

Research on Integrating Mathematical Modeling Thinking into Large, Medium and Small School Teaching

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Abstract: This study explores how mathematical modeling thinking can be integrated into large, medium, and small school teaching to enhance students' mathematical abilities and interdisciplinary thinking. Using various research methods, including literature review, surveys, teaching experiments, statistical analysis, and expert interviews, we aim to establish a localized model for integrating mathematical modeling, thinking into large, medium, and small school teaching to optimize the quality of mathematics education. Research both in China and internationally has shown that mathematical modeling thinking has garnered significant attention in the field of education and holds promise as an effective approach to improving students' mathematical thinking skills and overall quality of education. The results of this research are expected to offer new insights and methods for mathematical education within the context of large, medium, and small school integration and provide scientifically sound assessment standards for education. This study is not only academically significant but also expected to support educational reform and practice in schools and educational institutions, contributing to the development of innovative and practical talents.

1. Introduction

Mathematical thinking refers to a way of thinking that involves reasoning, analyzing, and problem-solving using mathematical methods, concepts, and language, including induction, deduction, abstraction, and logical reasoning [1]. Modeling is the process of abstracting real-world problems into mathematical problems and using mathematical methods and tools to analyze and solve them. Large, medium, and small school integration refers to the interconnection, penetration, and integration of preschool, primary, junior, and senior education to achieve a holistic educational system [2]. This study focuses on the application of mathematical modeling thinking in mathematics education within the context of large, medium, and small schools in Taian City.

In the United States, research on mathematical thinking and modeling began in the 1970s, resulting in a comprehensive theoretical framework. Countries such as the United States, the United Kingdom, and Australia have made significant progress in STEM education and mathematical modeling [3, 4]. For instance, the Common Core Standards in the United States emphasize mathematical modeling as a core component of mathematics education and provide related teaching standards and requirements. The UK's educational reform also highlights the importance of

mathematical modeling, incorporating it into national curriculum standards [5]. Australia's mathematical modeling education focuses on cultivating students' practical problem-solving abilities and interdisciplinary skills [6].

In China, research on mathematical thinking and mathematical modeling began in the 1980s, albeit relatively late and with limited achievements. In recent years, there has been increasing attention to mathematical modeling [7-9]. The "Mathematics Curriculum Standards for Primary and Secondary Schools" by the Ministry of Education of China includes mathematical modeling as an important part of mathematics education. Furthermore, various regions have launched teaching practices and research projects related to mathematical thinking and modeling, such as the "Mathematical Thinking and STEM Education Research" project by the Shandong Provincial Institute of Education Sciences [10, 11]. In Taian City, many schools and teachers have also begun to explore and implement the application of mathematical modeling thinking in large, medium, and small school education.

Large, medium, and small school integration has been a key focus of educational reform both nationally and internationally in recent years. Integration of education was implemented in the United States as early as the 1960s, while China started experimenting with large, medium, and small school integration in the early 21st century, achieving some experience and results [12, 13]. Numerous studies, both domestically and internationally, have investigated the application of mathematical modeling thinking in large, medium, and small school education. Some of these studies primarily explore the methods and effects of integrating mathematical modeling thinking into teaching, aiming to help students better understand and apply mathematical knowledge. Others investigate the application of mathematical modeling thinking in STEM (Science, Technology, Engineering, and Mathematics) education, focusing on nurturing students' interdisciplinary skills and practical problem-solving abilities [14, 15]. Additionally, some studies focus on assessment methods and strategies for mathematical modeling, thinking teaching, exploring how to evaluate students' mathematical thinking and problem-solving abilities.

Research indicates that using mathematical modeling thinking in teaching can effectively improve students' mathematical thinking skills and problem-solving abilities. In the context of large, medium, and small school integration, mathematical modeling thinking promotes integration and collaboration between different subjects, enhancing students' interdisciplinary skills and practical abilities. Simultaneously, mathematical modeling thinking helps students better understand and apply subject knowledge, thereby improving their academic performance and examination capabilities. Mathematical modeling thinking is an important educational approach that assists students in learning and applying mathematical knowledge and skills to real-world problems, enhancing their mathematical thinking and problem-solving abilities. In the context of large, medium, and small school integration, mathematical modeling thinking helps students better understand and apply mathematical knowledge, promotes integration between different subjects, and enhances students' interdisciplinary skills [16].

2. Research Content and Objectives

2.1. Research Object

This study focuses on mathematics education within the context of large, medium, and small school integration in Taian City, with an emphasis on the application of mathematical modeling thinking in primary and secondary education [17].

2.2. General Framework

(1) Theoretical Foundation and Model Construction: The study involves theoretical exploration and model construction related to mathematical thinking, mathematical modeling, and large, medium, and small school integration. The aim is to establish the theoretical foundation and model for integrating mathematical modeling, thinking into large, medium, and small school teaching.

(2) Design of Teaching Strategies and Methods: In line with the actual curriculum, scientifically designed teaching strategies and methods aim to enhance students' mathematical thinking abilities and practical problem-solving skills.

(3) Implementation of Teaching Experiments: Teaching experiments that incorporate mathematical modeling thinking into large, medium, and small school education will be conducted in selected experimental classes. The study will collect and analyze student learning data and feedback.

(4) Evaluation and Analysis of Experimental Effects: Data analysis tools will be used to analyze the experimental results and assess the effects of integrating mathematical modeling, thinking into large, medium, and small school teaching.

(5) Exploration of Practical Experience and Teaching Improvement: Based on the experimental results and feedback, the study will summarize practical experience and provide suggestions and measures for teaching improvement.

(6) Promotion and Application of Teaching Models: Research findings will be extended to more schools and classes, enhancing the application of mathematical modeling thinking in large, medium, and small school teaching.

(7) Summary of Research Results: The study will draft research reports summarizing the outcomes of integrating mathematical modeling, thinking into large, medium, and small school teaching. It will also propose further directions and recommendations for deeper research and expansion.

Within this general framework, the study will conduct research in various aspects, including theoretical exploration, the design of teaching strategies and methods, experimental teaching, data analysis, and evaluation, with the aim of enhancing students' mathematical thinking abilities and practical problem-solving skills, promoting the development and innovation of mathematics education.

2.3. Key Challenges

(1) This study lays a theoretical foundation for integrating mathematical modeling and thinking into the teaching of large, medium and small schools.

(2) This study designs a comprehensive evaluation system, teaching strategies and methods that are compatible with the actual curriculum.

(3) This study selects appropriate experimental categories for scientific and effective data collection and analysis.

(4) This study overcomes the limitations of teaching concepts and methods in the promotion process of teachers and improves their professional ability and innovation ability.

2.4. Main Objectives

(1) This study explores the construction of a model of mathematical modeling and thinking integration into teaching for large, medium and small schools suitable for the needs of students in Tai 'an, and provides a localized education model.

(2) This study improves students' mathematical thinking and practical problem-solving ability,

thereby promoting mathematics education and laying a solid foundation for students' future learning and career development.

(3) This study provides scientific and reasonable teaching strategies and methods for mathematics teachers in large, middle and small schools to promote interdisciplinary cooperation.

(4) This study provides scientific and effective evaluation standards and methods for educational evaluation, and comprehensively and accurately evaluates students' learning outcomes and abilities.

3. Research Approach and Methods

3.1. Basic Approach

(1) Theoretical Research: Building on the foundations of mathematical thinking, mathematical modeling, and large, medium, and small school integration, this research will establish a theoretical model for integrating mathematical modeling, thinking into large, medium, and small school teaching. The aim is to explore the underlying mechanisms and patterns.

(2) Practical Research: Focusing on experimental classes, this research will introduce teaching strategies and methods that incorporate mathematical modeling thinking. The goal is to enhance students' mathematical thinking abilities and practical problem-solving skills. Moreover, this study will apply the large, medium, and small school teaching model to mathematics education, emphasizing cooperative learning and knowledge diversification at different levels.

(3) Comprehensive Research: Integrating theoretical research and practical research, this approach will analyze both experimental results and theoretical models to develop scientifically sound teaching strategies and methods for integrating mathematical modeling, thinking into large, medium, and small school teaching.

(4) Promotion and Application: The results of this research will be applied to educational practice to promote the widespread integration of mathematical modeling thinking into large, medium, and small school teaching. This will provide new perspectives and methods for improving mathematics education.

3.2. Research Methods

(1) Literature review: This study comprehensively examines and analyzes relevant literature in the fields of mathematical thinking, mathematical modeling, integration of large, medium and small schools, etc., and forms the theoretical basis and research model.

(2) Questionnaire survey: This study designed questionnaires for teachers and students in large, middle and small schools to understand their views, attitudes and feedback on the integration of mathematical modeling thinking into teaching.

(3) Teaching experiment: This study selects courses for experimental teaching and explores the implementation of mathematical modeling thinking in the teaching of large, middle and primary schools. This will include collecting and analyzing student learning data and feedback.

(4) Statistical analysis: This study uses data analysis tools to conduct data analysis and statistics on experimental results, evaluates the impact of integrating mathematical modeling and thinking into teaching in large, medium and small schools, and proposes further improvement measures.

(5) Expert Interview: This study invites experts in related fields to conduct in-depth discussions and obtain more in-depth and professional insights and suggestions.

These methods will complement each other, providing a comprehensive understanding and evaluation of the effects of integrating mathematical modeling, thinking into large, medium, and small school teaching and offering scientific approaches and practical experience for improving mathematics education.

4. Research Results

Based on the research objectives and using the mentioned research methods, the following results have been obtained:

(1) The implementation plan for integrating mathematical modeling and thinking into teaching in large, medium, and small schools can serve as a reference for mathematical education reform.

(2) Teaching strategies and methods that integrate mathematical modeling and thinking into teaching in large, medium, and small schools effectively promote the development of students' mathematical thinking abilities and practical problem-solving skills, laying a strong foundation for their future learning and career development.

(3) The research methods and innovative approaches of this study provide valuable references for theoretical innovations in the field of education and contribute to the continuous development and progress of educational and teaching practices.

(4) The outcomes of this research will provide guidance and support for educational and teaching practices, helping educational professionals improve the quality of education and contribute to the cultivation of innovative and capable talents.

5. Conclusion

From an academic perspective, this research presents the concept of integrating mathematical modeling, thinking into large, medium, and small school teaching with the aim of infusing the development of mathematical thinking and practical problem-solving abilities throughout the entire mathematics teaching process. This concept emphasizes the mutually reinforcing relationship between mathematical thinking abilities and practical problem-solving skills, which is significant in enhancing students' overall quality.

In terms of academic viewpoints, this research explores teaching strategies and methods for integrating mathematical modeling thinking, aiming to enhance students' mathematical thinking abilities and practical problem-solving skills. Moreover, the research applies the large, medium, and small school teaching model to mathematics education, emphasizing cooperative learning and knowledge enrichment in mathematics teaching content and methods.

In the realm of research methods, this study employs experimental research methods. The research experiments involve the integration of mathematical modeling thinking into large, medium, and small school teaching, with the collection and analysis of student learning data and feedback. Additionally, data analysis tools are employed to analyze the experimental results and provide a scientific basis for improvement. This comprehensive research approach exhibits innovation within the field of mathematics education.

The results of this research primarily serve the field of education and teaching. The research paper provides new ideas and methods for academic research and offers theoretical support for educational and teaching practices. The research report serves as a reference for educational institutions and schools, aiding educational and teaching reform and providing guidance for improvements.

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