
Research on the Application of the Thought and Method of Combining Number and Shape in High School Mathematics Teaching

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Abstract – Under the background of the new curriculum standard, the thought and method of combination of numbers and figures has become an indispensable prerequisite for learning mathematics. In the teaching process of mathematics in senior high school, the thought and method of combination of numbers and shapes occupies the mainstay position in mathematics learning. Firstly, this paper expounds the connotation and teaching function of the thought and method of combination of numbers and figures, which is mainly embodied in four aspects: helping to understand and memorize mathematical concepts, improving the ability to solve problems, and cultivating mathematical thinking and mathematical core literacy. This paper analyses the application of the method of combination of numbers and shapes in the fields of Pythagorean theorem, inequality, the position relationship between circles and circles, sets, functions and equations, etc. It points out that teachers should pay attention to guiding students to understand the idea of combination of numbers and shapes in the teaching process of mathematics, and infiltrate the combination of numbers and shapes in solving various mathematical problems. Ideological methods, to "teach them to fish", so that students learn to master the application of mathematical thinking methods, improve students' thinking and ability to solve problems, to think independently and solve mathematical problems, and cultivate students' core mathematical literacy.

Keywords – Mathematics Teaching in Senior High School, Thought and Method of Combination of Numbers and Figures, Mathematics Core Accomplishment.

I. INTRODUCTION

Mathematics, as the basis of natural science and social science, has created immeasurable value for the development of science and technology and the progress of human civilization^[1]. Mathematics is the cornerstone of human thinking progress and promotes the rapid development of social productivity. The need for mathematical knowledge in modern society is increasing day by day. LuoGeng Hua, a great mathematician in Chinese history, once wrote such a philosophical passage: "Number and form are interdependent, how can they be divided into two sides to fly?"^[2] From this, we can realize that "number" and "shape" are unified whole, and they permeate each other, and they are closely linked and inseparable. In this vast universe, all things are made up of the unity of "number" and "shape".

The 2017 edition of senior high school mathematics curriculum standard has gradually changed from "knowledge-based curriculum system" to "ability-based curriculum system", and now it has developed into "quality-based curriculum system". The core literacy of mathematics is the basic goal of the curriculum, and the three-dimensional goal in the teaching process is implemented through six core literacy. The most essential characteristic of mathematics is the combination of numbers and shapes. Therefore, in the process of mathematics teaching, we should pay attention to the cultivation of students' thinking and methods of combining numbers and shapes, which is the only way to cultivate students' mathematical thinking and core literacy. The thought method of combination of numbers and figures is widely used in various fields of knowledge, and it is a mathematical

thought method that every student must master. The two most basic elements of mathematics are "number" and "shape" [3]. The important position of these two basic elements is fully reflected in the middle school mathematics textbooks. The idea of combining numbers and shapes covers almost all the key points of mathematical knowledge, such as Pythagorean theorem, set, inequality solution, function, equation, etc. The thought and method of combination of numbers and figures runs through the whole learning content of middle school mathematics. It is a vital means and method to solve mathematical problems. To master the thought of combination of numbers and figures skillfully is conducive to the learning of various kinds of mathematical knowledge. The combination of numbers and shapes can train students' mathematical thinking ability. It is the golden key to open the door of mathematics to correctly grasp and apply the combination of mathematics to analyze and solve problems. It is also the soul and essence of cultivating students' core mathematical literacy.

II. COMBINATION OF NUMBERS AND FIGURES FROM THE PERSPECTIVE OF MODERN MATHEMATICS

A. *The Connotation of the Combination of Numbers and Shapes*

The world is made up of matter, which is expressed by numbers and shapes. Everything in the world is an organic combination of numbers and shapes, without exception. "Number" can be broadly defined as numbers, formulas, definitions, concepts, properties and so on, while "shape" can be defined as: graphics, symbols, images, objects, etc. [4] According to the experience of historical development, the two can not be uniquely discussed, but a unified whole - the combination of numbers and shapes. The flexible transformation of "number" and "shape", in which you have me and I have you, perfectly combines with each other, fully and completely expresses the profound connotation of mathematics.

B. *Connotation of the thought and Method of Combining Number and Figure*

Mathematical thought is the product of the data information and existence form of the objective world, which is processed by human brain and processed by the way of thinking consciousness activity. Mathematical thought is a kind of non-subjective conscious activity formed by summarizing the essence and laws of things [5]. The method of combining numbers and shapes is a mathematical method that makes full use of the known mathematical information, builds a bridge between numbers and shapes, and combines and transforms them according to the need. By visualizing mathematical knowledge through specific graphics, students can solve problems with ease, understand and master mathematical knowledge profoundly, cultivate students' core mathematical literacy, and achieve the effect of comprehending and penetrating the learning mathematical knowledge.

III. THE TEACHING FUNCTION OF THE THOUGHT AND METHOD OF COMBINING NUMBER AND SHAPE IN MATHEMATICS TEACHING

A. *Helping Students Understand and Memorize Mathematical Concepts*

Mathematical concept is a kind of conscious reflection of human brain on the quantitative relationship and spatial form of objective existence, that is to say, mathematical concept is presented in the way of combining "number" and "shape" [6]. Mathematics concept is a generation of mathematicians from a large number of research and exploration summed up the essence of the content, experienced the human perception of rational

understanding of numerous leap, highly concentrated characteristics, its abstract and logical is the difficulty of students learning mathematics. The thought and method of combination of numbers and shapes constructs a bridge between words and images, stimulates students' thirst for knowledge, enables students to comprehensively and thoroughly understand mathematical concepts, easily understand the essential characteristics and links of mathematical knowledge, and learns mathematical knowledge in a more complete framework form, so that mathematical concepts can be easily, firmly and permanently imprinted. In the minds of students.

B. Improve Students' Problem-solving Ability

One of the most important tasks in the teaching goal of middle school mathematics is to improve the students' ability to solve problems. There is a famous saying that "teaching fish is better than teaching fish" in the book named "Huainanzi Shuolinxun". Teachers, as educators, shoulder the great mission of imparting knowledge and solving puzzles. In mathematics teaching, we should not only teach students how to solve problems, but also cultivate and improve students' ability to solve problems independently. Problem solving is an end, and the method is a means. It is not a long-term solution to solve one or more mathematical problems. If you want students to really learn mathematics knowledge, you need to master the mathematical method of solving problems. The thought method of combining numbers and figures will make students' thinking clear and find the best way to solve problems quickly, so that they can make answers independently and accurately, and their ability to solve problems has been significantly improved.

C. Training Students' Mathematical Thinking

Mathematical thinking is the general thinking ability of exponential science. The thought method of combination of numbers and figures is an important means and path of learning mathematics in senior high school. It covers almost all the difficulties and difficulties of mathematical knowledge. Through the thought method of combination of numbers and figures, students' thinking quality and thinking ability can be exercised^[7]. Efficient thinking can be formed in their minds. Problem-solving mode of thinking, improve students' cognitive level of mathematical knowledge, develop a scientific and systematic thinking habits, so that students have the ability to think and solve problems from a mathematical point of view and perspective. Further develop students' good mathematical thinking.

D. Cultivating Students' Core Mathematical Literacy

Teachers must pay attention to the cultivation of students' mathematics core literacy in the teaching process, which is the key to the development of students in the field of mathematics. The application of mathematical combination thought and method plays an important role. The combination of number and form plays a complementary role. The abstract and difficult mathematical knowledge is presented in a graphical way, and the key points of mathematical knowledge are accurately depicted. Graphics can express mathematical information more intuitively, so as to make full use of known data to solve problems. The effect of the problem makes the mathematical knowledge clear and accurate in the mind. Mastering the thought and method of combination of numbers and figures skillfully can make students use mathematics knowledge efficiently and improve learning efficiency significantly. It is a necessary tool to solve problems, and also a necessary condition to cultivate students' six core qualities in mathematics^[8].

**IV. APPLIED RESEARCH ON THE THOUGHT AND METHOD OF COMBINING MATHEMATICS
WITH FIGURE IN SENIOR HIGH SCHOOL*****A. Application and Analysis of the Combination of Numbers and Shapes in Pythagorean Theorem***

Pythagorean theorem appears frequently in the process of solving mathematical problems in middle schools, which is very important mathematical knowledge. Pythagorean theorem accurately depicts the rules and characteristics of the length of three sides in a right triangle. In the process of solving a problem, if we know the length of two sides, we can get the third side according to the formula. Through Pythagorean theorem in right triangle, we can directly discover and utilize the ingenious relationship between number and shape, which is the direct expression of the combination of figures.

In the process of using Pythagorean theorem to solve problems, we should make full use of the known conditions to make a composition, that is, to use the method of combination of numbers and figures to connect the known and unknown, to build a bridge between them, and to make the problems simple and intuitive, so as to exercise the students' ability to solve problems and mathematical thinking.

B. Application and Analysis of Number-Shape Combination Method in Inequality

Inequality is one of the important contents of high school mathematics. In the process of solving mathematical problems, the solution of inequality is complex. We need to observe the characteristics of inequality, use known mathematical methods, and use skills to solve problems. In the process of calculating inequalities, we usually use the method of combination of numbers and shapes, according to the inequalities given in the question, find out the characteristics and rules, and combine the content we have learned before to construct the images. We can visually express the inequalities in the form of images, so as to judge the inequalities and compare them accurately and quickly. Solving the problem not only saves time, but also greatly improves the accuracy of the problem. In the problem of comparing the size of inequalities, the formula is flexibly deformed, the process of understanding the problem is simplified, the size comparison of inequalities is transformed into a simple function comparison by the method of combining numbers and shapes, and the problem is solved simply and easily through images, which is simpler and more efficient than the conventional methods, and the results are more accurate.

C. Application and Analysis of the Method of Combining Number and Shape in the Position of Circle and Circle

The circle is one of the most common geometric figures, and it is also the key content of middle school mathematics. To learn the mathematics knowledge related to the circle, first of all, we should understand the position relationship between the circle and the circle. In this process, we usually adopt the idea of combining the number and the shape. By manipulating the geometric sketchpad, we can display the image of the position relationship between the circle and the circle. To five images of different position relations, this is the expression of "shape" in mathematics. According to five kinds of position relations, circles are divided into five categories. After measuring and recording the radius length and center distance of each group, through calculation and observation, it is not difficult to find that the relationship between the distance between the center and the length of the radius presents a rule, which is the expression of "number" in mathematical knowledge. The combination of number and shape makes the position relationship between circle and circle clear, simple and easy to

understand. Students can easily understand and grasp the law of mathematics in mathematical activities. The combination of number and shape makes mathematical knowledge lively and interesting, understanding smoothly and easy to remember.

D. Application and Analysis of Number-Shape Combination Method in Set Problem

As the beginning of high school mathematics curriculum learning, set plays a connecting role, which is a very important basic mathematical knowledge, so it is very important to learn set well. In the analysis of set problem, due to the complexity of data abstraction and the difficulty of direct problem solving operation, it is difficult to verify the right and wrong results. In order to solve the set problem, after a large number of practical research by numerous mathematicians, a relatively simple number of axes method and Wayne diagram method are summarized. By fully expressing the known quantitative relationship through graphics, the abstract "number" is transformed into intuitive "shape", and the set problem is simplified by using the expression of images, which is the embodiment of the idea of combination of numbers and shapes in the set.

1. Number Axis Method:

By combining the number axis with the set data given in the title, the existence area of the set median is circled by closed curve, and the image of the title is visualized intuitively. By observing the position relationship of the closed curve in the image, the inclusion relationship between the sets can be seen directly, and the answer can be given quickly and accurately. When encountering this kind of set problem, it is a good way to solve the problem to make corresponding images on the number axis by the method of combining numbers and shapes.

2. Wayne Diagram Method:

When confronted with complex set problems, direct calculation is difficult to accurately calculate the results. It is very easy to confuse data and make mistakes. Because of the complex relationship between data, students will feel dizzy and unable to start. When we use the method of combination of numbers and figures, we can express the data in the question with Wayne diagram, which can make the relationship between numbers clear and easy to operate. Students can solve the set problem efficiently and accurately. The flexible use of the method of combination of numbers and figures in the set problem is constantly increasing. It strengthens students' self-confidence and promotes their interest in learning collective knowledge.

E. Application and Analysis of Number-Shape Combination Method in Function Problem

Function is the core knowledge of mathematics course in middle school. Understanding the essence of function and mastering the methods to solve function problems are the key to learn mathematics well. When solving function problems, drawing function images, transforming complex and abstract function contents into simple geometric problems, the "shape" in function can deeply understand the nature, characteristics and rules of function, and make students better accept the essential meaning of "number". The idea and method of combination of numbers and figures undoubtedly provide the best way to learn function knowledge. For example, when judging the monotony of function, definition range and value range, we can use function image to simplify and visualize the content, and solve problems easily and pleasantly. Students constantly train the thinking of combining numbers and shapes, which can improve the ability of solving related function problems, and further realize the important role of combining numbers and shapes. The breakthrough point of learning function problem is to master function

knowledge more skillfully.

F. Application and Analysis of Number-Shape Combination Method in Equation Problem

In solving equation problems, there are many difficulties in direct calculation, which lead to students unable to start. In order to solve this problem, teachers should correctly teach students how to use the combination of numbers and figures. Through image analysis, the abstract equation can be presented intuitively, so that students can easily understand the characteristics of the equation, and use the method of combination of numbers and figures to learn the equation knowledge clearly and thoroughly, which is like a top-down learning experience. When there are unknown parameters in the equation problem, the problem becomes more abstract and difficult to understand. In order to understand the characteristics of the equation and find the corresponding quantitative relationship to find the unknown, the problem of "number" in the equation is transformed into the expression state of "shape" in the function by the method of combination of numbers and shapes. Through the analysis of the image, we found the implicit quantitative relationship in the equation, and finally got the correct answer.

V. CONCLUSION

The new curriculum standards put forward higher requirements for high school mathematics teaching, in which the mastery and application of the combination of numbers and figures is particularly important. By combining the abstract quantitative relation with the intuitive geometric figure, we can fully and comprehensively understand the essential characteristics of mathematics, reveal the objective law of the development of things, and excavate the truth of mathematical knowledge in practice. The thought and method of combination of numbers and figures can turn abstraction into intuition and difficulty into ease, which greatly improves the teaching efficiency and plays an important role in the process of mathematics teaching. Hidden in order to improve students' mathematical thinking and mathematical ability, we must attach importance to the use of the combination of numbers and figures, so that students can not only harvest knowledge in the process of learning mathematics, but also master the important means and methods of thinking and solving problems, so as to truly realize that students can benefit all their lives and form a good core element of mathematics. To cultivate and shape talents who are in line with the development of the country and society in the new era.

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