# A Review of the Application of Inquiry-Based Learning in Junior High School Mathematics Teaching

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#### ABSTRACT

Entering the 21st century, inquiry-based learning has gradually emerged as an effective teaching method in current junior high school mathematics education, becoming a topic worthy of discussion. This paper aims to explore the application, implementation methods, and effectiveness of inquiry-based learning in mathematics teaching through reviewing and analyzing relevant research papers on its application in junior high school mathematics instruction. Finally, corresponding strategies and suggestions are proposed, hoping to make positive contributions to improving the quality of mathematics education in China's junior high schools.

Keywords: Junior high school mathematics; inquiry-based learning; research limitations and prospects.

# One、 Introduction to the Application of Inquiry-Based Learning

# in Junior High School Mathematics Teaching

## (One) 、 Research Background, Purpose, and Significance

In today's society, with the rapid advancement of science and technology and the accelerating pace of knowledge renewal, educational models have begun to embrace innovation. Under the premise that traditional teaching methods no longer suit the new era and societal demands, inquiry-based learning, as a modern instructional approach, has gradually been integrated into classrooms.

The *Compulsory Education Mathematics Curriculum Standards* (2022 Edition) emphasize that through mathematics education at the compulsory education stage, students should gradually learn to observe the real world with a mathematical perspective, think about the real world with mathematical reasoning, and express the real world in mathematical language—known as the "Three Competencies" [1]. This form of inquiry-based learning highlights students' initiative and autonomy, playing a significant role in cultivating their innovative and practical abilities.

# (One) Definition of Inquiry-Based Learning

Inquiry-based learning was proposed by the renowned American scientist Schwab during the 1950s "Educational Modernization Movement" in the United States [2]. It's a student-centered teaching method that emphasizes initiative and autonomy in the learning process. It's also an active learning approach where students solve problems on their own [3]. Under the guidance of teachers, students acquire knowledge, apply it, and solve problems—meaning they actively explore and address issues through observation, experiments, discussions, and other methods.

# Two, Literature Review on the Application of Inquiry-Based

# Learning in Junior High School Math Teaching

## (One) Research Timeline

According to the China National Knowledge Infrastructure (CNKI) database, China's analysis and exploration of "inquiry-based learning in junior high math teaching" have been documented since 2006. Facing a pool of 66 Chinese-language papers, this study selected 40 for analysis.

# (Two) Theoretical Foundations of Inquiry-Based Learning

### **One.Dewey's "Learning by Doing" Theory**

As early as the late 19th century, Dewey emphasized "learning by doing" [4]. He argued that students in traditional school environments, where individualized attention is limited, often follow teachers' pacing to solve simple problems without fully mastering the knowledge themselves. Thus, the essence of Dewey's "learning by doing" is to let students develop their own thinking while solving problems hands-on, which better fosters their inquiry and innovation skills. This theory undoubtedly laid a crucial foundation for later educators.

### **Two.Bruner's Discovery Learning Theory**

Bruner believed that discovery learning is the best way for students to acquire knowledge [4]. In fact, this aligns with the goal of nurturing students' inquiry and innovation awareness. Further research reveals that "discovery learning" cultivates intuitive thinking, unlocking students' potential while enhancing their independent problem-solving abilities and fostering a habit of critical thinking—thereby reigniting their intrinsic motivation.

### **Three.** Constructivist Learning Theory

Also known as structural theory, constructivism posits that knowledge is neither purely objective nor subjective. It isn't directly absorbed from the environment but stems from individuals' reflection and organization of their understanding [5]. Simply put, people's perceptions of things aren't just passive reflections. Students should actively engage in learning rather than passively receiving pre-processed knowledge from teachers. In this sense, teachers act merely as scaffolds in the learning process.

# (Three) Overview of Literature Content

#### **One.** Growing Volume of Research and Expanding Topics

Among the sixty-six CNKI-retrieved papers, there are three master's theses, five academic journal articles, five conference papers, and fifty-two featured journal articles. While research on inquiry-based learning—a key teaching method—remains limited in China, an increasing number of scholars are delving deeper into it.

#### **Two.Current Application Status in Junior High Math Teaching**

The advantages of inquiry-based learning in math teaching are clear. Before its adoption, the "test-oriented education" mindset led many teachers to prioritize knowledge delivery over student comprehension. Students passively followed teachers' way, stifling their own thinking [6]. Math, as a highly logical subject, becomes indigestible under rote learning. Inquiry-based learning, however, actively engages students, undeniably improving teaching outcomes.

## (Four) Analysis of Research Methods

The forty papers primarily employed methods like literature analysis, case studies, surveys, observation, and practical research. While differences exist in specific content, methods, and conclusions, these variations enrich the research with diverse perspectives and emphases.

## (Five)Effectiveness Evaluation of Inquiry-Based Learning in Junior

## **High Math**

Junior high math teaching cultivates students' mathematical thinking and serves as a bridge for mutual growth between teachers and students [7]. Thus, inquiry-based learning demands much from both.

#### **One. Impact on Students**

After students have engaged in inquiry-based learning in mathematics classes for a period of time, teachers can assess their learning outcomes through multiple dimensions, with academic performance being the most immediately visible and straightforward evaluation method, allowing teachers to compare students' mathematical achievements before and after to determine progress or regression; however, such assessment may not apply equally to all students, as some may initially struggle to adapt to inquiry-based approaches and might exhibit declining scores. Secondly, learning attitudes and interest constitute another important evaluation component, where changes in students' attitudes toward mathematics can reveal whether most students enjoy and adapt to this teaching method. Thirdly, considering the benefits of inquiry-based learning, we can evaluate learning effectiveness by examining its positive impacts: the enhancement of students' thinking abilities, problem-solving skills, innovative thinking, and collaborative capabilities. If students demonstrate improvement in these areas after sustained inquiry-based learning, teachers can conclude that the application of this approach in mathematics instruction is effective and yields positive outcomes.

#### **One. Impact on Teachers**

The implementation of inquiry-based learning in classroom teaching not only impacts students' learning outcomes but also significantly influences teachers' educational philosophies, instructional methods, and professional competencies. Moreover, adopting inquiry-based pedagogy poses greater demands on educators' professional teaching skills. When teachers can effectively utilize instructional resources, maintain well-organized classroom management, and demonstrate precise subject matter expertise while implementing this approach, they inevitably experience professional growth and advancement. Therefore, inquiry-based learning serves as an effective approach for fostering lifelong learning and developmental education [8], benefiting both students in acquiring learning methodologies and teachers in their professional development.

## (Five)Challenges and Issues in Implementing Inquiry-Based Learning

## in Junior High School Mathematics Teaching

#### **1. Teacher Professional Development and Training Issues**

In inquiry-based learning, teachers play a role just as crucial as students—students' thinking and development rely heavily on teacher guidance. However, many teachers lack sufficient training opportunities. Suddenly shifting to an inquiry-based teaching approach can leave teachers feeling lost, disrupting lesson pacing and even leading to situations where they struggle to guide students in fully grasping mathematical concepts. Even for teachers who do receive training, much of the content is often disconnected from real classroom needs, making it impractical for actual teaching—a significant problem.

#### Two. Challenges in Students' Learning Habits and Abilities

At its core, inquiry-based learning in math class aims to help students better understand and internalize mathematical knowledge. Yet, many students are already at a disadvantage due to poor learning habits, which inevitably hinders their progress. Therefore, students must work on correcting these habits while striving to improve their critical thinking skills and refine their learning strategies.

#### **One. Shortcomings in Assessment and Evaluation Systems**

Beyond the subjective challenges faced by teachers and students, as well as objective resource limitations, the current evaluation and assessment systems also have major flaws. The most pressing issue is the excessive emphasis on grades—society, schools, and parents often prioritize test scores over the development of students' overall competencies and skills. This narrow focus leads to neglect in nurturing well-rounded abilities.

## (Seven) Improvement Strategies and Suggestions for Inquiry-Based

### Learning

# One. Enhancing Professional Training to Improve Teachers' Inquiry-Based Teaching Skills

As the leading force in classroom instruction, teachers' professional competence directly impacts the effectiveness of inquiry-based teaching. Therefore, strengthening teacher training is undoubtedly a top priority [9]. Schools and educational institutions should enhance professional development programs, providing ongoing learning opportunities and support for teachers, such as organizing regular seminars.

# Two. Optimizing Inquiry-Based Lesson Design and Creating Engaging Learning Scenarios

For many students, mathematics is inherently a challenging subject. Having become accustomed to passive learning methods over time, some students may struggle to adapt to the sudden shift to inquiry-based learning. This highlights the crucial role of teachers. Mathematics instructors should employ various methods to engage students, such as designing interesting inquiry scenarios to stimulate students' motivation for exploration [10].

# Three. Cultivating Students' Inquiry Awareness and Self-Directed Learning Abilities

In today's digital age, the internet has significantly facilitated student learning. Teachers can upload mathematics learning resources online, allowing students to engage in self-directed study according to their individual needs and schedules, thereby fostering independent inquiry skills [11]. Additionally, schools can offer specialized inquiry-based courses or activities to help students strengthen their inquiry awareness and autonomous learning capabilities. Furthermore, teachers should actively encourage students to formulate hypotheses, and to engage in proving or refuting problems, enabling them to confidently propose ideas in class. This approach stimulates students' enthusiasm and initiative in learning [12], ultimately cultivating their practical skills and innovative thinking.

# Four. Strengthening Home-School Collaboration to Support Inquiry-Based Learning

Through effective communication and cooperation with parents, teachers can better understand students' needs and interests, thereby developing personalized learning plans. By working together, both parties can create a supportive environment for inquiry-based learning. When home-school collaboration is well-coordinated, it ensures that students engage in intellectually stimulating and diverse learning activities driven by curiosity [13], thereby facilitating the development of their inquiry-based learning.

## Three, Research Limitations and Future Prospects (Conclusion)

## (One) Research Summary

Over the past few decades, although there have not been extensive research outcomes on inquiry-based learning, it has nevertheless attracted considerable attention from scholars. Existing studies demonstrate that inquiry-based learning positively impacts the innovative capabilities and critical thinking skills of most students. The application of inquiry-based learning activities in junior high school mathematics teaching essentially represents a breakthrough from traditional pedagogical constraints [14]. This relatively open approach for students can effectively stimulate their subjective initiative, playing a vital role in their long-term development. However, despite the achievements of inquiry-based learning in many aspects, its actual implementation effects still vary. Students of different age groups show different levels of adaptation and effectiveness with inquiry-based learning. After all, inquiry is essentially a process of deeper thinking [15], and younger students generally possess relatively weaker thinking abilities.

## (Two) Research Limitations

Due to constraints such as sample size in previous studies, the research process has the following main limitations:

One) Most existing studies focus on single-subject investigations and analyses, lacking comprehensive interdisciplinary research;

Two) Research time is limited [16], with each study being conducted in phases, making it difficult to determine long-term implementation effects;

Three) There is currently no unified evaluation method for inquiry-based learning, resulting in limited comparability between research findings.

### (Three) Future Prospects

For the future development of inquiry-based learning in junior high school mathematics teaching, teachers should devote more effort to designing specific approaches for inquiry-based learning [17]. Appropriately conducting interdisciplinary comprehensive research will help explore the effectiveness and applicability of inquiry-based learning in different contexts. Secondly, establishing unified evaluation standards can facilitate the application of this method in more subject teachings. This will not only improve students' learning efficiency but also reduce teachers' workload [18]. Finally, utilizing modern educational technology can further optimize the implementation process of inquiry-based learning, striving to maximize its educational value in the future and make positive contributions to improving the quality of mathematics education in Chinese junior high schools.

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