Problem Solving Strategies in Mathematics of Students in the of Primary Level: Basis for Strategic Study Guide

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Abstract: Mathematical problem solving ability refers to the thinking ability and problem solving ability that students show in solving mathematical problems, which is a very important ability in mathematics learning. However, because traditional mathematics teaching focuses on teaching basic concepts and algorithms and neglects the cultivation of students' problem-solving skills, many students are unable to begin to apply what they have learned to real-life problems. The Chinese government attaches great importance to the cultivation of students' mathematical ability in the educational reform for students. As China's society continues to develop and progress, we are paying more and more attention to how students use their knowledge to solve problems and how students can improve their problem-solving skills at the primary and secondary school levels.

Keywords: Mathematical Problem; Problem Solving; Primary School

Background of the study

There is a relevant discussion of mathematical problem solving in our latest elementary school curriculum standard, the National Curriculum (Primary) Syllabus (Experimental) of the People's Republic of China. This standard, which was officially implemented in 2021. Our latest elementary school curriculum standards include mathematical problem solving as an important learning objective and focus on developing students' problem solving skills in the teaching of mathematics.

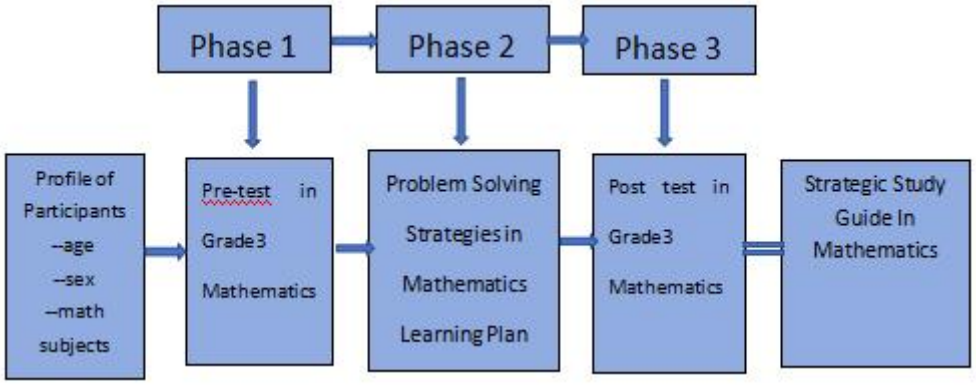
Research has identified several prevailing phenomena in the teaching of elementary school mathematics in China. Firstly, there is a strong emphasis on basic knowledge and arithmetic ability. Students spend a significant amount of time engaging in arithmetic operations and mastering fundamentals such as addition, subtraction, multiplication, division, fractions, and decimals during their early years. Additionally, extra-curricular practice plays a substantial role in reinforcing students' mathematical knowledge and skills. Students are assigned numerous homework assignments and exercise books to enhance their memory and arithmetic proficiency.

The researcher is a math teacher who has witnessed/observed the difficulties of grade 3 pupils in math problems. The researchers believe that it would be necessary to determine their problem solving strategies, if any, so that she can propose a strategic guide to scaffold students' problem solving in mathematics.

Statement of the Problem

This study intends to determine the problem-solving strategies in mathematics of students in the primary level.

Research paradigm



Significance of the Study

Through the conduct of the study, ①For instructional leaders, To enhance the teaching ability construction of the teacher team under

the leadership of the academic leaders, Combined with the teaching practice, Give full play to the teaching skills of frontline teachers, Research in the teaching practice; ②For math teachers, Can optimize the mathematics classroom teaching structure in our school, Promote the mathematics teacher to implement the mathematics professional theory into the mathematics classroom, Improve the level of classroom teaching; ③For the students, Can develop students' sense of innovation, Improve your problem-solving skills, Experience the diversity of problem-solving methods.

Research Methods

This study will involve pre-test and post test to determine the problem solving shall of grade 3 pupils. The researchers will devolep a pre-test and a post test in math ascending to the competencies for grade 3 puplis. The sample problem itens are provided for the pre-test. problem-solving strategies are:

①Arithmetic computing: two-digit addition（by Lesh, R., & Zawojewski, J. (2007)）

Arithmetic computing refers to problem-solving strategies that involve using basic mathematical rules and techniques to perform addition, subtraction, multiplication, and division operations.

②Logical Reasoning:（by Harel, G., & Sowder, L. (2005)）

Logical reasoning refers to the strategy of using logical thinking to reason and solve problems based on known facts and conditions.

③Model Construction:（Lesh, R., & Doerr, H. M. (2003)）

Model construction refers to the strategy of transforming mathematical problems into concrete models or graphical representations, and solving problems through model construction and analysis.

④Trial-and-error method: Two-digit by one-digit（Schoenfeld, A. H. (1985)）

The trial-and-error method is a strategy for approaching the problem-solving process gradually by trying different methods and strategies, practicing and correcting mistakes repeatedly.

⑤Graphical representation:（Harel, G., & Confrey, J. (1994)）

Graphical representation refers to the visual presentation of mathematical problems in the form of diagrams and images for better understanding of problems and problem-solving strategies.

Instrumentation

This study will employ teacher – made instruments involved in each phase. Phase 1 - Pre-test in Mathematics for Grade 3; Phase 2 – Arithmetic computation, logical reasoning, model construction, trial and error methods, and graphical representation five problem solving strategies ; and Phase 2 - Post-test in Mathematics for Grade 3.

Phase 1:Pre-Test In Mathematics For Grade 3

This phase involves a pre -test in Mathematics for Grade 3 pupils. The scope of the pre – test is aligned with the competencies in Mathematics for the primary level as per the Mathematics Curriculum mandated by the Ministry of Education in China.

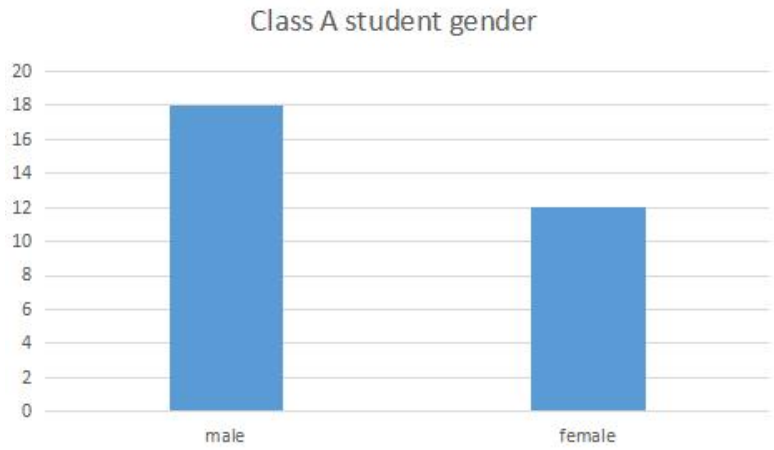
①“Calculate the results of the following equations: 18 + 27 = ?”

②“Xiao Mei has 16 apples and wants to share them equally among 4 friends, how many apples does each friend get?”

③“ Ming made a fruit platter with 3 apples and 4 oranges, and he has 2 apples left. How many fruits did he have at the beginning?”

④“A shopping site has 79 identical items, each priced at 9rmb. if all of them are sold, what are the total sales of this site?”

⑤"The bar graph shows the number of male and female students in the class. Study the chart and answer the following questions:



Question:How many boys are there in this class? How many girls are there? How many people are there there altogether?"

Phase 2:Problem Solving Strategies Applied/Integrated In Mathematics Lesson

Five strategies will be applied/integrated in this phase: arithmetic computation, logical reasoning, model building, trial-and-error method, and graphical representation. These five strategies will be applied by the teacher in all five learning programs so that students can learn the above strategies. According to the article "MATH PROBLEM SOLVING STRATEGIES" published by Ms. NOELLE in 2017, we can refer to the elementary mathematics problem solving classroom plan consisting of several parts, namely: ①C.U.B.E.S.; ②R.U.N.S.; ③MANEUVERING THE MIDDLE STRATEGY AKA K.N.O.W.S. The following study plan is an example of experimental teaching:

Learning Plan in Mathematics- Grade 3 Class

Objectives:

At the end of the lesson, the students are expected to : Solve vertical computation problems involving the addition of two-digit numbers.

Subject Matter:

Solve vertical computation problems involving the addition of two-digit numbers

References: Elementary Math Curriculum - Grade 3

Materials: flashcards, problem chart

Procedure:

A. Preliminary Activities:

1. Drill: Mental Computation

20 + 40 = ? 80 + 90 = ?

2. Review: Add Mentally

67 + 22 = ? 88 + 55 = ?

3. Motivation:

Present a problem opener.

Xiao Ming has 58 candies and Xiao Hong has24 candies. How many candies do the two of them have together?

B. Developmental Activities:

1. Presentation:

a. Let the pupil read silently the problem. Ask: Who are the children in the story? What can you say about them? Activity 1 –K.N.O.W.S. Strategy

a. Know

Write the important information in the problem.

Xiao Ming has 58 candies.
Xiao Hong has 24 candies.

b. Need to know

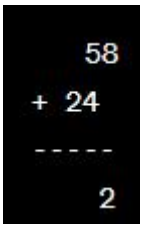
We need to know how many candies the two of them have together.

c. Organize

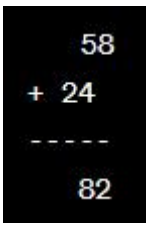
We will add the number of candies Xiao Ming has to the number of candies Xiao Hong has.

d. Work

Start with the ones place: 8 + 4 = 12. Write down 2 and carry over 1 to the tens place.



Move to the tens place: 5 + 2 + 1 (carry-over) = 8. Write down 8 in the tens place.



d. Solution

Solution needs to be checked. Did it work? Did it answer the question?

Evaluation:

A. Group work with 4 members each.

Create simple problems using the given data below. Then, solve the problem you have created.

Math book 28 RMB Language book 35 RMB English book 24 RMB

Assignment:

Answer the problem using POLYA's 4-steps. Don't forget to "look-back"

Xiao Ming's room has 93 toys and Xiao Hong's room has 68 toys. How many toys do they have together?

Phase 3:Post Test in Mathematics for Grade 3

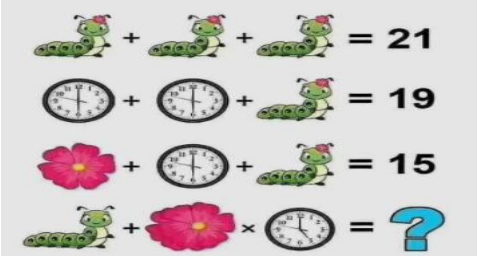
This phase involves a post -test in Mathematics for Grade 3 pupils. The scope of the post – test is aligned with the competencies in Mathematics for the primary level assessed/diagnosed in the pre - test as per the Mathematics Curriculum mandated by the Ministry of

Education in China.

Directions: Analyze each problem. Show your solution to each problem by visual imagery/drawing. Give your final answer.

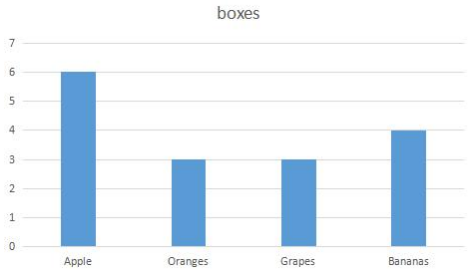
①"Calculate the results of the following equations: 48 + 17 = ?"

②"Question: Fill in the numbers in the question marks according to the pattern in the figure below?"



③" Xiao Ming had some apples and Xiao Hong gave him 17 apples, he now has 23 apples. How many apples did Xiao Ming have at first?"

④"A bus carries 38 passengers per trip and has 6 identical trips per day. What is the total number of passengers carried by this bus in a week?"



⑤"A store sells the following types of fruit in a week. Based on the information presented in the bar graph, try to ask and answer a question"

Conclusion and discussion

After research, we can obtain relevant data. 50 students participated in both tests. The pretest results are shown in Table 1:

Question number	The correct number	accuracy
No.1	37	74%
No.2	38	76%
No.3	36	72%
No.4	35	70%
No.5	33	66%
No.1--No.5	27	54%

The Post-test results are shown in Table 2:

Question number	The correct number	accuracy
No.1	48	96%
No.2	47	94%
No.3	46	92%
No.4	47	94%
No.5	45	90%
No.1--No.5	44	88%

Through the two sets of data, it can be clearly seen that in the pre-test, the correct rate of the first question of the class was 74%, the correct rate of the second question 76%, the third question 72%, the fourth question 70%, the correct rate of the fifth question 66%, 27 students had all the five test questions, accounting for 54% of the class. According to the pre-test data, the students' performance is relatively average, in line with the learning level of the third grade.

In the post-test, the correct rate of the first question was 96%, the second question 94%, the third question 92%, the fourth question 94%, the fifth question 90%, 44 students had all the five tests, accounting for 88% of the class. As can be seen from the two sets of data, after the experimental operation, the correct rate of the post-test questions in the class increased significantly, and the overall accuracy rate increased from 54% to 88%, indicating that the students' problem-solving ability has been improved to a certain extent.

However, in the process of experimental teaching, researchers also found some problems. A small number of students were inattention in class and cannot devote themselves to study; some students did not rationally apply the problem-solving strategies in the posttest, and some negligent mistakes occurred, not because students did not master the strategy but due to careless and wrong questions. These problems are recorded by the investigator and need to be addressed in the next study.

References

[1] NOELLE. (2017, June).Math Problem Solving Strategies. Blog posts. Retrieved.

[2] Lesh, R.& Zawojewski, J. (2007). Problem Solving and Modeling. In Second Handbook of Research on Mathematics Teaching and Learning (pp. 763-804). Information Age Publishing.

[3] Harel, G., & Sowder, L. (2005). Advanced Mathematical Thinking. In Handbook of Research on Mathematics Teaching and Learning (pp. 65-97). National Council of Teachers of Mathematics.

[4] Lesh, R., & Doerr, H. M. (2003). Beyond Constructivism: Models and Modeling Perspectives on Mathematics Problem Solving, Learning, and Teaching. Mahwah, NJ: Lawrence Erlbaum Associates.

[5] Harel, G., & Confrey, J. (1994). The Development of Multiplicative Reasoning in the Learning of Mathematics. Albany: State University of New York Press.

[6] National Curriculum (Primary School) Syllabus (experiment) [EB / OL]. (2021)[2022-03-25].http://www.moe.gov.cn/jyb_xwfb/gzdt_gzdt/s5987/202101/t20210111_512779.html.

[7] NCTM. (2014). Principles to Actions: Ensuring Mathematical Success for All. Reston, VA: National Council of Teachers of Mathematics.

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