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Instructional Design of "Images of Quadratic Functions"

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ABSTRACT

Classroom teaching is an indispensable part of education, and it is particularly important for teachers to carry out preset teaching design according to curriculum standards and teaching methods before teaching to determine whether classroom teaching can be carried out smoothly. After the release of the 2022 edition of the Compulsory Education Mathematics Curriculum Standards, this paper is based on the teaching design of the image of quadratic functions in the ninth grade curriculum according to the requirements of the new curriculum standards. It aims to provide new methods and ideas for the teaching process of quadratic function images. Through the analysis of curriculum standards, the objectives of this course are clarified, and the teaching process of this course is designed in combination with the teaching process of similar courses in the compulsory education stage. The resulting teaching design starts from the analysis of teaching materials, combines the students' learning situation and the teaching objectives that need to be achieved, analyzes the key points and difficulties of teaching, and carries out the teaching design of the complete course content according to the reasonable teaching method, and designs the board books in the course of the class and leaves homework after class: the consolidation and further exploration of the quadratic function.

KEYWORDS

Quadratic Function Image; Number Combination; Instructional Design.

1. DESIGN BACKGROUND

In the context of the new curriculum standards, teachers should explore more effective teaching methods based on the connotation of core literacy and improve the overall efficiency of teaching. Teachers should also establish a student-centered ideology, unify all aspects of teaching, learning, and evaluation for the purpose of cultivating core literacy, realize the mutual promotion of teaching and evaluation, and implement the educational concept of the new curriculum standard [1].

2. ANALYSIS OF TEACHING MATERIALS

"The Image of Quadratic Functions" comes from the first chapter, second section, first lesson of the ninth grade of "Mathematics" published by Zhejiang Education Press. It mainly includes the use of the tracing method to draw the image of quadratic functions, put forward the concepts of parabola and vertices, and study the openings, vertices and symmetry of special quadratic functions. Quadratic function images are an important tool for students to learn quadratic functions, and they are also a way to represent functions. It helps students learn and recognize quadratic functions $y = ax^2$.

The textbook inherits the concept of quadratic function in the previous lesson, explores and studies the image of quadratic function, and lays a foundation for the subsequent study of the properties of

quadratic function by using the image of quadratic function. After learning the translation of quadratic functions, the general quadratic functions are transformed into special quadratic functions through translation, so that the vertices and symmetry axes of general quadratic functions are studied $y = ax^2$.

3. ANALYSIS OF THE LEARNING SITUATION

From the perspective of students' knowledge level, after previous learning, students have mastered the drawing of the image of the primary function and the inverse proportional function, and have used the tracing method to draw the image of the function in the study of the image of the primary function and the inverse proportional function, especially the inverse proportional function, which needs to be connected to the points with smooth curves, which is similar to the quadratic function. However, the students' understanding of the general shape of the quadratic function image is insufficient, or the number of points taken is insufficient, which leads to certain problems in the quadratic function image drawn by the tracing method. The teacher can first observe a few quadratic function images for students, so that students have a certain understanding of quadratic function images.

From the perspective of students' ability, students already have a certain ability to combine numbers and shapes, abstract ability, and master some methods of drawing images, but due to the lack of understanding of quadratic functions and the unskilled use of the tracing method, there may be insufficient points to take and use straight lines to connect points, etc., teachers need to analyze the causes of wrong images and guide students to draw correct images. And although students already have a certain ability to think analytically, they cannot summarize the phenomenon in concise language.

4. TEACHING OBJECTIVES

In the teaching of junior high school mathematics, the idea of combining numbers and shapes is of great significance in the teaching of quadratic functions [2], so learning to draw quadratic function images is an indispensable part of the learning of quadratic functions. Teachers can help students better understand the image and properties of quadratic functions through the combination of numbers and shapes, and guide students to intuitively see the shape and change trend of quadratic functions, so as to better understand the properties and characteristics of functions, and master important concepts such as extreme and maximum values of quadratic functions. [3]

4.1. Knowledge and SKILLS

(1) Master the use of the tracing method to draw quadratic function images, and the quadratic function images represented by the list method and the analytical method are represented by the image method.

(2) Understand the concepts of quadratic function parabola, vertex, and axis of symmetry, and grasp the relevant properties of quadratic functions of form.$y = ax^2$

4.2. Process & Methodology

(1) By comparing the learning process of the primary function and the inverse proportional function learned in the past, the method of drawing the image of the quadratic function by using the tracing method is obtained.

(2) By studying the properties of the quadratic function image of a special form, the relevant properties are obtained, and the process from the special to the general is experienced.$y = ax^2$.

4.3. Emotional, Attitudinal, and Values

(1) In drawing the image of a quadratic function, I experienced the idea of combining numbers and shapes, so as to feel the joy of mathematics learning.

(2) The process of obtaining the general properties of such quadratic function images from a special class of quadratic function images can experience the beauty of mathematics and enhance the interest in mathematics learning. And subtly improve the ability of mathematical thinking.

5. KEY POINTS, DIFFICULTIES AND TEACHING METHODS

This course has established the following: the necessity to determine the teaching emphasis and problems, as well as the proper teaching method.

Teaching focus: master the use of tracing method to draw quadratic function images, understand the concept of quadratic function symmetry axis and vertex, and master the law of quadratic function image symmetry axis, vertex and opening direction $y = ax^2$.

Teaching difficulty: Use the tracing method to draw the image of the quadratic function, and experience the general "shape" of the quadratic function image, and the relevant properties obtained from the special point of view $y = ax^2 y = ax^2$.

Teaching methods: lectures, discussions, demonstrations.

Learning Method: Inquiry-based learning, cooperative learning.

6. TEACHING PROCESS

This course has five lessons: review and introduction of new knowledge, mastery of methods, group collaborative exploration, review and consolidation, and homework. Here's how to start teaching this lesson.

6.1. Review and Introduce New Knowledge

Teachers need to review what they have learned in the past to better understand what they are going to learn today.

Teacher: Draw the image$y = x, y = 2x + 3, y = \frac{2}{x}$

Preset: Students draw an image of the above function by tracing the dot method

Teacher: Praise and affirm students for remembering what they have learned.

Design intent: Review the method of drawing functional images using the tracing method, and lay the foundation for the next use of the tracing method to draw quadratic function images.

6.2. Method Mastery

Students need to go through the process of drawing the image of the function they have learned before, so as to obtain the method of drawing the image of the quadratic function.

Teacher: Links the general process of learning functions, from functions to concepts-images-properties-applications. and the process from the special to the general, according to the steps of the dot method $y = x^2$.

Preset: Most students can draw images, and a few use straight lines to connect special points.

Teacher: Discuss the reasons for the wrong image and invite students to actively reflect on why they drew the wrong image. Students are also asked to think about what requirements and experiences they have when taking values, and what they need to pay attention to when drawing points.

Preset: Students should reflect on it in time and sort out the points that need to be paid attention to when drawing the image of a quadratic function, such as not taking too few points, connecting them with smooth curves, etc., and taking points not only positive numbers, etc.

Teacher: What did you find out from the images?$y = x^2$.

Preset: Students can discover that the function image is axisymmetric with respect to the y-axis, has a minimum value, and can be extended up indefinitely without a maximum value.

Teacher: Introduce the concepts of parabola and vertices, and explain them.$y = x^2$.

Design intent: Through this special quadratic function, the process of tracing method is mastered, and the concept of parabola and vertex axis symmetry is proposed to pave the way for the properties of images to be studied in the future$y = x^2 y = ax^2$.

6.3. Group Collaborative Exploration

Create more drawings of quadratic functions in small groups and analyze them for trends.

Teacher: Work in small groups to draw$y = 2x^2$ an $y = -2x^2$image and explore the properties and think about the characteristics of a quadratic function image like this. $y = ax^2$.

Preset: The image of the quadratic function is a parabola, it is $y = ax^2$symmetrical with respect to the y-axis, the vertex is the coordinate origin, when a>0, the opening of the parabola is up, the vertex is the lowest point of the parabola, when a<0, the opening of the parabola is downward, and the vertex is the highest point of the parabola. In other words, when a>0, the quadratic function has a minimum, and when a<0, the opening of the parabola is downward, and the quadratic function has a maximum.

Design intent: Work together in a group to complete the process of drawing a quadratic function image using the tracing method, and use the image to think about the nature of the image and obtain the$y = ax^2$ nature of the image.

6.4. Review and Consolidate

After completing the content of this lesson, students need to review and consolidate the content of this lesson and summarize it.

Teacher: Think about reviewing what we learned in this lesson.

Preset: Starting from the primary function and the inverse proportional function, the image of the quadratic function is drawn by the tracing method, and the image of $a = 1,2,-2$ is drawn$y = ax^2$ and the law is summarized from it.

6.5. Homework

Ask students to complete the homework in the textbook to reinforce what they have learned today, and to think about the relationship between the new quadratic function and the previous quadratic function after translating the quadratic function image left and right.

7. NINE BOARD BOOK DESIGN

A good board book will help students better understand what they are learning. And it is a good way to analyze the content presented on the blackboard bit by bit. Therefore, I have created the following board book (see Figure 1).

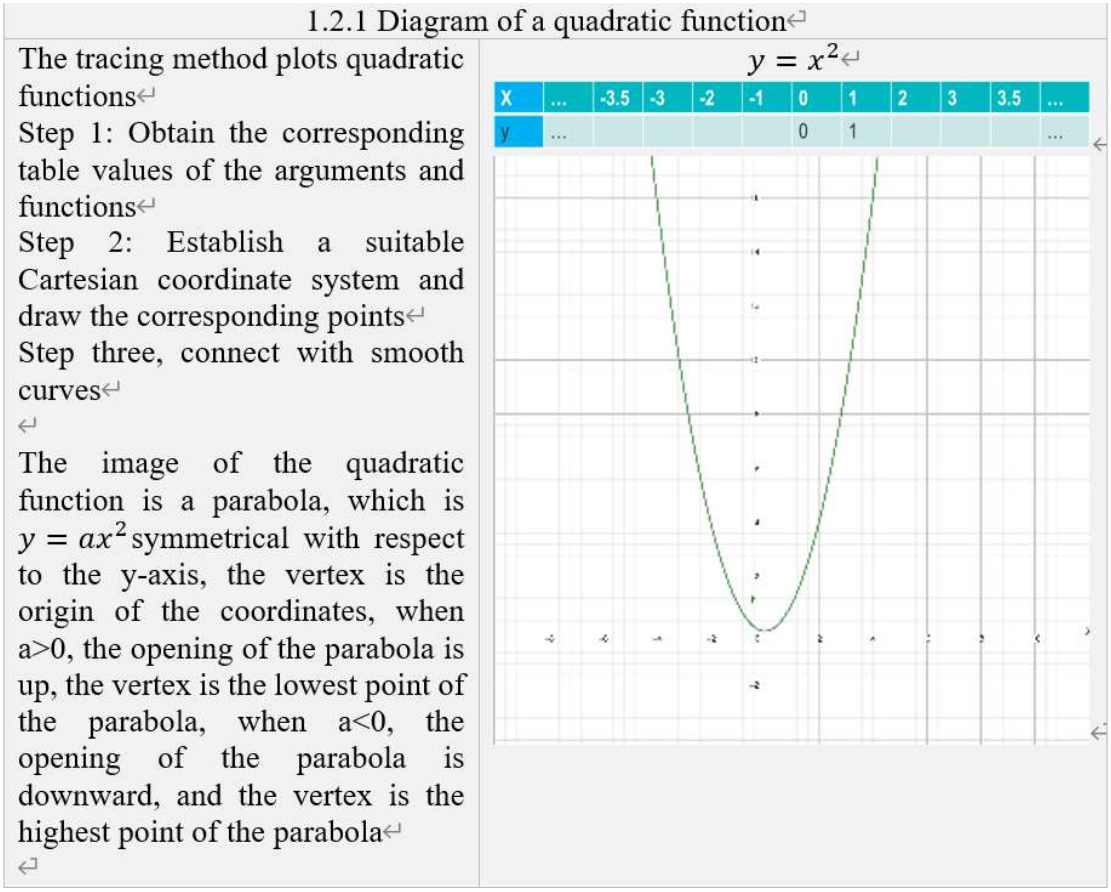

Figure 1. Shows the board book

Source: Author's work. The tracing method plots quadratic functions. Step 1: Obtain the corresponding table values of the arguments and functions. Step 2: Establish a suitable Cartesian coordinate system and draw the corresponding points. Step 3: connect with smooth curves.

The image of the quadratic function is a parabola, which is $y = ax^2$ symmetrical with respect to the y-axis, the vertex is the origin of the coordinates, when a>0, the opening of the parabola is up, the vertex is the lowest point of the parabola, when a<0, the opening of the parabola is downward, and the vertex is the highest point of the parabola.

Through this board, students will also gain a sense of satisfaction and strengthen their interest in learning mathematics after completing this lesson and intuitively feeling the learning content.

8. CONCLUSION

Based on the new curriculum standards, this paper sets appropriate teaching methods according to the order of teaching materials and students' receptivity, and sets the corresponding teaching focus, teaching difficulties and teaching objectives. The teaching design and board book design of the lesson of quadratic function images were carried out in complete detail.

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