Exploring the Cultivation Path of Algebraic Thinking Ability for Junior High School Students

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Abstract: With the deepening development of mathematics education, the cultivation of algebraic thinking has gradually become one of the core tasks of junior high school mathematics teaching. As a fundamental ability in mathematics, it not only has a positive promoting effect on students' logical thinking and abstract ability, but also provides important tools and methods for students to further learn advanced mathematical knowledge and solve practical problems. Based on the understanding of mathematical algebraic thinking, this article mainly discusses the importance of students' algebraic thinking and how to cultivate students' algebraic thinking ability in general operations, logical reasoning, mathematical modeling, etc. and explores new methods and approaches to cultivate students' algebraic thinking in junior high school teaching.
Keywords: Junior high school mathematics; Algebraic thinking ability; Cultivation strategy

Algebra is one of the important components of mathematics. The Ministry of Education emphasizes in the newly issued "Compulsory Education Mathematics Curriculum Standards (2022 Edition)" (hereinafter referred to as the "Curriculum Standards") that students' algebraic reasoning ability should be cultivated in junior high school curriculum teaching, and reasoning is one of the basic forms of thinking[1]. When conducting algebraic reasoning, the process of algebraic thinking will be reflected The Curriculum Standards also explicitly state that mathematics courses should cultivate students' core competencies, including the ability to use mathematical thinking to think about the real world. Algebraic thinking[2], as an important factor in mathematical thinking, plays a key role in improving the thinking ability of middle school students.

1. The concept of algebraic thinking

The concept of algebraic thinking mainly refers to a mathematical way of thinking that focuses on using algebraic tools such as symbols, variables, equations, inequalities, and functions to understand and solve problems. Algebraic thinking emphasizes the understanding of abstract structures and relationships, as well as the ability to model and solve practical problems through algebraic expressions and equations.

James J. Kaput proposed that algebraic thinking has two core aspects: one is to generalize laws and represent the generalized results with symbols; The second is to perform rule-based reasoning and operations on the generalized results. These two core elements are mainly reflected through three elements: generalized arithmetic, functional thinking, and modeling language[3]. Kaput believes that algebraic thinking is not limited to generalized operations of letter and symbol languages. When individuals attempt to describe and express relationships between different quantities in some form, they have already demonstrated the characteristics of algebraic thinking.

Bao Jiansheng and Zhou Chao also elaborated on the concept of algebraic thinking in their book "The Psychological Basis and Process of Mathematics Learning", stating that algebraic thinking is a form of symbolic operation; It is rule-based reasoning; It is a mathematical modeling activity. The core of algebraic thinking is the idea of generalization[4].

2. The Importance of Cultivating Algebraic Thinking Ability in Middle School Students

2.1 Helps improve the knowledge level of junior high school students

The Curriculum Standards point out that numbers and algebra are one of the core contents of junior high school mathematics, and the learning of their knowledge and abilities occupies an important position in the junior high school mathematics curriculum. In the junior high school stage, students' thinking development is in the transition from the specific operation stage to the formal operation stage, and through the cultivation of algebraic thinking ability, students can have a deeper understanding of mathematical basic knowledge, such as algebraic formulas, equations, inequalities, functions, etc. Through algebraic operations and logical reasoning, students can master the basic properties and operation rules of these concepts, and also help students understand abstract concepts in mathematics, such as variables, symbol representation, etc. laying a foundation for subsequent learning.

2.2 Helps improve students' ability to think abstractly

The core of algebraic thinking lies in the understanding and application of abstract concepts such as variables, equations, and inequalities. In middle school, students begin to be exposed to these concepts and learn how to solve practical problems by setting variables, constructing equations or inequalities. This process requires students to abstract concrete problems, thereby exercising their abstract thinking ability.

2.3 Helps cultivate students' innovation ability

Algebraic thinking encourages students to think about problems from different perspectives and explore new problem-solving methods. Through algebraic learning, students can learn to break through thinking patterns and try new methods to solve problems. This ability is not only important in mathematics, but also one of the important qualities needed for future society.

3. Paths for Cultivating Algebraic Thinking Ability in Junior High School Students

3.1 Cultivate students' algebraic thinking in general arithmetic

Generalized arithmetic plays an important role in students' mathematics education. It goes beyond the traditional arithmetic's focus on specific numerical results and instead focuses on the structure and relationships of equations, as well as the universal laws behind these structures. In the study of generalized arithmetic, it is crucial to correctly understand the meaning of the equal sign and the equivalence relationship it contains. The equal sign not only represents the result of the operation, but more importantly, it represents an equivalent relationship between the two sides of the equal sign, that is, the quantity or equation expressed at both ends of the equal sign is equal. In terms of content, generalized arithmetic mainly involves understanding the equality relationship in the equivalence equation, using arithmetic methods for generalization, representation, and reasoning. This includes applying operation laws such as commutative law, associative law, and distributive law, as well as using the "rounding method". Compared with traditional arithmetic, Generalized arithmetic places greater emphasis on understanding the structure of equations. Therefore, generalized arithmetic plays an irreplaceable and important role in students' mathematics education.

3.2 Cultivate students' algebraic thinking in logical reasoning

Reasoning ability is an important part of the core literacy in junior high school. Reasoning ability mainly refers to the ability to derive other propositions or conclusions based on some facts and propositions according to rules. In junior high school, students' logical thinking and reasoning ability are in an important stage of development. Generative problems, as a core part of mathematics, provide students with an excellent platform to exercise and demonstrate their logical thinking and reasoning ability. Solving algebraic problems usually requires students to follow a series of rigorous rules and steps, such as the properties of equations, the solutions of inequalities, etc. These rules not only require students to have solid mathematical foundation knowledge, but also require them to have clear logical thinking. Therefore, in the process of learning algebra, students need to constantly analyze problems. Searching for patterns Propose hypotheses and verify them, and through the cultivation of logical thinking and reasoning abilities, help them gradually master the methods and skills of solving algebraic problems, thereby improving their algebraic thinking ability.

3.3 Cultivate students' algebraic thinking in mathematical modeling

Mathematical modeling mainly refers to the construction of mathematical models that connect the internal and external worlds of mathematics, and use mathematics to solve practical problems. In mathematical modeling, students need to master basic algebraic operation methods, such as merging similar terms, transferring terms, factoring, and solving equations. These abilities are crucial for solving mathematical problems encountered in the modeling process. Algebraic thinking is the foundation of mathematical modeling, involving concepts such as variables, functions, equations, inequalities, etc. In the process of mathematical modeling, students need to use algebraic thinking to identify key variables in problems, establish relationships between variables, and find answers to problems through algebraic operations and equation solving. By combining practical problems with algebraic models, students' algebraic thinking can be effectively improved. Ability and mathematical modeling skills.

4. Conclusion

In the process of exploring the cultivation path of algebraic thinking for junior high school students, we deeply realize the importance of algebraic thinking for students' future learning and life. Algebraic thinking is not only one of the core competencies of mathematics, but also an important foundation for cultivating students' logical thinking, problem-solving ability, and innovation ability. In the teaching process, teachers can improve their algebraic thinking ability by cultivating junior high school students' generalized operations, logical reasoning, and mathematical modeling ability. With the continuous deepening of educational reform, more and more people are paying attention to the cultivation of algebraic thinking for junior high school students. Algebraic thinking, as the main thinking method of junior high school math-

ematics education, still has broad exploration space in its research field. These research results can not only promote the individual literacy improvement of students in mathematics and other fields, but also help promote the overall development of mathematics. Disciplines are moving towards higher levels Expand into deeper and broader fields.

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