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Teaching Functions from the Perspective of Big Concepts ---- Taking "The Graph and Properties of Exponential Functions" as an Example

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Abstract: In this paper, the author takes the teaching of "the graph and properties of exponential functions" in high school mathematics as an example, and through the analysis of teaching content and teaching design cases from the perspective of big concepts, clarifies the teaching design ideas contained in big concept teaching, the core literacy cultivation elements contained in exponential function knowledge, and explores the teaching path of developing students' mathematical core literacy through big concept teaching, Fully implementing classroom teaching plays a crucial role in landing core competencies.

Keywords: Big Concepts; Core competencies; Classroom teaching; Exponential function

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Introduction

The "Curriculum Standards for High School Mathematics (2017 Edition, 2020 Revision)" (hereinafter referred to as the "New Curriculum Standards") emphasizes the importance of "focusing on the overall concept of the subject, structuring the curriculum content, leading by the theme, making the curriculum content contextualized, and promoting the implementation of core competencies in the subject". So how to reflect the role of the overall concept of the subject in teaching, and promote the rooting of core competencies? Focusing on the new curriculum standards, the author takes "The Image and Properties of Exponential Functions" as an example in the compulsory course of High School Mathematics People's Education Press A Edition (2019) (hereinafter referred to as the "New Textbook"), clarifies the teaching design ideas, analyzes the elements of cultivating core competencies, explores the teaching path of developing core competencies, and shares teaching design practices and reflections based on the perspective of big concepts.

1. Content Analysis

1.1 Textbook Analysis

This lesson is the content of Compulsory Volume 1 , Section 4.2.2 of the"New Textbook". The content of this lesson is based on students having a preliminary understanding of the concept of functions and the general methods of studying power functions, and knowing the concept of exponential functions. This is a further deepening understanding of the concept of exponential functions, and also lays the foundation for future learning of logarithmic functions, trigonometric functions, and other basic elementary functions, as well as comprehensive and systematic research on the general principles of functions. It is an indispensable and important link under the guidance of the concept of "function" in the discipline. In addition, the knowledge of exponential functions is closely related to common bank deposit and loan interest rates in our daily lives, cell division, population or other life growth, decay of

radioactive substances, etc. It is a common mathematical model for describing real-world problems, so learning this part of knowledge is particularly of great practical value.

1.2 Teaching objectives

(1) Deepen the understanding of the concept of exponential functions and be able to draw specific graphs of exponential functions.

(2) Through the process of drawing specific exponential function graphs to sketching general exponential functions, cultivating and improving hands-on, eye and brain skills through activities such as observing graph induction and exploring properties, and consolidating the laws and methods of studying functions.

(3) By deepening the understanding of the concept of exponential functions, cultivate the core literacy of mathematical abstraction; By mastering the graphs and properties of exponential functions, cultivate intuitive imagination skills; By solving problems, cultivate mathematical core competencies such as mathematical modeling, data analysis, mathematical operations, and logical reasoning.

1.3 Key Points, Difficulties

Key points: Master the graphs and properties of exponential functions, and be able to flexibly apply graphs and properties to solve related problems

Difficulties: Understanding the properties of exponential functions and the impact of bases on exponential functions.

2. Teaching Design Practice Cases

2.1 Creating Situations and Introducing New Lessons

Teachers inspire students' interest through the famous physicist and mathematician Archimedes' motto "Give me a fulcrum, I can pry the entire earth", Guide students to intuitively experience the shock of the explosive growth of "stacking reports as a ladder to land on the moon", and introduce the new lesson.

Design intention: Using famous quotes as a medium can effectively focus students' attention and stimulate their enthusiasm for learning.

Joint activities between teachers and students：Review old knowledge and the concept of exponential functions; The conclusion drawn through calculation is that when the number of folds exceeds 42, the thickness of the paper exceeds the distance between the ground and the moon.

Design intention: Through intuitive perception, students can deepen their understanding, further appreciate the power of exponential explosion.

2.2 Analogical exploration, forming ideas

Teacher's guidance: In this lesson, we will further understand the power of exponential explosion and study the graphs and properties of exponential functions. How can we study them? Previously, we learned about power functions. When we recall the research ideas and methods of power functions? (Discuss and comment on the relationship between definitions, images, and properties).

Joint activities between teachers and students： Exploring the process of analogizing power functions, exploring the graphs and properties of exponential functions.

Design intention: Infiltrate the mathematical ideas of analogy, clarify the research ideas and methods for determining specific functions, and lay the foundation for the learning of this lesson.

Exploration 1: Firstly, we need to draw a graph of the specific exponential function.Which exponential function do students want to draw?

Joint activities between teachers and students： Teachers and students discuss together, and students summarize and summarize.

Design intention: Inspire students to actively think, guide students to communicate and discuss, and fully give students a subject position.

Question: What are the general steps we take when drawing function graphs? (List-- Draw Points-- Line)

Joint activities between teachers and students：Complete the table on the study guide and draw an image in the same coordinate system based on the obtained data.

2.3 Differentiate understanding and consolidate cognition

Exploration 2: To obtain the properties of exponential functions, we need more graphs of exponential functions for observation. Next, please have your classmates work together to draw graphs of exponential functions with bases of these in the same coordinate system? (Show PPT while reading questions).

Teacher's guidance: What are the commonalities between observing the position, common points, and changing trends of an

image? Can you summarize the graphical characteristics and properties of these exponential functions?

Joint activities between teachers and students：Students first think independently, then engage in group discussions, and teachers provide timely guidance.

Design intention: Guide students to classify and discuss through specific function images, experience the mutual transformation of graphic language, textual language, and symbolic language, and develop core competencies such as mathematical abstraction and logical reasoning.

Expansion: Do these conclusions also hold true for general exponential functions? Let's use the animation of a geometric drawing board to verify it. (Dynamic image display).

Joint activities between teachers and students：Explore the graph and properties of exponential functions, and complete the table.

Design intention: This part of the content is the focus and difficulty of this lesson's teaching. Teachers can use GeoGebra software to draw images and demonstrate changes, which can strengthen students' understanding and memory of knowledge and help them overcome teaching difficulties more easily.

2.4 Thinking and communication, flexible application

Exploration 3: With theoretical support, let's apply what we have learned to solve this set of problems. (Example Question 3 in Textbook)

Classroom exercise(Exercise 7 on page 119 of the textbook)

Design intention: Solving common problem types with gradient difficulty design can help students deepen and consolidate their understanding, and develop their awareness of combining numbers and shapes more smoothly; Develop data analysis, mathematical modeling skills, and mathematical operation skills by independently completing the complete problem-solving process.

3. Teaching Reflection

3.1 Clarify research methods to reveal the essence of knowledge

In order to scientifically construct a mathematical knowledge system, the primary task is to help students clarify the research object and research ideas. In this lesson, the research object is the graph and properties of exponential functions. The research idea is to analogize the research process of power functions, and according to the definition, draw a specific graph of exponential functions through the steps of "listing, drawing points, and connecting lines". By observing the graph, summarize and summarize the general properties of exponential functions, Using images and properties to solve simple mathematical problems.

3.2 Optimizing design to improve efficiency

In this section of teaching, the author uses Archimedes' words as a starting point to stimulate students' learning enthusiasm, analogize the process of exploring power functions, and further reflect the coherence of knowledge. The teaching design of the entire class is reasonable and orderly, optimizing the teaching design, adjusting the teaching plan, and improving classroom efficiency.

3.3 Infiltration of ideological development literacy

In classroom teaching, the mathematical ideas of analogy are infused through the study of power functions, and the mathematical ideas of transformation, reduction, and combination of numbers and shapes are infused through typical example problems. By deepening the understanding of the concept of exponential functions, cultivate the core literacy of mathematical abstraction; By mastering the graphs and properties of exponential functions, cultivate intuitive imagination skills; By solving problems, cultivate mathematical core competencies such as mathematical modeling, data analysis, mathematical operations, and logical reasoning.

4. Conclusion

The teaching of core competencies based on the perspective of big concepts requires teachers to first refine the subject's big concepts, and then clarify the elements of competency cultivation. Function is a main thread that runs through high school mathematics curriculum, and the concept of function is the major concept of this unit. In the teaching process of this lesson, teachers must stand from the perspective of this major concept, lead the entire teaching design process, and through reasonable design of teaching plans, enable students to form and develop core mathematical literacy while mastering knowledge and skills.

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