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# Some Measures to Develop Abstract and Generalizing Thinking for 4th-Grade Students in Teaching the Topic of Calculations with Fractions

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**ABSTRACT:** Developing abstract and generalizing thinking is an important skill that helps people approach problems more comprehensively, creatively, and effectively in study, work, and life. In the modern world, we often face large and complex amounts of information. The ability to abstract helps us filter out unnecessary details, focusing only on important factors. Generalization helps us simplify information, making them easier to understand and manage. Grade 4 Math has a lot of potential to develop abstract and generalizing thinking for students. This article proposes some measures to train students' abstract and generalizing thinking in teaching the topic of fraction operations in grade 4. These are also some suggestions for managers and teachers of primary schools in Vietnam to improve the quality of teaching Mathematics in general.

**KEYWORDS:** Mathematical, Thinking, Abstract and Generalizing Thinking, Calculations with Fractions, Primary School.

## I. INTRODUCTION

Integrating with the development of global education, our country's education is implementing fundamental and comprehensive innovation of the general education program, requiring "comprehensiveness in the quality and effectiveness of general education; combining literacy, human education and career orientation; contributing to the transformation of an education that focuses on knowledge transfer to an education that comprehensively develops both qualities and abilities, harmonizes morality, intelligence, physical fitness, aesthetics and best promotes the potential of each student." This transformation is first of all reflected in the requirement to innovate teaching and assessment methods, including regular and periodic assessments, especially important exams (end of term, end of year, end of grade).

Mathematics is one of the subjects that takes up a lot of time and plays an important role and position in contributing to the formation and comprehensive development of both the qualities and abilities of learners, especially the ability to think abstractly and generalize.

Math for grade 4 has an important position, like a hinge to help students transition from the early grades of primary school (grades 1, 2, 3) to the final grades of primary school (grades 4, 5). The content of the Math program for grade 4 also contains many opportunities for teachers to exploit in the direction of developing the ability to think abstractly and generalize for students. In addition to the same content as the 2000 program, the topic of calculations with fractions has been adjusted to reduce the load but still contains many opportunities to practice abstract thinking and generalization for students.

Students in the last grades of primary school have begun to develop abstract thinking, and their language skills are also better. Therefore, in addition to equipping students with the knowledge, training thinking, problem-solving, and thinking skills should be given attention in teaching in general, and teaching mathematics in particular. In many educational institutions, teachers only pay much attention to equipping students with knowledge but have not paid attention to training thinking skills. A few teachers have also begun to train thinking skills for students, but they are confused and have not had effective measures to train thinking and thinking skills for students in teaching.

In the study of the thinking process, Benjamin Bloom and his colleagues successfully built a thinking taxonomy consisting of six levels arranged in order from low to high: know, understand, apply, analyze, synthesize, and evaluate, which is widely used in the world. In the 1990s, this thinking taxonomy was revised by Lorin Anderson - a student and later a colleague of Bloom, with the desire that the thinking taxonomy be more suitable and meet the practical requirements of the 21st century. Accordingly, the thinking taxonomy was changed to: remember, understand, apply, analyze, evaluate, create. Bloom's thinking taxonomy has been widely used in designing curriculum and learning objectives, assessment tests, etc., thereby assessing the behavior and abilities of learners through their level of thinking ability. Some studies on thinking and thinking skills have been conducted such as: Why teach thinking

(R.S. Nickerson); Forms of thinking: An Integrative Perspective on teaching thinking skills (D.N Perkins); Teaching thinking: A developmental model for incorporating thinking skills into the teaching process (R.S. Swartz), Assessing thinking skills in the classroom (J.B Baron), …

Bruner views learning as an active, social process in which learners construct new ideas or concepts based on prior knowledge. He believes that education should help children experience mastery of knowledge and cognition. This is very beneficial for learners because they can access information that they did not know before. Bruner also emphasizes the role of strategies used in teaching, not just the learning environment itself...

Article Based on research on the most general theoretical and practical issues related to abstract thinking, generalization; the topic of operations with fractions and the characteristics of primary school students to propose some measures to teach the topic of operations with fractions in grade 4, thereby improving students' ability to abstract and generalize.

## II. ABSTRACT AND GENERALIZATION THINKING

### *A. What is abstract and generalized thinking*

According to Nguyen Ba Kim (2015), Abstraction is the separation of essential characteristics from non-essential characteristics. Of course, the distinction between essential and non-essential here is relative, it depends on the purpose of action.

According to Nguyen Phu Loc(2010), abstraction is the process of using the mind to eliminate secondary, unnecessary aspects, attributes, connections, and relationships and only retain the necessary elements for thinking.

We can understand that abstract thinking is the ability to think about objects, ideas, principles or problems without relying on specific, tangible or intuitive information. Abstract thinking helps us broaden our vision, understand more deeply the nature of the problem and find creative solutions to solve complex challenges. This operation allows us to ignore individual details and focus on the general attributes, nature, and laws of things or phenomena. Abstract thinking helps us not only solve problems effectively, but also develop the ability to think logically and creatively in everyday life.

Abstraction in mathematics is the process of extracting the essential nature of a mathematical concept, removing any dependence on real-world objects to which it may have been originally connected, and generalizing it so that it has broader applications or fits into other abstract descriptions of similar phenomena.

In mathematics, abstraction allows us to strip away specific details and focus on important properties. This helps us build general concepts and apply them to a variety of situations.

According to Nguyen Ba Kim (2015), “Generalization is the transfer from a set of objects to a larger set containing the original set by highlighting some common characteristics of the elements in the starting set.”

According to Hoang Chung, “Generalization is using the mind to separate out the common things in objects or phenomena, events. To generalize, it is often necessary to compare many objects, phenomena, events with each other. In the process, we ignore their other properties, the properties that distinguish those objects or phenomena from each other, not thinking about those properties but only examining the separated ones.”[6]

Thus, generalization is the process or method of creating a general principle, model, or concept from specific information, events, or phenomena. The goal of generalization is to find common, universal characteristics from individual cases, helping us to understand and apply knowledge more widely

Generalization in mathematics is the process or method of creating a general principle, model, or concept from specific information, events, or phenomena. The goal of generalization is to find common, universal characteristics from individual cases, helping us to understand and apply knowledge more widely or in accordance with other abstract descriptions of equivalent phenomena.

### *B. Stages of thinking*

The thinking process includes many stages, from when an individual encounters a problematic situation and perceives the problem, until the problem is solved, which can be divided into the following stages:

- Stage 1: Awareness of the problem

The situation is an important condition for thinking, but it does not itself give rise to thinking. Thinking only arises when people perceive the situation, at which point the "situation" becomes "problematic", that is, people identify the thinking task and express it.

A problematic situation contains different contradictions (between the known and the unknown, between what exists and what does not exist ...), which is the objective side of a problematic situation. However, a problematic situation is clearly subjective. In the same circumstances (situation), a problem may arise in one person when they see a certain contradiction, but in another person the problem does not arise. This depends on the knowledge and needs of the individual. The more experience a person has in a certain field, the easier it is for him to see the contradiction in its entirety, that is, to identify the problems that require him to solve. It can be said that a problematic situation is a merger of objective and subjective factors. It is this identified problem that needs to be solved that determines all subsequent stages of the thinking process, determines the thinking strategy. This is the first, very important stage of the thinking process.

- Stage 2: Mobilizing knowledge and experience:

Once the task to be solved has been determined, the thinking subject mobilizes knowledge and experience related to the problem to be solved, that is, creating associations. The emergence of related knowledge and experience depends on the determined task and the subject's level and experience, to determine whether it is complete and in the right direction or not.

- Stage 3: Filtering associations and forming hypotheses:

The knowledge, experience, and associations that initially appear are broad, comprehensive, and not specific, so they need to be filtered to suit the given task, that is, eliminating unnecessary knowledge that is not suitable for the task.

Based on the screening, a hypothesis is formed, that is, a plan, a possible solution to the task being thought about. In fact, a problem can be considered and solved in many ways from many different perspectives. The problem is to find the most correct and economical solution.

- Stage 4: Hypothesis testing:

Check which hypothesis corresponds to the conditions and problems posed. The test results will lead to the affirmation, negation or correction of the stated hypothesis. If correct, the task has been solved, if wrong or the hypothesis is negated, it is necessary to determine a new hypothesis, a new way to solve the problem or a new thinking process to start from the beginning.

In the process of testing the hypothesis, we may look at the same task but in a different system of relationships and connections, and thus may discover new tasks that have not been solved.

- Stage 5: Problem-solving:

This is the final stage of the thinking process. When the hypothesis has been tested and confirmed to be correct, it will be implemented, that is, coming to the answer to the problem posed. Sometimes, after solving this problem, a new problem arises that the subject needs to solve, at which point a new thinking process begins.

In the thinking process (solving tasks), people often encounter many difficulties due to many reasons.

There are 3 common reasons:

1. The subject does not recognize some facts of the problem that needs to be solved.
2. When solving the problem, the subject enters redundant facts.
3. The rigid, mechanical nature of the subject in the thinking process.

### *C. Some measures to develop students' abstract and generalization thinking through teaching the topic of calculations with fraction numbers in grade 4*

**Measure 1:** *Training in abstract and generalizing thinking in teaching forms new knowledge about calculations with fractions.*

Conceptual teaching is the act of conveying, teaching and helping students understand and master the basic concepts of a subject or field.

Through conceptual teaching, teachers create the basics and foundation for students to understand the subject more deeply.

Concept formation for students when learning mathematics is an extremely important process and has many positive effects on the development of their thinking and skills. Concept formation helps students see the connection between different concepts in mathematics. This connection helps them build an overall picture of mathematics, thereby facilitating learning and remembering knowledge.

Step 1: The teacher presents a practical situation so that from that practical situation, students will discover the problem that needs to be solved.

Step 2: If the problem comes from that practical situation.

Step 3: Comment on the characteristics of the calculations.

Step 4: The teacher concludes the concept so that students can identify the characteristics of the calculations.

The teacher presents a practical situation: In an experiential activity, three friends Viet, Mai and Robot are coloring a strip of paper in an experiential lesson. Nam said that he had colored được $\frac{1}{5}$ of the strip. Mai said that she would continue to color red on $\frac{2}{5}$ of the strip. Robot asked the question: how many parts of the strip of paper have the two friends colored?

From this practical situation, students can state how much of the paper strip both of them have colored and what calculation they need to do through the word "Both". Thus, students state the calculation is $\frac{1}{5}+\frac{2}{5}$. The teacher writes this calculation on the board for students to comment on the terms of the addition. From here, students can comment that all the terms are in the form of fractions. Then the teacher asks students to comment on the denominators of the two fractions. Students comment that these are two fractions with the same denominator and both equal 5. From there, the teacher goes on to introduce in a general way that this is the addition of two fractions with the same denominator.

In this situation, abstract thinking was demonstrated: Students eliminated non-essential elements: coloring, red, blue, paper strips, etc., keeping only essential elements: $\frac{1}{5}$, $\frac{2}{5}$. And students had to rely on the keyword "Both". Although this phrase is common language, it has a mathematical meaning of adding together. From that meaning of adding together, the addition operation is formed.

**Measure 2.** *Practice abstract thinking and generalization in teaching and solving problems related to calculations with fractions*. In addition to learning decimal calculations, students also develop logical thinking and reasoning skills through analyzing and helping students understand more deeply the nature of fractions. Fractions are not only formal expressions but also show the relationship between two numbers (numerator and denominator). For students to understand the meaning of calculations with fractions (addition, subtraction, multiplication, division), they need to think abstractly to see the nature and relationship between the components in the fraction, instead of just following the formula.

By understanding the nature of fractions through abstract thinking and generalization, students will feel more confident in solving more complex problems. This not only helps them achieve good results in math but also develops active learning skills.

Step 1: Teacher presents the calculation/problem.

Step 2: Students perform operations with visual aids to find the result of the calculation/ Apply the teacher's directions and suggestions to find the result of the calculation.

Step 3: Based on the comments on how to perform a specific example using incomplete induction and generalization, students, by themselves or in groups, can state the rules for performing the calculation/how to solve a type of problem.

After having the rules, the teacher lets students apply them to quickly do some calculations.

Step 4: The teacher summarizes the knowledge and gives notes to students if necessary.

**Measure 3:** *Build a system of exercises on calculations for fractions to create opportunities for students to practice abstract and generalizing thinking.*

Through solving problems that require abstraction and generalization, students can develop creative thinking, find different ways to solve the same problem, discover new rules or new approaches to difficult problems.

Step 1: Determine the requirements to be achieved.

- Perform addition and subtraction of fractions in the following cases: fractions with the same denominator; one denominator is divisible by the remaining denominators.
- Perform multiplication and division of two fractions.
- Solve some problems related to solving problems (with one or several calculation steps) related to 4 operations with fractions (for example, a problem related to finding the fraction of a number).

Step 2: Develop exercises that create opportunities for students to develop abstract and generalizing thinking. These are exercises that are general, can be generalized or students can apply rules to deduce/abstract.

Step 3: Design them in the form of exercises.

Step 4: Review and edit.

## III. CONCLUSIONS

The proposed measures to practice abstraction and generalization thinking can be expanded to other subjects and contents to contribute to activating learning activities, creating interest and thereby improving learning efficiency in primary schools. It is necessary to develop and equip teachers with the necessary pedagogical skills to practice thinking operations so that teachers can apply them to the teaching process more systematically and effectively.

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