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Strategies for Improving the Effectiveness of Classroom Questions in Primary School Mathematics under the New Curriculum Standards of Compulsory Education

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Abstract: *Classroom questioning is a key component of teachers' classroom teaching behavior, and the quality of the questions raised by teachers has a significant impact on the quality of teaching. This article is based on the requirements of the 2022 edition of compulsory education mathematics curriculum standards for developing students' core literacy, combined with the understanding that the question pointing to the core concept in the Ma Xinlan teaching method is an effective problem. Using questions that point to core concepts as a bridge between curriculum content and the development of students' core mathematical literacy, we generate effective questioning strategies based on core concepts in the math classroom. This will help students to learn math in depth, develop their core literacy, and meet the requirements of the "Double Reduction" to improve the quality and reduce the burden of classroom teaching.*

Keywords: *Mathematics Curriculum Standards for Compulsory Education; Classroom questioning; Core concepts*

1. Introduction

The 2022 edition of compulsory education mathematics curriculum standards clearly states that "mathematics education carries the fundamental task of implementing moral education and implementing quality education". It focuses on the development of core competencies for Chinese students, emphasizing the promotion of situational design and problem-solving for students to actively participate in teaching activities[1]. In addition, in July 2021, the General Office of the Central Committee of the Communist Party of China and the General Office of the State Council officially issued the "Opinions on Further Reducing the Homework and Off campus Training Burden of Students in Compulsory Education" (hereinafter referred to as the "Double Reduction"), with the aim of fully exerting the main function of school teaching and educating people, strengthening the main position of school education, which fully reflects the significance of school education and teaching reform[2]. Therefore, teachers should comprehensively optimize education and teaching methods, pay attention to classroom questioning strategies, improve classroom teaching effectiveness, guide students to gradually form core competencies that meet the needs of lifelong development in activities, in order to achieve the relevant requirements of implementing the dual reduction policy and the new curriculum standards.

In the current classroom teaching, although the ability of elementary school mathematics teachers to pose problems has improved compared to before, it is still difficult to pose high-quality classroom problems. So what kind of problem is an effective one? The new curriculum standards emphasize more on the structuring of course content, allowing scattered content to be linked through core concepts. In the book "How People Learn", it is mentioned that "core concepts help students better understand and strengthen more knowledge and methods, and apply them to learning in new scenarios, achieving the transfer of knowledge and methods. By replacing the surface coverage of all topics in the subject field with a small number of deep coverage of topics, these small number of topics enable key concepts in the subject to be understood" [3]. The Ma Xinlan teaching method points out that the core concept should be given a core position, and when the problem points to the core concept, it is truly effective and good. From this, it can be seen that the hierarchical issues pointing to the core concepts reflect the stage level of learning advancement. As the learning process progresses, the learning content continues

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to expand, gradually forming students' core literacy[4]. In view of this, based on the requirements of the new curriculum standards, we start with core concepts and use the Ma Xinlan teaching method to construct classroom questioning effectiveness strategies, helping teachers overcome inefficient questioning, guiding students to develop core mathematical literacy, and achieving the requirements of improving quality and reducing burden under the background of "double reduction".

2. The Importance of Asking Questions in Primary School Mathematics Classroom

In the history of educational development, research on questioning originated from Confucius' "heuristic teaching" and Socrates' "midwifery", and research on questioning has continued to this day. The classroom is the main battlefield of thinking education, and classroom questioning is an important means for teachers to guide students' creative thinking and deep learning.Teachers should have rich knowledge reserves and imagination, and be able to deepen students' accurate understanding of the content through examples, comparisons, and other forms in classroom teaching. In the teaching process, attention should be paid to cultivating students' mathematical thinking. Mathematics is a subject that requires precise and rigorous logical reasoning. Therefore, teachers need to demonstrate the beauty of mathematics to students through clear language expression, clear knowledge teaching, complete systematic summarization, and standardized problem-solving steps in the classroom, and guide students to enjoy the process of mathematics learning. Research has shown that in order to achieve good results in mathematics classrooms, one must ask questions well. The main functions of asking questions in primary school mathematics classrooms are as follows:

2.1 Clarify the objectives of mathematics classroom teaching and evaluate the achievement of teaching objectives

Classroom questioning is an effective way of exchanging ideas and perspectives between teachers and students during the teaching process, serving as a bridge and medium for communication between teachers, teaching content, and students. Teachers guide teaching direction by designing clear problem chains with clear goals and questioning generated questions, highlighting learning priorities, and identifying students' learning deficiencies. This results in the clarification of teaching objectives and the monitoring of their achievement.

2.2 Stimulate students' interest in mathematics learning and enhance their mathematical learning abilities

Classroom questioning can concentrate students' learning focus, strengthen their learning attention, guide them to discover points of interest, and stimulate their interest in mathematics learning. During the process of thinking about problems, students actively recall and construct knowledge, actively participate in classroom interactions, inspire students' positive thinking, deepen their participation in the classroom, and deepen their impression of the knowledge they have learned[5]. And this process requires teachers to inspire, assist, and guide students through carefully designed questions, helping them correct possible errors in expression through forms such as questions and answers, thereby enhancing students' logical and independent thinking abilities, and enhancing their mathematical learning abilities.

2.3 Promoting the formation of students' core mathematical literacy

Teachers inspire students to think through classroom questioning, encourage students to ask questions, and help cultivate students' critical and creative thinking skills. Classroom questioning involves students in high-level thinking processes, thereby enabling teachers and students to jointly complete the process of knowledge acquisition and new knowledge exploration, helping students enter deep learning, promoting effective classroom exploration, cultivating students' ability to discover, propose, and solve problems in real situations, and cultivating students' mathematical thinking qualities through subtle influence, gradually forming core competencies[6].

3. The Problems of Asking Questions in Primary School Mathematics Classroom

From the current reality of many primary and secondary school mathematics classroom questioning, there are still some problems and shortcomings in questioning teaching. Some classrooms become "full

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of questions", with students busy answering teachers' questions or listening to classmates' answers; Some teachers ask questions casually, and many lack rationality or necessity, which invisibly wastes time and shifts students' mathematical thinking trajectory. Some questions not only fail to promote students' mathematical thinking, but also guide them to wander at low thinking levels. Some questions cannot effectively promote students' understanding of mathematical knowledge, problem-solving, and the development of mathematical thinking abilities through extensive thinking.

3.1 Instilling questioning, neglecting students' initiative

Classroom questioning is a teaching activity that uses interactive Q&A between teachers and students as a teaching medium, but some classroom teaching neglects students' subjectivity. The most obvious manifestation in classroom teaching is that teachers have a single questioning method and lack innovation; The direction of questioning is fixed, with teachers asking students in a single direction and instilling questioning; The classroom questioning process is characterized by teachers leaning towards the traditional "one question, one answer" and "teachers asking students to answer" questioning modes. In such a classroom, teachers overlook students' subjective initiative and fail to give them sufficient classroom thinking time.

3.2 The problem is not precise enough, and the language expression is not accurate enough

Some teacher groups have insufficient teaching experience, which is reflected in the lack of classroom questioning ability. The quality of the questions raised is not high, and they are only isolated and scattered questions that point to the textbook content. Moreover, the directionality of the questions raised in the classroom is not precise enough, resulting in the inability to highlight classroom goals and key and difficult points. The language used by teachers to ask questions also has issues such as inaccuracy and verbosity, which gradually leads to students losing their expectations of the questions.

3.3 Unclear level and type of questioning

Some teachers lack a deep understanding of the teaching background, insufficient analysis of the learning situation, and a lack of hierarchy and gradient in the questions raised, resulting in a situation where there is no answer when asking questions in the classroom. Among them, only a small portion of students are able to understand the problem, thereby placing a cognitive burden on them. There are also some teachers who pose questions with a single type, lack challenge, and hierarchy, such as "right or wrong" and "yes or no", which are difficult to stimulate students' interest in answering and lose the true meaning of questioning.

3.4 The core competencies pointed to by the problem are not clear

Teachers lack a deep understanding of mathematics curriculum standards, focusing on students' recent learning goals, while neglecting their ability to solve problems in practical applications. Teachers often only focus on the mastery of students' basic knowledge and skills, and the problem only points to knowledge and skills. Although they have learned mathematical knowledge, they have not learned how to apply the knowledge they have learned to solve mathematical problems that arise in real life. Therefore, the ability to analyze and solve problems that focus on students' core competencies still needs to be emphasized.

4. Basic definition of effective classroom questioning

The definition of effective questioning or effective classroom questioning by domestic and foreign researchers can be roughly divided into the following categories. Firstly, at the student level, some scholars believe that effective questioning refers to the progress achieved by students during the teacher's questioning process. Emphasis should be placed on creating problems based on students' cognition in order to achieve the goal of promoting students' thinking. Secondly, pay attention to the problem and believe that effective questions can stimulate students to actively answer questions and participate in classroom teaching activities. Thirdly, focus on thinking and believe that questioning that can promote the development of open thinking is effective. Fourthly, focus on the effectiveness of questioning. From the perspective of quality and process, it is believed that effective questioning is carried out under specific conditions and based on course objectives to complete classroom tasks.

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Through questioning and answering, teacher-student interaction is achieved, achieving teaching effectiveness. Fifth, pay attention to the presupposition and generation of questioning, and believe that effective classroom questioning refers to the process in which teachers promote students' thinking development, achieve teaching goals, and review and reflect on the entire questioning process. This study mainly studies effective questioning in mathematics classrooms, aiming to promote students' mathematical understanding and cognitive enhancement, as well as the development of core competencies[7].

Summarize the basic characteristics of effective classroom questioning from the classroom questioning process. Firstly, from the perspective of teaching content, questioning should focus on important teaching content, highlighting the key and difficult points of teaching, and helping to achieve teaching objectives. Secondly, from the perspective of students, the questions raised should be in line with their cognitive level; Questions can promote classroom participation. Finally, starting from the problem itself, the expression of the problem should be clear; The problem should be logical, hierarchical, and of moderate difficulty; Questions should be inspiring and have a certain degree of expansion; The relationship between problems should be close.

5. Strategies for Improving the Effectiveness of Primary School Mathematics Classroom under the New Curriculum Standards

Mathematics classroom questioning is mainly divided into two aspects: questioning content and questioning types. Among them, the questioning content mainly refers to "what to ask". Specifically, questioning is divided into knowledge point questions, question information questions, and management questions based on the questioning content. This article focuses on analyzing how to construct knowledge point questions that focus on core competencies. The new curriculum standards integrate the content of four fields in a structured manner, emphasizing heuristic, exploratory, participatory, and interactive teaching methods. They emphasize the promotion of students' overall development and the gradual formation of core competencies through the understanding of core concepts and the transfer of knowledge and methods. To enhance the effectiveness of primary school mathematics classroom teaching, classroom questioning in mathematics learning should focus on the generation of students' core competencies, as shown in Figure 1:

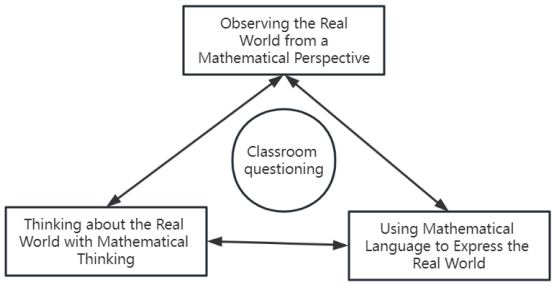

Figure 1: Classroom questions pointing to core competencies

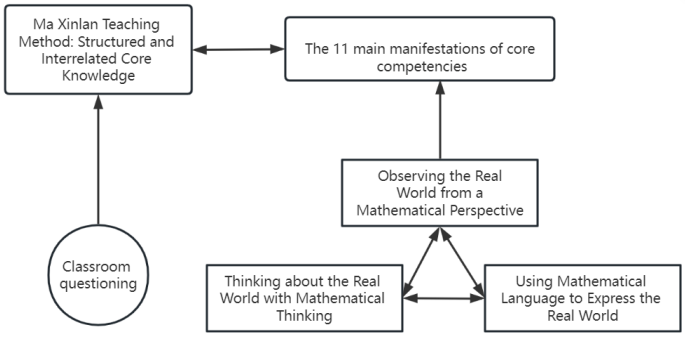

Figure 2:Questioning mode with core concepts as a bridge

How can we construct questions that point to core competencies? The Ma Xinlan teaching method has pointed us the direction. Using the core concepts that occupy a central position in the Ma Xin Lan teaching method as a bridge, connecting classroom problems with the performance of core

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mathematical literacy, and developing students' core mathematical literacy through questions directed towards core concepts. The structure is shown in Figure 2, and this article takes the example of abdication subtraction within 100 in first grade for analysis.

The core concepts are among many mathematical concepts, one of which belongs to the most basic concepts (or primitive concepts). These concepts are closer to the essence and have more generality in reflecting the internal connections of things compared to other concepts. Ma Xinlan and Sun Jiawei, in their book "Opening up Students' Mathematical Thinking", grasped the inherent connection between knowledge and the characteristics and laws of children's intellectual development. They selected more than ten core concepts from numerous mathematical concepts, such as "digits, counting units, and progression rates". These core concepts connect different learning contents, making them one thing in learning, thinking, and understanding, which is just a manifestation of different levels. This helps students understand the basic principles of the discipline by extracting, refining, and reflecting the core concepts of the discipline through structuring, thereby promoting the transfer of knowledge and methods. As the learning process progresses, the learning content continues to expand, gradually forming students' core competencies.

5.1 Based on course content analysis, this part of the course corresponds to students' core competencies

For example, the first grade volume of the People's Education Press, which includes the subtraction of two digits by one digit, falls under the category of "number operations" in the field of "numbers and algebra". Based on the latest curriculum standards, it has been found that it mainly carries the important task of cultivating students' sense of numbers and computational abilities. Arithmetic ability mainly refers to the ability to perform calculations correctly according to rules and algorithms. Cultivating computational ability helps students understand mathematical theory and seek reasonable and concise ways to solve problems. Number perception mainly refers to the intuitive perception of the relationship between numbers and quantities, as well as the results of operations.

5.2 Accurately Finding the Core Concepts of the Course Based on Ma Xinlan Teaching Method

The core concepts corresponding to this lesson are "digits, counting units, and progression rate". The core literacy level requirements for this lesson are determined based on the curriculum standard. Based on this, the teaching objectives of this lesson are obtained. With the core concept of "counting units" as the core, calculation methods are explored, compared, and analyzed in hands-on operations and drawing activities, and numerical values represented by numbers on different digits can be expressed, Understand the arithmetic of subtracting two digits by one digit (abdication subtraction) and be able to accurately calculate the abdication subtraction of two digits by one digit.

5.3 Generate a problem chain that points to core concepts and develop students' core competencies

At the beginning of the course, provide a scenario map and ask students what mathematical information they have discovered and what mathematical problems they can ask through reading the information. Students will list the equation "36-8=. Then, students work in pairs using small sticks, counter charts, and other methods to choose their preferred method. Then, students work in pairs and choose their preferred method, such as a stick or counter, to express the calculation process, and finally have students report and display it.

During the calculation process, the student attempted to use a small stick to solve the problem. During the student's presentation on stage, they raised a question pointing to the counting unit. Please see how the student took out 36 small sticks? After the students' explanation, ask them the question: Why open a bundle of sticks? The student solved this problem through several small stick methods: they all used small sticks. What are the similarities between these methods?

During the calculation process, students attempted to use a counter to solve the problem. During the presentation process, after the students explained, they were asked questions pointing to the core concept: clearly, there is one bead in ten places, how can there be so many in one place? Who will be called to help reduce when there is not enough room for reduction? Which student is pointing on the blackboard? How did it change from 3 to 2 in the top ten?

In the lesson of subtracting one digit from two digits, these progressive problems that point to the core concept of "counting units" help students develop and understand the principle of "borrowing one

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as ten", master algorithms, experience the diversity of algorithms, be able to calculate correctly, develop students' computing ability, and cultivate core literacy such as number sense.

5.4 Other considerations for strategy

Classroom questioning should be designed in advance. On the basis of understanding and mastering students' existing knowledge level, the speed of classroom questioning should not be too fast. As the course progresses, teachers should adopt different questioning methods for different types of questions, apply questioning strategies that are suitable for their own characteristics to different students, and have hierarchy and correlation between questioning questions, in line with students' cognitive development laws. After the question is raised, students should be given enough time to think and communicate, and the response time should be accurate, not too long or too short, to avoid phenomena such as "interrupting students' answers", "asking and answering questions", and "not evaluating students' answers".

6. Conclusions

Bruner once said, "Asking challenging questions to students can guide them to develop their wisdom." Compared to learning and recalling factual knowledge, teachers should pay more attention to the development of students' critical thinking abilities. In order to make students' thinking more active, teachers should invest more energy in designing analytical, comprehensive, and evaluative questions, giving students more opportunities to analyze and explore problems based on their core competencies, Evaluate the problem.Analysis of the effectiveness of classroom questioning directed towards core concepts.

6.1 Questions pointing to core concepts string together throughout the class, making the classroom more hierarchical

The learning of students in mathematics classrooms requires the organization and guidance of teachers. Based on core concepts, core questions are designed to run through the entire class, and a series of questions are derived from the core questions, ranging from shallow to deep and from easy to difficult. Based on this, classroom questioning is conducted. In this way, by pointing to the core issues and problem chains of core concepts and questioning based on classroom assumptions and generation, the teaching of the entire class is connected, making the classroom more hierarchical, guiding teaching direction, effectively promoting the improvement of classroom efficiency, promoting the development of students' high-level thinking layer by layer, and cultivating students' core literacy.

6.2 Pointing to core concepts and assisting teachers in accurately expressing them

Mathematics is a discipline that requires precise and rigorous logical reasoning. The new curriculum standards point out that "mathematics plays an irreplaceable role in shaping human rational thinking, scientific spirit, and promoting individual intellectual development." Mathematics education has an irreplaceable "disciplinary function" and even its "educational function". Therefore, teachers need to demonstrate the beauty of mathematics to students in the classroom through clear language expression, clear knowledge teaching, complete systematic summarization, and standardized problem-solving steps. The question of pointing to core concepts makes teachers' language more directional, providing a concise and systematic summary of a lesson's content, assisting teachers in precise expression, guiding students to enjoy the process of mathematical learning, developing mathematical thinking, and achieving their "disciplinary function" and "educational function".

6.3 Questions pointing to core concepts can develop students' core mathematical literacy

This article combines the 2022 curriculum standards and discusses mathematics classroom questioning strategies based on the development of students' core competencies. It designs questions that focus on core concepts, which not only reflect the teaching content but also effectively serve the cultivation of core competencies. Classroom questioning directed towards core concepts can promote students' deep learning, activate their thinking strings, open up their minds, and make the learning process more of a process of discovering, posing, analyzing, and solving problems. It also implements the requirements of double reduction and new curriculum standards for mathematics teaching, and

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develops students' core mathematical literacy.

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