A Preliminary Exploration of Situational Design in Middle School Mathematics Classroom Teaching

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Abstract: Based on constructivist theory and situated cognition theory, this paper mainly discusses the principles and creation methods of situational design in middle school mathematics teaching in combination with teaching practice. It aims to help students better understand abstract mathematical concepts and principles through reasonable situational design, stimulate students' interest in learning, and provide a practical path for enhancing students' core mathematical literacy.

Keywords: Situational Design; Middle School Mathematics; Classroom Teaching

1. Introduction

Mathematics, as a highly logical subject, is often regarded by students as the synonym for abstraction and dullness, leading to feelings of fear and aversion towards mathematics. However, as one of the most fundamental disciplines, mathematical knowledge is closely related to real life. Through reasonable situational design in teaching, abstract mathematical knowledge can be combined with specific life scenarios, enabling students to actively explore mathematical knowledge in vivid situations, form mathematical thinking, and enhance core mathematical literacy.

2. The Theoretical Basis and Practical Needs of Situational Design in Middle School Mathematics Classroom Teaching

2.1 Constructivist Views on Learning

Piaget's theory of cognitive development emphasizes that knowledge is the product of learners actively constructing in specific situations. The discipline of mathematics is highly abstract, and situational teaching can build a cognitive bridge between concrete experience and formal operations. Research shows that when mathematical concepts are embedded in real-life situations, students' working memory load is reduced by 32%, and concept retention rates increase to 67% (Hattie, 2012).

2.2 Situated Cognition Theory

Lave and Wenger's concept of "legitimate peripheral participation" points out that learning does not occur in isolation within an individual's brain; learners need to engage in activities in real situations and construct knowledge through interaction with others.

2.3 Requirements of the New Curriculum Standards for Situational Teaching

The 2022 "Mathematics Curriculum Standards for Compulsory Education" explicitly puts forward the importance of "emphasizing situational design and posing problems," requiring teachers to embed knowledge in real situations. Situational design should balance mathematical essence and life relevance, forming a teaching closed-loop of "situation-problem-inquiry-application," and avoiding many teachers directly presenting formulas and theorems, which leads students into the dilemma of rote memorization.

3. Principles of Situational Design in Middle School Mathematics Classroom Teaching

3.1 Principle of Authenticity

Situation creation should originate from real life or the forefront of the discipline, highlighting practicality. When learning "statistics," introduce local air quality data for a week, allowing students to count the number of good days, calculate the average pollution index, etc., to truly understand the role of statistics in monitoring the environment and aiding decision-making in life, cultivate data analysis literacy, and understand the significance of mathematics serving life.

3.2 Principle of Inspiration

Situation creation should contain problems, inspire students' thinking, match students' zone of proximal development, and promote students' exploration and understanding of new knowledge. For example, when learning "addition of rational numbers," create a situation where points gained in a competition are recorded as positive numbers and points deducted as negative numbers, allowing students to calculate the total score and explore and summarize the rules of addition of rational numbers independently.

3.3 Principle of Fun

Interest is the best teacher. Designing interesting teaching situations can quickly capture students' attention and immerse them in mathematics learning. For instance, when learning the "Pythagorean theorem," teachers can tell the story of ancient Greek mathematician Pythagoras discovering the special relationship among the three sides of a right-angled triangle on his friend's floor, and stimulate students' desire to explore the Pythagorean theorem with this mysterious journey of mathematical discovery, enabling students to embark on knowledge exploration with curiosity.

A situational design that satisfies the above three principles can basically help students learn the content well in class. If it also satisfies the principle of cognitive progression, serving as a thread throughout the entire class, making the whole class coherent, then it would be even better.

4. Methods of Creating Situational Teaching in Middle School Mathematics Classroom

4.1 Life Situation Method

Start with students' familiar daily life scenarios to create situations related to mathematical knowledge. For example, in teaching "linear equations in one unknown," create a situation of shopping discounts at a supermarket, allowing students to list equations based on price relationships and solve them.

4.2 Story Situation Method

Tell stories from the history of mathematics or about mathematicians. For instance, when teaching "irrational numbers," relate the story of Hippassus discovering that the length of the diagonal of a square with a side length of 1 cannot be represented by integers or fractions, breaking the contemporary Pythagorean belief that "all things are numbers (rational numbers)," causing shockwaves in the mathematical community, and even costing Hippassus his life. The story stimulates students' enthusiasm for exploring irrational numbers. When learning the concepts and properties of irrational numbers subsequently, students will be more exploratory, understanding that the development of mathematics is a process of continuously breaking through cognitive limitations, cultivating students' scientific spirit and mathematical abstraction literacy.

4.3 Experimental Situation Method

Create situations through mathematical experiments. For example, in teaching "probability," prepare opaque bags containing several red and white balls, allow students to conduct ball-drawing experiments in groups, record the color and number of balls drawn each time, and estimate the probability of drawing balls of different colors. During the experiment, students intuitively feel the uncertainty of random events and the stability of probabilities, abstracting the concept of probability from a large amount of repeated experimental data, strengthening mathematical abstraction and data analysis literacy, deepening knowledge understanding through personal experience, and changing the learning mode of rote memorization.

4.4 Game Situation Method

Conduct teaching activities using the form of games. For instance, design a "mathematical escape room" game, transforming tasks such as solving equations and factoring into clues to unlock password locks, and through role-playing and team collaboration, transforming symbolic operations into meaningful task-driven learning.

4.5 Problem Situation Method

Guide students to think and explore actively by posing challenging questions. For example, when learning the "sum of the interior angles of a triangle," teachers can ask, "Why is the sum of the interior angles of a triangle always 180 degrees?" and then guide students to

explore through drawing, measurement, splicing, and other methods.

5. Issues to Consider in Situational Design for Teaching

5.1 Fit Teaching Objectives: Situational design should revolve around teaching objectives, not for the sake of a situation itself, ensuring that the situation can help students achieve learning objectives.

5.2 Suit Students' Reality: Consider students' age, cognitive level, and life experience. The designed situations should be easy for students to understand and accept, and should not cause cognitive overload.

5.3 Be Instructive: Provoke students' thinking, guide students to actively explore knowledge, and cultivate students' thinking ability and innovative spirit.

6. Conclusion

High-quality teaching situations are like well-designed cognitive feasts that drive students' thinking development, enable students to actively explore, gradually accumulate core mathematical literacy, and grow into talents of the new era with innovative thinking, practical ability, and the ability to solve complex problems using mathematics, highlighting the deep value of mathematics education.

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