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Poster Presentation Session

Abstract

The Study of Mathematics Problem Solving Ability of Grade 5 Students in Primary Schools through Learning Management by using 5E Teaching Model

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Abstract

The purposes of this research were to: 1) compare mathematics problem solving ability of the students before and after learning through 5E Teaching Model. 2) To compare mathematics problem solving ability of the students with the determined criterion set at 70% .3) compare Mathematics achievement of the students before and after learning through 5E Teaching Model. 4) compare Mathematics achievement of the students with the determined criterion set at 70% of full scores. The sample used in this study was 40 students in Grade 5 of Bayi Primary School in Zhoukou, Henan Province, China. They were selected by cluster random sampling. The research tools were as follow: 1) Five lesson plans of the 5E teaching model on the topics of triangle area, parallelogram area, trapezoidal area rectangle and square volume、 rectangle and square surface area. 2) Mathematics achievement test with reliability of 0.704. Mathematical problem solving ability test with a reliability of 0.826. Statistical data used for data analysis were the mean value, standard deviation and T-test of samples.

The results are as follows:

1) Mathematics problem solving ability of fifth grade students after being exposed to the 5E teaching model was higher than before at a statistically significant level of 0.05.

2) Mathematics problem solving ability of fifth grade students after being exposed to 5E teaching model was higher than the 70% criterion at the 0.05 statistical significance level ($\bar{X}$=7.425, S.D. =0.931).

3) Mathematics achievement of fifth grade students after being exposed to 5E teaching model was higher than before at a statistically significant level of 0.05.

4) Mathematics achievement of fifth grade students after being exposed to 5E teaching model was higher than the 70% criterion at the 0.05 statistical significance level ($\bar{X}$=23.875,S.D. =3.975).

Keywords: 5E Teaching model、 mathematical problem solving ability、 Mathematics Achievement、 Student-centered、 Independent Exploration、 Knowledge construction

1. Introduction

In 2016, China Education Innovation Research Institute and global Education Innovation Summit jointly released a report 《Looking To the Future: Global

Experiences in Core Literacy Education for the 21st Century》 Put forward : "The cultivation goal of students is changed from the accumulation of knowledge to the ability to effectively use various resources, cooperate with heterogeneous others and solve problems. Specifically, it is to train from " knowledge" gradually to "energy" development extension" （Shang Yufei, 2020）. In 2022, the Ministry of Education of the People's Republic of China promulgated the "Mathematics Curriculum Standards for Compulsory Education" emphasized: The problem solving ability is regarded as the skills that students must master in the process of mathematics learning and also as the overall goal of curriculum development. It can be seen that training students' problem-solving ability has become an important task in current education and teaching, and at this time also highlights the importance of classroom teaching. It has become the goal of many educators to choose excellent teaching mode, let everyone get good mathematics education, and gradually acquire the ability to adapt to lifelong development.

Nowadays, with the development of big data analysis and artificial intelligence, the research and application fields of mathematics are also constantly expanding, and the growth environment of students is changing profoundly, their thinking and vision are constantly expanding, and the problems they face are emerging one after another, which requires a positive attitude and the ability to solve problems. In a word, mathematics

problem solving ability is not only to improve mathematics scores, but also the comprehensive embodiment of students' core accomplishment, which needs physical and mental cooperation and development. On the one hand, students need to have a certain mathematical literacy, to be able to see the subtle, divergent thinking in mathematical problems to solve subtly. On the other hand, students' interests and hobbies are the boosting agent for the development of this ability, which can well stimulate students' initiative to study problem solving methods. (Zhang Yuqing, 2020).

Primary school mathematics is the basic stage of learning mathematics, but also an important period to cultivate mathematical problem solving ability. At this time, classroom teaching is particularly important. But in the actual teaching process, there are still some unscientific phenomena, but also trying to find effective ways to solve the problem. The problems in teaching mainly include the following aspects:

1. Improper situation creation.

Mathematics teaching situation can arouse students' thinking. The curriculum standards also emphasize that students should focus on teaching tasks, choose close to their actual life, knowledge experience, age characteristics and cognition as materials for processing, follow the scientific, reasonable and interesting principles to design problem situations, stimulate students' motivation, expand students' thinking, help students better understand the knowledge, promote the improvement of problem solving ability. At present, the benefit of creating the artistic conception of questions has been attached importance by the majority of educators. But there are also problems in the creation of simple and boring form, lack of appeal; Or excessive pursuit of situation

creation and other issues, which makes students unable to form the required spatial thinking (Zhao Xiaoxiao, 2021).

2. Ignore the students' dominant position

Students are the main body of learning, and teachers are the organizers and guides of learning. Curriculum standards emphasize that students' principal position should be highlighted in teaching activities, and students should actively participate in the classroom. Through independent exploration links such as observation, practice and analysis, students can understand and master basic knowledge and skills, experience and apply mathematical thinking and methods, and acquire mathematical problem-solving experience and ability. Teachers in the classroom is to give certain

guidance and help. At present, there are still many teachers in the use of a single " indoctrination" teaching method, do not pay attention to the cognitive characteristics of pupils, resulting in students' classroom performance is not active, the quality of classroom learning is not high phenomenon, affecting students' in-depth learning (Cen Rongying, 2018).

3. Teaching guidance unclear.

When designing teaching, teachers should analyze the essence of teaching content and students' cognitive law, reasonably integrate teaching content, analyze the main performance of knowledge and ability cultivation in each chapter, determine teaching objectives, and implement them into teaching activities in an orderly and step by step way to promote students' understanding and mastery of what they have learned. however, there are still some cases in which teachers' teaching instructions are unclear and fail to reflect the teaching objectives of the chapters taught, resulting in students unknown how to raise valuable questions and unable to analyze the relationship between mathematical information in the situation, which affects their understanding and application of knowledge. (Zhao Xiaoxiao, 2021).

To solve these problems, we must Choose the appropriate teaching mode, which promotes both teachers and students. 5E teaching model insists on student-centered, from introduction to refinement, is the process of discovering and solving problems, creating opportunities for students to explore knowledge and promoting the development of mathematical thinking. Specifically, the 5E teaching model is suitable for the requirements and standards of "compulsory education mathematics curriculum standards". In this paper, based on the 5E teaching model, through the implementation of five teaching steps, to mobilize the enthusiasm and initiative of students to learn mathematics, deepen the understanding and application of knowledge, so as to improve mathematics performance and mathematical problem solving ability.

2. Research objectives

This research consisted of three objectives:

2.1 To compare mathematics problem solving ability of the students before and after being exposed to 5E Teaching Model.

2.2 To compare mathematics problem solving ability of the students with the determined criteria with a set criterion of 70 % .

2.3 To compare Mathematics achievement of the students before and after being exposed to 5E Teaching Model.

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3. Research hypothesis

3.1 Mathematics problem solving ability of Grade 5 students after being exposed to 5E Teaching Model is higher than before.

3.2 Mathematics problem solving ability of Grade 5 students after being exposed to 5E Teaching Model is up to 70%.

3.3 Mathematics achievement of Grade 5 students after being exposed to 5E Teaching Model is higher than before.

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4. Research Methodology

4.1 Samples

The population in this study was 120 Grade 5 students (3 classrooms) of primary schools in Bayi Road, Zhoukou City, Henan Province, China.

The sample for this study was 40 Grade 5 students （1 classrooms ） of primary schools in Bayi Road, Chuanhui District, Zhoukou City, Henan Province, selected through cluster random sampling method.

4.2 Research instruments

4.2.1 Instruments for measuring mathematical problem solving ability and mathematics achievement. Instructional innovation for 5 E Teaching Model comprised of five steps.

Step1 Engagement: (Teaching behavior) 1. Be familiar with the course content, students' original knowledge, experience and psychological characteristics. 2. Create interesting, effective and life-related problem situations through videos, games, experiments, etc. (Student behavior) 1. Think about the problem. 2. clear learning objectives and tasks.

Step2 Exploration: (Teaching behavior) 1. Provide relevant learning materials and give students sufficient time to conduct targeted research. 2. students encounter confusion, give indirect guidance. (Student behavior) 1. Explore individually or in groups. 2. Think about the problem, record the results, and form opinions.

Step3 Explanation: (Teaching behavior) 1. Encourage students to use their own language to explain their understanding of new concepts or skills in the process of inquiry. 2. Describe new concepts or skills in accurate, scientific and concise language. (Student behavior) 1. Actively interpret the findings 2. Listen to your classmates' answers and ask questions. 3. Understand what the teacher says and answer questions with new knowledge.

Step4 Elaboration: (Teaching behavior) 1. Ask students to use standard language to tell the new knowledge. 2. Create new problem situations and

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Step4 Elaboration: (Teaching behavior) 1. Ask students to use standard language to tell the new knowledge. 2. Create new problem situations and exercises to help students consolidate and strengthen the new knowledge, understand the transfer and application. (Student behavior) 1. Understand the connection between old and new

knowledge, and complete cognitive construction. 2. Able to solve problems with newly learned knowledge.

Step5 Evaluation: (Teaching behavior) 1. At the end or in each process, give appropriate evaluation on the overall performance of students in class. 2. Evaluate students' interpretation of inquiry results and mastery of skills. (Student behavior) According to the knowledge understanding and grasp of the situation to summarize, reflect, evaluate the advantages and disadvantages.

4.2.2 Lessons plan: A total of five lessons plans and 10 hours of primary math instruction were assigned. Lesson plans presented in this study were quality assessed by five experts (Professor and associate professor) on the appropriateness of their components. The average appropriateness score of the evaluation team was 4.8 points out of 5, which was very high and suitable.

4.2.3 Instruments for collecting data

In this study, two test papers were used as measuring tools to collect data, which was used to detect students' mathematical achievement and mathematical problem solving ability development.

4.2.3.1Instrument for measuring : mathematical problem solving ability

1) The test consists of two subjective questions(5 scores of 1 item, designed to examine students' ability to analyze and solve mathematical problems. The Index of Item Objective Congruence (IOC) of each item in the evaluation form was 1 higher than 0.8, the result of analyzing the IOC index showed that all test items were appropriate and could be used in the test difficulty (p) between 0.2-0.8 and discriminability (r) > 0.2, mathematical problem solving ability test with a reliability of 0.826.

2) Homework

3) Teacher's ask questions

4.2.3.2 Instrument for measuring: mathematical achievement

1) The test consists of 30 multiple choice questions (1 score of 1 item. This mainly examines students' memory, understanding and application of the knowledge they have learned. The Index of Item Objective Congruence (IOC) of each item in the evaluation form is 1 higher than 0.8, the result of analyzing the IOC index showed that all test items were appropriate and could be used in the test difficulty (p) between 0.2-0.8 and discriminability (r) > 0.2, achievements test with a reliability of 0.704.

2) Homework

3) Teacher's ask questions

4.3 Data collection

The procedures of data collection were as follows:

1. The samples was given the pretest for measuring Mathematics Achievement and Mathematical problem solving ability with constructed instrument.

2. The samples was taught by using 5E Teaching Model.

3. After finishing the instruction, the samples received the posttest by using the same instrument which was used in the pretest.

4.4 Data analysis

In this study, statistical procedures were used to analyze the data combined with the research objectives.

Compare Mathematics Achievement and Mathematical problem solving ability before and after were exposed to 5E Teaching Model by using t-test for dependent sample.

5. Research Results

The results were presented according to the research objectives as follows:

5. 1 Section 1 Result of comparing mathematics problem solving ability of the students before and after being exposed to 5E teaching model by using t- test for dependent sample are shown below.

Table 1

Paired samples test

Group	N	Pretest scores		Posttest scores		t	p
		$\bar{X}$	S.D.	$\bar{X}$	S.D.		
Experimental group	40	4.500	1.155	7.425	0.931	22.327*	.000

$p < 0.05$

Based on the results, we can state the following:

As shown in Table 1, Students had mathematics problem solving ability after being exposed to 5E Teaching Model (post-test) greater than before learning (pre-test) at .05 statistically significant level (t =22.327 *, p < 0.05).

On average, Posttest scores were 2. 925 points higher than Pretest scores (95%).

Thus, it was concluded that, mathematics problem solving ability of Grade 5 students after being exposed to 5E Teaching Model was higher than before.

5. 2 Section 2 Result of comparing mathematics problem solving ability of students with the determined criteria set at 70 % by using t-test for one sample.

Table 2

Group	N	Full score	Criteria score	$\bar{X}$	S.D.	t	p
Experimental group	40	10	7	7.425	0.931	50.462*	.000

p＜0.05

Based on the results, we can state the following:

According to *Table 2,* The average score for the mathematics problem solving ability of Grade 5 Students after being exposed to 5E Teaching Model was 7. 425 from a full marks of 10 and the standard deviation was 0. 931, which was statistically higher than the criterion of 70% at .05 level of statistical significance (t = 50.462* , p < 0.05).

Thus, it was concluded that, mathematics problem solving ability of students who were exposed to 5E teaching model was higher than 70%.

5.3 Section 3 Result of comparing mathematics achievement of the students before and after being exposed to 5E teaching mode by using t-test for dependent sample are shown below.

Table 3
Paired samples test

Group	N	Pretest scores		Posttest scores		t	p
		$\bar{X}$	S.D.	$\bar{X}$	S.D.		
Experimental group	40	19.575	3.706	23.875	3.975	12.373*	.000

p＜0.05

Based on the results, we can state the following:

According to *Table 3,* Students had mathematics achievement after being exposed to 5E Teaching Model (post-test) greater than before learning (pre-test) at .05 statistically significant level (t = 12.373*, p <0 .05).

On average, Posttest scores were 4. 3 points higher than Pretest scores (95%).

Thus, it was concluded that, mathematics achievement of Grade 5 students after being exposed to 5E Teaching Model was higher than before.

5. 4 Section 4 Result of comparing mathematics achievement of students with the determined criteria set at 70 % by using t-test for one sample.
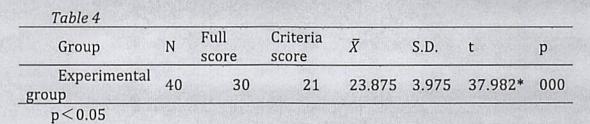
Table 4

Group	N	Full score	Criteria score	$\bar{X}$	S.D.	t	p
Experimental group	40	30	21	23.875	3.975	37.982*	000

$p < 0.05$

Based on the results, we can state the following:

According to *Table 4*, The average score for the mathematics Achievement of Grade 5 Students after being exposed to 5E Teaching Model was 23.875 from a full marks of 30 and the standard deviation was 3.975, which was statistically higher than the criterion of 70% at .05 level of statistical significance ($t = 37.982*$, $p < 0.05$)

Thus, it was concluded that, mathematics achievement of students who were exposed to 5E teaching model was higher than 70%.

6. Discussion

The following points based on the research results were discussed:

6.1 5E teaching model has changed the teaching process, teachers' teaching philosophy and students' learning methods. In this study, teachers actively accept the teaching concept of 5E teaching model, respect the cognitive characteristics of students, and believe that each student will have different progress and development. At the same time, based on the 5E teaching model, students are centered and the ability of inquiry, problem solving, cooperation and communication is cultivated through teaching activities. Therefore, mathematics education not only teaches students knowledge and skills, but also develops students' necessary character and development ability. (Xiang Xiannian 2020, Deng Haimei 2021).

6.2 Creating reasonable artistic conception of questions is conducive to the smooth development of teaching activities. Teachers set interesting questions related to students' life reality, familiar stories, cognitive characteristics and so on to introduce the new lesson, which can trigger students' knowledge conflict, stimulate students' curiosity, so that they can concentrate their attention, actively participate in the class, and complete
the corresponding learning tasks according to the teaching plan. It should be noted that teachers should give encouragement and guidance during the period to help students build up confidence to overcome difficulties. (Sun Jiadong 2022, Deng Haimei 2021).

6.3 5E teaching mode is helpful to teachers' teaching.

The teaching requirements of each teaching link of 5E teaching mode are different, and the teaching strategies adopted are also different, which points out the direction of teachers' teaching. Teachers understand the theory of the teaching model, combine the actual teaching situation and other aspects of the content, and make a reasonable and scientific planning of the whole teaching. In the process of implementation, the classroom becomes more interesting and more passionate about learning. Under the explicit guidance of teachers, students can understand

what they have learned and complete the dual transfer of knowledge and methods. Teachers' teaching effect and students' learning effect have been improved. (Xiang Xiannian, 2020; Burcu Sezginsoy Seker, Aliye Erdem, 2017).

7. Conclusion

In the process of experiment, through the actual situation of classroom teaching, testing, data analysis and other links, to understand the students' grasp of knowledge, summed up the following conclusions:

Compared with traditional teaching, 5E teaching mode has certain teaching effect. From the data and the classroom learning, the students in the experimental class no longer understand the superficial appearance of knowledge, but actively and seriously explore the context of knowledge, and actively use scientific thinking analysis, trying to use different methods to solve problems.From the analysis of the data results, it can be seen that the mathematical performance and mathematical problem solving ability of the students in the experimental class have been significantly improved, reaching the established standard of 70%, and the experimental results have reached the research objectives.

In a word, 5E teaching mode has certain operability in primary school mathematics education. To a certain extent, it stimulates students' interest in learning, gives full play to students' initiative and enthusiasm, and improves students' learning ability and quality. The teaching concept of "student-oriented, teacher-oriented" has been further implemented to improve teachers' teaching.

8. Recommendations

The following are some recommendations based on the research results:

8.1 Suggestions for applying the research results

1) In teaching practice, 5E teaching mode promotes students' understanding and learning of knowledge, and improves students' performance and problem-solving ability. Therefore, teachers can consider using 5E teaching mode according to the teaching content.

2) Teachers need to strengthen the theoretical study of 5E teaching mode, have a solid knowledge reserve, and master the key points and skills of each link flexibly. Only in this way can they effectively complete the teaching content and tasks, improve the teaching ability and quality, and build confidence in teaching.

3) 5E teaching model has more teaching steps, and students have less contact with some teaching links. Therefore, in teaching practice, teachers should give guidance and encouragement to help students build confidence, bravely express themselves, and enhance their interest in learning.

4) 5E Teaching mode in teaching practice, teachers should pay attention to the classroom performance and learning state of students, do a good job in classroom order
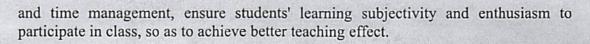
and time management, ensure students' learning subjectivity and enthusiasm to participate in class, so as to achieve better teaching effect.

8.2 Suggestions for the next research

1) This study only selected a primary school for teaching practice. In the future, expand the scope and practice in more schools, and the experimental results will be more empirical.

2) The 5E teaching model has high requirements on teachers. Due to the limited teaching experience and the influence of external factors and resources, the research on the 5E teaching model needs further exploration in the future.

3) Constantly reflect on and improve the shortcomings of this study in teaching practice in the future, and gradually improve it in long-term application, so as to provide guidance and reference for teachers to carry out teaching practice more effectively.

References

Shang Yufei. Research on the current situation of Ninth Grade Student's mathematical problem solving ability and cultivation strategy. [D]. Northwest Normal University, 2020.

Zhang Yuqing. Research on the current situation of mathematical problem solving ability of fifth grade Primary school [D.Tianjin Normal University, 2020.

Xiang Xiannian. Research on the Teaching Strategy of junior Middle School Mathematics Concept based on 5E teaching mode [D], Yunnan Normal University, 2020.

Deng Haimei. Research on the application of 5E teaching model in the teaching of "Graphics and Geometry" in primary school mathematics [D], Minnan Normal University, 2021.

Sun Jiadong. Research on the application of 5E teaching model in High school Mathematics teaching under the background of core literacy [D], Hubei Normal University, 2022.

Zhao Xioaxiao. Research on the Cultivation of Mathematical Problem solving Ability of middle and high grade students in primary school [D]. Southwest University, 2021.Burcu Sezginsoy Seker, Aliye Erdem. Deveopment of a template lesson plan base on 5E model enhanced with computer supported applications and conceptual change texts. [J]. (2017) Journal of Education and Training Studies, 2017,10(5): 88-89.