International Journal of Education and Social Science Research

ISSN 2581-5148

Vol. 7, Issue.5, Sep-Oct 2024, page no. 26-35

To cite this article: Dr. Bich Tran Ngoc, Dr. Nga Tran Thuy, Dung Bui Ngoc and Lan Vu Ngoc (2024). DEVELOP THE CAPACITY FOR MATHEMATICAL PROBLEM-SOLVING AMONG VIETNAMESE 5TH GRADE STUDENTS THROUGH TEACHING AND SOLVING PRACTICAL PROBLEMS, International Journal of Education and Social Science Research (IJESSR) 7 (5): 26-35 Article No. 970, Sub Id 1520

# DEVELOP THE CAPACITY FOR MATHEMATICAL PROBLEM-SOLVING AMONG VIETNAMESE 5TH GRADE STUDENTS THROUGH TEACHING AND SOLVING PRACTICAL PROBLEMS

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DOI: https://doi.org/10.37500/IJESSR.2024.7503

## ABSTRACT

The 2018 General Education Program for Mathematics in Vietnam outlines five components of mathematical competence that need to be formed and developed for students. Mathematical problem-solving ability is one of the five competencies specified in the mathematics curriculum. This paper presents a study on mathematical problem-solving ability and proposes a teaching process to develop this competence for 5th-grade students in Vietnam through teaching practical problem-solving. The proposal is illustrated with three examples related to real-life situations in three different topics in the 5th-grade Mathematics curriculum. Through solving practical problems, students not only practice mathematical knowledge and skills but also have the opportunity to develop their mathematical problem-solving ability and apply mathematics to real-life situations.

**KEYWORDS**: elementary math, elementary school, solve math problems, capacity, mathematical ability.

## 1. INTRODUCTION

Problem-solving ability in general, and mathematical problem-solving ability in particular, are essential for students. In teaching Mathematics, teachers need to create many opportunities to develop students' mathematical problem-solving skills. Many researchers have published their findings on various aspects of teaching that contribute to the development of mathematical problem-solving abilities.

The demands of the 21st century require students to understand concepts, master skills, and have the ability to learn Mathematics effectively. For instance, considering the goals of mathematics education, five related components are identified: concepts, skills, processes, attitudes, and metacognition. This emphasizes the development of students' mathematical problem-solving

abilities in Mathematics teaching. Teachers are encouraged to emphasize these five components in their lessons to help develop students' mathematical problem-solving skills [1].

Research on factors affecting the mathematical problem-solving ability of 6th-grade students has identified both direct and indirect influences. The results show that students' learning motivation, attitudes, and teachers' teaching methods are factors that affect mathematical problem-solving ability [2].

Research on the mathematical problem-solving ability of 9th-grade students through cooperative learning and the application of Polya's problem-solving process shows that using cooperative learning and Polya's process is effective in developing students' mathematical problem-solving skills. Students achieve better academic performance, and they are more satisfied and interested in learning when applying this method [3].

Research on the difficulties in mathematical problem-solving faced by Dutch students has identified the challenges students encounter and aimed to address these difficulties. This provides students with opportunities to develop their mathematical problem-solving skills [4].

Additionally, the Mathematics curriculum in some countries is designed to develop competencies. For example, the Danish Mathematics curriculum mentions a system of competencies, including mathematical problem-solving skills, that need to be developed in students [5]. Furthermore, the PISA organization considers problem-posing and problem-solving abilities as components of mathematical competence; the mathematics curriculum in the United Kingdom emphasizes mathematical problem-solving, and the mathematics curriculum in Ireland considers the ability to apply and solve problems as components of mathematical competence [7].

## 2. THEORETICAL BACKGROUND

### 2.1. Competence and Mathematical Problem-Solving Competence

Competence: There are various perspectives on competence. We approach the concept of competence according to the viewpoint of the Ministry of Education and Training of Vietnam: "Competence is a personal attribute formed and developed through inherent qualities and the process of learning and training, allowing individuals to mobilize a combination of knowledge, skills, and other personal attributes such as interest, belief, will, etc., to successfully perform a certain type of activity, achieving desired results under specific conditions" [6].

Mathematical Problem-Solving Competence: This includes identifying and posing different types of pure mathematical problems or practical applications; solving different types of mathematical problems (pure mathematics or practical applications) in various ways [5]. However, we believe that mathematical problem-solving competence is the ability of students to apply mathematical knowledge and skills to solve practical situations.

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### 2.2. Mathematical Problem-Solving Competence in Vietnam's Mathematics Curriculum

The 2018 General Education Program for Mathematics, issued by the Ministry of Education and Training of Vietnam, is implemented with the educational principle of "learning coupled with practice, theory linked with reality" consistently reflected. Specifically, the requirement to "solve some simple practical problems" is associated with the content of each knowledge strand, along with "having initial understanding of some professions in society."

The 2018 General Education Program for Mathematics not only includes requirements for mathematical knowledge and skills that students need to understand during their studies but also emphasizes the formation and development of students' qualities and competencies. Enhancing teaching situations linked with reality to allow students to practice, solve problems, and apply to real life, as well as interdisciplinary teaching to form and develop students' competencies, is a top priority in teaching Mathematics.

Additionally, the program specifies a system of competencies that need to be formed and developed for students in Mathematics. The program outlines five components of mathematical competence: mathematical thinking and reasoning competence; mathematical modeling competence; mathematical problem-solving competence; mathematical communication competence; and competence in using mathematical tools and means. Mathematical problem-solving competence is demonstrated through:

- Recognizing and identifying problems that need to be solved using mathematics.
- Selecting and proposing methods and solutions to solve problems.
- Using relevant mathematical knowledge and skills (including tools and algorithms) to solve the identified problems.
- Evaluating proposed solutions and generalizing them for corresponding problems.

The program specifies four manifestations of problem-solving competence for primary school students:

(1) Recognizing the problem that needs to be solved and stating it as a question.
(2) Proposing methods to solve the problem.
(3) Implementing and presenting the solution in a simple manner.
(4) Checking and generalizing the solution for similar problems.

### 2.3. The Role of Practical Problems in Teaching to Develop Mathematical Problem-Solving Competence

Practical problems play an important role in teaching Mathematics at the primary level. Through solving practical problems in Mathematics, students have the opportunity to develop their mathematical problem-solving competence. Practical problems contain situations that prompt problem-solving, requiring students to mobilize mathematical knowledge, experiences, and real-life

experiences to propose solutions; thereby, students have the opportunity to deepen their knowledge and enhance their understanding of the surrounding world.
In practical problems, mathematical information and data may not be explicitly stated, requiring students to filter out non-mathematical information. Thus, solving practical problems provides students with opportunities to develop critical thinking, independent and flexible thinking, and skills in collecting and processing information to solve real-life problems.

Through the activity of solving practical problems, students apply mathematical knowledge to solve real-life problems, helping them see the relevance of mathematics in everyday life. More importantly, students will be more interested in and enjoy learning Mathematics. Solving practical problems bridges theory and practice, helping students better understand the applications of mathematics in real life, thereby reinforcing and remembering knowledge.

Thus, solving practical problems is one of the activities that provide students with opportunities to develop their mathematical problem-solving competence. Therefore, using practical problems in teaching Mathematics in 5th grade in Vietnam will create opportunities to develop students' mathematical problem-solving competence.

## 3. RESEARCH RESULTS

### 3.1. Process for Developing Mathematical Problem-Solving Competence through Teaching Practical Problems to 5th Grade Students in Vietnam

Based on the requirements for achieving mathematical problem-solving competence at the primary level, we propose the following process for developing this competence when teaching problems related to decimal calculations:

Step 1: Select a Problem Containing a Practical Situation Teachers design problems that contain practical situations to give students the opportunity to apply mathematical knowledge to solve them.
Step 2: Identify the Problem to be Solved, Recognize the Relationship between Given Information and Information to be Found, and Formulate Questions Students read the problem, identify the given information, the information to be found, and the relationship between them. Through this, students can formulate questions or identify the problem to be solved.
Step 3: Establish a Mathematical Model from the Practical Problem and Find Ways to Solve the Problem From the given problem, students understand the given information, the information to be found, and formulate questions. At this point, students will establish the mathematical model needed to solve the practical problem. Students find ways to solve the problem from the established mathematical model.
Step 4: Solve the Problem with the Established Mathematical Model Students identify the mathematical knowledge used to solve the problem with the established mathematical model. Students then solve the problem.

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Step 5: Answer the Practical Problem and Generalize Similar Problems To answer the practical problem, students solve the problem containing practical content based on the results from the mathematical model. Teachers generalize similar problems and design problems containing practical information and mathematical models. Through solving these problems, students have the opportunity to develop their mathematical problem-solving competence.

### 3.2. Illustrative Examples

**Example 1:** Developing Mathematical Problem-Solving Competence through Problems Using Knowledge of Comparing Natural Numbers

Step 1: Select a Problem Containing a Practical Situation The problem containing practical information is given as follows: Read the following information and determine which mountain peak is the highest and which is the lowest.

| Mountain Image | Information |
|---|---|
|  Fansipan Mountain | Fansipan Peak is the highest peak in the Hoang Lien Son range in Lao Cai province. This peak is about 3143 meters above sea level. Fansipan attracts many tourists and mountain climbing enthusiasts. |
|  Bach Ma Mountain | Bach Ma Mountain is located in Hue city, Vietnam. Bạch Mã Mountain is famous for its pristine, majestic scenery and rich forest. Bạch Mã Mountain is 1444 meters above sea level. |
|  Bach Moc Luong Tu Mountain | Bach Moc Luong Tu Mountain is located in Lao Cai province, near the Vietnam-China border. Bạch Mộc Lương Tử Mountain is famous for its pristine, majestic mountain scenery, blending with the colors of nature. The mountain is 3046 meters above sea level. |
|  Ngu Chi Son Mountain | Ngu Chi Son Mountain is one of the famous tourist attractions in Sa Pa, Lao Cai. This mountain range is famous for its majestic, pristine beauty and beautiful natural scenery. Ngu Chi Son Mountain is 309 meters above sea level. |

Step 2: Identify the Problem to be Solved, Recognize the Relationship between Given Information and Information to be Found, and Formulate Questions Students read the information in the problem, learn about famous landmarks, and the majestic natural scenery of the country. Students identify the problem to be solved as determining which mountain peak is the highest and which is the lowest. The given information is the height of the mountain peaks above sea level: Fansipan Peak is 3143 meters high; Bach Ma Mountain is 1444 meters high; Bach Moc Luong Tu Mountain is 3046 meters high; Ngu Chi

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Son Mountain is 309 meters high. The information to be found is the answer to which peak is the highest and which is the lowest.

Step 3: Establish a Mathematical Model from the Practical Problem and Find Ways to Solve the Problem The mathematical model is established: Arrange the numbers 3143, 1444, 3046, 309 in ascending order. The way to solve the problem is to compare pairs of numbers according to the principle of comparing two natural numbers.

Step 4: Solve the Problem with the Established Mathematical Model Solve the problem with the established mathematical model: Arrange the numbers 3143, 1444, 3046, 309 in ascending order. When solving this problem, students apply the knowledge of comparing and ordering natural numbers they have learned. The order from smallest to largest is: 309, 1444, 3046, 3143. The smallest number is 309; the largest number is 3143.

Step 5: Answer the Practical Problem and Generalize Similar Problems The highest peak is Fansipan, and the lowest peak is Ngu Chi Son.

Generalize similar problems: At this step, teachers can reinforce knowledge for students by providing similar or generalized problems to consolidate knowledge and practice problem-solving skills.

**Example 2:** Developing Mathematical Problem-Solving Competence through Problems Using Knowledge of Map Scale

Step 1: Select a Problem Containing a Practical Situation The problem containing practical information is given as follows:

On a map with a scale of 1:10 000 000, the distance from Hanoi to Hue is measured to be 6,64 cm. What is the actual distance from Hanoi to Hue in kilometers?

The practical information is the distance from Hanoi to Hue.

Step 2: Identify the Problem to be Solved, Recognize the Relationship between Given Information and Information to be Found, and Formulate Questions

Organize students to read the problem, identify the given information, and the information to be found by underlining mathematical keywords. On a map with a scale of 1:10 000 000, the distance from Hanoi to Hue is measured to be 6,64 cm. What is the actual distance from Hanoi to Hue in kilometers?

Students work in pairs, asking and answering to understand the problem.

What does the problem state? (On a map with a scale of 1:10 000 000, the distance from Hanoi to Hue is measured to be 6,64 cm.)

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What does the problem ask? (What is the actual distance from Hanoi to Hue in kilometers?) Students formulate the question: What is the actual distance from Hanoi to Hue in kilometers?

Step 3: Establish a Mathematical Model from the Practical Problem and Find Ways to Solve the Problem

On a map with a scale of 1:10 000 000, the distance from point A to point B is measured to be 6,64 cm. Calculate the actual distance from point A to point B.

Students think and find ways to solve the problem: Perform multiplication, multiplying the measured distance on the map by 1: 10 000 000 to calculate the actual distance.

Step 4: Solve the Problem with the Established Mathematical Model When solving the problem "On a map with a scale of 1:10 000 000, the distance from point A to point B is measured to be 6,64 cm. Calculate the actual distance from point A to point B," students apply the knowledge learned about calculating the actual distance between two points when knowing the length on the map and the map scale.

Students solve the problem as follows: The actual distance from point A to point B:

6 64 × 10 000 000 = 66 400 000 (cm).

Step 5: Answer the Practical Problem and Generalize Similar Problems

The actual distance from Hanoi to Hue is:

6,64 × 10 000 000 = 66 400 000 (cm).

Convert 66 400 000 cm = 664 km.

Answer: 664 km.

Generalize similar problems: Calculate the actual distance between two points when knowing the map scale or vice versa, when knowing the actual distance between two points, calculate the length on the map corresponding to the scale. Additionally, teachers can design reverse problems for students to apply mathematical knowledge to solve. For example, teachers can design a reverse problem where the distance between Hanoi and Hue is 664 km, asking students to calculate the distance between Hanoi and Hue on a map with a scale of 1:10 000 000.

**Example 3.** Developing mathematical problem-solving skills through problems that apply knowledge of lateral surface area and total surface area of a rectangular box.

Step 1: Select a problem that contains a real-life situation.

The problem with a practical situation is as follows:

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Nam has a gift box shaped like a rectangular box with a length of 30 cm, a width of 15 cm, and a height of 6,8 cm. Please help Nam calculate the lateral surface area and the total surface area of that gift box.

Step 2: Identify the problem to be solved, recognize the relationship between the given information and the information to be found, and formulate it into a question.

Students read the problem, identify the given and required information by underlining the keywords containing mathematical information in the problem.

Nam has a gift box shaped like a rectangular box with a length of 30 cm, a width of 15 cm, and a height of 6,8 cm. Please help Nam calculate the lateral surface area and the total surface area of that gift box.

Students work in groups, ask and answer questions about the given information and the information needed to solve the problem.

- What information does the problem provide? (Nam has a rectangular gift box with a length of 30 cm, a width of 15 cm, and a height of 6,8 cm).

- What is the problem asking? (Please calculate the lateral surface area and the total surface area of the gift box for Nam).

Students can formulate the question: Calculate the lateral surface area and the total surface area of the rectangular box.

Step 3: Establish a mathematical model from the real-world problem and find a solution. The mathematical model is established: A rectangular box with a length of 30 cm, a width of 15 cm, and a height of 6,8 cm. Calculate the lateral surface area and the total surface area of this rectangular box.

Students search for solutions: Use the formulas for calculating the lateral surface area and the total surface area of a rectangular box to solve the problem.

Step 4: Solve the problem using the established mathematical model.

To solve the problem "A rectangular box with a length of 30 cm, a width of 15 cm, and a height of 6,8 cm. Calculate the lateral surface area and the total surface area of this rectangular box" students apply the rules for calculating the lateral surface area and total surface area of a rectangular box:

- To calculate the lateral surface area of a rectangular box, multiply the perimeter of the base by the height (using the same unit of measurement).

- To calculate the total surface area of a rectangular box, add the lateral surface area and the area of the two bases of the rectangular box.

Students solve the problem using the established model:

- The lateral surface area of the rectangular box: (30 + 15) x 2 x 6,8 = 612 ($cm^2$)

- The area of the two bases of the rectangular box: 30 x 15 x 2 = 900 ($cm^2$)

- The total surface area of the rectangular box: 900 + 612 = 1 512 ($cm^2$)

Step 5: Provide an answer to the real-world problem and generalize similar problems.

Students answer the real-world problem by solving the exercise as follows:
The lateral surface area of the gift box is: (30 + 15) x 2 x 6,8= 612 ($cm^2$)
The area of the two bases of the gift box is: 30 x 15 x 2 = 900 ($cm^2$)
The total surface area of the gift box is: 900 + 612 = 1 512 ($cm^2$)

Answer: 612 $cm^2$; 1 512 $cm^2$.

Generalizing similar problems: Teachers design problems with practical situations so that students can apply their mathematical knowledge of lateral surface area and total surface area of rectangular boxes and cubes to solve problems. For example, the following problems:

Problem 1: Calculate the area of the cardboard needed to make a rectangular bag with dimensions of 10 cm in width, 40 cm in length, and 50 cm in height. Assume the adhesive margins are negligible.

Problem 2: A wooden drawer is in the shape of a rectangular box with dimensions of 6 dm in length, 4,5 dm in width, and 2 dm in height. Calculate the surface area of the wood for the drawer.

## 4. CONCLUSION

Competency-based Teaching is one of the Responsibilities of Mathematics Teachers in Schools in Vietnam today. In teaching Mathematics, teachers need to create many opportunities for students to develop both general competencies and mathematical competencies. The ability to solve mathematical problems is one of the components of mathematical competency as defined in the Mathematics Curriculum. Through solving real-life problems, students reinforce their mathematical knowledge and skills and have the opportunity to develop their mathematical problem-solving abilities. Additionally, by solving practical problems, students can see the applications of mathematics in everyday life, which increases their interest and motivation to learn Mathematics.

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