Students' Mathematical Problem Solving Skills in Solving Math Problems at the Elementary School Level

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Abstract. This research seeks to examine elementary school students' mathematical problem-solving abilities in addressing mathematics-related tasks**.** The research subjects consisted of 28 fourth grade students from UPTD SDN 3 Percontohan Peusangan, Sekolah Alam Bireuen (SABIR), and UPTD SDN 5 Juli. Through a descriptive qualitative approach, this study identifies students' abilities based on four indicators of problem solving, namely: (1) problem understanding, (2) problem-solving planning, (3) plan execution, and (4) reexamination of the process and results of solving the problem. This study applied test and documentation techniques to collect data as well as data reduction, data presentation, and conclusion drawing techniques to analyze the data. The results prove that the level of students' ability in problem solving varies on each indicator. The percentage obtained from the analysis shows the level of students' mathematical problem solving ability as follows: (a) understanding the problem by 40%, (b) planning problem solving by 55%, (c) implementing the plan by 58%, and (d) checking the process and results by 39%. The findings provide insights into how students in primary school develop their problem-solving skills as well as the factors that influence each stage of problem-solving.

Keywords: descriptive qualitative, mathematical problem solving, mathematics, elementary school.

1 Introduction

Education is a structured and gradual process with the aim of forming individuals who have knowledge, skills, and character [1]. In this process, there is a reference or standard as a measuring point for educational success. The reference is usually in the form of a curriculum. The curriculum in Indonesia has undergone many changes over time to adapt to the development of science, technology, culture, and the needs of society [2] . Currently, Indonesia uses an independent curriculum or also called independent learning. The Merdeka Curriculum is a step forward in Indonesian education to form an adaptive and competitive generation in the global era. [3]. Although its implementation still takes time, this paradigm has the potential to provide significant positive changes in the world of education [4]. Fianingrum [5] in her research found that the implementation of Merdeka Curriculum has a positive impact on mathematics learning.

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A crucial subject in the field of education is the subject of mathematics [6]. Mathematics does have a very important role in the education system, both in Indonesia and in many other countries. This can be seen from the number of hours of this subject compared to other subjects [7]. Mathematics lessons in the implementation of education are given at all levels of education, ranging form elementary school to higher education. [8]. The competency in problem-solving is very important for everyone [9]. Not only because most of human life will face problems that need to be solved, but problem solving can also improve analytical skills and can help to solve problems in various other situations [10]. Mathematics encompasses the process of problem-solving [11]. Within the framework of mathematics learning process, the so-called problems are those associated with learning material or mathematics assignment material problems, and not problems related to obstacles in learning or low learning outcomes obtained by students in mathematics. The process of problem-solving in mathematics education holds significant importance, because not only aims to solve certain problems, but also to develop various cognitive aspects of students that are important in mathematics. [12]. One of the primary objectives of mathematics education is to develop students' proficiency in effectively solving problems. [13]. This ability includes several stages that are crucial to the mathematical thinking process, and is important to emphasize in every aspect of mathematics teaching [14]. Problem solving in mathematics is complex and can be challenging, both cognitively and emotionally [15].

In the context of education at the elementary school level, mathematical problem-solving is an essential competency that must be cultivated. One of the main objectives of learning mathematics in elementary school is to equip students with mathematical problem-solving competencies. Not only assists students understand mathematical concepts, problem-solving in mathematics also enables students to identify, analyze, and solve mathematical problems encountered in everyday life. [16]. However, although problem solving is a very important part of learning mathematics, many students still have difficulty in dealing with it [14]. At the primary school level, students' proficiency in mathematical problem-solving is a crucial determinant in the advancement of their mathematical skills. According to some previous studies, students' problem-solving skills at the primary school level tend to be low, especially in solving more complex math problems. This problem is often related to a lack of understanding of how to develop appropriate strategies in dealing with various types of math problems. According to Maghfirah & Sukamto, this is often caused by several factors, such as the lack of effective problem-solving strategies, limited basic knowledge that is not solid, and teaching methods that are not in accordance with students' learning needs. [17].

Mathematical problem-solving ability is a critical competency that students are required to acquire, including at the elementary school level. [14]. In the *Merdeka Curriculum*, the learning objectives of mathematics not only involve numeracy skills, but also the ability to identify problems, formulate strategies, and implement mathematical procedures correctly. This ability is the basis for developing students' critical, analytical, and creative thinking skills which are very useful in everyday life. Polya [18] asserted that problem-solving is the endeavor to identify a solution, and achieve goals that are not intentionally achievable. One of the efforts to train students' ability in mathematical solving is using Polya's theory with the first stage of understanding the problem, the second is developing a plan, the third is implementing the plan, the fourth is checking again. Solving a problem is not only by reading, but also by understanding the contents of the problem. Students here as objects who must master various concepts in mathematics.

The problem comprehension stage is a critical phase in the educational process, especially in the context of solving problems or completing tasks. Often, students face difficulties in understanding the essence of a problem due to a lack of critical thinking skills or experience in analyzing complex situations. Some of the problems often encountered by students include difficulties in reading and interpreting instructions correctly, as well as difficulties in identifying relevant information to address the problem. For instance, in mathematical problems, students may be confused by the language of the problem that contains concepts that have not been fully mastered, they may have difficulty connecting concepts that have been learned with the problem at hand. In addition, fear of failure or lack of confidence can also prevent students from fully understanding the problem, as they may feel pressured or hesitant to ask questions or try new approaches. In dealing with these issues, it is important to provide appropriate support, such as additional tutoring, more practice problems, and approaches that encourage confidence and independence in learning. This will help students understand the problem more clearly and improve their ability to complete the task.

In principle, mathematical problem solving teaches students to work independently and collaboratively, as they often have to discuss and work together with their peers in solving complex problems. By mastering mathematical problem solving skills early on, students will have a strong foundation to face future academic and daily life challenges. Therefore, it is important for education in primary schools to give sufficient attention to the development of students' mathematical problem-solving skills as a fundamental component of their curriculum.

This study seeks to explore and evaluate students' mathematical problem-solving comptencies in addressing mathematical problems at the primary school level. By understanding the challenges and factors that influence this ability, it is hoped that more effective teaching strategies can be found that can improve students' problem-solving ability at the primary level.

2 Research Method

The method applied in this study is qualitative with a descriptive approach. The focus of this research is to evaluate students' mathematical problem-solving competencies in addressing mathematical problems. The research subjects consisted of 28 fourth grade students from UPTD SDN 3 Percontohan Peusangan, Sekolah Alam Bireuen (SABIR), and UPTD SDN 5 Juli. The sample determination was done purposively. Primary data collection through tests as an instrument that includes 4 indicators of questions related to problem solving. The administration of this test is intended to gather data and observational materials concerning student errors in solving mathematical problems. The indicators of problem-solving competencies used include; (1) understanding the problem, (2) planning problem solving, (3) executing the plan, and (4) evaluating the process and solution outcomes. The instrument was given to 28 students from class IV in the three schools. The instrument was then analyzed to find out how students' problem solving skills. Primary data are derived students' responses to problem solving competencies test items. Meanwhile, secondary data are obtained from literature and documents, including students' mathematics scores from the previous semester. Data reduction, verification, data checking, and conclusion drawing techniques were applied to this study to analyze the data.

The techniques in analyzing the data are as follows:
Percentage Total score of each problem-solving competence indicator

$$P_k = \frac{Score\ obtained\ on\ indicator\ k}{Total\ score\ on\ indicator\ k} x\ 100\%$$

Description:
P_k = Percentage of total score on the k indicator 1,2,3,4

Table 1. Criteria for Percentage of Problem Solving Ability

Classification of Problem Solving Ability	Description
$\boldsymbol{P_i < 20\%}$	Very low
$20\% \leq \boldsymbol{P_k} < 40\%$	Low
$40\% \leq \boldsymbol{P_k} < 60\%$	Medium
$60\% \leq \boldsymbol{P_k} < 80\%$	High
$\boldsymbol{P_k} > 80\%$	Very High

3 Result and Discussion

3.1 Result

The findings of the error analysis from students in solving problem-solving ability tasks shows several indicators that need to be redirected or guided again with the aim of improving their skills in solving math problems that contain problem solving indicators. Mathematical problem-solving competence is a key skill that students need to master at the primary school level, particulary within the domain of area measurement, which constitutes a significant component of the mathematics curriculum. According to Polya [19], mathematical problem solving can be decomposed into four main stages, includes; comprehending the problem, formulating the solution, executing the plan, and evaluating the obtained solution. The following are the results of students' mathematical problem-solving competencies.

Table 2. Recapitulation Table of Students' Mathematical Problem Solving Ability

No.	Problem Solving Indicator (PM)	Student Score	Maximum Score	Percentage	Criteria
1	PM 1	168	420	40	Medium
2	PM 2	154	280	55	Medium
3	PM 3	245	420	58	Medium
4	PM 4	110	280	39	Low
	Total	677	1400	48	Medium

The table shows the data analysis of students' problem solving (PM) indicators as well as the scores obtained, maximum score, percentage of achievement, and assessment criteria. There are four problem solving indicators, namely Problem Solving (PM) 1, Problem Solving (PM) 2, Problem Solving (PM) 3, and Problem Solving (PM) 4. The scores obtained by students vary, with details: PM 1 scored 168 out of a maximum score of 420, PM 2 scored 154 out of 280, PM 3 scored 245 out of 420, and PM 4 scored 110 out of 280. The percentage of achievement of

each indicator was 40% for PM 1, 55% for PM 2, 58% for PM 3, and 39% for PM 4. Based on the criteria, the first three indicators (PM 1, PM 2, PM 3) were categorized as moderate, while PM 4 was classified as low. Overall, the total number of student scores is 677 out of a maximum total score of 1400, with an overall achievement percentage of 48%, which is categorized as medium. In the table, it appears that all samples have problem solving skills that are still classified as moderate and low. When grouped, no one can be classified as high or very high ability for each indicator.

Analysis of students' comptence to solve area measurement problems as well as this stage can provide an overview of the extent to which students are able to integrate mathematical concepts and apply them to real situations.

3.1.1 Understanding the problem

The initial stage in math problem-solving is understanding the problem. Students are required to recognize the critical aspects of the problem, such as the information given and what is being asked. In the context of area measurement, this involves an understanding of geometric shapes, units of measurement, and relationships between variables. As with the findings of this study, some students showed weaknesses in identifying important information relevant to the problem. This suggests that the ability to read and understand the text of mathematical problems is one among the primary challenges that influence problem solving comptence. For example, problems that involve the concept of the combined area of several flat shapes can confuse students who do not understand how to conceptually divide or combine the shapes. This is in line with Simbolon's findings [20] which shows that lack of mastery of basic concepts is often an obstacle in understanding problems.

3.1.2 Planning Problem Solving

The second stage is planning problem solving. At this stage, students are asked to formulate strategies or steps that can be used to solve the problem. In the context of area measurement, strategies that are often used include dividing flat shapes into simpler parts, such as rectangles or triangles, then calculating the area of each part before adding them up. However, based on the observation, not all students were able to design the plan well. Some students tend to immediately try to solve problems without clear planning, which often leads to errors. Research by Tarihoran et al. [21] showed that students who are taught to make diagrams or sketches at this stage tend to have a higher success rate than students who do not use visualization. At this stage, students must plan a solution that depends on their own experience and knowledge. [22].

3.1.3 Implementing the Plan

After the solution plan is made, the next step is to implement the plan. The stage of implementing the plan in mathematical problem-solving is an important step to implement the strategies that have been planned in the previous stage. At this stage, students or problem solvers begin to implement the steps that have been designed, in a systematic and organized manner.

After identifying the problem and formulating a solution plan, the next step is to start applying relevant mathematical methods or operations. For example, if the problem involves arithmetic operations, the problem solver will start using addition, subtraction, multiplication or division according to the plan. During this process, it is important to monitor interim results to ensure that the approach taken is correct and appropriate. Students should be open to the possibility of errors and be ready to correct if necessary. At this stage, the ability to apply the mathematical concepts that have been learned will be tested, as well as the accuracy and consistency in working through each step. If needed, tools such as pictures or diagrams can also be used to facilitate calculations and visualization. This process must be done with thoroughness to ensure that the findings are accurate and in accordance with the original purpose of solving the problem. At this stage, students should apply the relevant area formula, such as $L = p\ x\ l$ for rectangles with high accuracy. Errors at this stage are often due to a lack of calculation accuracy or errors in the substitution of values into the formula. For example, students may miscalculate the side lengths or err in the final sum. Research shows that students with good basic arithmetic skills tend to be more successful at this stage compared to students who have weaknesses in arithmetic operations. In this step, students implement the plan that has been developed to solve the given problem, providing intensive practice with gradual problems can improve students' skills in carrying out the solution plan more accurately [14]. [14][23].

3.1.4 Checking the Settlement Process and Results

The last stage according to Polya is to check the process and solution results that have been obtained. This stage aims to ensure that the answer given is correct and relevant to the problem posed. However, research shows that many students skip this stage due to a lack of habit to reflect on their answers. In area measurement, for example, students who make calculation errors often do not realize it because they do not recheck their work. At this stage, it has been shown that *scaffolding*, such as asking students to verbally explain the steps they took, can help improve their ability to double-check their answers [24]. [24][25]. The stage of checking the process or result is often a challenge for students because it involves the ability to evaluate and reflect on what they have done. In general, students will have difficulty in identifying errors or shortcomings. One of the main challenges is the lack of skills in providing feedback to oneself, which can lead to them not realizing small mistakes that can affect the final result. In addition, many students find it difficult to determine whether they have achieved the desired goal, especially if the success criteria are not clearly explained. Some students also tend to feel less confident in checking their results, afraid of making more mistakes or criticizing their own work. This process requires perseverance and critical thinking skills, which do not always develop automatically in every individual. Therefore, it is important for educators to provide effective guidance in training students to examine and assess their learning processes and outcomes, by providing concrete examples, tools and reflection strategies that can help students identify improvement steps that need to be taken.

Various factors can affect students' ability to solve area measurement problems. Internal factors, such as concept understanding, learning motivation and self-confidence, play an important role. In addition, the learning environment also contributes to students' problem-solving comptence. The effectiveness of teaching, the limited diversity of instructional methods, and the insuffcient application of problem-based approaches are often obstacles in developing students' abilities. According to research by Hudojo (2005), learning approaches that are

interactive, problem-based and involve exploration and group discussion can improve students' ability to understand and solve problems. [26][27][28][29]

3.2 Discussion

Students' mathematical problem-solving ability in this study was classified as low, with a percentage of 40%. In contrast to the research of Agustami et al [30]who found that the indicator of understanding the problem was the stage that students mastered the most; they obtained 50% of the indicator. This is because the problems given during the test are different in level from the problems that students often receive. Even though the easiest stage for students is understanding the problem, some students still wrote the wrong information needed, even wrote the wrong elements they knew when asked about the material of the area of flat buildings. The percentage of students who have mathematical problem-solving comptence in the indicator of solution planning is 55%, which indicates that they meet the medium criteria. As with Kurniawan' et al study where the planning stage of problem solving has a higher percentage than the indicator of understanding the problem. Because the majority of students do not write down the necessary information for the problem, but they immediately write down the strategy, formula or method in solving the problem.

Students' competence to handle problems in the plan implementation indicator is also still relatively low, which is at 58%. This happens because students are often not given the opportunity to practice challenging problems in real contexts, students are often given routine problems in the educational process. Thus causing students find it difficult in identifying steps to implement the plan. Low motivation and lack of confidence can also make students lazy to try or continue implementing the plan if they feel they will fail. Zimmerman and Schunk [31] showed that intrinsic motivation is positively correlated with successful plan execution in problem solving. According to Vygotsky [32], *scaffolding* from teachers or peers is very important in helping students implement plans effectively. The last stage is the indicator of checking back with the indicator at 39%. This is the lowest indicator after the indicator of understanding the problem. This happens because many students are rarely trained to re-examine their solutions. Training at school often focuses on solving problems quickly rather than on the process of reflection and evaluation. Polya [19] emphasizes that the evaluation step is often neglected in the learning process, so this ability is less developed. In addition, low self-confidence can make students hesitate to recheck their answers. Conversely, students with excessive confidence may feel no need to double-check. Zimmerman [33] suggests that self-confidence is related to learning strategies, including self-evaluation. When students are given limited time to complete a task, they tend to ignore the evaluation step to save time. In addition, Montague and Applegate [34] showed that time pressure makes students focus more on problem solving than on the quality of the solution. Teachers can contribute to building this positive attitude by creating a supportive learning environment and reducing excessive pressure on the final result. For example, providing constructive feedback rather than simply pointing out correct or incorrect answers can help students understand their mistakes and correct them in the future. Also, giving students the opportunity to work in groups can boost their confidence, as they can learn from their peers.

The limited mathematical problem-solving proficiency of students can also be influenced by the teacher's ability to teach how to handle the problems. Educators must be trained to recognize various problem-solving strategies and adapt them to the needs of students. This

training includes not only pedagogical aspects, but also a deep understanding of the mathematical concepts themselves. Thus, teachers can be effective facilitators in helping students develop their problem-solving skills. In addition, the use of teaching aids and technology also plays an important role in supporting students' problem-solving skills. Concrete props, such as blocks or pictures, help students to visualize problems, especially in students who have a visual learning style. On the other hand, technological applications, such as interactive math software, provide opportunities for students to learn through simulation and independent exploration. However, access to these technologies is uneven in all schools, especially in remote areas, creating gaps in student learning outcomes.

4 Conclusion

Students' mathematical problem solving skills are generally still not good, especially seen from the four indicators of problem-solving, including:

a. Understanding the Problem: Many students have difficulty in understanding the problem in depth. They are often unable to identify relevant information in the problem and lack understanding of what is actually being asked. As a result, students tend to misunderstand the given context or conditions.
b. Planning Problem Solving: In the planning stage, students often have difficulty determining the appropriate strategy to solve the problem. Most students tend not to make a clear plan or are confused about choosing the right way, which results in them not having a clear direction in solving the problem.
c. Implementing the Plan: At the implementation stage, students who have made a plan often have problems implementing the planned steps consistently. Many students make operational errors or do not carry out the plan correctly, so that the results obtained are not appropriate.
d. Checking the Completion Process and Results: At this final stage, students rarely check the process and results they have obtained. Most students immediately accepted the results without reviewing or checking the correctness of the steps taken, so that errors that might have appeared in the previous process were not detected.

As a multifaceted skill, it requires collaboration between teachers, parents and policymakers in problem solbing comptencies to create a supportive learning enivronment. With the right efforts, students at the primary school level can develop problem-solving skills that are not only useful in mathematics, but also in everyday life. Overall, the limited mathematical problem-solving competence of elementary school students highlights the need for a learning model that emphasizes problem comprehension, solution planning, plan implementation, and the evaluation the process and solution outcomes, thereby students' familiarity with systematic and independent problem-solving approaches.

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