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# TEACHERS' BELIEFS ABOUT MATHEMATICAL PROBLEM SOLVING IN ELEMENTARY SCHOOLS : A CASE STUDY IN NUNUKAN REGENCY

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***Abstract***

*This study aims to describe the beliefs of fifth-grade elementary school teachers and students regarding mathematical problem solving, as well as their approaches to teaching and learning problem-solving activities. The research employed a qualitative descriptive method, focusing on the alignment between teachers' and students' perceptions of problem solving within an authentic classroom context. The participants consisted of three teachers from different elementary schools in Nunukan Regency, North Kalimantan, and six students identified by the teachers three categorized as successful and three as less successful in solving mathematical problems. Data were collected through semi-structured interviews and documentation, using an interview guide developed to explore teachers' beliefs and students' problem-solving strategies. The validity of data was ensured through source triangulation and member checking. Data were analyzed using Miles and Huberman's (1992) interactive model, which includes stages of data reduction, data display, and conclusion drawing. The findings revealed three main points: (1) teachers generally associated students' problem-solving success with innate ability, while students attributed success to effort and persistence; (2) both teachers and students shared a narrow understanding of problem solving, viewing it mainly as procedural computation rather than reasoning or exploration; and (3) teachers assessed students' success primarily based on accuracy in calculation, resulting in classroom practices that emphasized procedures over conceptual understanding. In conclusion, the study highlights the need to strengthen teachers' pedagogical beliefs and promote reasoning-oriented instruction in mathematics classrooms. However, the limited number of participants restricts the generalizability of the findings. Future studies with larger samples and classroom observations are recommended to validate and expand these results.*

***keywords:*** *Teachers' Beliefs; Problem Solving; Mathematics; Elementary School.*

**Abstrak**

Penelitian ini bertujuan untuk mendeskripsikan keyakinan guru dan siswa kelas V sekolah dasar mengenai pemecahan masalah matematika serta pendekatan mereka dalam proses pembelajaran. Penelitian ini menggunakan metode deskriptif kualitatif yang berfokus pada kesesuaian antara persepsi guru dan siswa terhadap pemecahan masalah dalam konteks pembelajaran yang autentik. Partisipan penelitian terdiri atas tiga orang guru dari sekolah dasar yang berbeda di Kabupaten Nunukan, Kalimantan Utara, serta enam orang siswa yang diidentifikasi oleh guru, tiga siswa tergolong berhasil dan tiga siswa kurang berhasil dalam pemecahan masalah matematika. Data dikumpulkan melalui wawancara semi-terstruktur dan dokumentasi, menggunakan pedoman wawancara yang disusun untuk menggali keyakinan guru dan strategi siswa dalam menyelesaikan masalah. Keabsahan data dijamin melalui triangulasi sumber dan pemeriksaan anggota (member checking). Analisis data dilakukan dengan model interaktif Miles dan Huberman (1992) yang meliputi tiga tahap: reduksi data, penyajian data, dan penarikan kesimpulan. Hasil penelitian menunjukkan tiga temuan utama: (1) guru cenderung mengaitkan keberhasilan siswa dalam pemecahan masalah dengan kemampuan bawaan, sedangkan siswa mengaitkannya dengan usaha dan ketekunan; (2) baik guru maupun siswa memiliki pemahaman yang sempit tentang pemecahan masalah, yang dipandang hanya sebagai kegiatan perhitungan prosedural; dan (3) guru menilai keberhasilan siswa terutama berdasarkan ketepatan perhitungan, sehingga pembelajaran lebih menekankan pada prosedur daripada penalaran konseptual. Sebagai kesimpulan, penelitian ini menegaskan pentingnya penguatan keyakinan pedagogis guru serta penerapan pembelajaran matematika yang berorientasi pada penalaran dan eksplorasi. Namun demikian, jumlah partisipan yang terbatas menjadi keterbatasan penelitian ini. Penelitian lanjutan dengan sampel yang lebih luas dan observasi kelas disarankan untuk memperkuat dan memperluas temuan ini.

**Kata Kunci:** Keyakinan Guru; Pemecahan Masalah; Matematika; Sekolah Dasar

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## Introduction

The 2022 National Assessment of Minimum Competency (Asesmen Kompetensi Minimum/AKM), released in March 2023, revealed that the national average numeracy score of elementary school students was 1.57 on a scale of 1–3. This finding indicates that the numeracy mastery of Indonesian students at the national level only reaches about half of the expected standard. In North Kalimantan Province, the average numeracy score was 1.43, while Nunukan Regency scored 1.47, both below the national average. The AKM aims to assess students' ability to think mathematically using concepts, procedures, facts, and tools to solve everyday problems in various relevant contexts. These data reflect that students' numeracy competence remains low and uneven across regions.

To gain deeper insight into this issue, preliminary interviews were conducted with teachers, principals, and school supervisors in Nunukan Regency. The results revealed that the low numeracy performance was primarily linked to students' difficulties in solving mathematical problems similar to those found in AKM tasks. Teachers reported that many students struggled to interpret problems, identify relevant information, and apply appropriate mathematical strategies. This situation illustrates a gap between the expected problem-solving competencies measured by AKM and the actual classroom practices, where mathematics instruction often emphasizes rote procedures rather than conceptual understanding and reasoning. Problem solving is defined by D'Zurilla and Goldfried (1971) as a behavioral process that involves generating various alternative responses to problematic situations and selecting the most effective one. In the context of mathematics education, problem solving serves as an essential skill that allows learners to apply concepts, reasoning, and creativity in addressing unfamiliar situations. Schoenfeld (1982) emphasized aaexploring, formulating, and testing strategies to reach logical conclusions.

Several studies have identified multiple factors influencing students' ability to solve mathematical problems, including attitudes toward mathematics, learning motivation, self-efficacy, and teachers' instructional approaches (Memnun & Akkaya, 2012; Pimta et al., 2009). Guven and Cabakcor (2013) found a significant correlation between students' problem-solving performance and their academic achievement, indicating that developing problem-solving competence contributes directly to broader learning success. However, research also shows that teachers often emphasize procedural knowledge and memorization of formulas rather than reasoning and conceptual understanding (Phonapichat et al., 2014; Karatas & Baki, 2013). As a result, students tend to associate mathematics with mechanical calculation instead of reflective thinking.

Teachers themselves often face challenges in implementing problem-solving-based instruction. Although many recognize its importance for student learning, they still struggle to integrate reasoning and exploration into their classroom practices (Siswono et al., 2017; Yavuz & Erbay, 2015). This challenge may stem from limited pedagogical knowledge about teaching problem solving effectively (Palraj et al., 2017). Studies also reveal inconsistencies between teachers' beliefs and practices, as well as insufficient problem-solving content knowledge,

despite a strong connection between teachers' confidence and their understanding of mathematical problem solving (Siswono et al., 2016).

Considering these findings, it becomes essential to investigate teachers' beliefs about students' mathematical problem-solving abilities. Teachers' beliefs play a crucial role in shaping their instructional decisions and influencing students' opportunities to engage in meaningful problem-solving experiences. Therefore, this study aims to describe elementary school teachers' beliefs regarding mathematical problem solving among students, focusing on three dimensions proposed by Ford (1994): (1) beliefs about the nature of mathematical problem solving, (2) beliefs about the causes of success and failure in problem solving, and (3) beliefs about teaching and learning processes related to problem solving.

## Research Method

This research employed a qualitative descriptive design aimed at explaining teachers' perceptions regarding their confidence in mathematical problem-solving activities at the elementary school level. The participants of this study were three teachers from Class V of elementary schools located in Ngunut District. The selection of participants was based on the variation of teachers' success in facilitating problem-solving activities, those who were considered successful and those who encountered challenges.

Data were collected through semi-structured interviews, classroom observations, and documentation. The interviews were conducted in two stages: (1) initial interviews to explore teachers' understanding of problem-solving, and (2) follow-up interviews to validate responses and clarify findings. Each interview session lasted approximately 45–60 minutes and was conducted individually. The instruments used for data collection consisted of an interview guide, observation sheets, and field notes accompanied by documentation checklists. The interview guide contained open-ended questions designed to explore teachers' beliefs about the nature of problem solving, performance attributions, and classroom practices. The observation sheets were employed to record teachers' instructional strategies and interactions with students during mathematics lessons. Meanwhile, field notes and documentation checklists were used to capture relevant contextual information and to ensure data triangulation throughout the research process.The data were analyzed through three stages data reduction, data presentation, and conclusion drawing as proposed by Miles and Huberman (1992). To ensure validity, data triangulation was applied by comparing information obtained from interviews, observations, and documentation.

**Tabel 1.** Categories of question

| No | Category | Question |
|---|---|---|
| **1** | Nature of Problem Solving | What is mathematical problem solving?<br>Is problem solving also found in other subjects? |
| **2** | Attribution of performance causes in Problem Solving | How do you determine whether a student is successful in problem solving?<br>Why do some students struggle to solve problems? |
| **3** | Teaching and Learning problem solving | What materials do you prepare to teach problem solving?<br>How do you organize the classrooms to support it?<br>Can students use assistive tools, such as calculators, during problem solving? |

In the interviews, teachers and students were presented with four problem-solving tasks. Teachers were first asked to predict which problems their students would be able to solve successfully. Afterward, the same problems were given to students, who were asked to solve them orally. The set of problems, adapted from Ford (1994), is shown below:

**Tabel 2.** Problems

| No | Question Type | Question Form |
|---|---|---|
| **1** | A Story Problem that requires one or two steps to solve | Andi has 4 pictures, in each picture there are 3 motorcycles and 5 cars. Which number sentence shows the total number of vehicles in all the pictures?<br>a. 4 + 5<br>b. 4 x 3<br>c. 4 x 5<br>d. 4 x 5 + 3<br>There were 31 birds on a fence, 6 flew away, and 3 more landed. How many birds are now on the fence? |
| **2** | Reasoning Problems | Everyone on the Football Team is tall, Ari is a tall person. Is Ari on the football team?<br>a. Ari is on the team<br>b. Ari is not on the team<br>c. There isn't enough information to determine whether Ari is on the team.<br>d. I Don't Know<br>Four Cars are parked in a row at the traffic lights. The red car is the first in line. The blue car is behind the red car. The Green car is between the white and blue cars. Which car is last in line? |

This problem was presented to the teachers at the end of the interview session. Teachers were asked to determine whether each problem could be solved by students identified as successful or less successful problem solvers. During the student interviews, these problems were used as interludes between the main interview questions to keep students engaged and to prevent fatigue or frustration. Researchers did not provide any assistance while students attempted to solve the problems. Instead, the interviewer only asked guiding questions such as: *"Can you solve this problem?"*, *"How did you solve it?"*, or *"Why did you choose that method?"* If a student was unable to solve a problem, the researcher moved on to the next question without providing hints or corrections.

## Results and Discussion

### *Results*

The interviews revealed teachers' beliefs about how mathematical problems should be solved. Based on the interview results, it was found that teachers generally perceived a "problem" in problem solving as a task that requires students to apply their computational skills to real-life situations. The three participating teachers expressed their views as follows:

Teacher 1: *"...Problem Solving is to* use *mathematical concepts* and *use them to solve problems in daily life, for example, addition and subtraction."*

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Teacher 2: *"...Problem solving involves performing addition, multiplication, and division operations related to students' daily experiences..."*
Teacher 3: *"...Problem solving is applying mathematical concepts and skills to any real life situation..."*

Next, the teachers were asked to define what problem-solving skills mean and to explain the mathematical concepts involved in such processes. Their responses primarily emphasized students' ability to perform basic computations, particularly addition, subtraction, multiplication, and division. This perspective reflects a procedural understanding of problem solving, focusing on calculation rather than reasoning or strategy. This view was further supported by teachers' responses to the interview question: *"Can you provide examples of problem-solving tasks that allow students to engage in problem-solving activities?"* The examples given illustrated that the problems were designed and assigned directly by the teachers, highlighting a strong emphasis on routine computational exercises rather than open-ended or exploratory problem-solving experiences.

Teacher 1: *"Mrs. Ros went to the market with Rp 100,000 to buy 2 kg of wheat flour, 1.5 kg of sugar, and 0.5 kg of eggs. If 1 kg of wheat flour costs Rp. 12,000, sugar costs Rp. 15,000 per kg, and eggs costs Rp. 18,000 per kg, how much money does Mrs Ros have left?"*
Teacher 2: *"One day, Andi ranked first in his class. The next day, He bought a total of 60 marbles to share equally with his friends. How many marbles did each of Andi's friends receive?*
Teacher 3: *"49 birds were flying in the sky before being divided into seven equal groups. How many birds were in each group?"*

The interview results showed that the problems presented by the teachers were generally routine in nature, focusing primarily on computational operations such as multiplication and division. None of the teachers reported assigning problems from other mathematical domains such as geometry, data, or measurement. When asked whether problem solving also appeared in other subjects they taught, all teachers acknowledged that it did, although their interpretations were limited to tasks involving numerical calculations. Their responses were as follows:

Teacher 1: "*Yes, sometimes in science lessons, such as when calculatinf distances from one place to another"*
Teacher 2: "*Maybe in science or social studies lessons where students have to peform calculations."*
Teacher 3: *"Yes, in science lessons when students are asked to count distance"*

Teachers' beliefs about problem solving indicate that they perceive problem-solving activities as occurring in other subjects as well. However, this perception is primarily based on the idea that those subjects involve numerical calculations or computational tasks. Similarly, students' understanding of the nature of problem solving was largely consistent with their teachers' views. Students described problem solving as follows:

> *"Solving story problems that include numbers that must be subtracted, added, or multiplied to get an answer"; "…word problems that contain numbers and require finding the answer through mathematical operations" "…A kind of problem that must be solved by adding, subtracting, multiplying, or dividing."*

Teachers emphasized that the ability to perform calculations represents an essential skill that is useful in daily life. Students with strong computational abilities are often perceived as capable problem solvers who are likely to succeed in future academic and professional contexts. This perception reflects teachers' beliefs that mathematical problem-solving competence is inherently linked to students' arithmetic proficiency.Furthermore, teachers associated students' success or failure in problem solving with their general academic ability and level of achievement. They also highlighted that effective problem-solving performance depends not only on mathematical knowledge but also on students' reading comprehension skills, which enable them to interpret and analyze problems accurately.

Teacher 1: "…*It seems quite good. Students who can solve problems already know how perform addition and subtraction…"*

Teacher 2: "… *In addition to mathematical ability, students also need to have good reading skills in order to solve problems effectively."*

Teacher 3: "… *Intelligent students are generally able to solve problems well..."*

This viewpoint illustrates teachers' beliefs about the relationship between students' problem-solving abilities and their academic achievement. Teachers reported difficulties in teaching problem solving to students who lacked a strong foundation in basic mathematics. It is common for teachers to associate problem-solving ability with other fundamental skills, such as arithmetic proficiency and reading comprehension. Teachers' attribution of students' problem-solving abilities was further explored through the question, *"Why do you think some students who are unable to solve problems now might perform differently in the future?"* The teachers generally responded that students who are capable of solving problems possess the necessary prior knowledge and experience acquired through previous classroom learning.

Nevertheless, the study revealed variations among students in their ability to solve problems. When asked about students' problem-solving abilities, teachers frequently linked success to effort and persistence. Similarly, students who were initially identified as less capable believed that through greater effort, they could eventually improve their problem-solving skills, even though not all students achieved success. Teachers' predictions regarding students' performance on the four problem-solving tasks showed a consistent pattern. They tended to overestimate students' ability to solve problems involving calculations while underestimating their ability to handle reasoning-based tasks. Correlation analysis indicated a moderate relationship between teachers' predictions and students' actual performance ($r = 0.48$ for students identified as successful problem solvers and $r = 0.57$ for those identified as unsuccessful; $p < 0.005$).

Further analysis revealed that teachers were more accurate in predicting success on procedural or computational problems than on reasoning problems. Teachers generally believed that their students were incapable of solving reasoning tasks. However, contrary to these expectations, several students demonstrated the ability to solve reasoning problems successfully. This finding suggests that the reasoning-based problems used in the study were unfamiliar to

students because such tasks are rarely practiced in daily classroom instruction. Teachers' beliefs about teaching and learning mathematical problem solving in primary schools appear to be inconsistent with contemporary educational approaches. The teachers stated that students should be able to perform calculations independently without using any tools such as calculators. Both teachers and students viewed the use of calculators as a form of dishonesty or "cheating." However, the ability to solve problems is not merely determined by computational skills. Effective problem solving also involves reasoning, specifically, how students understand a problem, develop strategies, and execute solution processes. Thus, problem-solving competence extends beyond mere calculation to include logical thinking, interpretation, and planning.

In practice, problem-solving skills are taught in the same way as other mathematical topics. Teachers typically rely on lectures and demonstrations, presenting examples of problems and solution procedures directly from textbooks or teacher manuals. Students are then expected to follow the same procedures to solve similar problems. This instructional approach focuses primarily on procedural fluency rather than conceptual understanding or strategic reasoning.

Heuristic or inquiry-based strategies commonly recommended in mathematics education were rarely observed in classroom instruction. Supporting evidence from student interviews indicated that many students could not recall ever being explicitly taught how to reason through or evaluate problem-solving processes in mathematics lessons.

***Discussion***

According to the interview findings, teachers perceived a "problem" in problem solving as a task that requires students to apply their computational skills in everyday situations. This view limits the notion of problem solving to students' ability to perform basic arithmetic operations such as addition, subtraction, multiplication, and division. Teachers' perceptions of mathematical "problems" and "problem solving" are often indistinguishable. This aligns with the findings of Xenofontos and Andrews (2014), who reported that many prospective teachers struggle to differentiate between a mathematical problem and the process of problem solving.

Charles and Lester, as cited in Cathcart et al. (2006), define mathematical problems as tasks that require individuals to find a solution for a situation in which the answer is not immediately apparent. Similarly, Resnick and Glaser (1975) describe problem solving as engaging with a situation for which one has no prior solution or experience. Rott (2021) further argues that a problem that can be solved through routine or direct effort should not be considered a true problem-solving task; rather, genuine problem solving involves challenges that require creative insight and non-routine strategies.

Therefore, a mathematical problem in the context of problem solving can be understood as a non-routine task that demands reasoning and adaptability. The non-routine nature of a problem is subjective, depending on the learner's prior experiences—what is challenging for one student may be routine for another (Doorman et al., 2007). Consequently, students' exposure and familiarity with certain problem types influence whether they perceive a task as a genuine problem-solving challenge.

Teachers' assumptions about problem solving also extend to other subjects. They often perceive problem solving as present in disciplines such as science or social studies simply because these subjects include numerical calculations. However, this interpretation reflects a narrow view that equates problem solving solely with computation rather than reasoning or exploration. This misconception contributes to students' limited understanding of problem

solving, leading them to associate it exclusively with numerical word problems that require mathematical operations.

Regarding attribution, teachers tend to relate students' problem-solving success to their initial academic ability and prior achievement. While this may explain students' current performance, Ford (1994) argues that such an assumption cannot predict their future development. In contrast, students themselves often attribute improvement in problem solving to effort and persistence rather than innate ability. Interestingly, several students who were initially considered "less capable" demonstrated the ability to solve reasoning-based problems, suggesting that lack of exposure rather than lack of ability may be the primary barrier.

In terms of instructional practice, teachers predominantly employ lecture and demonstration methods to teach problem solving. They often model step-by-step procedures using examples from textbooks or teacher manuals, which students are then expected to replicate. This approach emphasizes procedural fluency rather than strategic thinking or conceptual understanding. Although teachers recognize the importance of problem solving, studies indicate that they frequently rely on rote memorization and procedural imitation (Siswono et al., 2017; Yavuz & Erbay, 2015). Palraj et al. (2017) further note that this tendency may arise from teachers' limited pedagogical knowledge of how to teach problem solving effectively. Consequently, students may come to perceive problem solving as a short, formulaic activity that relies on memorized procedures rather than creative reasoning (Ozturk & Guven, 2016).

## Conclusion

This study aimed to explore elementary school teachers' beliefs about mathematical problem solving in terms of the nature of problem solving, attribution of performance outcomes, and approaches to teaching and learning. The findings revealed that teachers conceptualized problem solving primarily as story problems involving numerical operations, such as addition, subtraction, multiplication, and division. This view aligns with students' own perceptions, which also associate problem solving with performing calculations to obtain answers.

Teachers attributed students' success in problem solving mainly to basic mathematical abilities and reading comprehension. In classroom practice, teachers' beliefs were reflected in their instructional methods lessons were dominated by lectures and demonstrations that emphasized procedural repetition rather than reasoning or conceptual exploration. Assessment was typically conducted individually rather than collaboratively, as teachers considered group evaluation challenging.

The findings of this study highlight that teachers' conceptions of problem solving remain limited to routine and procedural tasks, whereas true mathematical problem solving involves non-routine situations that require reasoning, creativity, and flexible thinking. Strengthening teachers' understanding of this distinction is essential, as it directly influences how students develop their own problem-solving abilities in the future.

To enhance the quality of mathematics instruction, teachers should be encouraged to adopt heuristic and inquiry-based strategies that engage students in exploration and reflective reasoning rather than memorization. Learning approaches such as Realistic Mathematics Education (RME) and Mathematics in Context (MiC) offer practical frameworks for implementing such strategies, as they emphasize contextual understanding and the development of informal strategies that evolve into formal mathematical reasoning.

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