

Exploring Function Teaching Points from the Perspective of Student Engagement: A Case Study of Quadratic Functions

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Abstract: In the context of junior high school education, effectively imparting knowledge of quadratic functions while engaging students' thought processes can pave new paths for mathematical instruction. Through exploration, this study focuses on practical strategies such as stimulating interest, linking to real-world applications, enhancing intuitive perception, problem-guided learning, exploring properties, and understanding patterns of change. These strategies aim to construct an effective teaching method that not only deepens students' mathematical understanding but also ignites their enthusiasm for learning and active participation, thereby improving the effectiveness and quality of mathematics education.

Keywords: student thinking, quadratic functions, Mathematics classroom

Introduction

In the process of junior high school education, mathematics instruction significantly influences students' logical reasoning and problem-solving skills, particularly in the realm of quadratic functions. As a core component of mathematics, the effectiveness of teaching quadratic functions not only affects students' interest and depth of understanding in mathematics but also plays a crucial role in the development of their cognitive abilities within the field. Conventional teaching methods often struggle to arouse students' enthusiasm and enhance their application skills due to their abstract and conceptual nature. In current educational research, designing and implementing teaching strategies that enable students to grasp the concept of quadratic functions deeply and apply them to real-life scenarios is a critical and urgent issue. In actual teaching activities, a method system emphasizing students' active thinking has been formed based on principles from educational psychology. By employing specific teaching methods, significant improvements in students' learning outcomes in mathematics can be achieved, simultaneously shaping and strengthening their mathematical and innovative thinking skills, thereby establishing a solid mathematical foundation for their future academic and professional careers.

1. Intuitive understanding of function definitions and graphs

In the process of secondary education, providing a visual interpretation of function concepts and their graphs helps students grasp the basic forms, characteristics, and variation patterns of parabolas^[1]. By presenting examples from real-life scenarios, such as arches, roof structures, or the path of thrown objects, students gain an in-depth understanding of the nature of quadratic functions. Observing these graphs allows students to intuitively grasp the shape and characteristics of parabolas in real-world contexts, aiding in their understanding of its significance. Using specific mathematical applications or hand-drawn graphs, students can directly observe how changing coefficients affect the shape of quadratic function graphs, including adjustments in flatness, shifts in position, and alterations in the size of the opening. For junior high

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school mathematics teachers, assigning post-class exercises that require students to derive corresponding function expressions based on parabolic graphs or construct quadratic function models in real-life scenarios can enhance their sense of participation and motivation for learning. During post-class assignments, students can apply theory to solve specific problems, thus enhancing their engagement and stimulating their learning drive. Throughout the teaching process, teachers can use vivid graphical presentations and concrete examples to help students gain a deeper understanding of the essential characteristics and inherent properties of quadratic functions. This teaching method not only makes mathematical concepts more concrete and vivid but also helps students delve into the essence of parabolas and related mathematical theories.

2. Problem-driven learning

In the process of junior high school mathematics education, employing a problem-driven teaching strategy for the quadratic function unit can effectively enhance students' ability to apply mathematical tools to solve specific problems, while boosting their motivation and classroom participation. For instance, using quadratic functions as an example, teachers can ask students to observe the graph of a quadratic function and deduce its specific mathematical expression based on the graph. Among the students tasked with this, their objective is to analyze the graphical information to identify the characteristics of the parabola, including its opening direction, vertex coordinates, and intersections with the y-axis. Based on these identified characteristics, students further infer the coefficients of the function. Furthermore, teachers can set up real-life scenarios such as projectile motion represented by parabolas, guiding students to construct quadratic function models to describe their trajectories. Through this teaching approach, learners can concretize abstract mathematical theories and effectively apply them to solve real-world problems. Understanding the significant role of mathematical tools in everyday life, students are not only required to grasp the concepts and characteristics of quadratic functions but also to apply their knowledge to solve various complex problems. Faced with challenging problems, students are encouraged to engage in deeper levels of thinking, thereby promoting deeper exploration of mathematical principles. Compared to traditional knowledge transmission methods, a problem-driven learning model is more effective in arousing students' interest and motivation because they recognize that mathematics is not just abstract theory but also an effective tool for addressing real-world issues. By constructing quadratic function models, students not only master the application skills of these models but also enhance their practical modeling capabilities, which are crucial for applications in everyday life and advanced mathematical explorations. In designing problems, junior high school mathematics teachers can guide students to engage in in-depth discussions in groups, dissecting and solving challenging problems through collective intelligence. Through communication and collaboration, students not only absorb insights from others' perspectives but also enhance their teamwork and social skills in effectively solving problems^[2]. Upon completing the quadratic function problem-solving tasks, teachers should provide immediate feedback. During the answer process, targeted guidance can address students' shortcomings in understanding and applying the concept, motivating them to delve deeper and optimize their problem-solving strategies. The problem-centered learning model enables students to master theoretical and practical aspects of quadratic functions, enhancing their problem-solving skills and driving force for autonomous learning, thus achieving better overall results and participation in mathematics education.

3. Exploring function properties and variation patterns

In the mid-stage of secondary education, guiding students through teaching activities to explore the basic properties and variation patterns of quadratic functions is crucial for deepening their grasp of fundamental mathematical concepts. By examining quadratic function graphs, teachers can analyze their characteristics of symmetrical reflection about the vertex, centered along the axis of symmetry. Symmetry about the axis is a fundamental property of parabolas, which can be explained through a combination of observation and mathematical deduction. For quadratic functions, under specific conditions, zero values can be obtained, representing the points sought by solving quadratic equations. At this point, the x-coordinate value is depicted on the function graph. To further optimize the curriculum, teachers can demonstrate how adjusting the values of the quadratic function coefficients a , b , and c alters the shape and position of its graph, simulating real-life parabolic phenomena such as projectile motion and arch design. Assigning tasks to students involving changing

parameter values of quadratic functions based on specific scenarios can solve problems such as minimizing the distance from the parabola to a target point. Using mathematical software or manually drawing graphs to illustrate changes in quadratic function graphs under various parameter combinations, students can better grasp the variation patterns of function properties through intuitive display methods in class^[3]. Students can deeply understand the characteristics and variation rules of quadratic functions, not only in terms of theoretical grasp of mathematical concepts but also importantly in applying knowledge to real-world problem-solving. This cultivates their skills in problem-solving and model construction. By employing diverse teaching methods, significant enhancements are observed in students' interest in learning mathematics and their degree of engagement, thereby promoting improvements in their initiative and depth of learning.

4. Conclusion

In summary, a deep analysis has been conducted on how students can better understand and master key concepts of quadratic functions during their thinking process, as well as effective teaching methods that can further stimulate their interest in learning. By employing practical applications, visual representations of function definitions and graphs, guided problem-solving approaches, and exploring the properties and patterns of functions, students' understanding of quadratic functions can be strengthened, and their mathematical skills cultivated. Through educational activities, it has been observed that specific methods not only help students build a solid foundation in mathematics but also ignite their enthusiasm for learning and enhance their problem-solving abilities. Problem-oriented learning models enable students to integrate mathematical concepts with real-world scenarios, significantly boosting their initiative and engagement in learning. Combining visual presentations with specific examples in teaching helps students to better grasp the essence, graphical features, and variation laws of quadratic functions, thereby enhancing their mathematical intuition and creative thinking. Future educational research can continue to explore more teaching strategies based on student thought engagement to further optimize the effectiveness and quality of mathematics education. Through ongoing innovation and practical exploration, students can experience richer and deeper learning experiences in mathematics, thus laying a solid foundation of mathematical knowledge for their future academic development and professional careers.

Conflicts of interest

The author declares no conflicts of interest regarding the publication of this paper.

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