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DEVELOPING MATHEMATICAL LANGUAGE FOR VIETNAMESE GRADE 3 STUDENTS THROUGH MATH TEACHING

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ABSTRACT

This paper presents research findings on the development of mathematical language for Grade 3 students in Vietnam through Mathematics teaching. We propose several measures to foster mathematical language development among students in Mathematics lessons. These include: utilizing images, diagrams, and visual models in Grade 3 Mathematics instruction to support the development of mathematical language; cultivating skills in transitioning between mathematical language and natural language (Vietnamese) to enhance mathematical language competence; and designing and applying exercises and real-life situations in Grade 3 Mathematics teaching to promote the development of mathematical language.

KEYWORDS: language, mathematical language, primary education, Mathematics

INTRODUCTION

Mathematical language is both a medium of communication and a tool of mathematical thinking. It has a significant impact on students' achievement in Mathematics. In the learning process, if students are not familiar with and do not fully understand mathematical language, they will face many difficulties, often make mistakes, and achieve poor learning outcomes. Therefore, it is essential to establish, practice, and develop mathematical language for students through Mathematics teaching. For this reason, our study focuses on the development of mathematical language for Grade 3 students in Vietnam within the context of Mathematics instruction.

II. CONTENT

1. Overview of Mathematical Language

1.1. Concept

We understand "mathematical language as a system of symbols, notations, words, phrases, and rules for combining them, used as a means of expressing mathematical content in a logical, precise, and clear manner. Symbols include images, drawings, diagrams, or models of specific objects. Notations consist of numbers, letters, alphabetic characters, operations, and relations used in Mathematics" [1].

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1.2. Characteristics of Mathematical Language

- Mathematical language is univocality

The univocal characteristic of mathematical language means that each notation or expression in Mathematics carries only one specific meaning within a given context. For example, the symbol "π" in Mathematics is always understood as the number 3.14159… and cannot be interpreted otherwise. This univocality enables mathematicians worldwide, regardless of language or culture, to communicate and understand each other without ambiguity.

- Mathematical language is Systematic

Mathematical language is built and developed according to a systematic structure, in which concepts, definitions, notations, and rules are organized coherently and logically connected. From basic concepts such as numbers, points, and lines, mathematicians gradually construct more complex theories such as spatial geometry or algebra. Each stage of development follows the principle of inheritance, supplementation, and expansion, ensuring that the entire mathematical system functions harmoniously and logically. This systematic nature makes Mathematics a global language, both rigorous and infinitely extendable to address new problems.

- Mathematical language is abstract

Mathematical language goes beyond describing concrete phenomena, abstracting them into concepts, notations, and models. Abstraction allows Mathematics to transcend the limits of direct perception, making it possible to describe underlying laws and structures of the natural world and human thought.

- Mathematical language is international

Mathematical language transcends barriers of speech, culture, or geography, becoming a common system of expression for humanity. For instance, a mathematical expression such as $15 \times 4 + 6; 126:6 - 145$ can be understood and applied in exactly the same way in any country. This uniformity in notations, conventions, and modes of expression has made Mathematics a universal tool of communication among scientists.

2. Measures for developing mathematical language for Grade 3 students in mathematics teaching

2.1. Principles for proposing and implementing measures to develop mathematical language for Grade 3 students in teaching Math

Principle 1. Proposed measures must comply with the theory and methodology of Mathematics teaching.

When proposing measures to develop mathematical language for Grade 3 students, the first principle is to ensure alignment with modern educational theories as well as the specific pedagogical characteristics of primary Mathematics teaching.

Principle 2. Proposed measures must aim at developing mathematical language for Grade 3 students in Mathematics teaching.

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All proposed measures should focus on the central goal of developing mathematical language for Grade 3 students during the learning process. The measures should not merely help students memorize knowledge mechanically but also foster an understanding of the essence of Mathematics, the ability to explain mathematical phenomena, and the capacity to apply learned knowledge flexibly in solving problems.

Principle 3. Proposed measures must meet the learning outcomes required by the Grade 3 Mathematics curriculum

The proposed measures should be framed within the scope of the Grade 3 Mathematics curriculum. Accordingly, they must ensure that students achieve the expected knowledge, skills, competencies, and values set by the curriculum.

Principle 4. Proposed measures must be feasible and implementable in primary schools.

The proposed measures should not only have theoretical value but also be practically applicable in the teaching context of primary schools. Feasibility here includes several aspects: suitability to Grade 3 students' cognitive level and psychological characteristics; compatibility with school facilities, teaching equipment, and instructional time; and reasonableness in terms of teachers' workload and capacity.

2.2. Measures for developing mathematical language in Grade 3 mathematics teaching

2.2.1. Utilizing images, diagrams, and visual models in Grade 3 mathematics teaching to develop mathematical language

a) Purpose of the measure

This measure aims to help students:

- Approach mathematical knowledge in an accessible and systematic manner, thereby fostering deep and sustainable development of mathematical language.
- Transition from concrete visual thinking to abstract reasoning, while using mathematical language to facilitate the acquisition of mathematical knowledge.
- Strengthen memory retention and the ability to apply mathematical knowledge to real-life situations through visual representations.

b) Content and implementation

To transform visual representations into mathematical expressions using symbols, students must first interpret the mathematical content embedded in these visual models. This process requires students to initially use natural language for description, then abstract the information, establish mathematical relationships, and finally employ mathematical language to formulate appropriate propositions or mathematical expressions.

Step 1: Selection and design of images, diagrams, and visual models containing mathematical content.

Teachers play a proactive role in selecting and designing visual materials that are appropriate for the

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lesson content and students' cognitive level. The selection process should not only consider aesthetics but also ensure scientific accuracy, pedagogical appropriateness, and alignment with lesson objectives.

Step 2: Exploiting images, diagrams, and models to interpret mathematical content.

Teachers should integrate these materials flexibly and creatively into specific teaching activities. At the introduction or knowledge-building stage, diagrams may be used to spark curiosity and guide students' thinking. During the lesson, models or images may serve to illustrate abstract concepts, making them easier for students to comprehend. At the end of the lesson, teachers may employ concept maps to systematize the learned content, thereby helping students consolidate knowledge and visualize logical relationships among concepts.

Step 3: Organizing learning activities to solve mathematical problems.

At this stage, teachers engage students in actively interacting with visual materials to develop analytical skills, reasoning ability, and knowledge application—core manifestations of cognitive understanding. Furthermore, encouraging students to design their own mind maps or models that summarize lesson content promotes systematic thinking, visual reasoning, and information synthesis—all essential factors in developing students' cognitive competencies.

c) Notes for implementation

– Images, diagrams, and models must be scientifically accurate, aligned with expected learning outcomes, and should not cause misconceptions or oversimplify essential content.

– Visual materials should be presented clearly, aesthetically, and in a manner accessible to students' cognitive levels.

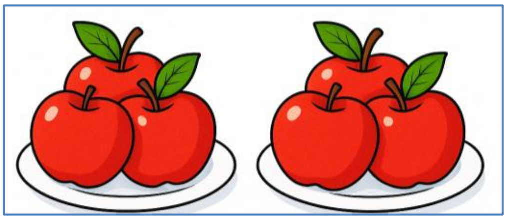
– Teachers should guide students to engage actively with visual representations in a directed way, ensuring effective acquisition of knowledge.

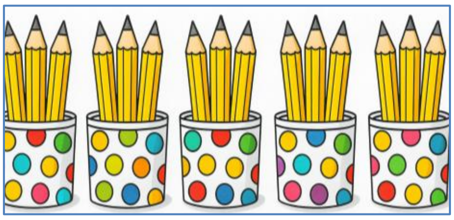
d) Illustrative Example

Example: Using images, diagrams, and visual models in teaching problem-solving with the Multiplication Table of 3 to foster the development of mathematical language

Step 1: Selection and design of images, diagrams, and visual models containing mathematical content.

For the content of applying the multiplication table of 3 in calculation practice, we designed visual materials that are familiar to students' daily life and embed mathematical information. Based on this purpose, we developed the following exercise: *"Write the appropriate multiplication expression for each of the following pictures."*





Step 2: Exploiting images, diagrams, and models to interpret mathematical content.

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Students are organized to observe the pictures and identify the mathematical content within them. Pair work activity: students explain to their partners and listen to each other.

– Picture 1: There are 2 plates of apples, each plate has 3 apples.
– Picture 2: There are 5 cups of pens, each cup contains 3 pens.

Step 3: Organizing learning activities to solve mathematical problems.

Students work individually to write the appropriate multiplication expression.

Whole-class activity: representatives of students present the mathematical content of each picture and write the corresponding multiplication expression on the board.

– Picture 1: There are 2 plates of apples, each plate has 3 apples. Thus, 3 apples are taken 2 times, or 3 is taken 2 times, giving the multiplication expression:

$$3 \times 2 = 6$$

– Picture 2: There are 45 cups of pens, each cup has 3 pens. Thus, 3 pens are taken 5 times, or 3 is taken 5 times, giving the multiplication expression:

$$3 \times 5 = 15$$

Students provide comments and ask questions to their peers. The teacher then gives feedback.

2.2.2. Developing the skill of transitioning between Mathematical Language (ML) and Natural Language (NL) to foster the development of ML

a) Purpose of the measure

– To help students flexibly use both NL and ML during the process of learning mathematics.
– To contribute to improving students' ability to use ML accurately as well as to foster logical thinking.
– To enable students to recognize the interrelationship between these two types of language in solving mathematical problems.

b) Content and procedure

The ability to shift between NL and ML plays a crucial role in helping students effectively solve word problems and real-life mathematical situations. This process not only assists students in grasping the mathematical essence of problems but also makes mathematics more approachable, engaging, and applicable to daily life.

In addition, the ability to convert from ML back into NL helps teachers assess students' level of comprehension and mastery of mathematical knowledge. Therefore, training this skill needs to be conducted regularly and consistently throughout mathematics teaching. Moreover, students' ability to convert between different representations such as pictures, diagrams, and models into mathematical expressions and symbols is also an essential component in strengthening ML competence.

c) Implementation notes

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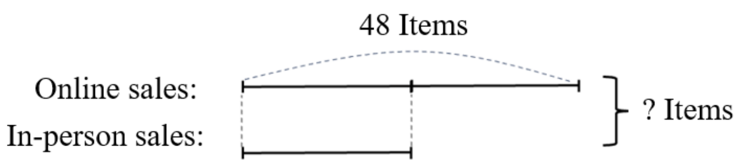
- During mathematics instruction, teachers should design a system of exercises or mathematical scenarios that require students to flexibly use different forms of language to solve problems, thereby fostering ML competence naturally.
- Recognizing that students may initially encounter difficulties in language transitions, teachers need to design simple, familiar situations closely related to daily life. Once students gradually adapt, the complexity can be increased to promote deeper thinking and more effective ML development through problem-solving activities.

d) Illustrative example

Example: Practicing the skill of transitioning between ML and NL through teaching the problem "Formulate a problem based on the given outline and solve it."

Outline: Presented as a line-segment diagram



Analysis: The problem provides a line-segment diagram containing mathematical information. Students read and interpret the diagram using ML, then employ NL to formulate a word problem. Students then use both ML and NL to present the solution.

Activity steps: Students read the line-segment diagram: *Online sales: 48 items; In-person sales: half of online sales. Find the total number of items sold (online and in-person).*

Students work individually to fulfill the task. Possible student responses include:

Problem 1 (Pizza shop): A pizza shop sold 48 pizzas online on Sunday. The number of pizzas sold in person was half of the online sales. How many pizzas did the shop sell in total on that day?

Solution: Number of pizzas sold in person:

$$48 \div 2 = 24 \text{ (pizzas)}$$

Total number of pizzas sold:

$$48 + 24 = 72 \text{ (pizzas)}$$

Answer: 72 pizzas.

Problem 2 (Phone shop): A phone shop sold 48 phones online last week. The number of phones sold in person was half of the online sales. How many phones did the shop sell in total last week?

Solution: Number of phones sold in person:

$$48 \div 2 = 24 \text{ (phones)}$$

Total number of phones sold:

$$48 + 24 = 72 \text{ (phones)}$$

Answer: 72 phones.

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Whole-class activity: The teacher invites representatives to present their formulated problems. Other students provide comments and suggestions, and read their own problem statements aloud.

The teacher reviews and invites another student to present the solution.

Students comment on their peer's solution, ask for clarification if needed, and the teacher confirms the final result.

2.2.3. Designing and using practical exercises and situations in teaching mathematics in Grade 3 to foster the development of Mathematical Language (ML)

a) Purpose of the measure

To help students:

– Through solving life-related situations, not only develop critical and systemic thinking, but also form a positive, proactive, and creative learning attitude.
– Realize the applicability of mathematics, thereby increasing interest and motivation in learning, and contributing to the development of ML.

b) Content and procedure

Step 1: Identify the learning objectives and suitable lesson content for integrating practical situations

Teachers need to clearly define the lesson objectives and select knowledge units with potential for integration with real-life contexts. The chosen content should be open-ended, allowing students to approach and explore problems from multiple perspectives. Topics related to the environment, daily life, health, agriculture, technology, and social ethics are often suitable for building such situations.

Step 2: Design practical exercises and situations

Practical situations should be designed to be familiar to students' daily life while also containing problematic elements that stimulate thinking. A good situation must be clear, specific, and provide sufficient but not complete information, requiring students to use their knowledge to analyze, reason, or propose solutions. Teachers should also consider ethical, cultural, and cognitive appropriateness to ensure suitability.

Step 3: Organize learning activities to address the situations

Teachers present situations during lessons and guide students to solve them individually, in small groups, or as a whole class. Students are required to read and analyze the situation, identify the core problem, and discuss possible solutions. Teachers play the role of facilitator, orienting and supporting deep thinking, while avoiding off-track or non-academic discussions.

After students present their solutions, the teacher organizes feedback and reflection, helping students recognize strengths and weaknesses in their approaches. From there, both teacher and students draw lessons learned and systematize the related knowledge.

c) Implementation notes

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- Situations must be familiar and connected to students' real-life experiences, suitable for their developmental psychology.
- Effective situations should make students feel personally connected, thereby sparking interest and curiosity.
- The level of difficulty should be moderate, enabling students to mobilize prior knowledge and combine it with reasoning skills to provide explanations and solutions.
- Situations with high educational effectiveness often help students develop flexible and creative thinking in learning.

d) Illustrative example

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Example: Designing and using practical situations in teaching the topic "Rounding whole numbers to the nearest hundred; Comparing and ordering numbers within 10,000" to foster the development of ML.

Step 1: Identify the objectives and lesson content for integration

Learning objectives: Become familiar with rounding numbers to the nearest hundred. Identify the largest or smallest number in a group of no more than 4 numbers (within 10,000). Arrange numbers in ascending or descending order in a group of no more than 4 numbers (within 10,000).

Content: Comparing and ordering numbers within 10,000; Rounding whole numbers to the nearest hundred.

Step 2: Design practical exercises and situations

Read the information below and answer the questions:

Ba Den Mountain is known as "the Roof of the Southeast." It has an elevation of 986 m above sea level. Seen from afar, it looks like an inverted conical hat standing out in the plain.

Pu Si Lung Mountain, located on the Vietnam–China border in Lai Chau province, has an elevation of 3,076 m above sea level. To climb to the summit, one must obtain a permit from the border guard station to ensure safety and security.

Bach Moc Luong Tu Mountain, lying between Lao Cai and Lai Chau provinces, has an elevation of 3,045 m above sea level. During the cloud season, standing at the summit allows one to view a dreamy sea of floating white clouds.

Fansipan Mountain, known as "the Roof of Indochina," belongs to the Hoang Lien Son range and lies between Lai Chau and Lao Cai provinces. It has an elevation of 3,143 m above sea level.

Questions:

a) Round the elevations of the mountains to the nearest hundred and complete the table.

Ba Den Mountain

Pu Si Lung Mountain

Bach Moc Luong Tu Mountain

Fansipan Mountain

Mountain Name	Approximate Elevation
Ba Den Mountain	
Pu Si Lung Mountain	

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Mountain Name	Approximate Elevation
Bach Moc Luong Tu Mountain	
Fansipan Mountain	

b) Among the above mountains, which is the highest and which is the lowest?

c) Write the names of the mountains in order from the highest to the lowest.

This exercise provides real-life information about mountains in Vietnam, including their elevation above sea level and geographical location.

Step 3: Organize learning activities

Students work individually to read the information and share what they have learned.

They complete the exercise in their notebooks.

a) Round the elevations to the nearest hundred:

Mountain Name	Approximate Elevation
Ba Den Mountain	1 000 m
Pu Si Lung Mountain	3 100 m
Bach Moc Luong Tu Mountain	3 000 m
Fansipan Mountain	3 100 m

b) Fansipan is the highest, Ba Den Mountain is the lowest.

c) Order from highest to lowest: Fansipan, Pu Si Lung, Bach Moc Luong Tu, Ba Den.

Whole-class activity: Representatives present their answers. Other students provide feedback and ask questions,

for example:

– “The actual elevation of Ba Den Mountain is 986 m. Why did you round it to 1,000 m?”
– “Why did you choose Fansipan as the highest mountain even though both Fansipan and Pu Si Lung round to 3100 m?”
– “How did you determine the order of the mountains from highest to lowest?”

III. CONCLUSION

In teaching Mathematics, teachers need to place importance on developing students’ mathematical language. Therefore, the development of mathematical language in Grade 3 Mathematics plays a crucial role in shaping mathematical thinking and fostering students’ learning qualities. Measures such as making use of images, diagrams, and visual models; training the skill of switching between

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mathematical language and natural language; as well as designing and using practical situations, all contribute to making learning more comprehensible, engaging, and connected to real life. Through this, students not only acquire knowledge but also develop logical thinking, critical thinking, and the ability to apply their learning. If implemented regularly, systematically, and in accordance with students' age characteristics, these measures will contribute to improving the quality of mathematics teaching in primary education.

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