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Some Measures to Develop Analytical and Synthetic Thinking Skills in Teaching the Topic "Numbers and Operations" in Grade 3.

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ABSTRACT: Mathematics plays an important role in developing students' logical thinking, creativity, and problem-solving abilities. It is not only a subject that provides fundamental knowledge but also a foundation that helps students develop higher-order thinking skills. In the Grade 3 Math curriculum, the topic "Numbers and Operations" holds a core position, serving as a bridge between the early learning stage and the more advanced knowledge in Grades 4 and 5. Teaching this topic not only helps students form and develop calculation skills but also trains their ability to think analytically and synthetically, enabling them to better understand the nature of mathematics and apply it flexibly in real life.

This article presents several key aspects of analytical and synthetic thinking, as well as the Grade 3 Math curriculum in Vietnam. Based on that, it proposes some methods to develop analytical and synthetic thinking skills in teaching the "Numbers and Operations" topic in Grade 3.

KEYWORDS: analysis, synthesis, thinking, numbers and operations, grade 3, Vietnam

I. INTRODUCTION

The study of cognitive operations in education has a long history and has yielded several notable achievements. In the early 19th century, research in this field primarily focused on foundational theories of thinking, cognition, and learning. Scholars paid particular attention to the development of object-based reasoning and analytical capabilities in mathematical problem-solving. However, during this period, there was a lack of in-depth studies, and few concrete instructional methods were proposed—especially in the domain of arithmetic instruction for primary school students.

According to Hac P.M, (1992) *analysis* is a process of breaking down the components of real-world objects or phenomena, identifying their features and properties, as well as the interrelationships among them in a specific direction. He asserts that this analytical process aims to facilitate a more comprehensive and profound understanding, thereby enabling a complete perception of the objects and phenomena under investigation [5].

In contrast, *synthesis* is described as a fundamental integrative process through which individual components are combined into a unified whole. Uan N.Q et al (2004) emphasizes that genuine synthesis is not a mechanical aggregation of parts, nor a mere summation of elements. Rather, it is a distinct intellectual activity that leads to a qualitatively new outcome, offering a novel and deeper understanding of reality.

According to G. Polya: "Analysis and synthesis are two essential operations of the mind. If we delve too deeply into details, we may become overwhelmed. An excess of minor and fragmented information can obstruct thinking and distract from the fundamental point. This is akin to someone who sees the trees but not the forest. First, we must understand the problem as a whole. Once this comprehension is achieved, it becomes easier to identify which specific details are essential. We must examine the problem closely, break it down into steps, and be cautious not to go too far beyond what is necessary at any given stage" (Acorrding to Hue B.V).

According to Bloom, *analysis* involves breaking information and concepts into smaller parts to gain a deeper understanding, while *synthesis* entails combining ideas to create new content.

In Vietnam, research aimed at enhancing students' analytical and synthetic thinking skills has also achieved notable success. From a theoretical standpoint, viewing thinking as a unified process with dual aspects, author Tho C.C (2017), argues that thinking is both a process of discovery—seeking out new and essential elements—and a process of reconstruction, in which knowledge and socio-historical experiences accumulated by humanity are reproduced.

Ngo P.T (2005) defines analysis as the act of breaking down a whole into various parts in order to deeply explore the details within each component. Synthesis, by contrast, is the act of forming an overarching view of a complete structure made up of multiple components, identifying the interrelationships among those components and between the whole and its surrounding environment. He notes that analysis enables synthesis, while synthesis, in turn, provides direction for further analysis.

According to the group of authors Hoan P.V et al,"Analysis involves breaking a whole into parts, fragmenting it into components, isolating elements, or abstracting certain features or individual aspects. Synthesis is the process of combining these individual parts, generalizing characteristics, and constructing a complete whole" [3]

From this perspective, analysis can be understood as an intellectual process in which the whole is mentally divided into smaller parts—separating an object into distinct components or isolating specific elements or aspects within a whole—to examine their interrelations and gain a clearer understanding of them. This operation involves breaking down information or concepts into smaller segments and identifying their connections to the larger structure in order to achieve deeper comprehension.

Conversely, synthesis refers to the cognitive process of reassembling these components—integrating isolated parts or harmonizing different elements and aspects within a whole—to arrive at a unified understanding of the entire entity.

The body of research by these scholars places significant emphasis on the role of analytical and synthetic thinking in fostering students' intellectual development. This widespread academic interest highlights the critical need for further investigation into thinking processes and their role in teaching and learning. Accordingly, there is a pressing need to continue exploring strategies for developing students' analytical and synthetic thinking skills within educational contexts.

Content

A. Key Conceptual Tools

Thinking

Cognitive operations refer to a sequence of mental activities carried out by individuals during information processing, problem-solving, decision-making, and the formation of new knowledge. These operations begin with the reception of information and continue through stages of analysis, comparison, synthesis, evaluation, and conclusion-making. They play a crucial role in fostering independent and creative thinking.

The core cognitive operations include:

Analysis: The ability to deconstruct a problem or situation into its constituent elements to better understand the structure and the relationships among those elements. This operation helps learners identify and clarify the issues that need to be addressed.

Synthesis: The ability to integrate previously analyzed elements into a comprehensive whole, forming new concepts or solutions. Synthesis enables learners to view problems holistically and connect discrete elements into a coherent and meaningful system.

Reasoning (Inference): The process of drawing conclusions based on existing information, either by generalizing from specific data (inductive reasoning) or applying theoretical knowledge to predict specific outcomes (deductive reasoning).

Evaluation: The capacity to assess and compare different options, and to make informed judgments or decisions based on established criteria.

Generalization: The ability to derive overarching principles or rules from specific cases or illustrative examples.

In mathematics education, these cognitive operations are employed not only to facilitate the acquisition of knowledge but also to enhance students' abilities in analysis, evaluation, and problem-solving. This contributes significantly to the development of creativity and critical thinking skills.

Analytical and Synthetic Thinking

Analytical and synthetic thinking are two essential operations within the cognitive process. These forms of thinking enable individuals to gain deeper insights into complex issues, make informed decisions, and solve intricate problems. While closely interrelated, each possesses distinct characteristics and functions.

Analytical thinking refers to the process of breaking down a problem or a body of information into smaller components or elements to better understand its structure and the relationships among its parts. It is typically the initial step in problem-solving, helping individuals identify critical components and their interconnections. Analytical thinking enhances the clarity of each element, supporting more accurate evaluation and judgment. This form of thinking requires the ability to examine an issue from multiple perspectives.

Synthetic thinking, in contrast, involves assembling and integrating the previously analyzed components to form a conclusion or develop a concrete solution. It promotes comprehensive understanding and facilitates the generation of new ideas based on an existing foundation. Synthesis is not merely about recognizing elements, but about combining them into a meaningful whole that enables creative and effective problem-solving.

In essence, analytical thinking dissects a problem into its constituent parts for easier interpretation, while synthetic thinking reconnects those parts to achieve a holistic understanding. Both operations are fundamental to developing logical reasoning and effective problem-solving abilities—especially for primary school students.

In educational settings, cultivating students' analytical and synthetic thinking equips them to deconstruct problems (e.g., identifying key components of a lesson and breaking down information to deepen understanding) and synthesize knowledge (e.g., combining learned concepts to form a comprehensive perspective and solve problems creatively). Together, these cognitive skills are vital in fostering critical thinking, creativity, and problem-solving competence in learners.

B. Strategies for Developing Analytical and Synthetic Thinking Skills in Teaching "Numbers and Operations" in Grade 3

Measure 1: *Developing Analytical and Synthetic Thinking through Real-Life Problem Situations*

Step 1: Selecting and Constructing Real-Life Situations

Teachers should identify situations closely related to students' daily lives (e.g., measuring a garden plot, calculating expenses, sharing objects, planning transportation). These scenarios must contain core mathematical elements that require students to analyze given data and synthesize solution steps to arrive at an answer.

Step 2: Identifying the Mathematical Task within the Situation

From the real-life context, teachers extract the central mathematical problem. This step fosters analytical thinking as students are guided to isolate relevant data, recognize conditions, and define the specific task. At the same time, students begin to understand the relationship between real-world contexts and mathematical concepts.

Step 3: Guiding Students in Data Analysis and Processing

Teachers facilitate student discussions and encourage the use of visual tools (e.g., charts, diagrams, models) to classify and filter information. Students must identify relationships between data points, detect unnecessary or missing information, and propose processing strategies. This is a crucial step in cultivating higher-level analytical skills.

Step 4: Supporting Students in Synthesizing Information and Constructing Solutions

Based on their analysis, students are encouraged to connect pieces of information and select appropriate mathematical tools and methods to solve the problem. This process reinforces synthetic thinking—integrating separate elements into a coherent line of reasoning that leads to a final solution. Teachers also prompt students to compare, evaluate, and choose the most efficient solution strategies.

Step 5: Generalization, Extension, and Application

After completing the task, students are encouraged to extract a general problem-solving framework for similar situations. Teachers may vary the given data, adjust the conditions, or prompt students to create new real-world problems. Through this process, students not only arrive at specific solutions but also develop their capacity to generalize and apply mathematical knowledge across diverse contexts.

Measure 2: *Developing Analytical and Synthetic Thinking through Tiered Exercises and Structured Activities*

Step 1: Defining the Overall Mathematical Task

Teachers should select a mathematical task that aligns with the lesson objectives and students' cognitive level. The task should be sufficiently complex to prompt the use of multiple cognitive operations. Clearly defining the overall task helps orient students toward practicing analytical operations (e.g., identifying data, recognizing relationships) and synthetic operations (e.g., integrating and generalizing information to construct a complete solution).

Step 2: Decomposing the Task into Hierarchical Activities

From the overall task, teachers break it down into smaller steps or activity levels, corresponding to different levels of cognitive processing. These levels may include: recalling and reproducing basic knowledge; identifying relationships among data; synthesizing intermediate results to form a complete solution; and generalizing or extending the knowledge to new situations. This progression scaffolds students' development from basic to advanced cognitive operations.

Step 3: Designing Learning Activities for Each Tier

At each level, appropriate instructional strategies should be applied. In the initial stages, teachers may use individual work with direct guidance to support data analysis. At intermediate levels, group discussions should be encouraged to foster peer interaction, solution comparison, and collaborative reasoning—strengthening both analytical and emerging synthetic thinking. At higher levels, students are encouraged to present ideas, propose novel solutions, or generalize mathematical concepts, thereby advancing higher-order thinking skills.

Step 4: Providing Scaffolding and Guided Support during Problem Solving

Throughout the process, teachers should employ a structured system of guiding questions to support students' thinking. These questions may focus on identifying key data, discovering relationships, clarifying objectives, or introducing modified scenarios to prompt exploration of alternative solutions. Such scaffolding enables students to develop independent thinking skills in both analysis and synthesis, rather than relying solely on predefined instructions.

Step 5: Evaluating and Generalizing Results

Assessment should address both the process and the final product. Teachers should evaluate students' abilities to analyze data, establish relationships, synthesize intermediate results, and generalize solutions to new contexts. After each activity, students should be guided to extract generalized problem-solving strategies, thereby reinforcing and internalizing their analytical and synthetic thinking skills in a sustainable manner.

Measure 3: *Developing Analytical and Synthetic Thinking through Problem-Solving Activities*

Some Measures to Develop Analytical and Synthetic Thinking Skills in Teaching the Topic "Numbers and Operations" in Grade 3.

Step 1: Identifying the Problem Requirements

Students read the problem carefully, identify the given data, and determine what is being asked. To develop analytical thinking, students should break the problem into distinct elements: given data (numerical values, conditions), the unknown(s), and the relationships among them. If any part of the given information is abstract or unclear, it can be clarified through paraphrasing or rewording.

Step 2: Analyzing Relationships among Data

Students learn to identify the mathematical operations or logical connections implied in the problem. Analytical skills are enhanced by helping students uncover the relationships between what is given and what needs to be found. Visual aids such as diagrams, tables, charts, or underlining keywords can help clarify these links. Students may also be encouraged to anticipate the operations or intermediate steps involved in solving the problem.

Step 3: Planning the Solution

Students synthesize the given information to formulate a solution strategy. This step fosters synthetic thinking as students connect isolated relationships into a logical sequence of steps. For example, if they need to find variable *X*, what prior values must be determined first? This phase is about structuring the solution process.

Step 4: Executing the Solution

Apply the planned sequence of operations to solve the problem. Students carry out each step in the solution plan, providing justifications for their approach (e.g., "Why did I perform this operation here?"). They are also encouraged to compare the actual results at each stage with their initial plan, promoting reflective thinking.

Step 5: Reviewing and Generalizing

Students evaluate the solution and extract broader strategies. Analytical skills are reinforced by assessing whether the result is logical and consistent with the problem's conditions. Synthetic thinking is further developed by generalizing the method used to solve similar problems. Teachers may prompt reflection with questions such as: "Is there another way to solve it?", "Can it be done more efficiently?", or "Would the same method apply if the data changed?"

Step 6: Applying and Extending

Cultivate creativity and real-world application skills.

Teachers may provide similar problems with modified conditions or incorporate real-life scenarios such as measuring areas, calculating travel time, or budgeting. This step helps students transfer their analytical and synthetic thinking to practical and novel contexts.

II. CONCLUSIONS

In teaching in general—and mathematics instruction in particular—developing students' analytical and synthetic thinking plays a crucial role. Analytical thinking enables students to deconstruct problems by identifying key components and breaking down information for deeper comprehension. In contrast, synthetic thinking allows them to integrate previously learned concepts to form a holistic understanding and generate creative solutions to problems. Together, these skills are essential for fostering critical thinking, creativity, and effective problem-solving abilities in students.

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