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The Effect of Teaching a Mathematics Course Based on Multiple Intelligences Theory to Enhance Students' Mathematical Reasoning Ability

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Abstract
Background and Aim: With the implementation of the new teaching syllabus, we realize that the requirements of the latest teaching syllabus provide conditions and operational platforms for cultivating students' intellectual diversity. At the same time, cultivating students' divergent thinking and logical thinking abilities and improving their comprehensive qualities have become teaching requirements of the new teaching syllabus. The aims of this study were: 1) to compare the students' mathematical reasoning ability before and after implementing the mathematics course based on multiple intelligences theory for the fourth-grade students of primary school, and 2) to compare the students' satisfaction toward the mathematics course based on multiple intelligences theory for the fourth-grade students of primary school with the criterion of 70%.
Materials and Methods: This study used quantitative methods and experimental methods, including a mathematical reasoning ability test and a student satisfaction questionnaire, with a sample size of 30 fourth-grade students from Fugou Road Primary School in Zhoukou. Statistical analysis includes content analysis of descriptive statistics, correlation analysis, and inductive methods.
Results: After studying the mathematics course based on multiple intelligences theory, students' mathematical reasoning ability was higher than the determined criterion of 70% at the .05 statistical significance level; Additionally, students' satisfaction was at a high level.
Conclusion: The development of a mathematics course based on multiple intelligences theory has a significant effect on enhancing mathematical reasoning ability for students. Furthermore, students were satisfied with their learning of this course.
Keywords: Mathematics Course; Multiple Intelligences Theory; Mathematical Reasoning Ability; Students' Satisfaction

Introduction

In June 1992, the National Education Commission issued the "Nine Year Compulsory Education Full-Time Primary School Mathematics Teaching Outline (Trial)", which has the following characteristics: (1) It clarifies the position and role of primary school mathematics in improving the overall quality of the nation; (2) The teaching purpose is clear and comprehensive, and the teaching requirements are appropriate and specific; (3) The teaching content and requirements reflect both foundational and flexible aspects; (4) Enhanced the pertinence and feasibility of guiding teaching. This is the starting point for China to transform its educational concepts and promote quality education. This is also an important document guiding national education reform and development in the future period. Because of this, education must be student-centered, promote quality education, mobilize students' learning enthusiasm, improve their initiative in learning, and cultivate students' divergent thinking and logical reasoning abilities. (The National Education Commission, 1992)

The textbook "Mathematics Teaching for Fourth Grade" at Zhoukou Fugou Road Primary School was published in 2018. This textbook focuses on theoretical learning and rarely involves cultivating students' mathematical reasoning abilities. In classroom teaching, students rarely have the opportunity to engage in mathematical practice, nor can they improve their mathematical reasoning ability through practice. Students generally believe that the combination of theoretical knowledge and practice is low, the content is boring, and teachers are unable to tailor teaching according to their aptitude during the

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teaching process, nor can they develop corresponding teaching plans based on the individual characteristics of students. At the same time, teachers still use traditional teaching methods in the teaching process. Teachers are only responsible for giving lectures and explaining knowledge points, and students are responsible for memorization. This will inhibit the personal development of students and make them feel that mathematics is boring. Students' enthusiasm for learning and applying mathematics will decrease, and their mathematical reasoning ability cannot be improved (Li, 2022)

In the current curriculum teaching, a book-centered approach is still adopted, with teachers explaining theoretical knowledge and then conducting mathematical calculations and simulation exercises. The teaching strategy is mainly based on teacher lectures, with a single teaching method that cannot mobilize students' enthusiasm and initiative. The teaching effect is relatively poor and cannot effectively improve students' mathematical reasoning ability. At the same time, teachers do not pay attention to the individual development of students in the teaching process, and their teaching plans do not take into account the individual differences of students, let alone highlight the differences in intelligence among different students in learning. (Zhang, 2022)

In 2022, a survey on the mathematical reasoning ability of primary school students in Henan Province, China showed that the "failure rate" of students' mathematical reasoning ability was on the rise compared to the survey in 2021. The passing rates of students' mathematical reasoning abilities from first grade to sixth grade are 35%, 32%, 28%, 5%, 18%, and 20%, respectively. (Education Department of Henan Province, China, 2022). Why is this the result? The actual situation is that on the one hand, the current primary school mathematics Course has not fully played the role of students as the main body and the leading role of teachers. Efforts should be made to promote open and exploratory teaching, expand the diverse intelligence of primary school students, and fully tap into students' personalities; On the other hand, primary school mathematics teachers use traditional teaching methods during the teaching process, which cannot explore feasible ways to cultivate students' logical reasoning ability. In 2014, the National Education Commission issued the "Opinions on Comprehensively Deepening Course Reform and Implementing the Fundamental Task of Cultivating Virtue and Cultivating Talents", which made "quality education" the focus of the new round of Course reform and pointed out the direction for teaching at all levels and types of schools. In the process of elementary school mathematics teaching, improving elementary school student's mathematical logical reasoning ability has become an important part of cultivating elementary school mathematics literacy, as mentioned in the Opinion. (Zhang, 2021)

To address the above issues, the researcher considers developing a mathematics course based on Gardner's Multiple Intelligences Theory to improve the mathematical reasoning ability of fourth-grade primary school students. The development of mathematics courses based on the Multiple Intelligences Theory is to improve students' mathematical reasoning ability, find the rules in mathematical knowledge, actively explore the rules found, and solve the problems encountered in mathematical learning. Many countries such as the United States, the United Kingdom, and Canada are developing mathematics courses based on Gardner's Multiple Intelligences Theory, and find that mathematics courses based on Gardner's Multiple Intelligences Theory are superior to traditional teaching methods in cultivating students' reasoning ability and logical thinking ability (Wei, 2020). For example, American scholar Anaduaka (2011) conducted a study on the multiple intelligences teaching method. The research topic is "The Multiple Intelligences Teaching Method and Mathematics Teaching". In the study, it was found that the mathematics teaching method based on the theory of multiple intelligences is more effective than traditional teaching methods. British scholar Marcelo (2015) conducted a study on the reasoning ability of college students. The research topic is "A Survey Report on the Reasoning Ability of College Students", in which it is mentioned that "College students who use the Multiple Intelligences Theory teaching methods have higher reasoning ability than those who use traditional teaching methods." Canadian scholar Roggensen (2012) conducted a research survey on the teaching methods of middle school mathematics. The research topic is "Teaching Method of Middle School

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Mathematics Based on the Theory of Multiple Intelligences". In the research conclusion, it is mentioned that "the teaching method of mathematics based on the theory of multiple intelligences is worth promoting and meets the requirements of scientific teaching. Classes using the teaching method of multiple intelligences have significantly higher math scores than other classes."

Based on the above results, the research questions about the development of mathematics courses based on multiple intelligences theory to enhance students' mathematical reasoning ability are as follows:

1. Are students' mathematical reasoning ability after implementing the developed mathematics course based on Multiple Intelligences Theory higher than before?

2. How satisfied are students with the mathematics course based on Multiple Intelligences Theory in primary school is higher than the criterion of 70%?

Objectives

The objectives of this research were to determine the effectiveness of implementing the mathematics course based on multiple intelligences theory to enhance students' mathematical reasoning ability.

1. To compare the students' Mathematical reasoning ability before and after implementing the mathematics course based on Multiple Intelligences Theory for the fourth-grade students of primary school.

2. To compare the students' satisfaction toward the mathematics course based on Multiple Intelligences Theory for the fourth-grade students of primary school with the criterion of 70%.

Literature review

Mathematics course based on Multiple Intelligences Theory

The multiple Intelligences theory refers to the ability that individuals need to solve real problems or produce and create effective products under the value standard of a certain social or cultural environment. This theory believes that, each individual's intelligences have its characteristics. According to Gardner's theory of multiple intelligences, as individuals, each of us has nine relatively independent intelligences at the same time, but the nine relatively independent intelligences in each person are not isolated and irrelevant in real life, but organically combined in different ways and degrees. It is the combination of these nine intelligences in different ways and to different degrees that makes each person's intelligence have its characteristics. The nine Intelligences are 1) Linguistic intelligence, 2) Logical-Mathematical intelligence, 3) Spatial intelligence, 4) Bodily-Kinesthetic intelligence, 5) Musical intelligence, 6) Interpersonal intelligence, 7) Intrapersonal intelligence, 8) Naturalist intelligence, and 9) Existential intelligence.

In Gardner's view, it is the essence of the theory of multiple intelligences to recognize that intelligences are composed of multiple abilities that are equally important, rather than one or two core abilities.

Mathematics course based on Multiple Intelligences Theory refers to the mathematics course in which students determine their own Mathematics learning objectives, Mathematics practice methods, Mathematics practice supervision, Mathematics feedback methods, Mathematics performance summary, and other processes according to their own Mathematics foundation and reasoning ability under the necessary intensive teaching, demonstration, and help of Mathematics teachers. To achieve the ultimate learning ability of students to improve the mathematics course. The course has 6 elements: 1) course principle 2) course objective 3) course content 4) course teaching strategies 5) course materials 6) course evaluation. This course employs Multiple Intelligences Theory as an instructional strategy that can stimulate students' interest in learning by designing reasoning-based mathematical learning tasks and activities, thereby promoting their high level of participation and improving their mathematical reasoning abilities. The teaching process of mathematics courses based on the theory of multiple intelligences is divided into the following 6 steps:

Step 1: Introduce the scenario and introduce the new contents

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Teachers create specific learning scenarios, showcase teaching cases or problem scenarios, stimulate students' interest in learning new knowledge, introduce new content, and introduce new knowledge.

Step 2: Investigate students' multiple intelligences and group them into groups

Firstly, introduce the theory of multiple intelligences to students and let them know that everyone has at least one of the nine intelligences. Then, using the "intra-group complementarity" grouping strategy, students are grouped.

Step 3: Group discussions and presentations

Each team leader leads each group to explore, reflect on, and engage in group discussions on the scenarios and new knowledge introduced by the teacher. After the group discussion, each group recommends a representative to present their results.

Step 4: Practical operation and teacher-student communication

The transformation from theoretical knowledge to practical operation can enhance students' interest, discover problems in practice, think about them, and communicate problems. Internal group communication and communication between students and teachers can make problems clearer and solve problems.

Step 5: Expand knowledge, practice reflection, and enhance abilities

Expand new knowledge again, set new questions based on existing knowledge points, explore solutions to the problem through group discussions, and obtain correct answers through practice. After practice, reflect and summarize, thereby improving students' reasoning ability.

Step 6: Result evaluation and activity summary.

The teacher evaluates the results of group discussions, identifies problems, and introduces relevant successful experiences. Students are required to use mind maps or summary reports to summarize the difficulties encountered in the learning process, accumulate learning experiences, and write improvement suggestions to improve their academic performance.

Mathematical reasoning ability

Mathematical reasoning ability refers to a relatively stable personality psychological feature that can draw conjectures or results based on existing mathematical facts or conclusions (definitions, theorems, axioms, etc.) intuition, experience, analogy, observation, etc., and use deductive reasoning to prove conjectures and conclusions in mathematical activities. It is the ability to formulate and represent a given mathematics problem, and to explain and justify the solution or argument. Students must be able to evaluate conjectures and assertions, to reason deductively and inductively by formulating mathematical assertions, and to develop and maintain their reasoning ability. If their reasoning ability remains underdeveloped, students will come to view mathematics as an aggregate of specific rules, and an ensemble of thought lessly executed calculations and drawings.

The components of the mathematical reasoning ability in this research consist of analysis, generalization, synthesis, justifying, and non-routine problem-solving. According to the components, there was one subject who could analyze the given problem while the other subjects could not. Moreover, all of the subjects have a difficulty in another component.”

Five components: 1) analytical ability, 2) generalization ability, 3) synthesis ability, 4) justifying ability, and 5) non-routine problem-solving ability.

1) Analytical ability refers to the skill and ability of a person to break down the overall objective object into several parts in their thinking for research and understanding. Objective things are a unified whole composed of different elements, levels, and regulations. To deeply understand objective things, each element, level, and regularity can be temporarily separated in thinking for examination and research, to clarify the nature of each part, the interrelationships between parts, and the connection between parts and the whole. With the help of analytical skills, one can have a deeper understanding of the decision-making object, from surface to surface, from shallow to deep, from difficult to easy, and from complex to simple, thereby grasping the essence of the decision-making object and laying the foundation for scientific decision-making.

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2) Generalization ability refers to the ability to combine general things from different things or different parts, characteristics, and aspects of the same thing. The growth of various talents often relies on their ability to summarize, especially in the process of engaging in creative labor.

3) Synthesis ability refers to the skill and ability of a person to combine various parts of an objective object into an organic whole in their thinking for examination and understanding. The synthesis in thinking is to connect the various elements, levels, and regularities of objective existence with certain clues, and discover the essential relationships and development laws between them.

4) Justifying ability refers to an individual's ability to support their viewpoint or refute others' viewpoint through reasonable evidence and reasoning chains. This ability is reflected in observing a person's argumentative process in debate, writing, or speech, evaluating whether their argumentative ability can be supported by logically rigorous arguments and whether they can eliminate irrelevant and irrational emotional factors. Justification not only includes the process of explaining and proving the correctness or rationality of a certain viewpoint or proposition but also includes the degree of overall grasp of disciplinary knowledge, as well as the logical and hierarchical organization of answers.

5) Non-routine problem-solving ability refers to the inability of students to solve mathematical problems using existing and conventional methods. It includes asking students to solve a problem using multiple methods, explaining or proving a solution, completing a process that requires multi-step calculations with multiple results, establishing mathematical models based on the situation, etc. Solving "unconventional mathematical problems" often requires students to engage in more reading, comparison, abstraction, reasoning, planning, analysis, judgment, creation, etc.

Conceptual Framework

In this research, the independent variable is the implementation of the mathematics course based on Multiple Intelligences Theory, and the dependent variables are Students' mathematical reasoning ability and students' satisfaction with this course.

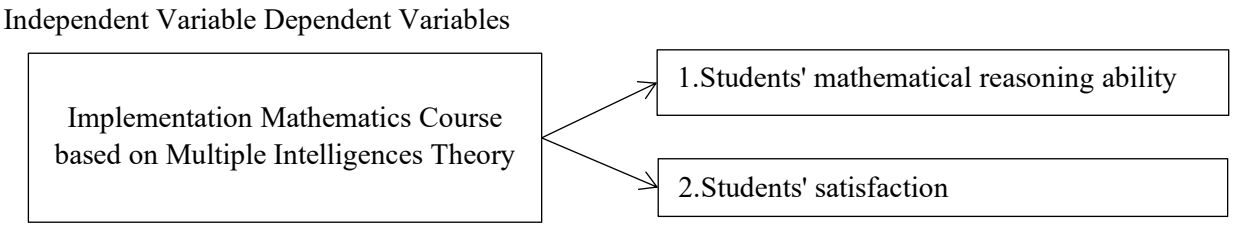

Figure 1 The Independent Variable and Dependent Variables

Methodology

Population and Samples: The population was 120 fourth-grade students (4 classes) in Zhoukou Fugou Road Primary School. The sample was 30 fourth-grade students (1 class) derived from cluster random sampling.

Research Instruments: Research instruments are the tools for researching to collect data. The research instruments which were used in this study were:

1. Experimental instruments

1.1 Mathematics Teaching Theory course based on Multiple Intelligences Theory: The Mathematics course based on Multiple Intelligences Theory includes six steps: 1) Introduce the scenario and introduce the new contents, 2) Investigate students' multiple intelligences and group them into groups, 3)Group discussions and presentations, 4) Practical operation and teacher-student communication, 5) Expand knowledge, practice reflection, and enhance abilities, 6) Result evaluation and activity summary. Five experts evaluated the draft course, in 24 items of the course evaluation form, the lowest mean score was 4.40 (SD=0.55), and the highest mean score was 4.80 (SD=0.45). It was revealed that the Mathematics Teaching Theory course based on Deep learning was at a high level (M=4.53, SD=0.54).

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1.2 Lesson plans: Five experts evaluated the six lesson plans, in 15 items of the 6 lesson plans evaluation form, the lowest mean score was 4.20 (SD=1.10), and the highest mean score was 4.60 (SD=0.89). It was revealed that lesson plans were at a high level (M=4.55, SD=0.92).

2. Instruments for collecting data

2.1 Mathematical reasoning ability test: The test had a total of 30 items. The index of Item Objective Congruence (IOC) value of 30 items in the test was 0.60 at the lowest and 1.00 at the highest. The result of analyzing the IOC index showed that all the items were appropriate and could be used in the mathematical reasoning ability test. Analyze the item of the mathematical reasoning ability test and find out that item Reliability (0.88) is more than 0.70. This showed that the quality of the mathematical reasoning ability test was good. (Cronbach,1951)

2.2 Students' satisfaction questionnaire: The questionnaire is provided to 5 experts for content validity check and suggestions. The result of analyzing the IOC index (0.60-1.00) showed that all test items were appropriate and could be used in the test. The Cronbach's Alpha coefficient of the reliability of the student satisfaction questionnaire is 0.76, which is greater than 0.70. Therefore, the reliability of the student satisfaction questionnaire meets the requirements (Cronbach, 1951)

Data Collection: The procedures of data collection were as follows:

1. The samples were taught by the mathematics course based on Multiple Intelligences Theory.
2. After completing the instructions, the samples received the post-test by using the instrument.
3. The samples were given the students' satisfaction questionnaire.

Data Analysis: In this study, data were analyzed by using statistical methods according to the research objectives.

1. Compare students' reasoning ability before and after implementing the mathematics course based on Multiple Intelligences Theory for the fourth-grade students of primary school.

2. Compare the students' satisfaction toward the mathematics course based on Multiple Intelligences Theory for the fourth-grade students of primary school with the criterion of 70% by using a t-test for one sample.

Results

According to the research objectives, the results were as follows:

1. The result of the comparison of Mathematical Reasoning Ability before and after learning through the Mathematics Course

When analyzing the results of the comparison of Mathematical Reasoning Ability before and after implementing the Mathematics Course, the researcher mainly analyzed the following data: Comparison of the test paper score before and after implementing the Mathematics Course.

A paired sample t-test was conducted on the pre-test scores and post-test scores of the derived 30 students' Mathematical Reasoning Ability test papers. The results are as follows.

Table 1 The finding comparing the different scores of Mathematical Reasoning Ability before and after learning through the Mathematics Course

Group	N	Pretest scores		Post-test scores		t	p
		M	SD	M	SD		
Experimental group	30	17.27	5.56	20.70	5.01	8.34*	.001

*$P < .05$

As presented in Table 1 the mean scores of pretests of students' Mathematical Reasoning Ability was (*M=17.27, SD=5.56*) and post-test of students' Mathematical Reasoning Ability was (*M=20.70, SD=5.01*).

Moreover, it aimed to examine the different scores of before-and-after learning through mathematics courses to enhance mathematical reasoning ability The finding of this table revealed that after learning through mathematics courses, students' mathematical reasoning ability was higher than

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before at .05 level of statistical significance ($t=8.34, p<.05$). The average scores of the study developed increasingly higher than pretest.

2. The result of the comparison of students' satisfaction after implementing the Mathematics Course based on Multiple Intelligences Theory

The researchers used the satisfaction questionnaire to survey the fourth-year mathematics students of Zhoukou Fugou Road Primary School and randomly selected 30 students' data for analysis (The same students to pretest and post-test, the data came from the same datasheet).

Table 2 The students' satisfaction with the mathematics course based on Multiple Intelligences Theory

Question number of satisfaction questionnaire		*M*	*SD*	*Satisfaction level*
Section	***Question number***			
Part 1: Teaching objectives	1. Satisfaction with whether the teaching objectives of the Primary school mathematics course based on Multiple Intelligences Theory are clear and accurate:	4.63	0.49	Very high level
	2. Satisfaction with the clarity of teaching objectives of the Mathematics Course based on Multiple Intelligences Theory:	4.57	0.50	Very high level
	3. Satisfaction of the teaching objectives of the Primary school mathematics course based on Multiple Intelligences Theory meets the requirements of enhancing Mathematical Reasoning Ability:	4.67	0.48	Very high level
Part 2: Teaching content	4. The Satisfaction of whether the teaching content of the Mathematics Course based on Multiple Intelligences Theory is easy to understand:	4.73	0.45	Very high level
	5. Satisfaction with whether the teaching content of the Primary school mathematics course based on Multiple Intelligences Theory is new and can stimulate learning interest:	4.67	0.48	Very high level
	6. Satisfaction of whether the teaching content of the Primary school mathematics course based on Multiple Intelligences Theory has practical significance:	4.67	0.48	Very high level
	7. Satisfaction with whether the teaching content of the Mathematics Course based on Multiple Intelligences Theory can enhance students' Mathematical Reasoning Ability:	4.77	0.43	Very high level
	8. Satisfaction with whether Offline class discussions organized by teachers are very helpful for learning class content:	4.77	0.43	Very high level
Part 3:	9. Satisfaction level of effective communication between teachers and students in the	4.60	0.50	Very high level

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Question number of satisfaction questionnaire		*M*	*SD*	*Satisfaction level*
Section	***Question number***			
Teaching strategy	Mathematics Course based on Multiple Intelligences Theory:			
	10. Satisfaction with the teaching process design steps of the Mathematics Course based on Multiple Intelligences Theory:	4.63	0.49	Very high level
	11. Satisfaction with the teaching method of the Mathematics Course based on Multiple Intelligences Theory to improve the classroom atmosphere:	4.70	0.47	Very high level
	12. Satisfaction with class hour allocation of Mathematics Course based on Multiple Intelligences Theory:	4.50	0.51	Very high level
	13. Satisfaction with the teaching approach of the Primary school mathematics course based on Multiple Intelligences Theory to enhance students' Mathematical Reasoning Ability:	4.70	0.47	Very high level
Part 4: Teaching materials	14. Satisfaction with the combination of teaching materials of practical problems:	4.60	0.50	Very high level
	15. Satisfaction with teaching materials to enhance Mathematical Reasoning Ability:	4.47	0.51	High level
	16. Every student satisfied with the teaching materials used in the introductory mathematics course based on Multiple Intelligences Theory:	4.47	0.51	High level
	17. Satisfaction with the difficulty of the assignment of the Mathematics Course based on Multiple Intelligences Theory:	4.53	0.51	Very high level
Part 5: Teaching evaluation	18. Satisfaction with the number of assignments for the Primary school mathematics course based on Multiple Intelligences Theory:	4.57	0.50	Very high level
	19. Satisfaction with the effectiveness of the evaluation system (including test paper and course thesis):	4.60	0.50	Very high level
	20. Evaluation system (including test paper and course thesis) can differentiate students' Mathematical Reasoning Ability in learning the Mathematics Course based on Multiple Intelligences Theory:	4.67	0.48	Very high level
	Total/Overall	4.63	0.48	Very high level

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The result of Table 17 showed that the student's satisfaction with the Mathematics Course based on Multiple Intelligences Theory was very high level (M= 4.63, SD=0.48). In the 20 items of the satisfaction questionnaire, the lowest mean score was (M=4.47, SD=0.51), and the highest mean score was (M=4.77, SD=0.43).

3. The finding of comparison of students' satisfaction after learning through Mathematics Course with the criteria set at 70 percent.

The result of comparing the different scores of students' satisfaction after learning through Mathematics Courses with the criteria set at 70 percent. The below table shows descriptive statistics and t-tests as analyzed by the statistical package program. This table aims to answer the research objective of whether the implementation of mathematics courses based on multiple intelligences can improve students' satisfaction.

Table 3 The result of comparing the different scores of students' satisfaction after learning through mathematics courses based on multiple intelligences with the criteria set at 70 percent.

Group		Criteria	M	SD	t	
Experimental group	0	70% (3.50)	92.6% (4.63)	.20	1 24.34*	.01

*p＜.05

As presented in Table 18, the mean scores of students' satisfaction after learning through mathematics courses based on multiple intelligences was 4.63 which was statistically higher than the criterion of 70% at a .05 level of statistical significance (t=124.34, p=0.01< .05).

It can be seen that the student's satisfaction of the students through mathematics courses based on multiple intelligences is higher than 70%.

Discussion

The following points based on the research results were discussed:

1. The researcher conducted a detailed literature analysis in the early stage, discussing the research background of this study from the current status, structure, and composition of mathematics courses, and briefly introducing the research situation of this study. This article elaborates on the definition of the theory of multiple intelligences, analyzes the problems and shortcomings of current mathematics courses, discusses the components of mathematics courses developed based on the theory of multiple intelligences, lays the foundation for the development of mathematics courses at Zhoukou Fugou Road Primary School, promotes the development of mathematics courses based on the theory of multiple intelligences, and improves the mathematical reasoning ability of fourth-grade students.

2. The current curriculum development and its foundation are weak, traditional teaching courses are deeply rooted, and every step in the process of developing new courses faces difficulties and pressure. The theory of multiple intelligences provides useful perspectives and strategies to help overcome these difficulties and challenges, improve student learning outcomes, and meet their needs.

Multiple intelligences theory and pre-training in mathematics teaching. The theory of multiple intelligences encourages learners to utilize the advantages of their intelligence to learn and master knowledge. However, to better enable students to utilize their strengths and intelligence, teachers can assess student intelligence before teaching mathematics courses. Examining the intelligence results of students can help them better understand their strengths and intelligence, thereby leveraging their strengths and intelligence to learn more effectively. In terms of personal needs, encourage personalized learning and group collaborative learning. The reason for encouraging personalized learning is that each student has their strengths and intelligence, values student differentiation, and allows students to choose learning methods that are suitable for themselves based on their strengths. This way, students can adopt different learning paths and obtain different solutions. Schools can also use different teaching methods to meet the diverse needs of students. This includes providing resources and guidance for personalized learning and customizing courses based on student's interests and learning styles. Through this approach, students can better achieve personalized learning goals, overcome their weaknesses, and realize their potential.

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3. Based on multiple intelligences theory, developing mathematics courses is of great help in improving students' mathematical reasoning abilities, and student satisfaction has been greatly improved after students adopted this approach. The first is that timely feedback and evaluation are key to ensuring students understand Theoretical knowledge and reasoning ability to improve. This includes educators providing feedback, students receiving grades and comments as soon as possible after submitting assignments, and students being able to self-assess their learning progress. Make sure students actively participate in self-valuation and not just be assessed by the teacher. Students may need to develop skills in self-reflection and self-evaluation. Zhang (2012) also proposed to further optimize the design of learner evaluation activities: (1) Evaluation results should be selectively applied according to different student ability levels; (2) Teachers should give more help to students in the early stages of participating in evaluation; (3) It is necessary to continue to pay attention to the development of students' evaluation abilities.

The second is continued improvement involving educators and schools regularly reviewing and updating curriculum and teaching methods to reflect student needs and the latest educational trends. This can include updating teaching materials, improving course design, and adopting new teaching technologies. In practice, educational institutions may be affected by budget constraints, time constraints, and policy constraints that may prevent timely improvements in curriculum and teaching methods. Additionally, educators may need training to adapt to new teaching methods and technologies, which may require additional resources and time. Zhang (2022) mentioned a similar view on teaching resources, achieving the integration and complementarity of new media resources, and enriching diversity. In addition to PPT and textbooks as the core, it also includes animation, anime, comics, picture books, audio, and short videos.

The third is student well-being including physical health, mental health, and social support. Schools and educators should provide resources and services to help students maintain healthy lifestyles, provide mental health support, and promote social interaction and support. Student mental health issues may become more prevalent in educational settings, but providing adequate mental health support is a complex task.

Conclusion

Through the comparative analysis of the results of the pretest and post-test of the fourth-grade students using the Mathematics Course based on Multiple Intelligences Theory, after the intervention of Mathematics Course combined with Multiple Intelligences theory. The conclusion was as follows:

After the implementation of the Mathematics Course based on Multiple Intelligences Theory, the Mathematical Reasoning Ability of the students majoring in mathematics in Zhoukou Fugou Road Primary School had been significantly improved, and the students' satisfaction was very high level.

1. The Mathematical Reasoning Ability data analysis about pre-test and post-test showed the mean score of post-test data was 3.43 higher than that of pre-test data. When the confidence level was .05, the correlation between pre-test data and post-test data was 0.91, and the t-test value Sig. = 0.000 <.05 (The mean of the pre-test was 17.27, and the mean of the post-test was 20.70).

2. The students' satisfaction was very high level. The lowest mean score was 4.47 and the highest was 4.77, higher than 3.51. The mean scores of students' satisfaction with the Mathematics Course based on Multiple Intelligences Theory were very high level (M = 4.63, SD = 0.48). The mean scores of students' satisfaction after learning through mathematics course based on multiple intelligences was 4.63 which was statistically higher than the criterion of 70% at a .05 level of statistical significance (t=124.34, p=0.01< .05).It can be seen that the students' satisfaction of the students who through mathematics course based on multiple intelligences are higher than 70%.

In this study, SPSS software was used to evaluate the student's satisfaction with the teaching of a Mathematics Course based on Multiple Intelligences Theory. The results show that students have higher satisfaction with Mathematics Courses based on Multiple Intelligences Theory. In the classroom practice of Mathematics Courses based on Multiple Intelligences Theory, students' abilities and characteristics such as problem-solving, cooperation, and communication with each other. Students will be involved in learning faster, helping to enhance their Mathematical Reasoning Ability, and winning popularity of students.

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Therefore, mathematics courses based on the theory of multiple intelligences can improve students' reasoning ability, and it has been found that students' satisfaction is high after implementing the course. Yang (2018) also holds the same view. He believes that teachers should pay attention to students' intellectual diversity in the teaching process, adopt group discussion mode according to their different intelligences, discover patterns in the discussion process, and thus improve students' mathematical reasoning ability.

Recommendation

Recommendation for implication

1. Due to the complexity of the learning system and the limitation of research time, the research in this article is not perfect and requires further in-depth research and exploration in the following aspects. Since the researcher is still engaged in teaching work at Zhoukou Fugou Road Primary School, he lacks in-depth research on this topic and will continue to study the content of this topic. Pay attention to process evaluation, pay attention to students' learning process, promptly discover and correct misconceptions and deficiencies in their mathematics course learning, and provide targeted guidance. The determination of the mathematical reasoning ability indicators of primary school students is specifically reflected in the appendix. On this basis, the indicators are screened and modified, and then through expert discussion, the establishment of indicators is initially completed. This process involves the subjective understanding of experts. Although " mathematical reasoning ability is the core of problem-solving", experts' grasp of the core meaning is closely related to personal value orientation. Future research can further improve the indicators on this basis. Making its "localization" more distinct will also be more conducive to guiding the teaching practice of front-line teachers.

2. The determination of the mathematical reasoning ability indicators of Primary School students is specifically reflected in the appendix. On this basis, the indicators are screened and modified, and then through expert discussion, the establishment of indicators is initially completed. This process involves the subjective understanding of experts. Although "mathematical reasoning ability is the core of problem-solving", experts' grasp of the core meaning is closely related to personal value orientation. Future research can further improve the indicators on this basis. Making its "localization" more distinct will also be more conducive to guiding the teaching practice of front-line teachers. In the future, non-local teachers can be invited as experts, to reach a wider audience and conduct classified research on different levels of Primary Schools in China. The reliability of the research data will be higher.

3. Add educational technology-related content to the classroom and develop comprehensive technology for mathematics courses. Let teachers of mathematics courses become familiar with the operation of various commonly used teaching equipment and the development and utilization of digital resources so that they can use educational technology to optimize the teaching process and promote education and teaching reform. Some subject-specific information technologies (such as geometric sketchpad, Information Computing Science, etc.) By integrating technology, integrating into mathematics curriculum teaching can not only promote the scientific and advanced development of the curriculum but also improve the learning efficiency of students in the classroom and enhance their mathematical reasoning ability. Technology integration makes full use of modern technology and online resources to improve teaching effectiveness and make the learning experience more interactive and practical. Increase educational technology-related content: Add educational technology-related content to the classroom, develop comprehensive technology for mathematics courses, and familiarize students with the operation of various commonly used teaching equipment and the development and utilization of digital resources, so that they can use educational technology to optimize the teaching process and promote education Teaching Reform.

Recommendation for further research

1. Adhere to the "dual learning" purpose of reflective teaching in mathematics teaching

Reflective teaching aims to develop both teachers and students, and the ultimate goal of teaching is for students to learn how to learn while learning how to teach is the direct goal. In other words, teachers' learning to teach is for students to learn better. Therefore, reflective teachers understand that learning to teach must be based on a deep experience of students' learning to learn. Only by thinking about learning from the perspective of students' learning to learn can they truly learn to teach.

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Continuously learning to teach can effectively guide students to learn how to learn under constantly changing educational conditions and make mathematics classrooms efficient.

2. Explore the diversification of mathematics classroom teaching methods.

Mathematics teaching breaks through the traditional methods, helps to cultivate students' mathematical Reasoning ability, and also helps to develop teachers' teaching abilities. Its role is extraordinary. As an effective teaching method for mathematics classroom teaching, it may be one of the best choices, but it is not the only choice. According to the teaching content and students' learning situation, diversified teaching methods should be appropriately selected to carry out reasonable teaching of mathematical Reasoning ability.

3. Primary school mathematics course teaching needs to "follow the trend"

Mathematical reasoning ability is a key ability for students and is the core of problem-solving ability. The classroom is the main place for students to learn mathematics courses. Classroom teaching is the main position to cultivate students' mathematical literacy, which is measured by six core mathematical literacy (mathematical operations, mathematical abstraction, mathematical modeling, data analysis, intuitive imagination, and logical reasoning), these six core competencies all contain elements of mathematical reasoning. The compilation of teaching materials should extract the core content of the core mathematical competencies, and cultivate students' mathematical reasoning ability to "follow the trend" without deliberately highlighting the types of core mathematical competencies.

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