded as the concrete application of transforming ideas. In fact, this model has played an important role in Descartes' research work. We know that in the whole middle school mathematics thought system, "reduction thought" is one of the more important mathematics thoughts. At present, the process of solving practical problems in mathematics in middle school is often manifested as continuous problem discovery and analysis, until it is transformed into a process that can solve the problem through resolution. For example, in higher algebra, the basic idea of solving general equations and inequalities should be from "multivariate, high degree" to the single and low degree reduction, fractional equations are reduced to integral equations, irrational equations are reduced to Rational equations; using trigonometric function-induced formulas, arbitrary angles of trigonometric

functions can be turned into acute angles, or "different names" of trigonometric functions can be turned into the same name; in analytical geometry, geometric problems are often reduced to algebraic problems. Carrying out research, and in the function image, often discuss the algebra problem into geometric figures. There are many such problems and examples in the current teaching of naturalization thinking in middle school mathematics. If the majority of teachers can deeply study and apply them to the mathematics textbooks, the "reduction thought" of middle school mathematics content will be excavated and refined. Consciously strengthening the "reduction thoughts" in the teaching process has a profound impact and significance on improving the current teaching status of the mathematics education that emphasizes conclusions and ignores problems, as well as training and cultivating a group of creative talents.

2.3 The Status and Function of "Reduction Thought"

One of the most basic mathematical thinking methods to solve mathematical problems is "reduction thought", which has an important position and role in the current mathematics teaching and mathematics learning, and also has an important dominant position in the growth and learning of students And its value, the main role is reflected in the following three aspects:

First of all, the "reduction thought" method can play an important role in cultivating students' independent innovation consciousness. The cultivation of independent innovation consciousness is the inherent foundation and motivation of mathematics teaching activities. Without independent innovation consciousness, there can be no independent innovation activities. The cultivation of independent innovation awareness is also a necessary condition for teachers to motivate students to actively study independently and realize their potential. The fundamental purpose of independent innovation teaching of high school mathematics courses is to develop and cultivate students' intelligence and their applied mathematics abilities through the understanding and learning of basic mathematics knowledge. Through the understanding and learning of "reduction thought", students can fully grasp the consciousness and ability of mathematics method problems in middle school, cultivate the comprehensive quality of mathematics at a higher knowledge level, and lay the foundation for middle school mathematics major for future teaching research and practical work. At the same time, in turn, it will help stimulate students' interest in learning mathematics and promote the deepening of mathematics knowledge, so that students have the corresponding independent innovation awareness and theoretical practical ability.

Secondly, "reduction thought" can play an important role in improving the structure of students' mathematics cognition and improving the ability to transfer thinking. "Reduction thought" method is a refinement of mathematical knowledge and a kind of mathematical essence Cognition is also a solution to mathematical problems, and it is also the basic idea and thought of mathematics learning and theoretical teaching. The wide application of the teaching method of reduced thought can make students no longer have scattered knowledge of the mathematics they have learned, and it is no longer a mechanical imitation of solving mathematical problems. The concept and method of "reduction thought" helps students to carry out systematic and meaningful mathematics learning, form an orderly mathematical knowledge chain, internalize new mathematical knowledge into their own mathematical cognitive structure and improve transfer thinking Ability plays an extremely important role.

Reduction is a variety of logical connections within mathematics: including various vertical and horizontal connections of mathematical knowledge, the inevitable connection between conditions and mathematical conclusions, and the inevitable connection between mathematical methods and thought research methods. "The wide application and development of research methods provide a new possibility. In the process of implementing the new curriculum reform in our country, the research method of "reduction thought" is the ideal educational material for cultivating the majority of students in China to correctly establish the world view.

3. Comparison of the Connection between Middle School Mathematics and Higher Algebra in Thinking

Higher algebra has a wide range of applications in middle school mathematics education. For example, when the coefficient determinant of higher algebra is not equal to zero, the determinant can be used directly to give the formula solution of the linear equation system; when the coordinates of each vertex of the triangle or the linear equation of the three sides are known, the determinant can be used to represent the triangle Area; while using the determinant, it can also solve mathematical problems such as planes and triangle equations, which are closely connected with our middle school mathematics.

Higher algebra is the continuation and improvement of middle school mathematics. It not only explained many problems that middle school mathematics failed to make clear, such as the root and factorization theory of polynomials, the theory of linear equations, etc., but also took integers, real numbers, complex numbers, and plane vectors as examples, and introduced number rings and number fields. , Vector space, Euclidean space and other algebraic systems. This is very useful for guiding middle school mathematics teaching with modern mathematics viewpoints, principles

and methods. [2]

The knowledge background of many contents of higher algebra originates from the middle school. It is an axiomatic statement based on the specific algebra structure, that is, the commonality extracted from the individuality. In the practice of curriculum teaching reform, it is necessary to not only explore the connection of knowledge system, but also the connection of mathematical thinking methods and mathematical concepts [3].

The following uses the advanced algebra course as an example to explore its connection with the reduction thought of middle school mathematics.

In middle school mathematics, turn irrational equations into rational equations, turn fractional equations into integral equations, turn ternary linear equations into binary linear equations up to unary linear equations, and derive parallelogram area formulas by reducing rectangles. All of these apply to the idea of transformation. In higher algebra, by expanding by rows and columns, the determinant of higher order is transformed into the determinant of lower order; by separating coefficients, the study of linear equations is transformed into the study of augmented matrix; by selecting Fixing the basis, transforming the relationship between vectors into the relationship between vector coordinates, transforming linear transformation studies into matrix studies, transforming quadratic studies into real symmetric matrix studies, etc. are also used to the thought of reduction. [2]

4. Conclusion

In summary, we can see that higher algebra is in the same vein as the theoretical knowledge and reduction thought of middle school mathematics in China, but because of the shallow content and theoretical knowledge of middle school mathematics in China, the role and significance of mathematics thoughts are not reflected deeply. Through the study of mathematics courses such as advanced algebra, people have initially realized that mathematics thoughts can deeply reveal the consciousness and internal connections of a variety of mathematics, thereby cultivating the application ability of mathematics naturalization thoughts and enhancing them when learning correctly and flexibly applying mathematical naturalization thoughts Consciousness, this kind of consciousness brings important test and promotion to the development of the teaching quality of middle school mathematics in China.

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