

# The Construction Model of Problem-oriented Teaching in Junior Middle School Mathematics Classroom

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**Keywords:** Problem-oriented teaching; Junior high school mathematics; Construction model

**Abstract:** It can be realized by problem-oriented teaching to cultivate students' problem consciousness and mathematical ability in junior middle school mathematics classroom teaching. The literature research found that the problem-oriented teaching model suitable for junior middle school mathematics classroom is to carefully prepare lessons before class, assign preview tasks, create problem situations during class, drive the teaching process by problems, reserve time for students to ask questions, and timely reflect after class.

## 1. Introduction

### 1.1 Research Background

With the reform and development of mathematics education, the traditional education model of "filling the classroom" and "cramming" can no longer meet the needs of modern mathematics classroom. In the process of constantly seeking to break through the teaching dilemma, mathematics teachers and researchers have tried to establish a new teaching model that runs through the mathematics classroom teaching with problems, such as "problem-driven", "problem-led" and "problem-oriented". In his book *Design of Mathematics Quality Education*, Mr. Zhang Dianzhou proposed that "problem-solving is the breakthrough of mathematics education reform" [1]. He believed that problem-driven mathematics is a kind of new concept mathematics. Like new concept English, vivid, rich and easy to understand mathematical problems help students open a new channel to master mathematical science [2]. The curriculum content of the *Compulsory Education Mathematics Curriculum Standard (2011 edition)* is mentioned in order to guide students to find and put forward problems in specific situations; Develop a sense of evaluation and reflection on issues raised in class [3]. Under the background of the mathematics curriculum reform in our country, the students' innovative spirit and practical ability training mode make some efforts to innovate. The problem-oriented teaching mode conforms with the developing trend of mathematics education in our country. The advantage of problem-oriented teaching is seen by more and more mathematics teachers, and it has become the choice to implement efficient mathematics teaching.

### 1.2 Research purpose and significance

However, on the one hand, the influence of traditional teaching mode is deeply rooted, and problem-oriented teaching method requires teachers to be highly flexible and creative. Some mathematics teachers are more willing to take the "shortcut" of traditional teaching mode rather than spend energy to explore the application strategies of problem-oriented teaching in the classroom due to the influence of limited professional ability or low enthusiasm for scientific research. As a result, the application frequency of this new teaching mode in practical teaching is not high. On the other hand, some teachers pay too much attention to the output of problems and ask questions for the purpose of raising questions, ignoring students' feedback on problems. In essence, it is the teaching that ignores students' subjectivity, making problem-oriented teaching become rigid and inaccurate. Aiming at the above problems, the author explores the effective application strategies of problem-oriented teaching in junior middle school mathematics classroom, hoping to achieve the following research objectives: (1) To explore the construction model of problem-oriented teaching in junior

middle school mathematics classroom; (2) Designing classroom teaching cases under the problem-oriented teaching construction model; (3) Analyze the application effect of problem-oriented teaching in junior middle school mathematics classroom.

Problems are the heart of mathematics, just as the solution of one famous mathematical problem after another promotes the progress and development of mathematics, teachers constantly ask questions around a topic in mathematics class can stimulate students' thinking, promote the learning process, and make students' understanding and mastery of knowledge from shallow to deep and progressive layer by layer. Only when teachers run questions through the whole course of classroom teaching and can timely raise questions, and students actively think about problems and take the initiative to explore and solve problems, and take the initiative to raise questions under the reasonable guidance of teachers, can a better problem-oriented teaching effect be achieved. This means that the mathematics classroom in junior middle school under the problem-oriented teaching mode not only requires teachers to "ask questions", but also requires students to "take the initiative to ask questions". The process of students taking the initiative to ask questions is the internalization and reprocessing of knowledge, which means the improvement of thinking ability and the improvement of self-learning consciousness. Therefore, the author combs different scholars' research on problem-oriented teaching mode in mathematics classroom through literature research, and constructs a problem-oriented teaching mode in junior middle school mathematics classroom, in order to provide reference for junior middle school mathematics teachers to implement problem-oriented teaching.

### **1.3 Research Questions**

Based on existing research and theories, this study constructs a problem-oriented teaching model for junior middle school mathematics classroom, puts forward relevant application strategies, and demonstrates the implementation process and results through specific teaching cases. The core question of this study is: what are the effective construction models of problem-oriented teaching method in junior middle school mathematics classroom? It includes the following three sub-problems: First, how to implement problem-oriented teaching for junior middle school mathematics teachers; Second, how to highlight the main position of junior high school students in the teacher-led classroom; Thirdly, what is the significance of problem-oriented teaching in junior middle school mathematics classroom?

## **2. Literature Review**

### **2.1 Overview of problem-oriented teaching**

#### **2.1.1 Definition of the problem**

Often, a problem is thought of as a situation in which an individual wants to do something. [4] The first questions in the book were translated as "questions requiring answers or explanations", and later produced many derivative meanings, such as "critical point", "accident, accident" and so on. There are many kinds of words that contain the meaning of "problem" in English. The commonly used ones are problem, translated as "difficult problem", "confusing thing" [5], and question, translated as "problem to be solved". The former tends to be objectively existing and difficult problems encountered, while the latter tends to be subjective and needs "answer" [6]. The problems in mathematics class are based on a certain situation and need to be solved.

#### **2.1.2 Definition of problem-oriented teaching**

Problem-based Learning (PBL) is also known as "problem-based teaching", "Problem solving teaching" and "problem-based teaching" [4]. Problem-oriented teaching method was originally used in the field of medical education. It is a teaching process to develop learners' ability to solve problems and deepen their understanding of problems. Subsequently, the problem-oriented teaching method gradually attracted the attention of the field of mathematics education, and developed into a problem-centered teaching process in which learners, under the guidance of teachers, use different methods from different angles to explore independently and discuss and solve problems cooperatively. Zheng

Yuxin believes that "problem solving teaching" in the new mathematics curriculum reform is to provide students with the motivation for mathematics learning and make them truly understand the significance of mathematics learning [7]. Liu Rude believes that PBL enables learners to construct knowledge base flexibly, develop high-level thinking ability, and become independent learners and effective collaborators [8]. Song Naiqing, Xu Ranran et al believe that problem-raising teaching is based on the premise of equality of learning opportunities and promotes the maximization and diversification of each student's learning opportunities [9].

### **2.1.3 Overview of problem-oriented teaching construction model**

Based on previous researches on problem-oriented teaching, it is found that the steps of math teachers' problem-oriented teaching generally include the following five steps: (1) creating problem situation, setting goals, and guiding observation; (2) Find and raise problems, and students solve problems through independent learning or communication and cooperation; (3) Teachers guide students to summarize the previous stage of learning, raise and solve problems again, step by step; (4) Summarize the knowledge and the whole learning process at the end of the class; (5) Evaluation and reflection at last.

## **2.2 Overview of the theoretical basis of problem-oriented teaching**

### **2.2.1 Cognitivism theory**

Bruner, the author of discovery learning, believes that learning lies in the active formation and development of cognitive structures. Under the guidance of this theory, teachers should encourage students to think and explore actively in the classroom to stimulate their internal learning motivation [10]. The problem-oriented teaching method echoes the requirements of cognitivism theory. It emphasizes the principal position of students. In the process of solving problems, students continue to broaden their thinking and improve their learning ability, and their enthusiasm and confidence in mathematics learning are also enhanced.

### **2.2.2 Constructivism theory**

Constructivism is based on the cognitive development theories of Piaget and Vygotsky, and focuses on human psychology and cognitive development. Junior high school students are in the formal operation stage of Piaget's cognitive development theory, and their thinking ability is mature. They have such thinking characteristics as hypothesized deductive reasoning, propositional reasoning and combinatorial reasoning, which provides a guarantee for the implementation of problem-oriented teaching in junior middle school. To put mathematics knowledge in a certain problem situation, teachers only need to create the situation well and guide students, and then fully believe that students have the ability to answer around the problem or raise more questions. This also fully reflects the leading role of teachers and the subject status of students in the problem-oriented teaching classroom. Teachers are the helpers of students' learning and students are the active constructors of knowledge.

## **3. Construction model of problem-oriented teaching in junior middle school mathematics classroom**

### **3.1 Preparation before class**

Make "three preparations". Lesson preparation is an important part of teachers' work, and it is a careful presupposition of the teaching process. Before the implementation of problem-oriented teaching, teachers should first formulate reasonable teaching objectives according to the cognitive characteristics of students in the class, with the purpose of infiltrating mathematical thoughts to students and cultivating mathematical literacy [10]. Secondly, starting from the experience of students, we set up effective problem situations, design questions with levels and difficulty levels, and make the transition between problems clever and natural.

Prepare for class. The task of preview can effectively cultivate students' autonomous learning ability. Students who are familiar with the knowledge in advance can grasp the core of the teacher's

questions more accurately, and their understanding and response speed to the questions are faster than those who have not prepared the knowledge before class. Pre-class preview provides students with the opportunity to develop independent thinking and problem-solving ability. The problems that cannot be solved in the preview process can be solved in class, which greatly increases the frequency of classroom questioning and the activity of the classroom atmosphere. Junior high school students are in the critical period of learning habits, so it is of far-reaching significance to cultivate self-learning habits based on pre-class review.

### **3.2 Implementation in the classroom**

Create problem situations. Mathematics comes from life, so teachers should be good at exploring mathematics problems related to students' life experience from life situations and applying them to mathematics classroom. Effective problem situations can promote students to apply mathematics knowledge to life, induce students' desire for knowledge and exploration, and thus improve their enthusiasm to participate in class.

Design problem hierarchy. The cognitive development of students is sequential, a gradual process from simple to complex. The design of hierarchical and gradient mathematical problems conforms to the law of students' cognitive development, helps students realize the inherent logic of mathematical knowledge, gradually deepen their understanding and application of mathematical knowledge, and also helps to improve class concentration and classroom efficiency.

Guide independent learning and cooperative inquiry. It is the focus of teaching to cultivate students' autonomous learning ability. The new curriculum reform requires students as the main body, teachers as the leading, through the "independent, cooperative, exploratory" way to implement mathematics teaching. After the teacher throws out a question, he or she asks the students to think independently and answer it within a specified time, or organizes group communication so that the students can explore their ideas in mutual assistance and cooperation.

Allow time for students to ask questions. Students can break the situation of "passive learning" and take the initiative to raise questions to teachers or classmates, which is an indispensable part of the successful implementation of problem-oriented teaching in junior middle school mathematics classroom. Teachers should first pay attention to this part of students' initiative to ask questions, and constantly encourage students to observe and find problems carefully, dare to ask questions and question. Students experience the process from passive learning to finding problems, and then to proactively raising questions, and their thinking will also change from closed to open to open, so as to achieve the goal of developing high-level thinking ability.

Focus on process evaluation. Process assessment and problem-oriented teaching complement each other. Each student has a different level of development such as cognition and ability, so teachers should consider the choice of objects to answer questions, and try to give each student opportunities to participate in the interaction between teachers and students, and benefit from the process of thinking and answering questions. The process evaluation is not based on the result of the answer, but on the students' enthusiasm to participate in the class, active learning and thinking, and completing the questions matching their own ability. In this way, every student can have the opportunity to succeed and improve on their original ability level.

### **3.3 Reflection after class**

Reflection includes teachers' reflection on teaching and students' summary and reflection on learning content and process. Learning to reflect is the main way for teachers to improve their teaching ability and level. Teachers timely reflect on the implementation process and effect of problem-oriented teaching, and apply the summarized experience to the next teaching. In such a virtuous cycle, they will gradually master the implementation skills and experiences of problem-oriented teaching. Student reflection can take place both in the classroom, with teachers asking open-ended questions: "What did you learn in this lesson?" "What have you gained?"; They can also assign written homework such as "math diary" and "classroom reflection" after class to cultivate students' consciousness of active reflection and summing up learning experience, and promote the development of thinking and ability from reflection.

## 4. Summaries

### 4.1 The value of problem-oriented teaching from the perspective of junior high school students

The problem-oriented teaching method plays an important role in promoting students' learning ability and problem awareness in mathematics. The improvement of students' mathematical ability is manifested in the participation in mathematical activities, the attention in mathematics class, the ability of mathematical thinking, and the ability to solve mathematical problems [11]. In the problem situations created by teachers or the problems that inspire students to think, students' consciousness and enthusiasm of independent inquiry, active learning and cooperative learning are aroused, and the emotion of willing to learn and love to learn mathematics is generated. Following the progress of problems, students' understanding of mathematical concepts gradually deepens in the process of solving problems, and their cognitive schemata become more perfect and clear. The improvement of problem awareness is manifested in the ability to find problems in mathematical activities and take the initiative to raise questions. Problem-oriented teaching is not only for teachers to keep asking questions, but also for students to ask questions.

### 4.2 The value of problem-oriented teaching from the perspective of mathematics teachers

The significance of problem-oriented teaching for mathematics teachers lies in improving teachers' teaching ability, which is manifested in studying teaching materials intensively, enriching teaching methods, improving classroom innovation ability, improving teaching quality, etc. It is a booster for mathematics teachers to polish profound professional skills [12]. Teachers optimize and innovate teaching methods, cultivate students' innovative consciousness and literary and artistic problem-solving ability, enable students to obtain a high degree of thinking development, stimulate students' interest in learning and studying mathematics, and gradually enhance teachers' professional identity and self-efficacy.

## Acknowledgments

This research was supported by the college teaching reform research project of Shandong provincial education department (Grant No. M2021375).

## References

- [1] Zhang Dianzhou. Design of Mathematics Quality Education [M]. Nanjing: Jiangsu Education Publishing House,1996.4.
- [2] Zhang Dianzhou, Zhang Yinnan. New concept: Problem-driven Mathematics Teaching [J]. Research in Advanced Mathematics,2004,(03):8-10.
- [3] Ministry of Education of the People's Republic of China. Curriculum Standards for Compulsory Education Mathematics [M]. Beijing: Beijing Normal University Press,2011.
- [4] Zhang Zhangran. On Problems [D]. Wuhan: Wuhan University,2005.66.
- [5] Zhang Ling, Song Naiqing, Cai Jinfa. Question: Basic implication and educational value [J]. China Audio-Visual Education,2019,(12):31-39.
- [6] Zheng Yuxin. "problem solving" and mathematics education (2008) [J]. Journal of mathematics education, 2009, 17 (01) : 1-4.
- [7] Liu Rude. Application of Problem-based learning in Middle and Primary schools [J]. Journal of East China Normal University (Educational Science Edition),2002,(01):22-30.
- [8] Song Naiqing, Xu Ranran, CAI Jinfa. Teaching Implication and implementation Path of problem Raising from the perspective of learning opportunity [J]. Tsinghua University Educational Research, 2022,43(01):34-41. (in Chinese)

- [9] Zhang Jinghuan. Educational Psychology [M]. Jinan: Shandong People's Publishing House, 2010:113.
- [10] Chen Jianmin. Research and Practice of problem-based Teaching in junior Middle School Mathematics Classroom [D]. Shandong Normal University,2018.
- [11] Zhao Sujuan. Research on Problem-oriented Teaching Strategies of Primary School Mathematics with the Support of Information Technology [J]. Science and Technology Wind, 2017, (06): 235.
- [12] Wang Haiqing; Cao Guangfu. Basic Principles, ideas and implementation Steps of Problem-driven Mathematics Teaching [J].Journal of mathematics education, 2022, 31 (01) : 24-27.