Teaching Design of High School Mathematics Review Based on Thinking Maps

——Taking the Concepts and Properties of Functions as an Example

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Abstract: In high school, due to the fact that mathematical knowledge is more abstract and theoretical, the efficiency of revision will be reduced if students fail to establish the knowledge framework effectively. Taking the chapter of Concepts and Properties of Functions as an example, applying mind mapping to high school mathematics revision and making teaching design suggestions for its revision class can promote the development of students' thinking ability and the ability of constructing the knowledge framework independently, and prompt students to grasp the knowledge in a more systematic way, so as to improve the efficiency of revision.

Keywords: Mind Map; High School Mathematics Review; Teaching Design; Concept and Property of Function

Introduction

High school mathematics knowledge is highly abstract and theoretical. In the traditional revision mode, students review the learned knowledge points under the teacher's leadership in a carpet style and try to solve all the difficult problems. However, this mode of review will, to a certain extent, reduce the efficiency of students' review, which is not conducive to the development of students' mathematical thinking. Students are unable to match the questions with the knowledge points and mathematical methods when they are doing the problems. The reason is that students fail to construct a systematic knowledge framework during revision, which often leads to the neglect of some knowledge points when doing problems. At this time, mind mapping as a common auxiliary tool, its appearance can show the knowledge at a glance. Students can use the mind map, thoroughly review the knowledge points, so as to systematically grasp the knowledge, improve their ability to think out of the box, the ability to independently build a knowledge framework, and ultimately improve the efficiency of review.

1. Status of research

Searching the database of China Knowledge Network with the theme of "Thinking Maps" shows a total of 32,635 related documents; searching the database of China Knowledge Network with the theme of "High School Mathematics Review" shows a total of 2,255 related documents; combining "Thinking Maps" and "High School Mathematics Review" by theme shows a total of 260 related documents; combining "Thinking Maps" and "High School Mathematics Review" by theme shows a total of 260 related documents. "Thinking Maps" and "High School Mathematics Review", the results show that there are only 260 pieces of related literature; combining "Thinking Maps" and "High School Mathematics Review", the results show that there are only 260 pieces of related literature; combining "Thinking Maps" and "High School Mathematics Review", the results show that there are only 260 pieces of related literature. High school mathematics review" combined with further search by title, showing that there are only 72 pieces of related literature; according to the visual analysis of the search results on the ZhiNET, it is found that in the past two years, the research on the application of Thinking Maps in high school mathematics review has been increasing, or it will become a trend in the era of big data in the future. Therefore, based on the abstract and theoretical characteristics of high school mathematics and the cognitive situation of first-year high school students, the author takes the concepts and properties of functions as an example, and puts forward the review teaching suggestions based on the mind map.

In terms of mathematics, Wu Zhidan believes that reviewing mathematics by constructing a mind map can cultivate the sense of student-student cooperation, promote teaching reflection, exercise logical thinking.[1]

Based on the teaching characteristics of function properties, Fu Qiuping introduced the mind map into the review class of function properties in high school mathematics, which improved the review efficiency.[2]Zhang Xiaoxiong believes that teachers should reasonably use

mind maps to link abstract mathematical knowledge, so that students can use the complete mathematical knowledge structure to recall knowledge.[3]

2. Overview and characteristics of mind mapping

British brain development expert and psychologist Tony Buzan first proposed a new method of note-taking called "mind mapping".[4]In 1974, The Brain was published and Mind Mapping was officially launched. In Mind Maps, Tony Bozan says, "Mind maps are external mirrors of your own radioactive thinking, giving you access to this great thinking energy station."[5]He pointed out that the traditional mode of drafting and note-taking wastes time, buries the key words and fails to form an effective stimulus to the brain, and is therefore not conducive to memorization. On the contrary, mind mapping, with its concise and efficient features, can help the brain store long-term memory. Guided mapping is based on the structure of a network, in the form of diagrams, supplemented by keywords and key images, for storing, organizing and optimizing information.[6]The core of the mind map is radioactive thinking, it is a dispersive tool, along with the continuous dispersal of thought, and gradually formed a structured, sequential tree diagrams.[7]

3. The application of the principles of the mind map in high school mathematics revision

3.1 The principle of autonomy

The new curriculum reform proposes that we should respect the students' subjective position and guide them to learn actively. In the process of reviewing high school mathematics with the help of the mind map, teachers should encourage students to use the mind map to construct their own knowledge system and internalize knowledge.

3.2 The principle of proportionality

The principle of moderation must be observed in everything you do. Although the mind map has many advantages in high school math review, it must be used practically. If it is not practicable to use the mind map, it will inadvertently lead to an increase in the students' learning burden. Therefore, we teachers should make a scientific, reasonable and moderate choice of mind maps according to the actual situation of teaching, rather than using them for the sake of using them.

3.3 The principle of reflective summarization

Teachers introduce the mind map into high school mathematics review, mainly because they hope that students can more systematically recognize and understand the knowledge points, reflect on and summarize the knowledge in the process of drawing the mind map.

4. Suggestions for teaching design of reviewing the concepts and properties of functions based on mind mapping

4.1 Reviewing knowledge and building frameworks

The concepts and properties of functions are very important knowledge points in high school mathematics, which are used in all functions studied in high school. Students' knowledge of this chapter is too fragmented, which is not conducive to memorization and application. In order to ensure the effective mastery of this chapter, the knowledge framework is constructed with the help of mind maps, and classic examples are shown for students to consolidate their knowledge.

Teacher: for the knowledge of this chapter, you review what you have learned?

Students: the definition of function, three elements, representation, monotonicity of functions, the most value, parity, power functions, functions in real life applications.

Teacher: If you want to divide these contents, can be divided into several parts?

Student:The book is divided into four parts, namely, the concept of function and its representation, basic properties, power functions and applications of functions (I).

Teacher: Well, although the content of this chapter has been clearly divided into four parts, but students are still confused about the knowledge framework of each part?

Students: Yes, subdivided into each part of the knowledge of the mastery of a little confused.

Teacher: Well, that today by the teacher to lead you with the help of a mind map to draw the knowledge framework, so that we can review the knowledge clearly. Since you already know the knowledge of this chapter can be divided into four parts, then the overall knowledge framework should not be difficult to draw, we try to draw.

Teachers show the concepts and properties of functions of the overall knowledge framework as follows.

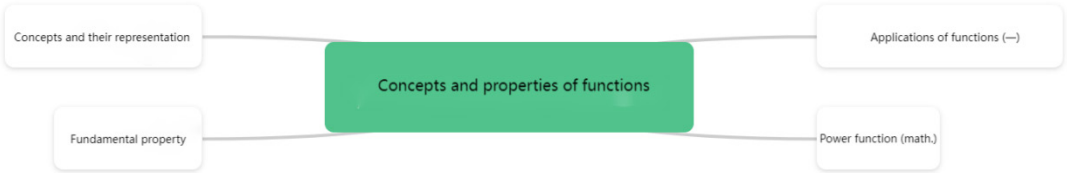

Figure 1 Overall knowledge framework of concepts and properties of functions drawn with the help of mind maps

4.2 Refine the branching and solve the example

Teacher: This is the overall knowledge framework, you can see at a glance the chapter contains four parts, then we have a more detailed classification of each individual branch. Now you first in the group to discuss together, review the first branch of what knowledge.

Student: The first branch is the concept of a function and its representation, which is divided into concepts and representations. The concepts include the definition, three elements, special functions; representation is the list method, image method, analytic method.

Teacher: Very good, now you according to the knowledge points, combined with the textbook, try to work in groups to draw the knowledge framework of the branch.

Teacher shows the knowledge framework of the first branch - the concept of function and its representation as follows.

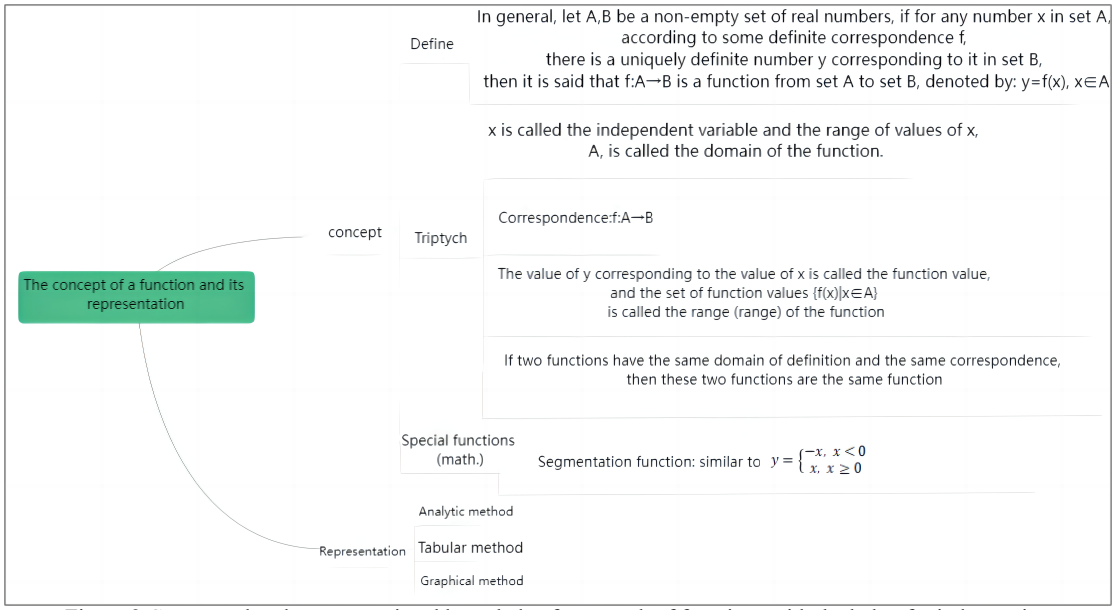

Figure 2 Conceptual and representational knowledge framework of functions with the help of mind mapping

Teacher: students are not found with the help of the mind map to draw the knowledge framework, knowledge is more organized, clear. So after sorting out the knowledge points, we do the following relevant types of questions to deepen consolidation.

Example 1 Find the domain of the following functions

(1) $f(x)=\frac{3x}{x-3}$; (2) $f(x)=\sqrt{x^3}$; (3) $f(x)=\frac{\sqrt{3-x}}{x-1}$.

Example 2 Determine whether the following functions are the same function as

(1) $f(x)=x-2,\ g(x)=\frac{x^2-2}{x}$; (2) $f(x)=(x-1)^2,\ g(x)=(\sqrt{x-1})^4$;

Example 3 It is known that the function $f(x)=2x^2-5x+1$, 求 $f(\sqrt{2})$ $f(3)$ $f(1)+f(-2)$ values of .

Example 4 Sketch the graph of a function $f(x)=\begin{cases}x-1, x\le 1,\\ x^2+1, x>1.\end{cases}$

Teacher: Briefly analyze the above examples. Example 1 is about solving the domain of definition, we should pay attention to the fact that the denominator of the formula cannot be 0 and the quadratic root of the formula, the square number is non-negative. Example 2 test "the same function", if a function of the definition of the domain, the correspondence is the same, can be determined as the same function. Example 3: Substitute the value of the independent variable to obtain the value of the function or the unknown. Example 4: According to the range of the independent variable, the corresponding image can be drawn. After analyzing the examples, we will classify the second branch, the basic properties of functions, in detail. In small groups, review what is included in the second branch.

Sheng: The second branch is the basic properties of functions, which is divided into monotonicity and maximum (minimum) value and parity. Among them, monotonicity and maximum (small) value include monotonicity, maximum (small) value.

Teacher: Good, now you according to the knowledge points, and combined with the textbook, try to work in groups to draw the knowledge framework of this branch.

Teacher shows the knowledge framework of the second branch - the basic properties of functions as follows.

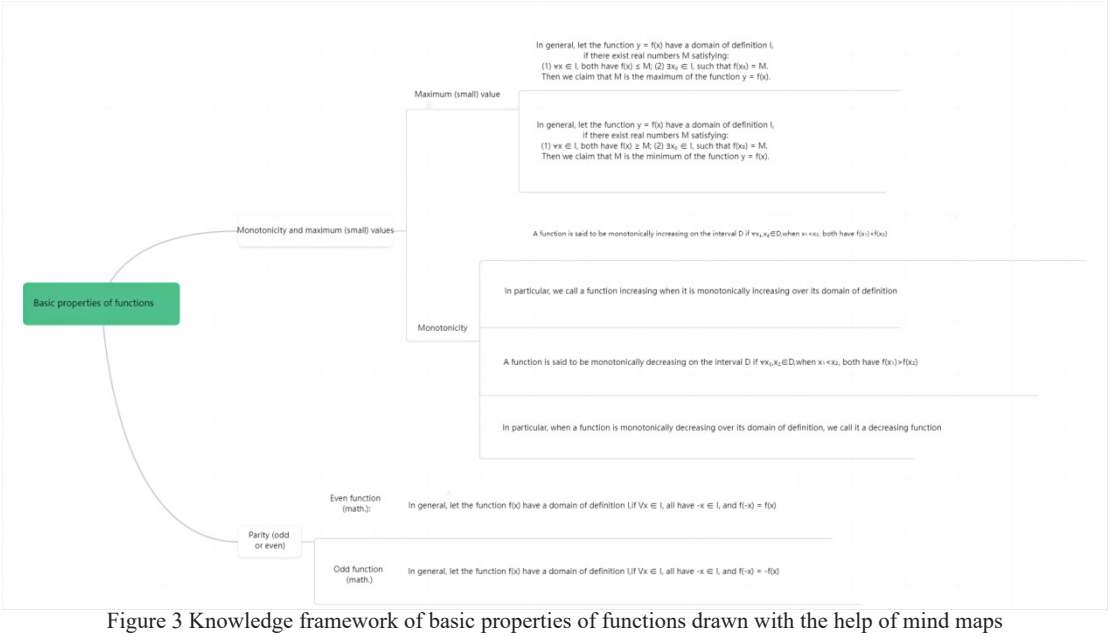

Figure 3 Knowledge framework of basic properties of functions drawn with the help of mind maps

Teacher: students now think the use of mind maps have any benefits?

Sheng: with the help of the mind map can be monotonic function, the most value, parity clearly shown, the memory of the knowledge of the mind is no longer confusing.

Teacher: Well, it seems that students have seen the mind map in the math review of the convenience. So after sorting out the knowledge points, the following do the relevant types of questions to deepen the consolidation.

Example 1 Find the monotonic interval and the maximum value of the following function y = f (x)

(1) $y=x^2-7x+10$; (2) $y=4-x^2$.

Example 2 Proof.

(1) The function f(x) = -x+2 is a decreasing function;

(2) The function $f(x)=x^2+2$ 在 $(0,+\infty)$ is monotonically increasing on;

Example 3 Determine the parity of the following functions.

(1) $f(x)=x^2+2$; (2) $f(x)=\frac{x}{x^2+2}$.

Teacher: Briefly analyze the above examples. Example 1 and 2 examine the monotonicity, the most value, you can use the definition of monotonicity or draw the function image, judge, prove the monotonicity, find the most value. Example 3 examines parity, with the definition of parity, determine the parity.

Teacher: We will review the power functions with the help of the previous knowledge, and open the third branch - the detailed classification of power functions. The first two branches are led by the teacher to review and draw the framework of knowledge, this branch is for you to think independently and complete on your own.

Sheng: the third branch for the power function, the power function of the knowledge of less content, divided into the definition and properties. Definition is described in one sentence, explaining clearly the base and exponent. Properties include monotonicity, parity.

Students demonstrate the following framework for the third branch, the power function.

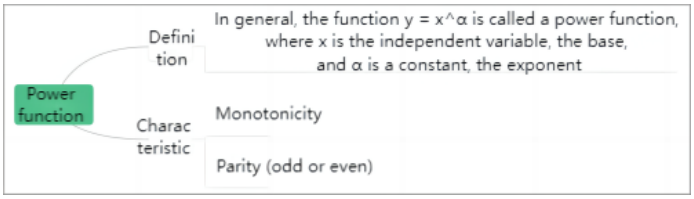

Figure 4 Power function knowledge framework drawn with the help of mind maps

Teacher: It seems that this student has reviewed the knowledge sufficiently and basically grasped how to draw a knowledge framework with the help of a mind map. She drew the knowledge framework is no problem, very concise and clear. After sorting out the knowledge points, we will do the related types of questions to deepen the consolidation.

Example 1 Draw the image of the function $y=\sqrt{|x^2|}$ false and determine the parity of the function and discuss the monotonicity of the function.

Example 2 At a fixed pressure difference (the pressure difference is a constant), when a gas passes through a circular pipe, its flow rate V (in: s/cm3) is proportional to the fourth power of the pipe radius r (in: cm).Write an analytical equation for the gas flow rate as a function of the radius r of the pipe.

(1) Write an analytical equation for the gas flow rate as a function of the pipe radius R;

(2) If the gas is in a pipe of radius 2 cm, the flow rate is 400 cm3/s, find the expression for the flow rate v when the gas passes through a pipe of radius r.

Teacher: Briefly analyze the above examples. Example 1 examines the parity and monotonicity of functions. First of all, we need to determine that this function is a power function, and then according to the previous review of the definition of parity, the definition of monotonicity, determine the parity, and discuss the monotonicity. Example 2 and the real life connection, analyze the title, you will find that this question examines the power function of real life problems. Therefore, the next review of the last branch - applications of functions (a). This branch of the structure has been very clear, here will not draw a separate knowledge of this branch of the framework. Here are some related types of questions to deepen the consolidation. Example To build a volume of 1200cubic meter, the depth of 6 meters of the rectangular swimming pool, the cost of the pool wall is 95 yuan / square meter, the cost of the bottom of the pool is 135 yuan / square meter, ask how to set the length of the swimming pool, the width of the pool, in order to control the swimming pool's total cost of 70,000 yuan or less (accurate to 0.1 m)?

Teacher: Briefly explain this example problem to emphasize the important role of functions in real life.

Teacher: After the classification of the four branches of knowledge, students have constructed a detailed knowledge framework in their minds, but also a clear understanding of the knowledge of the form of the question. Let's take a look at the complete version of the mind map knowledge framework drawn by the teacher.

Teachers show the full version of the mind map knowledge framework as follows.

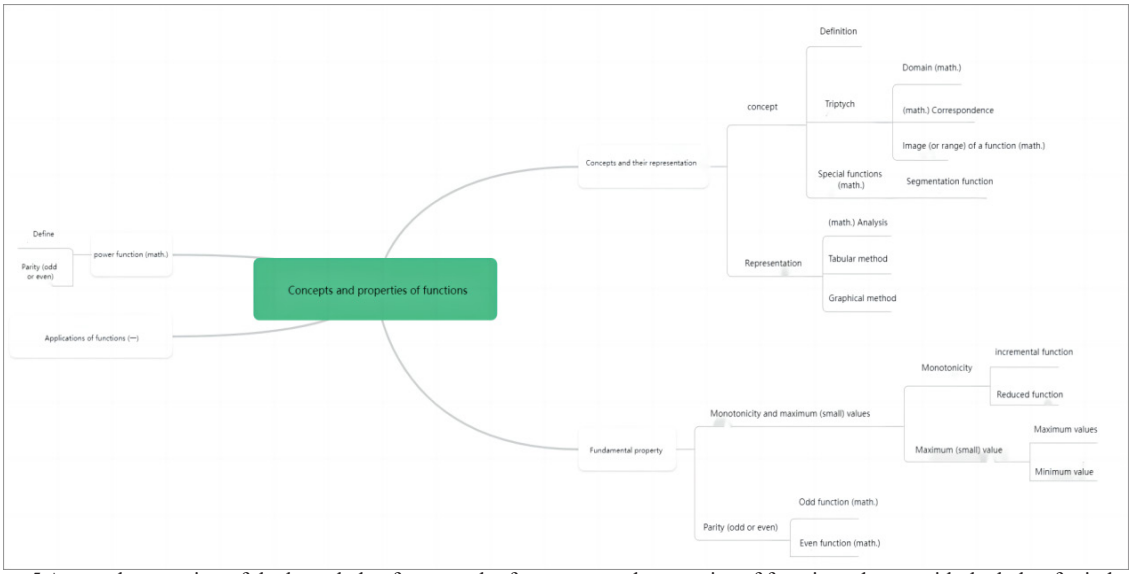

Figure 5 A complete version of the knowledge framework of concepts and properties of functions drawn with the help of mind maps

4.3 Classroom summary, in-depth reflection

Teacher: through the review of this lesson, what are the new gains?

Sheng: we use the mind map, first constructed the concepts and properties of the function of the third chapter of the overall knowledge framework, and then review each branch of the knowledge under the knowledge points, drawing its knowledge framework. According to each branch of the knowledge framework, organized review, to avoid the situation of mixed knowledge.

Teacher: In this lesson, we have reviewed the concepts and properties of functions in Chapter 3 systematically, with the help of the mind map to build a knowledge framework for easy memorization. In the subsequent study, whether it is a review class or a new lesson, you can use the mind map to assist in learning.

5. Summary

Nowadays, with the progress of information technology, mind mapping as an auxiliary teaching method, in high school mathematics review has been widely used. Teachers in the review class, the use of mind maps to help students intuitively construct the knowledge system, cultivate creative thinking, to ensure that students can be more systematic mastery of the knowledge learned, so as to effectively improve the efficiency and quality of students' review. It is believed that in the future, with the trend of technology, there will be more cases of combining mind mapping and mathematics teaching.

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