Using 5E Teaching Method to Improve Mathematics Learning Ability for Primary School Students

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Abstract

The objectives of this study were 1) to use 5E teaching method to improve mathematics learning ability for primary school students; 2) to compare mathematics learning ability before and after the implementation base on 5E teaching. The sample group consists of 50 students from 3/1 class of third grade students of Heyuan No. 4 Primary School, who were selected through the whole cluster random sampling method. The research instruments included 1) lesson plans for using the 5E teaching model and 2) mathematics learning ability measurement scales. The data were statistically analyzed using mean, standard deviation and t-test for dependent samples. The results showed that: 1) the study found that the 5E teaching method can improve mathematics learning ability; 2) after adopting the 5E teaching method, the mathematics learning ability of primary school students was significantly higher than before class, with statistical significance reaching the 0.01 level.

Keywords: 5E Teaching Method, Mathematics Learning Ability, Primary School Students

Introduction

Teaching method is a strategy to develop learners' skills to match the demands of a changing society. According to the Outline of Curriculum Reform of Basic Education, teachers should actively interact and develop with students in the teaching process, properly handle the relationship between implanting knowledge and cultivating ability, pay attention to cultivating students' creativity and independent learning ability, guide students to have critical thinking and initiative in the learning process, and deeply understand knowledge through questioning, investigation and analysis. At the same time,

it is also necessary to combine learning with practice, so that students can master and use knowledge in practice, to improve the learning effect. (Cheng Xiaomeng ,2022).

Mathematics curriculum standards point out that mathematics learning should be an active and in-depth way of learning and cannot rely solely on imitation and memorization. On the contrary, students should truly understand and master the basic knowledge and skills of mathematics through hands-on practice, independent analysis and cooperative communication, and develop mathematical ideas and methods(Chen Mohua,2021).

Wei Chi. (2015) believes that good mathematics learning ability is related to a person's comprehensive quality. It is the need for students to improve their comprehensive ability, the need to further deepen the reform of mathematics education, and the need to overcome obstacles to mathematics learning.

Primary school is a key period to cultivate students' learning ability, including students' learning motivation, perseverance and ability, and students' learning efficiency, learning results and comprehensive quality are closely related. Adopting effective teaching methods is very important to improve students' learning ability in mathematics, and it is an important prerequisite to cultivate students' good learning habits, increase their knowledge and improve their learning quality. (Yue Chuan, 2020) Primary school mathematics isa basic subject teaching, which has a wide range of application and practice. From the perspective of primary school students' mathematics learning psychology, students' learning process is not a passive absorption process, but a reconstruction process based on existing knowledge and experience. From the perspective of our educational goal, while imparts knowledge, we should pay more attention to cultivating students' comprehensive ability of observation, analysis and application, so that students can independently carry out research-based learning in mathematics learning and further improve their learning ability (Hu Jian, 2018).

At present, the law of physical and mental development of primary school students has certain particularity, and the current teaching content and teaching method of primary school mathematics cannot adapt to this particularity. This leads to a lack of enthusiasm and interest in learning mathematics, and poor learning results. In order to improve this situation, teachers need to pay more attention to the law of physical and mental development of primary school students, adjust the teaching content and teaching methods appropriately, so as to stimulate students' learning enthusiasm and interest and improve their learning effect (Qiao Hong,2021).

The predecessor of 5E teaching model is the "learning loop" model proposed by two scholars in Berkeley University, which is based on Piaget's genetic epistemology. The "learning loop" model includes three links: exploration, concept introduction and concept

application. With the development of science education reform and the penetration of learning theories such as constructivism, the "learning loop" model has gradually developed into the 5E teaching model that we are familiar with today. The 5E is the five levels of learning: Engagement, Exploration, Explanation, Elaboration, and Evaluation. The setting of these five stages not only conforms to the law of students' cognitive development, but also conforms to the theme of the new curriculum reform(Huang Ruocheng,2022).

Summarizing the 5E teaching mode, these five-teaching links are relatively independent and interrelated, constituting a closed loop of classroom teaching. Each link has its own unique educational ideas and values, such as the stimulation link pays attention to the setting of inspiring questions, the explanation link emphasizes the process and method of students' understanding of new knowledge, and the expansion link pays attention to the cultivation of students' independent learning and innovative ability.

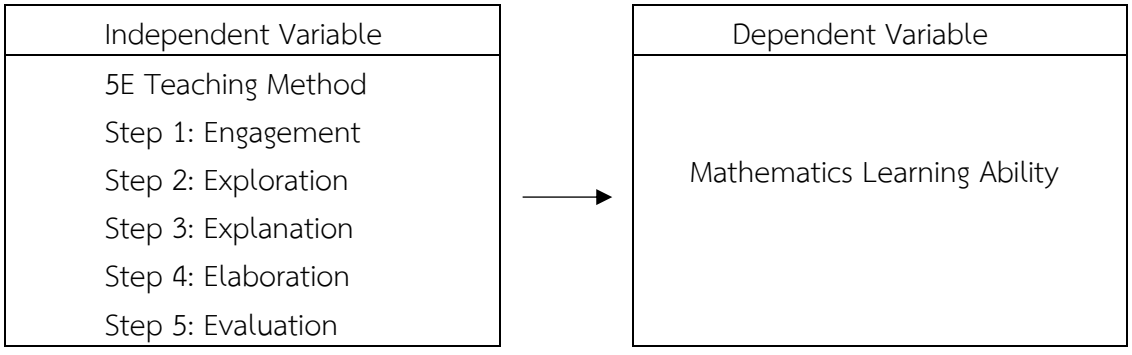
To sum up, the adoption of 5E Teaching Method has a significant promoting effect on improving the Mathematics Learning Ability of primary school students. Through this teaching method, students can better grasp knowledge and improve their learning initiative and problem-solving skills. Therefore, I choose "Using 5E Teaching Method to improve Mathematics Learning Ability for Primary School Students" as my research topic. Our goal is not only to improve student learning ability, but also to have a positive impact on the future teaching of mathematics in the classroom.

Objectives

1. To use 5E Teaching Method to Improve Mathematics Learning Ability for Primary School Students.
2. To compare Mathematics Learning Ability before and after the implementation base on 5E Teaching.

Concept theory framework

Using 5E Teaching Method to improve Mathematics Learning Ability for Primary School Students. The research concept framework is as follows:



Research Methods

1) Lesson plans for using the 5E teaching model and Mathematics Learning Ability measurement scales.
2) The data were statistically analyzed using mean, standard deviation and t-test for dependent samples.

Population and samples

Population

There are 300 third grade students in Heyuan No. 4 Primary School, with 6 classes of room 3/1, room 3/2, room 3/3, room 3/4, room 3/5,room 3/6 and 50 students in each class.

The Sample Group

Through the cluster random sampling method, by considering from classes with grades mixed of high level, medium level and low level. 50 students with classes in room 3/1 from third grade students of Heyuan No. 4 Primary School.

Research Instruments

The research Instruments is as follows:

1. Lesson plan according to the 5E Teaching Method.

The researchers used 5E teaching theory to design 3 Chapters, 12 hours in total.

1.1 Used as a guide for developing learning objectives, content, and for organizing measurement and evaluation of course activities.

1.2 To conduct an index analysis based on the core learning content of a group, we need to set learning objectives, determine the learning content, and estimate the teaching time.

1.3 Learn relevant concepts and theories from literature, books, textbooks, and related research, and develop corresponding study plans.

1.4 The researcher's teaching curriculum for using 5E Teaching Method to improve Mathematics Learning Ability for Primary School Students consisted of three chapters. Chapter 1: Understand the meaning of Area, 4 hours; Chapter 2: Understanding the origin of Area units, 4 hours and Chapter 3: Converting Area Units, 4 hours, for a total of 12 hours. Each chapter was developed based on 5E Teaching Method: 1) Engagement; 2) Exploration; 3) Explanation; 4) Elaboration; 5) Evaluation.

1) Engagement: This session is designed to stimulate students' interest in participation and inquiry.

2) Exploration: Students engage in authentic and effective inquiry, experience and learn key concepts, acquire new skills, and gain the experience of researching, inquiring and questioning.

3) Explanation: Group members exchanged speeches and group representatives

exchanged reports.

4) Elaboration: Students are able to make full use of previously learned knowledge and concepts to apply, explain and solve problems in new and approximate situations.

5) Evaluation: A variety of evaluation methods, such as teacher evaluation, student self-evaluation, group mutual evaluation, etc., are used to discover whether students have mastered the knowledge and concepts.

Validity and Reliability of the Instrument

1.5 Study the process of developing an instrument quality checklist.

1.6 Measurement and evaluation of learning outcomes.

1.7 Submit the completed teaching plan to the tutor, check the consistency and applicability of the content, and make modifications based on the suggestions from the tutor's reply.

1.8 Submit the revised teaching plan to three experts for review to verify the accuracy and applicability of the teaching content, and the consistency of learning objectives, content, learning activities, teaching media, and measurement and evaluation. Find the IOC (Index Target Consistency).

Table 1: Evaluation Results of Chapter

Using 5E Teaching Method to improve Mathematics Academic Performance for student primary school	hours	IOC	Evaluation results
chapter 1: Understand the meaning of Area	4	1.00	accept
chapter 2: Understanding the origin of Area units	4	1.00	accept
chapter 3: Converting Area Units	4	1.00	accept

1.9 Each curriculum activity plan had a consistency index greater than or equal to 0.50 and was considered suitable for use in research. The analysis result of the IOC (Index Objective Congruence) is that each chapter is 1.00.

Data Analysis

2. Mathematics Learning Ability measurement form

2.1 Analyze the content of Mathematics Learning Ability consistent with the curriculum activity plans.

2.2 Learn theories and methods of Mathematics Learning Ability assessment from the literature and relevant research.

2.3 Determine the scoring criteria for the aptitude test: 1 point for a correct answer to a multiple-choice question, 0 points for a wrong answer, 1 point for a correct answer to a judgment question, 0 points for a wrong answer, 3 points for a correct answer to the first point of an applied question, 1 point for a correct answer to the second point, and 1 point for a correct answer to the third point. A point is worth 1 point, all correct answers are worth 5 points, and all wrong answers are worth 0 points

2.4 Submit the designed Mathematics Learning Ability evaluation criteria to the thesis supervisor, check their accuracy, and make modifications.

2.5 Submit the Mathematics Learning Ability evaluation criteria created to three experts for measurement and inspection. Experts check the Content Validity and calculate the Index of Item Objective Congruence (IOC). The consistency indicator of each evaluation content is greater than or equal to 0.50 and is considered suitable for research. The IOC (Index of Item Objective Congruence) value for each item in this evaluation standard is 1.00.

2.6 Revise and improve the scoring criteria, then try out with students who were not the sample to ensure the quality of the assessment.

2.7 Check the reliability of measurement standards using Cronbach's α Coefficients is 1, which can be used for research.

Symbol and Abbreviations

Represent data analysis results based on symbols and semantics**.** The details are as follows**:**

$\bar{X}$	means	average value
SD.	means	standard deviation
n	means	number of students
D	means	scores of differences between pre and post test
df	means	degree of freedom
t	means	statistical data for t-test value
**	means	statistical significance at level .01

Results

The study using 5E Teaching Method to improve Mathematics Learning Ability for undergraduates**.** The researchers conducted research in the following order:

Part 1**:** Using 5E Teaching Method, the teaching curriculum is designed to improve Mathematics Learning Ability for student primary school.

Firstly, the researcher analyzed the content, background, importance, purpose and significance of 5E Teaching Method through literature research, understood the current status of research on 5E Teaching Method, clarified the constituent elements, necessity and methodological content of teaching Mathematics Learning ability through the teaching

purposes and requirements of the current curriculum system, as well as the current status of research in the current context. Finally, the development of a teaching curriculum based on 5E Teaching Method was identified to improve Mathematics Learning ability of student primary school.

Secondly, the instructional course was conducted through 5E Teaching Method in order to improve Mathematics Learning ability of student primary school, and this instructional course was divided into the following 3 parts, totaling 12 hours. This course consists of 3 chapters. Chapter 1: Understand the meaning of Area, 4 hours; Chapter 2: Understanding the origin of Area units, 4 hours; Chapter 3: Converting Area Units, 4 hours. Each lesson plan was developed based on 5E Teaching Method: 1) Engagement 2) Exploration 3) Explanation 4) Elaboration 5) Evaluation.

Thirdly, from the specifics of the teaching course mentioned above, the researcher through the random cluster sampling method, by considering from classes with grades mixed of high level, medium level and low level. 50 students with classes at room 3/1 from third grade students of Heyuan No. 4 Primary School.

Part 2**:** To compare student's Mathematics Learning ability before and after implementation base on 5E Teaching Method.

In this section, we aim to evaluate the effectiveness of 5E Teaching Method of teaching, the researcher tested and analyzed Understand the meaning of Area, Understanding the origin of Area units and Converting Area Units of 50 students in primary school student before and after participating in a 12 hours instructional course in an instructional class. presentation was tested and analyzed. The teaching effectiveness of the instructional course was analyzed as follows.

The researcher analyzed using 5E Teaching Method to compare Mathematics Learning Ability before and after implementation. In this research, 50 students in primary school were selected as experimental subjects in this study, including 30 female students (60.00%) and 20 male students (40.00%). The evaluation standard of Mathematics Learning Ability consists of 32 evaluation items. Each evaluation item is worth 1-3 points, totaling 40 points. The results are summarized in Table 2 below.

Table 2 score on Mathematics Learning Ability before and after implementation through 5E Teaching Method. As can be seen in Table 2, through the application of teaching theory based on 5E teaching method, Mathematics Learning Ability scores for primary school student before and after the class averaged 17.80 before the class and 33.94 after the class, with a difference of 16.14 points in the average scores, which indicates that the scores of after the class were higher than those of before the class.

The researcher conducted data analysis using the mean, standard deviation, and dependent t-test based on the students' Mathematics Learning Ability scores before and after the class. The results of the data analysis are presented in Table 2.

Table 2: Mathematics Learning achievement score between before and after learning

Student ID	Pre-test Scores (Full Score=40)	Post-test Scores (Full Score=40)	Difference Scores (D)
1	18	29	11
2	14	31	17
3	12	33	21
4	13	34	21
5	14	30	16
6	16	35	19
7	17	37	20
8	14	32	18
9	14	30	16
10	15	33	18
11	14	31	17

Table 2: Mathematics Learning achievement score between before and after learning (continue)

Student ID	Pre-test Scores (Full Score=40)	Post-test Scores (Full Score=40)	Difference Scores (D)
12	13	32	19
13	24	35	11
14	16	36	20
15	20	37	17
16	21	38	17
17	19	33	14
18	16	31	15
19	18	34	16
20	22	36	14
21	17	32	15
22	15	33	18
23	24	35	11
24	19	31	12
25	16	31	15
26	25	36	11
27	15	37	22
28	19	38	19
29	18	33	15
30	13	31	18
31	16	34	18
32	16	36	20
33	20	32	12
34	21	33	12
35	19	35	16
36	18	31	13

Table 2: Mathematics Learning achievement score between before and after learning (continue)

Student ID	Pre-test Scores (Full Score=40)	Post-test Scores (Full Score=40)	Difference Scores (D)
37	18	30	12
38	19	35	16
39	17	37	20
40	15	32	17
41	24	39	15
42	23	33	10
43	14	31	17
44	23	32	9
45	18	31	13
46	21	36	15
47	16	37	21
48	17	38	21
49	17	34	17
50	19	35	16
$(\bar{X})$	17.80	33.94	16.14
SD	3.57	2.62	3.37

Table 3: Comparison of students' Mathematics Learning Ability before and after the Implementation of the Instructional Program through 5E teaching method

Mathematics Learning Ability	n	full scores	$\bar{X}$	SD.	t	p
Pre-test	50	40	17.80	3.57	33.88**	.00
Post-test	50	40	33.94	2.62		

**Statistically significant at the level .01($p<.01$)

According to Table 3, through the implementation of 5E teaching method with the students, their Mathematics Learning Ability post-class significantly improved compared to their ability before the class. This supports the research hypothesis and demonstrates a statistically significant improvement at the level .01.

Conclusions and Discussion

Conclusion

According to the research topic, the summary of the research on development of Mathematics Learning Ability in Area course using 5E Teaching model of grade 3 students was as follows:

1. The development of learning achievement in Area course using 5E Teaching model which includes five steps: Step 1. Engagement : This session is designed to stimulate students' interest in participation and inquiry. Step 2.Exploration:Students engage in authentic and effective inquiry, experience and learn key concepts, acquire new skills, and gain the experience of researching, inquiring and questioning. Step 3. Explanation: Group members exchanged speeches and group representatives exchanged reports. Step 4. Elaboration: Students are able to make full use of previously learned knowledge and concepts to apply, explain and solve problems in new and approximate situations. Step 5. Evaluation: Through teacher evaluation, student self-evaluation, group mutual evaluation and other evaluation methods, find whether students have mastered the knowledge and concepts. This method can improve the learning effect of the third-grade students in the Area course and reach the goal of the research.

2. The comparing students' Mathematics Learning Ability before and after teaching with the 5E Teaching model, the average score for primary school students in pre-class assessments was 14.52 of full score 30 , and in post-class assessments, it was 24.64. The post-class assessment scores were significantly higher than pre-class assessment scores at a statistical significance level of .01. This aligns with the research hypothesis.

Discussion

The objective of this study is to empower primary school students to improve their Mathematics Learning Ability through 5E Teaching model. The results of this research can be discussed as follows:

1. Using the 5E model to develop the learning outcomes of the "Primary School Mathematics - Area" course, the researchers divided lesson plan writing into five steps according to the 5E teaching model: 1) classroom introduction, 2) independent exploration, 3) scientific explanation, 4) In-depth exploration and problem solving, 5) evaluation. Academic performance is evaluated through examinations. Data analysis: Three experts evaluated the quality of the teaching plans based on the 5E teaching model. The results were evaluated by the experts on the quality of the teaching plans. It is necessary to use the 5E teaching model to improve academic performance. The 5E teaching model provides an active and interactive learning environment, stimulating students' enthusiasm for learning and cultivating their cooperation and problem-solving abilities. This teaching model helps students actively participate in the learning process, thereby improving their

academic performance. The research results are consistent with Deng Haimei(2021) research on the application of the 5E teaching model in the teaching of "Graphics and Geometry" in primary school mathematics. The application of the 5E teaching model in the teaching of "Graphics and Geometry" in primary school mathematics has improved students' enthusiasm and initiative in learning to a certain extent, and stimulated students' interest in learning. In particular, the exploration and explanation links have established a good foundation for students' cooperation and communication. The platform can effectively improve students' communication and collaboration skills and improve students' classroom participation. The use of the 5E teaching model in the teaching of "Graphics and Geometry" in primary school mathematics is beneficial to improving students' performance. It can be seen that this model is a feasible and effective teaching model. Therefore, advocating and implementing the 5E teaching model is particularly important in the field of education.

2. Comparison of Mathematics Learning Ability before and after the implementation of the 5E teaching model. The researcher reviewed a large number of literature and research related to the 5E teaching model and conducted research based on the 5E teaching model. The research results show that in the primary school mathematics-area course, the use of the 5E teaching model can promote the improvement of students' Mathematics Learning Ability. The results showed that the average score before learning was 17.80 points, and the average score after learning was 33.94 points, with an average difference of 16.14 points. The results showed that students scored an average of 17.80 points (SD = 3.57) in the pre-course assessment and 33.94 points (SD = 2.62) in the post-course assessment. The post-course assessment scores were significantly higher than the pre-course assessment scores, and the difference was statistically significant (0.01). The 5E teaching model brings new possibilities to traditional classroom teaching. This teaching model has shown good results in improving Mathematics Learning Ability and stimulating students' interest in learning and achieved the purpose of the research.

To sum up, the 5E teaching method provides a positive and effective mathematics learning environment for primary school students with its gradual, exploratory and participatory characteristics. It helps students establish a solid foundation in mathematics and develops their logical thinking, problem-solving and innovation abilities, enabling them not only to master mathematical knowledge, but also to apply the knowledge they have learned to real life. Therefore, the 5E teaching method is considered a successful teaching strategy and is of great significance to the improvement of primary school students' mathematics learning ability.

Recommendations

Based on the findings of this study, the following recommendations are made:

1. Teachers should receive the necessary training to learn how to make the most of this teaching method.

2. In addition to teacher training and learning, schools and educational institutions should also provide high-quality learning materials to assist teaching.

3. Under the 5E Teaching Method, students should be encouraged to actively participate in discussions and exchanges, ask questions, and share their opinions. This engagement helps build a learning community among students and promotes deep learning.

4. Under the 5E Teaching Method, class time mainly focuses on in-depth discussion, group cooperation and communication analysis. Teachers should design interesting and challenging activities to promote student interaction and discussion.

5. Under the 5E Teaching Method, teachers should regularly collect feedback from students to understand their learning progress and needs, and adjust teaching strategies accordingly.

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