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Some Theoretical Issues Regarding the Development of Mathematical Problem-Solving Skills for 4th and 5th Grade Students

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ABSTRACT

In the context of educational reform toward a competency-based approach, mathematical problem-solving competence is identified as one of the core competencies to be developed in primary school students. In particular, students in Grades 4 and 5 are at a critical transitional stage of cognitive development, serving as a foundation for mathematics learning at higher educational levels. This paper aims to examine key theoretical issues related to the development of mathematical problem-solving competence for students in Grades 4 and 5. Based on an analysis of scholarly perspectives on competence and problem-solving competence, as well as the requirements of the 2018 General Education Curriculum, the paper clarifies the concept, structure, and manifestations of mathematical problem-solving competence in primary mathematics education. In addition, the study analyzes the cognitive characteristics of Grade 4 and 5 students and identifies the requirements for developing mathematical problem-solving competence at this stage. Accordingly, several theoretical orientations for mathematics teaching are proposed to contribute to the development of students' mathematical problem-solving competence, providing a theoretical foundation for practical implementation and further research.

KEYWORDS: mathematical problem-solving competence; mathematics teaching; Grade 4 and 5 students; primary mathematics education; 2018 General Education Curriculum.

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1. INTRODUCTION

1.1. Rationale for the Study

In contemporary education, problem-solving competence has been widely recognized as a core competency that learners need to develop in order to adapt to rapidly changing social, technological, and academic contexts. In mathematics education, problem solving is not only considered a key learning outcome but also an essential means through which mathematical knowledge, thinking, and skills are constructed and applied. Developing students' ability to identify problems, analyze situations, select appropriate strategies, and evaluate solutions is therefore regarded as a fundamental goal of mathematics teaching at the primary level (OECD, 2019; NCTM, 2000).

In Vietnam, the 2018 General Education Curriculum emphasizes a competency-based approach, in which mathematical problem-solving competence is identified as one of the central components of mathematical competence. The curriculum requires mathematics instruction to move beyond procedural practice toward fostering students' abilities to apply mathematical knowledge in diverse and meaningful contexts. Accordingly, developing students' mathematical problem-solving competence has become a critical requirement in primary mathematics education.

Students in Grades 4 and 5 occupy a distinctive position in the primary school curriculum. This stage represents a transitional period in cognitive development, during which students gradually move from predominantly intuitive and concrete thinking toward more logical and abstract forms of reasoning. At this level, students are expected to handle increasingly complex mathematical concepts, multi-step word problems, and situations that require flexible thinking and strategic planning. Therefore, Grades 4 and 5 play a foundational role in shaping students' problem-solving competence and preparing them for mathematics learning at the lower secondary level.

However, practical experience in primary mathematics teaching indicates that many students still encounter significant difficulties in mathematical problem solving. Common challenges include misunderstanding the requirements of word problems, struggling to plan appropriate solution strategies, and experiencing limitations in applying learned knowledge to new or unfamiliar situations.

These difficulties suggest that the development of mathematical problem-solving competence has not yet been adequately supported in instructional practice.

From this perspective, there is a clear need to examine and clarify the theoretical foundations of developing mathematical problem-solving competence for students in Grades 4 and 5. A systematic analysis of relevant theoretical issues can provide an essential basis for improving teaching practices and guiding further research in primary mathematics education.

1.2. Research Objectives

This study aims to examine key theoretical issues related to the development of mathematical problem-solving competence for students in Grades 4 and 5. Specifically, the objectives of the study are as follows:

1. To clarify the concept of mathematical problem-solving competence from a theoretical perspective.
2. To analyze the characteristics and manifestations of mathematical problem-solving competence in students in Grades 4 and 5.
3. To identify theoretical requirements and orientations for developing mathematical problem-solving competence for students at this educational stage.

1.3. Research Object and Scope

The research object of this study is mathematical problem-solving competence in students in Grades 4 and 5.

The scope of the study is limited to theoretical issues related to the development of mathematical problem-solving competence, examined through an analysis of the national curriculum, relevant scientific literature, and the context of primary mathematics teaching in Vietnam. No empirical or experimental research is conducted in this study.

1.4. Research Methods

To achieve the stated objectives, the study employs the following research methods:

- Analysis and synthesis of relevant scientific literature on competence, problem solving, and mathematics education.
- Analysis of the 2018 General Education Curriculum and primary mathematics textbooks for Grades 4 and 5.
- Logical and systematic analysis to organize theoretical perspectives and identify key issues related to the development of mathematical problem-solving competence.

2. THEORETICAL FRAMEWORK OF MATHEMATICAL PROBLEM-SOLVING COMPETENCE

2.1. Concept of Competence and Problem-Solving Competence

In competency-based education, competence is commonly understood as an integrated combination of knowledge, skills, attitudes, and personal attributes that enables individuals to effectively perform tasks and solve problems in specific contexts. According to the 2018 General Education Curriculum of Vietnam, competence is defined as the ability to successfully mobilize knowledge, skills, and personal qualities to perform activities and solve problems in learning and real-life situations. This definition emphasizes the functional and contextual nature of competence, highlighting learners' capacity for application rather than the mere acquisition of knowledge.

Internationally, similar perspectives on competence can be found in the frameworks proposed by organizations such as the Organisation for Economic Co-operation and Development (OECD) and the National Council of Teachers of Mathematics (NCTM). The OECD views competence as the ability to meet complex demands by drawing on and mobilizing psychosocial resources in particular contexts, while NCTM emphasizes mathematical competence as students' capacity to reason mathematically, solve problems, communicate ideas, and apply mathematics meaningfully. Although these perspectives vary in emphasis, they consistently stress the integration of cognitive, procedural, and dispositional components (Rychen & Salganik, 2003; Weinert, 2001). Within this framework, problem-solving competence in education refers to learners' ability to identify and understand problems, design and implement appropriate strategies, and evaluate solutions in diverse contexts. It is not limited to the execution of predefined procedures but involves higher-order thinking, flexibility, and reflective judgment. In mathematics education, problem-solving competence is regarded as a central dimension of mathematical competence, encompassing both the process and the outcome of learning.

Problem-solving competence is characterized by several key features. First, it is integrative in nature, as it requires the coordinated use of mathematical knowledge, cognitive strategies, and metacognitive awareness. Second, it is application-oriented, focusing on learners' ability to use mathematics to address unfamiliar or non-routine problems. Third, it is context-dependent, as mathematical problems are often embedded in practical, real-life, or interdisciplinary situations. These characteristics underline the importance of designing mathematics instruction that promotes meaningful engagement with problems rather than routine procedural practice.

2.2. Problem-Solving Competence in Mathematics Education

In mathematics education, problem solving plays a dual role. On the one hand, it is a fundamental learning objective, as developing students' ability to solve mathematical problems is a core aim of mathematics curricula worldwide. On the other hand, problem

solving also functions as an essential instructional approach, through which students construct mathematical knowledge, develop reasoning skills, and deepen conceptual understanding.

Mathematical problem-solving competence is closely related to several key aspects of mathematical thinking. It is inherently linked to mathematical reasoning and logical thinking, as students must analyze conditions, identify relationships, and justify their solutions. Problem solving also involves reasoning and argumentation, enabling learners to explain their thinking processes and evaluate the validity of different solution strategies. Furthermore, at an elementary level, problem-solving competence is connected to mathematical modeling, as students are required to translate real-world situations into mathematical representations and interpret results in meaningful ways. In primary education, this modeling process is typically simple and intuitive but plays an important role in fostering flexible and applied mathematical thinking.

For students in Grades 4 and 5, developing mathematical problem-solving competence is particularly important, as they are increasingly expected to engage with multi-step problems, word problems, and tasks that require strategic planning. At this stage, problem solving serves as a bridge between basic computational skills and more advanced mathematical reasoning.

2.3. Structure of Mathematical Problem-Solving Competence

Building on classical and contemporary models of mathematical problem solving, particularly those proposed by Polya (1973) and Schoenfeld (2016), … From a theoretical perspective, mathematical problem-solving competence can be described as a structured process consisting of several interrelated components. To clarify the internal structure and dynamic nature of mathematical problem-solving competence, this study conceptualizes problem solving as a cyclic and interactive process rather than a linear sequence of steps. Building on classical and contemporary theoretical models, particularly those proposed by Polya (1973) and Schoenfeld (2016), mathematical problem-solving competence is viewed as a process in which different components interact continuously through reflection and adjustment. This dynamic perspective is illustrated in Figure 1.

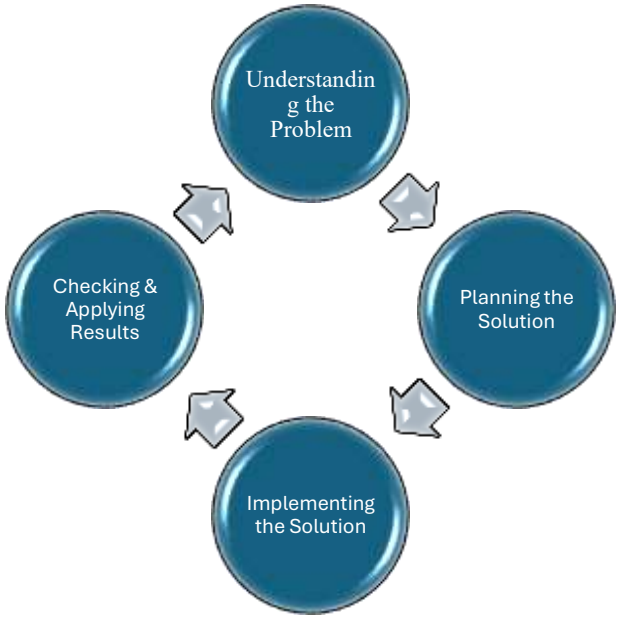


Figure 1. Dynamic structure of mathematical problem-solving competence

As shown in Figure 1, mathematical problem-solving competence consists of four core components: understanding the problem, planning the solution, implementing the solution, and checking and applying results. These components are interconnected and mutually influential rather than strictly sequential. The feedback loop emphasizes that checking and reflection may lead students to revisit earlier stages, such as reinterpreting the problem or adjusting solution strategies. This dynamic structure is particularly relevant in primary mathematics education, as Grade 4 and 5 students often refine their understanding through repeated interaction with problem situations. Therefore, Figure 1 provides a theoretical foundation for viewing problem solving as an adaptive and reflective process rather than a fixed procedural routine.

In the context of primary mathematics education, this competence typically includes the following core components:

1. Identifying and understanding the mathematical problem: This component involves recognizing the problem situation, understanding given information, identifying the problem's requirements, and clarifying relevant mathematical relationships. For primary students, especially in Grades 4 and 5, this stage is closely associated with reading comprehension and the ability to interpret word problems accurately.

2. Planning a problem-solving strategy: At this stage, students select appropriate mathematical concepts, operations, or strategies to address the problem. Planning may involve choosing a known method, organizing information, or predicting possible solution paths. In primary mathematics, effective guidance and scaffolding are essential to help students develop this strategic thinking.

In order to operationalize the structure of mathematical problem-solving competence in the context of primary mathematics education, the core components are further specified in terms of their instructional focus and observable manifestations in Grades 4 and 5. Table 1 summarizes these components, linking theoretical descriptions with practical expressions in primary mathematics learning activities.

Table 1. Structure of Mathematical Problem-Solving Competence in Primary Mathematics

Component	Description	Manifestation in Grades 4-5
Understanding the problem	Identifying given data and requirements	Analyzing word problems
Planning	Selecting strategies and operations	Choosing solution methods
Implementing	Carrying out calculations	Performing multi-step solutions
Checking & applying	Verifying and extending results	Evaluating answers

Table 1 illustrates how each component of mathematical problem-solving competence can be identified through students' learning behaviors and instructional activities in Grades 4 and 5. Understanding the problem is reflected in students' ability to analyze word problems and identify relevant information. Planning is manifested through the selection of appropriate operations and solution strategies. Implementing the solution involves performing calculations and executing multi-step procedures accurately, while checking and applying results requires students to verify their answers and extend solutions to similar or new situations. By linking theoretical components with concrete classroom manifestations, Table 1 contributes to bridging the gap between abstract theoretical frameworks and primary mathematics teaching practice.

3. Implementing the solution: This component refers to carrying out the selected strategy, performing calculations, and applying mathematical procedures accurately. Although procedural skills are important at this stage, they are meaningful only when connected to the overall problem-solving plan.

4. Checking, evaluating, and applying the result: The final component involves reviewing the solution, verifying its correctness, and reflecting on the problem-solving process. Students may also be encouraged to apply the result to similar or extended situations, thereby reinforcing transfer and flexibility in mathematical thinking.

These components are not strictly linear but interact dynamically throughout the problem-solving process. Understanding this structure provides a theoretical basis for designing instructional activities and assessment practices that support the development of mathematical problem-solving competence in primary school students.

On this theoretical basis, the following section examines the characteristics and manifestations of mathematical problem-solving competence in Grade 4 and 5 students, taking into account their cognitive and psychological development.

3. CHARACTERISTICS OF MATHEMATICAL PROBLEM-SOLVING COMPETENCE IN GRADE 4 AND 5 STUDENTS

3.1. Psychological and Cognitive Characteristics of Grade 4 and 5 Students

Students in Grades 4 and 5 are at a critical stage of cognitive development, characterized by a gradual transition from intuitive and concrete thinking to more logical and abstract forms of reasoning. At this level, learners begin to demonstrate improved abilities in classification, comparison, and logical inference. However, their thinking is still strongly supported by concrete representations, visual models, and contextualized examples. As a result, mathematics instruction for this age group needs to balance abstract reasoning with visual and manipulative support.

In addition, students' reading comprehension and expressive abilities develop significantly during this stage. Grade 4 and 5 students are increasingly capable of understanding longer and more complex word problems, identifying key information, and expressing mathematical ideas through spoken and written language. Nevertheless, their comprehension is sometimes limited by vocabulary, sentence structure, or the contextual complexity of problems, which can directly affect their problem-solving performance.

Furthermore, students at this level begin to form basic inferential and deductive reasoning skills. They are able to make simple justifications for their solutions and recognize logical relationships between mathematical elements. However, such reasoning is often unstable and requires systematic guidance and practice to become consistent and transferable across different problem contexts. These cognitive characteristics create both opportunities and challenges for developing mathematical problem-solving competence in Grades 4 and 5.

3.2. Manifestations of Mathematical Problem-Solving Competence in Grade 4 and 5 Students

The mathematical problem-solving competence of Grade 4 and 5 students is reflected in several key aspects of their learning activities. First, in analyzing word problems, students demonstrate an emerging ability to identify given information, recognize what is being asked, and relate the problem to previously learned mathematical concepts. Many students can distinguish relevant from irrelevant data when problems are presented clearly and familiarly.

Second, in selecting operations and solution strategies, students begin to show flexibility in choosing appropriate mathematical procedures. They may apply basic operations, combine multiple steps, or select known methods to solve problems. However, this ability often depends on the similarity between the current problem and previously encountered examples.

Third, in presenting solutions, students are increasingly able to organize their work, write mathematical expressions, and explain their reasoning in a structured manner. Clear presentation reflects not only procedural accuracy but also students' understanding of the problem-solving process.

Despite these positive manifestations, several common difficulties persist. Many students do not fully understand the requirements of word problems, leading to incorrect interpretations or incomplete solutions. In addition, students often rely heavily on familiar patterns or standard solution templates, which limits their ability to adapt to new or non-routine problems. Another frequent limitation is the lack of habit in checking and evaluating results. Students may stop once an answer is obtained without verifying its correctness or considering alternative solution approaches. These difficulties indicate that problem-solving competence has not yet been fully internalized at this stage (Verschaffel et al., 2000; Schoenfeld, 2016).

3.3. Requirements for Developing Mathematical Problem-Solving Competence According to the 2018 General Education Curriculum

The 2018 General Education Curriculum places strong emphasis on developing mathematical competence, with mathematical problem-solving competence identified as a core component. At the primary level, the curriculum requires students not only to acquire fundamental mathematical knowledge and skills but also to apply them effectively in learning and real-life contexts. This requirement is reflected in learning outcomes that prioritize understanding, application, and reasoning over rote calculation.

In relation to specific content areas in Grades 4 and 5, the development of mathematical problem-solving competence is embedded across multiple domains. In the area of numbers and operations, students are expected to solve problems involving natural numbers, fractions, and decimals, often through multi-step reasoning. In measurement and quantities, learners apply mathematical knowledge to practical situations involving length, mass, time, and capacity. In geometry, students engage in identifying shapes, analyzing spatial relationships, and solving problems related to perimeter, area, and simple geometric reasoning. In word problem solving, which cuts across all content areas, students are required to interpret contextual situations, model them mathematically, and communicate solutions clearly.

These curriculum requirements imply that the development of mathematical problem-solving competence in Grades 4 and 5 should be systematic, continuous, and integrated across content areas. Understanding these requirements provides an important theoretical foundation for designing instructional approaches that align with curriculum goals and support students' cognitive development.

4. THEORETICAL ORIENTATIONS FOR DEVELOPING MATHEMATICAL PROBLEM-SOLVING COMPETENCE IN GRADE 4 AND 5 STUDENTS

4.1. Orientation Toward Competence Development Through Learning Activities

From a theoretical perspective, developing mathematical problem-solving competence requires organizing learning activities that actively engage students in the construction and application of mathematical knowledge. For students in Grades 4 and 5, learning activities should increasingly emphasize exploration and experiential learning, enabling students to interact with mathematical ideas through concrete materials, visual representations, and meaningful contexts.

Creating problem situations that are appropriate to students' cognitive levels plays a crucial role in supporting problem-solving competence. Such situations should be designed to stimulate curiosity, encourage questioning, and require students to think beyond routine procedures. When students are placed in problem-based learning contexts, they are provided with opportunities to analyze situations, formulate questions, and explore possible solution strategies. These activities contribute to creating favorable conditions for the gradual development of mathematical problem-solving competence.

4.2. Orientation Toward Competence Development Through Teaching Mathematical Word Problems

Mathematical word problems serve as a central medium for developing problem-solving competence in primary mathematics education. From a theoretical standpoint, instruction should focus on diversifying types of word problems rather than limiting learning to repetitive or stereotypical formats. Exposure to varied problem structures enables students to recognize underlying mathematical relationships and apply knowledge flexibly.

Encouraging multiple solution strategies is another important orientation. Allowing students to approach the same problem in different ways helps them develop strategic thinking and deepen conceptual understanding. In addition, emphasizing mathematical communication supports students in articulating their reasoning processes. Through the systematic use of mathematical language, symbols, and representations, students gradually develop the ability to explain, justify, and reflect on their solutions. These orientations contribute to strengthening the cognitive and communicative dimensions of mathematical problem-solving competence.

4.3. Orientation Toward Competence Development Through Assessment

Assessment plays a formative role in the development of mathematical problem-solving competence. From a theoretical perspective, assessment should focus not only on final answers but also on students' problem-solving processes. Process-oriented assessment provides insight into students' thinking, strategy use, and reasoning, thereby creating opportunities to support and guide learning.

The use of open-ended questions and real-life problem situations is particularly important in assessing problem-solving competence. Such tasks allow students to demonstrate their understanding, creativity, and ability to apply mathematics in meaningful contexts. In addition, creating opportunities for self-assessment and peer feedback helps students develop reflective thinking and metacognitive awareness. These assessment orientations help create conditions that support the continuous development of mathematical problem-solving competence rather than merely measuring learning outcomes.

5. CONCLUSION

Developing mathematical problem-solving competence for students in Grades 4 and 5 is a fundamental requirement of contemporary primary mathematics education, particularly within the context of competency-based curriculum reform. This study has examined key theoretical issues related to mathematical problem-solving competence, including its conceptual foundations, structural components, and manifestations in primary school students. By analyzing the cognitive characteristics of Grade 4 and 5 students and the requirements of the 2018 General Education Curriculum, the study highlights the importance of aligning instructional practices with students' developmental needs. The proposed theoretical orientations, focusing on learning activities, word problem instruction, and assessment, provide a conceptual basis for supporting the development of mathematical problem-solving competence in primary education.

Future research may build upon these theoretical foundations by conducting empirical or experimental studies to examine the effectiveness of specific instructional approaches and assessment strategies. Such studies would contribute to enriching both theory and practice in primary mathematics education.

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