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DEVELOPING MATHEMATICAL COMMUNICATION ABILITIES FOR VIETNAMESE PRIMARY SCHOOL STUDENTS

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ABSTRACT

Mathematical communication is an essential component of math lessons. It facilitates the exchange of mathematical information between teachers and students. Moreover, effective mathematical communication can enhance students' understanding of Mathematics. However, both teachers and students face numerous challenges in this area. Therefore, developing mathematical communication skills in students is a critical responsibility for Vietnamese teachers under the 2018 General Education Program. This article examines the challenges related to mathematical communication faced by teachers and primary school students in Vietnam. Additionally, it proposes solutions to address these challenges while contributing to the development of mathematical communication skills among Vietnamese elementary school students.

KEYWORDS: students, elementary school, mathematical communication, mathematical language, elementary math

INTRODUCTION

Mathematics is a subject that creates numerous opportunities for students to develop communication skills because mathematical communication and thinking are essential in learning and daily activities. Mathematics is a science, but it is also a language with terms, symbols, diagrams, tables, graphs, and more. When students think, explore, and explain a mathematical situation or problem, the results of that thinking must be expressed through speaking, writing, discussing, and debating with peers and teachers.

In math classes, there are many forms of mathematical communication that take place, such as communication between individual students, between individual students and the whole class, between individual students and the teacher, and between the whole class and the teacher. Teachers create many opportunities for students to express their opinions and allocate time for students to discuss with peers during class.

Mathematical communication is an essential part of mathematics and mathematics education. Mathematical communication involves sharing and discussing mathematical ideas to solve mathematical problems quickly [7]. Therefore, mathematical communication is always a topic of interest among researchers and educational experts. Researchers have studied the effectiveness of realistic mathematics education models versus problem-based learning models in terms of mathematical communication skills; the effectiveness of mathematics learning models on mathematical communication skills based on cognitive styles [1]. An analysis of the mathematical communication skills of 9th-grade students in secondary schools through written tests. Through research, the authors concluded that students have the ability to connect images, diagrams, tables, and mathematical ideas; students can explain mathematical ideas through mathematical writing, drawings, diagrams, and tables; students can express situations in mathematical language or symbols; research on the mathematical communication skills of Indonesian students in solving problems [2]. The authors discussed students' ability to organize and link mathematical thinking through mathematical communication; express mathematical thinking logically and clearly in mathematical communication with peers, teachers, and others; use mathematical language to accurately express mathematical ideas [3]. The results of the study on the analysis of mathematical communication skills for students in learning mathematics aimed to explore students' mathematical communication skills in solving practical problems [4]. The authors studied and assessed students' mathematical communication skills through tests. Researchers have been interested in enhancing secondary school students' mathematical communication skills through the effectiveness of using the Think - Speak - Write model [5]. A group of authors also studied the development of mathematical communication skills for 8th-grade students in Vietnam when teaching the topic of similar triangles [6].

Theoretical Background

1. Mathematical communication capacity in Vietnam's Math curriculum

According to the 2018 Mathematics Curriculum issued by the Ministry of Education and Training of Vietnam, mathematical communication competency includes four criteria:

- Listening, understanding, reading, and recording essential mathematical information presented in mathematical texts or conveyed by others through speech or writing.

- Presenting and expressing (speaking or writing) mathematical content, ideas, and solutions in interaction with others (with appropriate requirements for completeness and accuracy).

- Effectively using mathematical language (numbers, letters, symbols, charts, graphs, logical connections, etc.) combined with ordinary language or body gestures when presenting, explaining, and evaluating mathematical ideas in interaction (discussion, debate) with others.

- Demonstrating confidence when presenting, expressing, asking questions, discussing, and debating mathematical content and ideas.

Based on this, the expected outcomes for mathematical communication competency after Vietnamese students complete primary school are:

(1) Listening, understanding, reading, and recording (summarizing) key mathematical information in texts or communicated by others (at a basic level), thereby identifying the problem that needs to be solved.

(2) Presenting and expressing (speaking or writing) mathematical content, ideas, and solutions in interaction with others (not yet requiring full accuracy). Asking and answering questions when reasoning.

(3) Using mathematical language combined with ordinary language and body gestures to express mathematical content in simple problem-solving situations.

(4) Demonstrating confidence when answering questions, presenting, and discussing mathematical content in simple situations.

Therefore, to develop mathematical communication competency for Vietnamese primary school students, mathematics teaching needs to create many opportunities for students to practice mathematical communication skills (listening, understanding, reading, and expressing through speaking or writing) by using mathematical language during math lessons.

2. Current status of mathematical communication capacity of Vietnamese primary school students

Purpose of the Survey

To understand the current situation regarding the development of mathematical communication competency for students in teaching mathematics at primary schools in Vietnam.

Survey Subjects

- Teachers and administrators from several primary schools.
- Students from several primary schools.

Survey Content

Teacher Survey Content:

- The necessity of developing mathematical communication skills for students in mathematics teaching.

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- The level of development of mathematical communication skills for students in teaching.
- The difficulties teachers often encounter in creating opportunities for students to develop mathematical communication skills.

Student Survey Content:

- Survey of students' learning products.

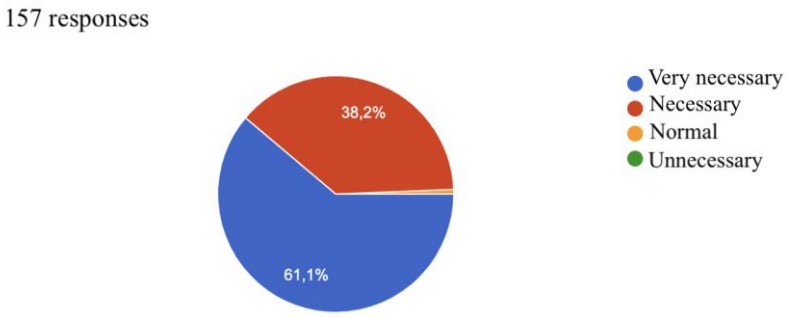
Survey Methods

- Using the interview method and the questionnaire method with teachers from several primary schools.
- Using the method of studying students' learning products: analyzing and evaluating students' worksheets and exercise books.
- Using the mathematical statistics method to calculate the percentage.

Analysis of Survey Results

Teacher Survey Results:

When asked about the necessity of developing mathematical communication skills for students in teaching mathematics, we received the following results:



61.1% of the surveyed teachers believe it is very necessary to develop mathematical communication skills for students in teaching mathematics; 38.2% consider it necessary to develop mathematical communication skills during math lessons for students. These results confirm that most teachers recognize the importance of mathematical communication in teaching mathematics.

When asked about the level of attention given to developing mathematical communication skills for students during math lessons, we received the following results:

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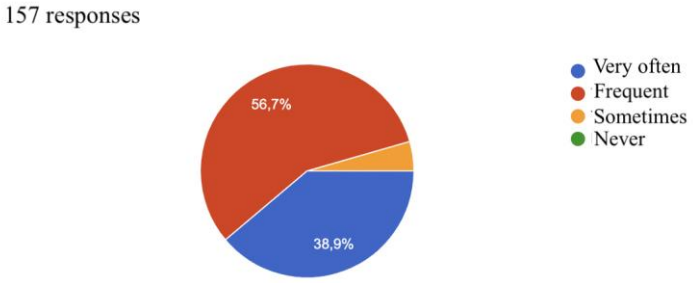
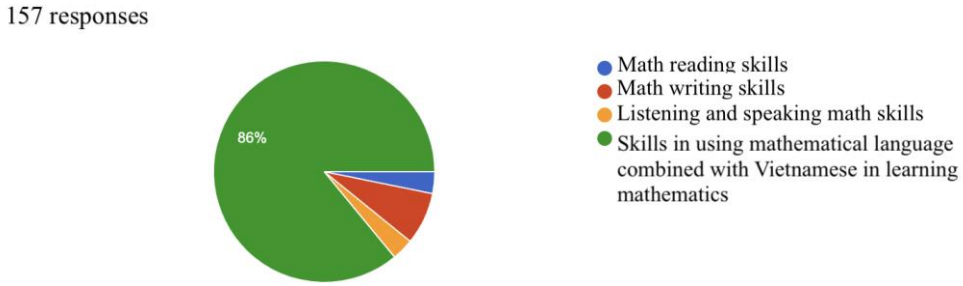


56.7% of the surveyed teachers very frequently value the development of mathematical communication skills, 38.9% regularly practice and develop these skills for students through learning activities during math lessons. Only 4.5% of teachers occasionally pay attention to the development of mathematical communication skills for students. No teacher reported never developing these skills during math lessons. These results are due to the identification of the role and importance of mathematical communication skills in teaching mathematics.

We were interested in the specific mathematical communication skills that need to be practiced and developed for students in teaching mathematics. When asked, "In your opinion, which mathematical communication skills are necessary to develop for students in teaching mathematics?" we received the following results:



Of the 157 surveyed teachers, 135 teachers (86%) believe that the skill of using mathematical language in combination with natural language in learning mathematics is necessary to develop for students. 7.6% think it is necessary to develop mathematical writing skills, and the skills of reading and listening to mathematics were equally selected by 3.2% of teachers each.

When asked, "Do you often encounter difficulties when developing mathematical communication skills for students in teaching mathematics?" the results show:

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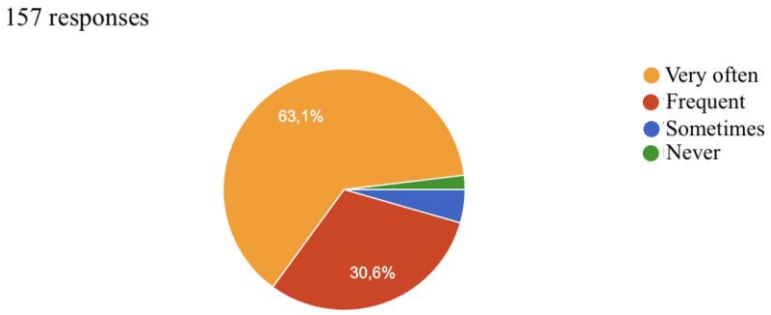
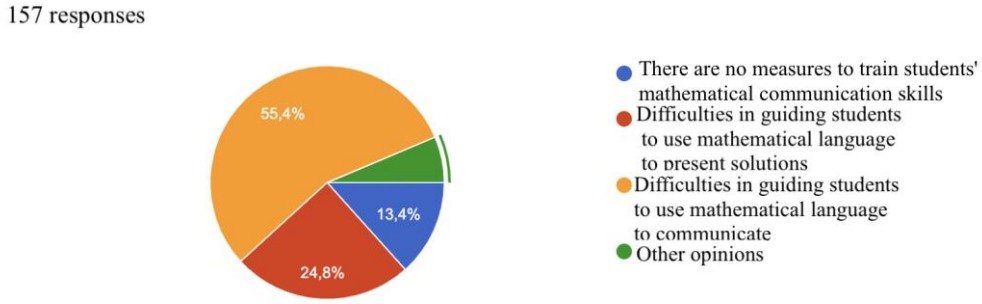


99 out of 157 teachers (63.1%) frequently encounter difficulties in developing mathematical communication skills, and 30.6% of teachers often face difficulties. We further investigated the difficulties teachers face and received the following results:



55.4% of the surveyed teachers encounter difficulties in guiding students to effectively use mathematical language in communication; 24.8% have difficulties in guiding students to use mathematical language to present solutions; 13.4% face difficulties due to the lack of specific methods to develop mathematical communication skills.

Through the teacher survey, we found that in teaching mathematics, teachers face significant challenges in creating opportunities for students to develop mathematical communication skills.

Student Survey Results:

The survey subjects were primary school students in Vietnam, assessed through their math exercise books and worksheets. The qualitative results obtained are as follows: We conducted a study of students' learning products by examining their exercise books. Through the survey, we found that students' reading comprehension of mathematical content is still limited.

For example, students read the problem but do not fully understand the given data. Specifically, some students overlooked the detail "after one week." The cause of this mistake could be that students either do not understand the term "after one week" or they read without recognizing all the given data in the problem. Additionally, students' mathematical writing skills are also limited, as shown by their solution statements in the second calculation step, which recorded only part of the given data.

Some students, when solving exercises, do not correctly identify units or identify them inaccurately. Students express solution statements incorrectly or inaccurately. This indicates that students' ability to use natural language and mathematical language is still limited, which affects their performance.

Many students forget to carry over numbers when performing calculations, and in some cases, they remember to carry over in some steps but forget in others. Some students misidentify the number needed to solve the problem. For example, they cannot identify the smallest four-digit number, though they can correctly identify the largest three-digit number, but fail to identify the largest four-digit number. This indicates that students' reading comprehension skills are still limited, partly due to their lack of understanding of mathematical vocabulary and terminology or their limited mathematical language proficiency.

Moreover, through observing math lessons at several primary schools, we found that students do not yet know how to share with peers and teachers about the mathematical content they need to present verbally. Students may understand the essence of the problem but cannot express it or use words inaccurately to express it. Many students do not have critical thinking skills when listening to the mathematical content presented by their peers. Part of these limitations is due to teachers not creating opportunities for students to "talk math" and not engaging them in group activities where they can listen to or speak about mathematical content with peers.

Analysis of the Survey Results on the Current State of Mathematical Communication Skill Development:

- 100% of the surveyed teachers have identified the necessity of developing mathematical communication skills for students in teaching mathematics.
- Teachers also regularly create opportunities for students to develop mathematical communication skills through teaching mathematics.
- Teachers face significant difficulties in developing mathematical communication skills for students, with the main challenge being the lack of specific methods to develop these skills in teaching mathematics.
- Students face many challenges in reading comprehension of mathematical content. They are often confused and do not fully understand the problem's content, partly due to their limited mathematical language proficiency.
- Students use mathematical symbols and terminology inaccurately. The connection between mathematical language and natural language (Vietnamese) is still limited.

3. Solutions to develop mathematical communication capacity for Vietnamese primary school students

3.1. Developing Mathematical Language Proficiency for Students

a) Purpose

- Help students reinforce their mathematical vocabulary.
- Assist students in gaining a clearer understanding of the syntax and semantics of mathematical language.
- Enrich the students' mathematical language proficiency in learning mathematics.

b) Content and Implementation

Mathematical language is crucial in students' learning process in mathematics. It not only serves as a tool for thinking but also as a medium for mathematical communication. Students can only truly understand mathematical content when they have a solid grasp of the vocabulary and syntax of mathematical language. Therefore, alongside providing the necessary mathematical knowledge, teachers should also focus on training and developing students' mathematical language skills.

When developing students' mathematical language proficiency, teachers can follow these steps:

Step 1: Expanding Mathematical Vocabulary Teachers present problems, organize activities for students to engage with the problem, and identify both known and new mathematical vocabulary in the lesson. However, given that primary school students' thinking is still quite concrete and visual, teachers should present problems linked to specific situations and contexts related to the students' daily learning and life. The use of pictures and illustrations should carry knowledge and clearly display the words and terms of mathematical language.

Since primary students' thinking remains somewhat concrete, teachers should organize activities that allow students to work with tools and learning materials in mathematics. Students should engage in activities where they can independently identify mathematical vocabulary presented in illustrations or problem-based situations.

Step 2: Understanding the Semantics and Syntax of Mathematical Language

In teaching mathematics, teachers should not directly explain the meanings of words, terms, or symbols of mathematical language; instead, students should grasp these meanings through specific situations or illustrations. Teachers should guide students to understand the situations, pictures, and illustrations that convey mathematical content. Teachers also instruct students on how to write and use the syntax of newly introduced mathematical vocabulary and semantics.

Initially, teachers should organize activities that help students understand how to use the newly introduced mathematical language in terms of semantics and syntax within specific contexts and apply it directly in exercises and practice questions.

Step 3: Using Mathematical Language in Learning

After students have acquired new mathematical terms and symbols, and understood the semantics and syntax of the newly introduced mathematical language, teachers should provide opportunities for students to practice and apply what they have learned. Teachers guide students on how to connect new terms and symbols with the ones they already know to solve exercises and address real-world

situations. Opportunities should be created for students to use mathematical language in various situations, helping them apply it flexibly and accurately in their learning process.

c) Considerations When Implementing the Method

The situations, questions, and exercises posed to students should be appropriate for their level of thinking and language abilities.

Situations presented should be relatable and familiar, connected to the students' daily lives.

Opportunities should be provided for students to encounter and use mathematical language at different stages of the learning process.

d) Illustration Example

Example: Developing Students' Mathematical Vocabulary When Learning the Lesson "Introduction to Roman Numerals"

Step 1: Expanding Mathematical Vocabulary

Students observe images of two clocks and identify the difference in the numbers displayed on the clock faces.

Students observe images of two clocks and identify the difference in the numbers displayed on the clock faces.
Students can read the time on Clock A but cannot read the time on Clock B.

Clock A.

Clock B

The teacher introduces the Roman numerals commonly used on Clock B: I (one), V (five), and X (ten).

- Students look at the symbols and read them silently.
- A few students are asked to read the Roman numeral symbols aloud.
- Students pair up, write the symbols I, V, X, and quiz their partner on reading them. They then switch roles and repeat the activity.
- A few pairs are chosen to demonstrate the activity in front of the whole class, and classmates provide feedback.

Step 2: Understanding the Semantics and Syntax of Mathematical Language

The teacher introduces how to write numbers from 1 to 20 using the Roman numerals I, V, and X.

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I	II	III	IV	V	VI	VII	VIII	IX	X
1	2	3	4	5	6	7	8	9	10

XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX	XX
11	12	13	14	15	16	17	18	19	20

- Students discuss and discover the method for writing numbers from 1 to 20 using Roman numerals.
- Students write the numbers from 1 to 20 in their notebooks using Roman numerals.
- In groups, students take turns reading the numbers written in Roman numerals aloud.

Group Activity: "Challenge Your Friend to Write Numbers in Roman Numerals"

Rules: The game master (a designated student or the teacher) calls out a number within the range of 1 to 20. The groups write that number using Roman numerals. The group that writes the correct number the fastest earns one point. The game consists of 20 rounds, with no repeated numbers. After the game ends, the group with the most points wins.

A few students are selected to write and read the numbers from 1 to 20 using Roman numerals in front of the class.

Step 3. Using Mathematical Language in Learning

Students use the mathematical language they have just learned to complete the Learning Sheet.

Full name ..... Class: .....

STUDY SHEETS

Lesson 1. a) Write how to read the following Roman numerals:

I	II	IV	VI	VIII	IX	XI	XV	XVIII	XX

b) Write the following numbers in Roman numerals

3	5	7	10	12	131	14	16	17	19

Students work in pairs to exchange worksheets to check, encourage students to express their emotions with simple drawings (hearts) on their partner's learning products if they do it completely, correctly, beautifully and carefully.

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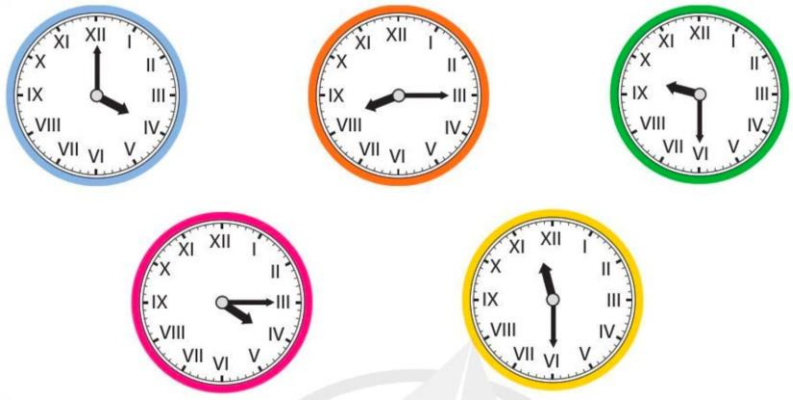
Lesson 2. What time does each clock show?



In this exercise, students associate the mathematical symbols they have just learned (Roman numerals) with how to read the time on the clock they have learned to read the time on each clock. Teachers can organize in the following way:

Students work individually, observe the time on the clock and read the time silently.

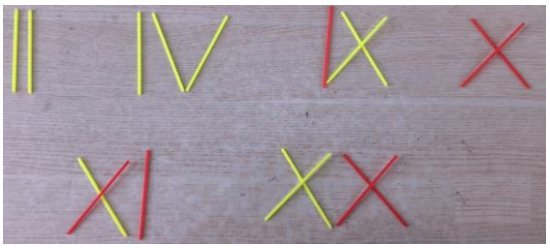
Students work in pairs, point to any clock and then challenge their partner to read the time on that clock. When listening to their partner read, students give comments (whether their partner reads the time correctly or incorrectly) and encourage students to explain how they did it. Then switch roles.

Representatives of a few pairs challenge each other in front of the class, other students comment. Teachers comment and correct the results of the exercise.

Lesson 3. Use the calculator to arrange the following numbers using Roman numerals:

2 ; 4; 9; 10; 11; 20

Students work individually using counting sticks to arrange the numbers 2, 4, 9, 10, 11, 20 in Roman numerals.



Students work in groups, point to the numbers arranged in Roman numerals and ask their classmates to read.

Students work in groups to report the results of arranging the numbers 2, 4, 9, 10, 11, 20 in Roman numerals. Students read the numbers they have arranged.

Other students comment. Teachers comment and evaluate.

Thus, the way learning activities are organized has contributed to helping students consolidate and develop mathematical language, use mathematical symbols and terms in solving exercises and solving practical situations.

3.2. Developing Communication Skills in Mathematics Lessons for Students

a) Objectives

To help students develop reading, writing, speaking, and listening skills using mathematical language.

To enable students to use mathematical language accurately during mathematics lessons.

To create opportunities for students to communicate with peers and teachers in learning activities.

b) Content and Methodology

In mathematics lessons, students use mathematical language combined with natural language to communicate with their peers and teachers. Mathematical language significantly impacts students' communication and learning outcomes in mathematics. When students understand mathematical language, they can use it correctly and precisely in math, which enhances their learning results. Teachers can follow these steps to develop students' mathematical communication skills in math lessons:

Step 1: Cultivate Reading Comprehension Skills in Mathematics

Organize activities for students to read a mathematical text silently or aloud, fluently, and accurately.

The teacher asks questions to assess students' understanding of the mathematical content they have just read. For example, in a word problem, after asking students to read the problem statement, the teacher might ask, "What information is given in the problem?" or "What is the problem asking for?" to help students identify the given data and the required data of the problem. The teacher can also ask about the relationship between the given data and the required data to gauge the students' level of reading comprehension.

Step 2: Cultivate “Math Speaking” and “Math Listening” Skills for Students

Provide opportunities for students to engage in “math speaking” and “math listening” through group activities or by having them present the mathematical content they have read or heard in front of the entire class.

The teacher asks questions about the mathematical content that the student just presented to deepen their understanding and give them the opportunity to use mathematical language to explain their solutions. Additionally, the teacher can ask other students in the group or class about the mathematical content they just heard, encouraging them to ask questions or comment on what they heard.

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Step 3: Cultivate "Math Writing" Skills for Students

In math, students use mathematical language to present their problem-solving processes. To develop "math writing" skills, the teacher should guide students to write a brief outline of their solution on scratch paper before presenting it carefully.

When using mathematical language for "math writing," it is important to ensure accuracy, coherence, and flexibility in language. Students can use various ways of representing mathematical symbols to convey the same mathematical content. For example, when referring to the number eight, students can use the symbol (8) or express it in different forms like 10 - 2, 5 + 3, 4 × 2, 24 ÷ 3, etc.

Encourage students to review their written mathematical content to ensure coherence and mathematical accuracy.

c) Considerations During Implementation

Encourage students to read silently and accurately understand mathematical content. For word problems, students may underline key terms to retain essential mathematical information.

Create opportunities for students to debate and discuss to find solutions to problems in their math studies.

Encourage students to use mathematical language accurately and flexibly when expressing mathematical content in written or spoken form.

d) Illustration Example

Developing Mathematical Communication Skills in Students When Solving the Problem: "Observe the Following Pictograph":

Number of books sold in 4 days

Day one	📖📖📖📖
Day two	📖📖📖📖📖📖📖📖
Day three	📖📖📖📖📖📖
Day four	📖📖📖📖📖📖📖📖📖
📖 = 5 books	

Answering the Questions:

a) How many books were sold on Wednesday?

b) On which day were 40 books sold?

c) How many books were sold in total over the four days?

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Step 1: Cultivating Reading Comprehension Skills in Mathematics

Students read the problem statement, possibly 2 to 3 times, to better understand the given data and the data required. In this exercise, students need to read and interpret the mathematical information from the pictograph about the number of math books sold over four days. When reading, to determine how many books were sold each day, students must understand that each symbol in the pictograph represents not 1 book but 5 books.

For example, when students see that the first day is represented by 4 symbols, and they understand that each symbol equals 5 books, they can conclude that 20 books were sold on the first day. Similarly, students will read the pictograph and recognize the number of books sold each day as follows:

- Day 1: 20 books sold
- Day 2: 40 books sold
- Day 3: 30 books sold
- Day 4: 45 books sold

Step 2: Cultivating "Math Speaking" and "Math Listening" Skills for Students

Students work in groups, with one member explaining their solution to the problem to the others. The other group members provide feedback and suggestions. Encourage students to ask questions about the mathematical content they just heard, such as, "How did you find that 45 books were sold on the fourth day?" or "How do you know that 10 more books were sold on the third day than on the first day?" Answering these questions requires students to explain their thought processes.

A few groups present their discussion results to the entire class, with other groups providing feedback and asking questions for further clarification. The presenting group can also ask questions to ensure that other groups understand the presented solutions.

Step 3: Cultivating "Math Writing" Skills for Students

Students write their solutions in their notebooks or on worksheets as instructed by the teacher.

Answering the Questions:

a) The number of books sold on Wednesday is: $5 \times 9 = 45$ (books).
b) The number of books sold on the second day is: $5 \times 8 = 40$ (books).
c) The total number of books sold over the four days is: $5 \times (4+8+6+9) = 135$ (books).

CONCLUSION:

During lessons, multiple communication relationships occur between the teacher and students. These include relationships between the teacher and individual students, between the teacher and the entire class, between individual students, and between the class as a whole. In mathematics lessons, both the teacher and students use mathematical language as a tool and means of communication. Mathematical

communication significantly impacts students' learning outcomes. Therefore, it is essential to have strategies to develop students' mathematical communication skills in mathematics instruction. The strategies proposed in this article aim to address some of the challenges faced by teachers in teaching mathematics in elementary schools in Vietnam and contribute to developing students' mathematical communication skills.

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