

The Application of Thinking Visualization in the Training of Mathematical Thinking Ability in the Whole Cycle

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Abstract: At present, online teaching has gradually become a mainstream way of education. In the context of current quality education, teachers need not only to impart students' knowledge, but also to teach students how to think and cultivate their autonomous learning ability. This paper constructs a comprehensive, multi-level and three-dimensional special training model of thinking visualization ability at three time nodes before, during and after class. In the whole training process, students give full play to their own initiative, and the interaction between teachers and students is better improved. The use of visualized thinking teaching method is helpful to get rid of the difficult predicament of teaching and achieve the goal of cultivating logical thinking and improving teaching efficiency.

1. Introduction

With the continuous development of science and technology, online teaching has gradually become a mainstream way of education [1]. At present, online teaching has shortcomings such as students' scattered thinking, boring teaching and lack of interaction [2-3]. In the context of current quality education, teachers not only teach knowledge, but also teach students how to think and learn independently [4]. The visualization of teaching content can tap students' logical thinking ability, intuitively show students the thinking process of mathematical thinking, stimulate students' interest in learning, help students better master relevant concepts and operation rules, so as to improve students' logical thinking, improve learning efficiency, and build a complete knowledge system [5-7].

The effective integration of thinking visualization and online teaching makes specific knowledge subject learning systematic and clear, thus improving teaching efficiency [8-10].

The specific process of thinking visualization training is shown in Figure 1.

First, according to the corresponding teaching courses, match the online teaching process and methods, and flexibly adapt to different student groups to attract students' attention. Then redesign the content to better bring students into the problem situation and guide students to think actively. Then it is the law mining, leading students to explore the problem solving skills and laws behind the problem types. Visualization of thinking. Show the problems in front of the students in the form of illustrations. Simplify and visualize the difficult problems, and improve the efficiency of understanding and learning. Interactive design, full interaction and communication with students, full interaction and communication between students, let the thinking collide, and the teacher makes a summary to make up for deficiencies.

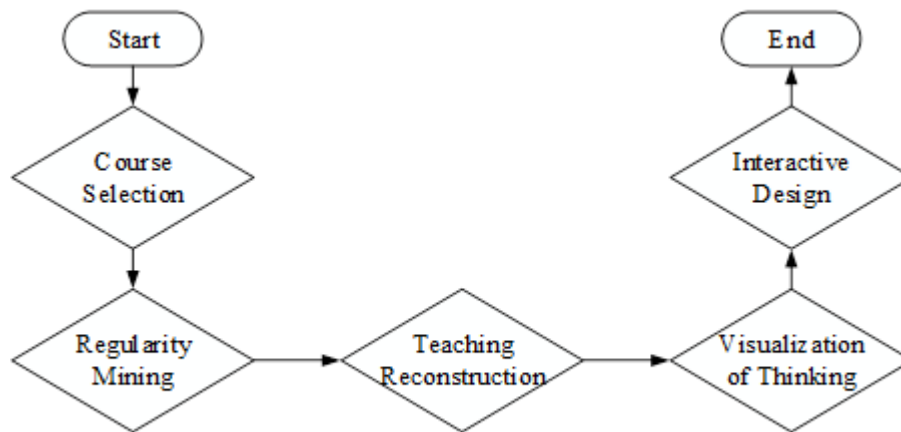


Figure 1: Training steps of thinking visualization

2. The Development of Visualization of Thinking in Mathematics Teaching

2.1. Problems

Nowadays, online education has been widely introduced into every student's family, but most educators blindly pursue new forms [11], ignoring the internal logic among all levels, which leads to the fact that mind maps cannot really play the role of guiding students' thinking, instead increasing the burden of students' learning. In addition, there are also problems in the content such as rough manufacturing [12]. Most teachers directly present the map to the students, without effectively guiding the students' thinking.

Online teaching has such shortcomings as short class time, limited interaction time between teachers and students, and inability to fully judge the progress of students' knowledge [13]. Mathematical knowledge itself is very boring. With the gradual development and deepening of the knowledge context, the content is more obscure and difficult to understand. The dull teaching method is difficult to arouse students' interest in learning and hinder students' logical thinking ability. Therefore, it is an urgent problem to explore teaching methods suitable for online teaching, cultivate students' interest in learning, and enable students to fully understand and use knowledge in the learning process.

2.2. Proposed Solution

When teaching online, teachers should pay attention to the overall guidance of knowledge points and the horizontal connection between each knowledge point. Visual thinking classroom is a two-way activity that teachers and students participate in together. Teachers should pay attention to the subjectivity of students when designing teaching content. Online teaching pays attention to interaction with students. The effective participation of students is more conducive to the diffusion and display of thinking, thus improving classroom efficiency [14-15].

Visualization of thinking is helpful to get rid of the existing teaching difficulties. Considering the limited online teaching time, it is difficult for students to grasp the key points of knowledge simply in class [16]. Therefore, this paper intends to build a comprehensive, multi-level and three-dimensional special training mode of thinking visualization ability at three time nodes before, during and after class. Distribute the guidance plan before class, and show the key knowledge of this lesson with the mind map. The thought map in the guidance plan is displayed in the form of

residual map to guide students to study purposefully and improve the preview efficiency. Students can have an overall understanding of this lesson before previewing the lesson, and can put forward and solve the questions in class. The online teaching process is actually a process in which students internalize and absorb knowledge. Therefore, teachers' explanations play a crucial role. The effective transformation of mathematical language can deepen students' understanding of relevant knowledge points. Teachers must pay attention to the conversion between the three mathematical languages: teaching students to understand problems in written language, analyzing problems in graphical language, and solving problems in symbolic language. The graphic language here can be thought map, thought map, process map and other thinking visualization tools, depending on the content of the visual knowledge points. Exercise class is an important part to help students understand what they have learned, and the final summary of exercise class is even more important. Flow chart is characterized by concise language and clear logic. It is better for students to remember the content of this lesson in the form of flow chart. The visual training of thinking after class can not be ignored either: summarizing and sorting out the internal connections of various knowledge points by means of tree diagram, bracket diagram, etc. can help students summarize the key points, activate their thinking, clarify the knowledge clues and context, so that students can have a systematic and comprehensive understanding of this lesson.

3. Special Training of Mathematical Thinking Visualization Ability

3.1. Before Class

Considering the time limitation of online teaching, the preparation before class is very important. In order to enable students to better preview the content of this lesson, the guidance plan can be presented in the form of a circle chart, which can effectively expand students' thinking and conceptual generalization, and help improve the overall mathematical thinking ability [17]. Take the positive and negative numbers in Section 1, Chapter 1, Volume 1, Grade 7, Jijiao Press as an example: The following are some data that we often see in our lives. Can you fill in circles for them and explain the classification basis?

① 3 degrees above zero, ② 15 degrees above zero, ③ 3 degrees below zero, ④ 20 degrees below

zero; The circle diagram of the four cases is shown in Figure 2.

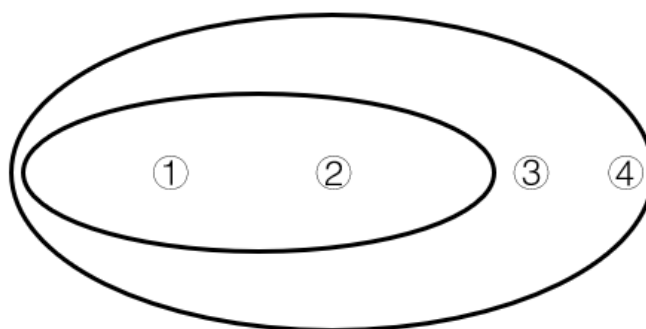


Figure 2: Circle Chart

Through classification, students can clearly know that the common data listed in life can be divided into two categories, one is the positive numbers that have been learned in primary school, and the other is the numbers that are common but do not know their names, thus arousing students' interest: what is the name of this kind of numbers? What are their properties? The guidance plan does not need to be very complex, as long as it can stimulate students' curiosity about learning this

section.

3.2. In Class

3.2.1. New Teaching

It is also essential to introduce the new teaching content to the students clearly, so that they can show their way of thinking in the process of learning. There are often close connections between various knowledge points of mathematics, and some concepts are very similar, which is easy to be confused if not pointed out to students.

Double Bubble Chart can distinguish two groups of similar concepts, which can be used to compare the similarities and differences between the same things and cultivate students' reasoning ability. Take the second volume of Grade 7 of Hebei Education Press as an example: we learned the linear equation of one variable last semester. The so-called "yuan" refers to the unknown number, while "times" refers to the number of items containing the unknown number; We can know from the name of the unary linear equation that an equation with an unknown number and an unknown number term whose degree is one is a unary linear equation; So, can you guess the properties of the binary linear equation by its name? The diagram is shown in Figure 3.

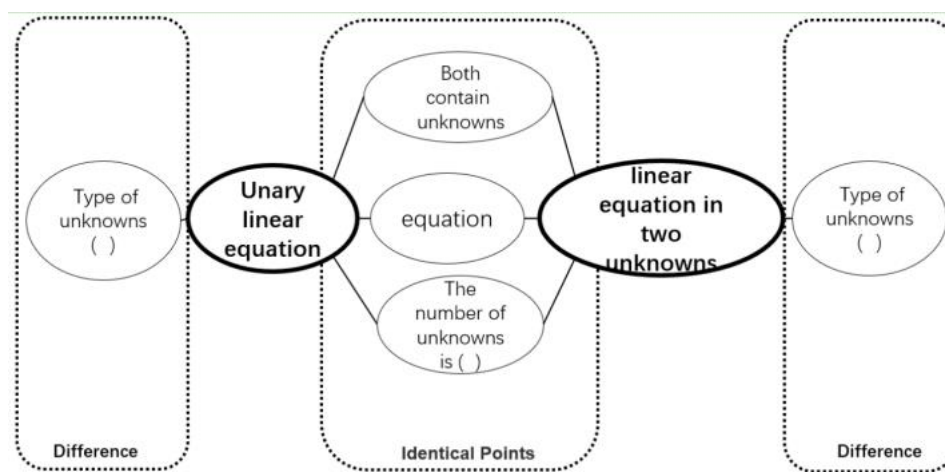


Figure 3: Double Bubble Figure Remnant

Students can not only help students quickly recall the past knowledge points, but also effectively distinguish the concepts of the univariate linear equation and the binary linear equation by filling in the residual map of the double bubble chart. Through the comparison of new and old knowledge, students can deepen their understanding of two pairs of similar concepts and establish the relationship between each knowledge point.

3.2.2. Uebung

The exercise class should pay more attention to the visualization of students' thinking, so as to facilitate the observation of students' learning progress at any time. For the explanation of exercise class, you can choose the flow chart as the tool of thinking dominance. Take the solution of fractional equation in Chapter 12, Volume 1, Grade 8, Jijiao Press as an example.

The fractional equation is solved as follows:

Solve equations $36/9x+2/x=1$,

Method 1: Denominator removal, multiply both sides of the equation by $9x$, obtain $36+18=9x$, To solve this integral equation, we get $x=6$. After testing, $x=6$ is the solution of the original

equation

Method 2: general division, move 1 to the left of the equal sign, obtain $36/9x+2/x-1=0$, Pass Divide $36+18-9x/9x=0$. So $36+18-9x=0$, solve this integral equation, and get $x=6$. After testing, $x=6$ is the solution of the original equation

For all fractional equations, there are no other solutions than these two methods. Keeping these two methods in mind will help students to quickly solve fractional equations. In order to facilitate students' memory, the flow chart can be used to visualize problem solving thinking, as shown in Figure 4.

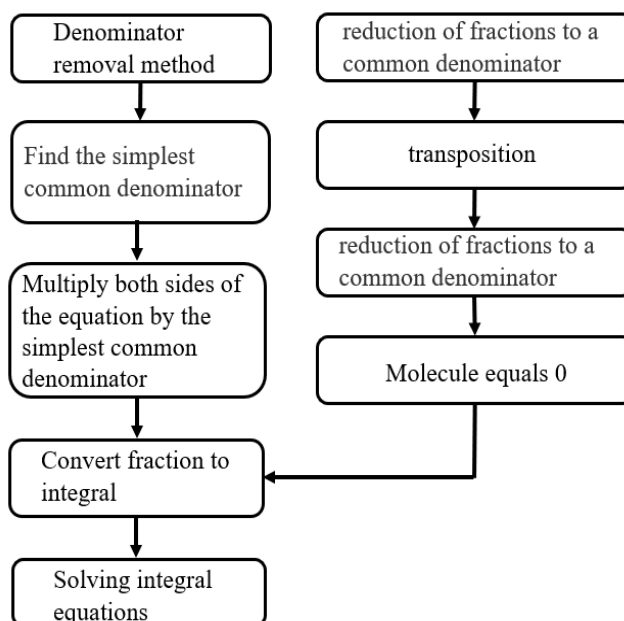


Figure 4: Flow Chart of Problem Solving Thinking

By reciting the key words, students will have the whole flow chart in their mind, and the solution of fractional equation will be clearer.

3.2.3. Review and Summing-Up Work

High quality courses need refined summaries. Under the guidance of teachers, students can undoubtedly get twice the result with half the effort by summarizing the knowledge points of this chapter. Considering that students of different grades have different understanding and mastering abilities, teachers can appropriately reduce the difficulty of drawing mind maps according to the actual situation, dig out the key information of the complete mind map, and guide students to fill in independently. This kind of mind map can also play a visual role in thinking, but the difficulty is greatly reduced and it is easy to operate. Take the example of the congruent triangle in Chapter 13 of the eighth grade volume I of Hebei Education Press: the whole chapter can be divided into two parts: proposition and proof and congruent figure; Congruent triangle is the key content of congruent graph, including the properties and judgments of congruent triangle. It is difficult for students to form a specific thinking loop in their minds only by language narration. At this time, the residual map of mind map plays a role. As shown in Figure 5.

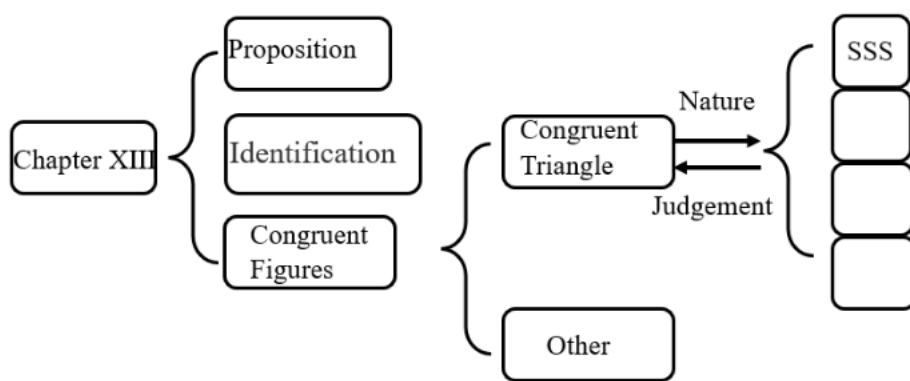


Figure 5: Mind Map Remnant Map

3.3. After Class

In the process of solving problems, students should be trained to develop the habit of thinking overtly. Topic design is usually presented in the form of words. We call it literal language, which is a kind of literal thinking and is not conducive to problem solving. The process of showing answers is actually the process of transforming written language into symbolic language, while graphic language is the bridge from written language to symbolic language. The process of graphic writing language is the visualization process of thinking. Showing your thinking by drawing will make the whole problem-solving process more smooth and easy. In the process of solving problems, students should be guided to introduce diagrams in the process of thinking. Take the encounter, pursuit and problem that junior high school students do not understand as an example.

Mr. Liu and Mr. Li respectively walked from AB, 1300 meters away. Mr. Liu walked 70 meters every minute, and Mr. Li walked 60 meters every minute. They started at the same time. How long did they meet? As shown in Figure 6, the text language that is not convenient for students to understand is converted into graphic language.

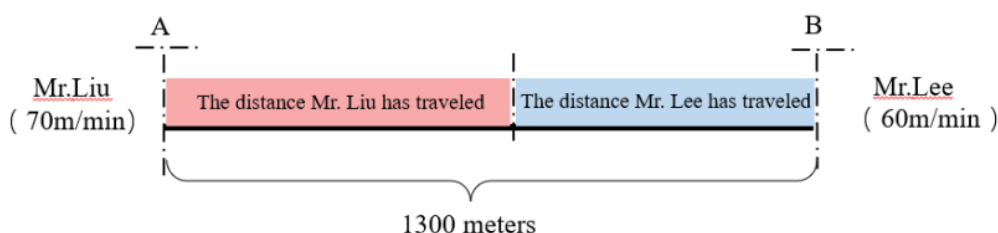


Figure 6: Opposition problem diagram

At the same time, Mr. Liu's journey is the red part, and Mr. Li's journey is the blue part. The place where the red meets the blue is the meeting point. Through the process diagram, students can also intuitively see that the sum of Mr. Liu's journey and Mr. Li's journey is 1300 meters away from AB.

Mr. Li and Mr. Li went from place A to place B. Mr. Li walked for 10 minutes first and then Mr. B left. How long did Mr. Li catch up with Mr. Liu? The transformation of text language into graphic language is shown in Figure 7.

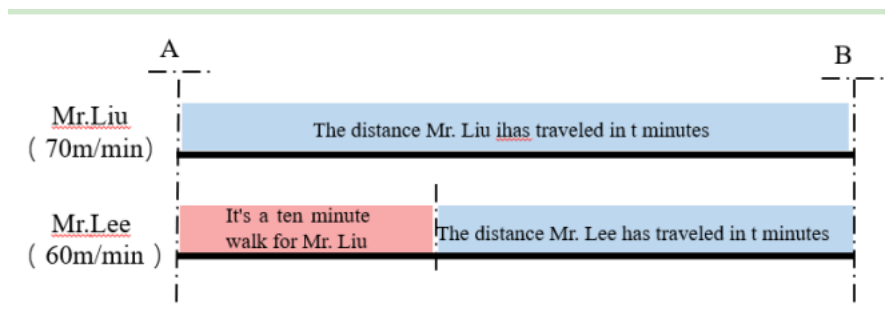


Figure 7: Tracing problem diagram

Mr. Li walked for 10 minutes first. At this stage, Mr. Li walked the red part of the road, and then they walked for t minutes at the same time; It can be seen intuitively from the process diagram that the distance traveled by Mr. Liu in t time minus the distance traveled by Mr. Li in t time is the distance traveled by Mr. Li in 10 minutes, and an equivalent relationship can be established accordingly.

4. Conclusion

As one of the important teaching methods, online education has effectively guaranteed the continuity of students' knowledge education and played an irreplaceable role under the impact of the epidemic. Create visual training of thinking before, during and after class, help students build a thinking network model, reduce students' learning difficulty to a certain extent, improve students' interest in learning, change from imparting knowledge to imparting methods, further improve students' learning ability, so that students can better manage knowledge and use knowledge.

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