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Analysis Of Problem-Solving Ability in Solving Open-Ended Problems of Junior High School Students on Social Arithmetics Material

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Abstract
This study aims to determine students' problem-solving abilities in solving open-ended problems in social arithmetic. Problem-solving ability refers to students' capacity to understand problems, plan appropriate strategies, carry out solutions, and evaluate the results. The research method used in this study is descriptive with a qualitative approach. Data collected in this study were taken from problem-solving ability test results and interviews. The study subjects were seventh-grade students of SMP Negeri 1 Botupingge in the 2025/2026 academic year, each of whom was selected using purposive sampling based on their high, medium, and low problem-solving ability levels. The obtained data were then reduced and analyzed qualitatively, taking into account indicators of the problem-solving ability process. The results show that students with high problem-solving abilities demonstrated excellent problem-solving abilities across almost all indicators. Meanwhile, students with moderate problem-solving abilities were at a sufficient level but were not yet stable and still required guidance, especially in planning and interpreting solutions. Meanwhile, students with low problem-solving abilities had not yet mastered problem-solving skills and required intensive learning intervention.

Keywords: Problem-solving Ability, Social Arithmetic

1. Introduction

Mathematics is a fundamental field of study that plays an important role in developing students' logical, analytical, and systematic thinking abilities (Hanifa et al, 2025). Learning mathematics emphasizes not only calculation but also understanding concepts, relationships between concepts, patterns, and their application to everyday problem-solving.

The curriculum emphasizes that students must understand concepts, use procedures flexibly and accurately, and communicate mathematical ideas through various representations. (Kobandaha et al., 2022) The benefits of technological developments for human life are very noticeable, one of which is in the field of education. One of the benchmarks in mathematics learning activities is the students' ability to solve mathematical problems (Ristyaningsih et al, 2019). The ability to solve mathematical problems is a crucial part of the mathematics learning process (Suleman et al, 2023). The importance of problem-solving skills is reflected in the objectives of mathematics education (Isa et al., 2023). Problem-solving is an application of the concepts, skills, and understanding possessed by students, where solving problems involves a combination of concepts, skills, and understanding in new or different situations.

The indicators of problem-solving ability in this study refer to Polya's theory, which consists of four main stages. First, understanding the problem, which involves identifying known and unknown information. Second, devising a plan, which includes determining appropriate strategies or methods to solve the problem. Third, carrying out the plan, which refers to implementing the chosen strategy systematically. Fourth, looking back, which involves checking and interpreting the results obtained. These indicators are used to assess the extent to which students are able to solve mathematical problems effectively.

One effective way to develop this ability is through Open-Ended problems. (Hariyono and Susanah, 2021) state that Open-Ended problems encourage students to think divergently and explore various solution strategies. However, learning practices in junior high schools still tend to emphasize single procedures and correct answers, thereby hindering students' creativity (Prihatiningsih and Ratu, 2020). As a result, students lack confidence, show minimal participation in discussions, and struggle with more complex problems.

Previous studies show that students' problem-solving abilities on Open-Ended problems are still low. (Dila and Zanthy, 2020) report that eighth-grade students still struggle with Open-Ended

social arithmetic, while (Fatmala et al, 2020) find that many students make errors in understanding, planning, carrying out, and checking their solutions.

Interviews with teachers also indicate that students can follow examples but fail when problems are modified. The errors found in students' work reflect insufficient conceptual understanding and an inability to construct appropriate solution plans. This aligns with previous findings and highlights the need for deeper analysis.

Internal factors such as motivation also influence problem-solving ability; students with higher motivation are better able to explore strategies (Isna and Kurniasari, 2018). External factors such as teaching methods also play a role, and teachers have a major responsibility in providing varied types of problems (Hidayat & Widjajanti, 2018). Social arithmetic material itself is closely related to everyday life and can be solved in various ways (Diza et al., 2022); it also requires creativity (Mauliddiyah, 2021), although students' understanding remains low (Fatmala et al, 2020).

Thus, there is a gap between the goals of mathematics learning and the realities in the classroom. The low ability of students to solve Open-Ended problems, particularly in social arithmetic, indicates the need for further research. Therefore, this study, titled "An Analysis of Junior High School Students' Problem-Solving Ability in Solving Open-Ended Problems on Social Arithmetic," aims to contribute to the improvement of mathematics learning.

2. Methods

This study employs a qualitative approach with a descriptive qualitative research design. According to Sugiyono (2023), qualitative research is a method grounded in post-positivist philosophy, used to investigate natural conditions of objects, in which the researcher functions as the key instrument. Data collection techniques are conducted through triangulation (a combination of various techniques), while data analysis is carried out inductively. The results of qualitative research emphasize meaning rather than generalization.
Through this study, the researcher aims to explore in depth students' problem-solving abilities in solving open-ended problems based on their levels of mathematical ability, namely high, medium, and low. Problem-solving ability in this study refers to students' capacity to understand problems, devise solution strategies, carry out the plans, and evaluate the results. This is in line with Polya's theory, which consists of four stages: understanding the problem, devising a plan, carrying out the plan, and looking back.

The level of students' problem-solving ability is determined using a scoring formula:
Score = (obtained score / maximum score) × 100%
The results are then categorized into three levels: high (80–100%), medium (60–79%), and low (<60%).

The data obtained in this study consist of descriptive verbal information conveyed directly according to actual conditions in the field, including what is experienced, felt, or expressed by the participants. This research primarily focuses on students' activities when solving open-ended problems. The observed processes include students' activities during learning as well as when working on the given tasks.

3. Result and Discussion

Problem-solving ability is an essential skill in mathematics learning because it enables students to apply concepts in new and unfamiliar situations. According to Polya (1957), problem-solving consists of four stages: understanding the problem, devising a plan, carrying out the plan, and looking back. These stages provide a systematic framework that helps students solve mathematical problems in a structured way.

This idea is supported by Firda, Suryadi, and Dahlan (2023), who state that problem-solving ability includes identifying known information, determining strategies, constructing mathematical models, implementing solution steps, and checking the correctness of the solution.

In addition, research by Jannah, Herman, and Hasanah (2024) shows that Polya's steps are effective in helping students understand and solve social arithmetic problems systematically.

Furthermore, studies in Edumatsains also explain that students' problem-solving ability is influenced by their conceptual understanding and the learning model used. For example, student-centered learning and Open-Ended problem approaches can improve students' ability to analyze and solve mathematical problems in various ways (Edumatsains, 2023).

Another study by Madzkiyah, Subanji, and Arifin (2024) also confirms that students' problem-solving performance based on Polya's stages is generally still low, especially in the stages of planning and evaluating solutions.

Therefore, based on these theories and previous studies, problem-solving ability is not only defined as obtaining the correct answer, but also as a process involving understanding, planning, implementing, and evaluating solutions systematically.

Determination of Research Subjects

Table 1. Categories of Students' Problem-Solving Ability Levels After Test Result Analysis

Solving Ability Category	Number Of Students
High	3
Medium	22
Low	3

Table 1 shows that there are 3 students categorized as having high problem-solving ability, 22 students categorized as Medium, and 3 students categorized as low. Based on these results, the researcher asked for suggestions and recommendations from the mathematics teacher regarding the selection of students who would serve as research subjects. These suggestions were expected to help the researcher gain a deeper understanding of the students' characteristics, particularly those who are able to express ideas or thoughts clearly. Based on the teacher's recommendations, 6 students were selected as the research subjects, as presented in the following table.

Table 2. research subjects

No.	Name	Score	Category	Code
1	AS	69,7	High	PMH1
2	FS	62,1	High	PMH2
3	SN	40,9	Medium	PMM1
4	NZ	38,8	Medium	PMM2
5	FY	18,2	Low	PML1
6	RR	12,1	Low	PML2

Data Triangulation Results

The results of the study show that students' problem-solving abilities in social arithmetic vary based on their ability categories, and this can be analyzed using Polya's four problem-solving indicators. In general, students in the high, medium, and low categories demonstrated consistent patterns of differences, both in test results and interview responses.

In the high category, students were able to understand the problem, select relevant information, and formulate appropriate solution strategies. This indicates that they possess good conceptual understanding and can connect information within the context of the problem. However,

weaknesses were found in their mathematical communication, particularly in writing complete strategies and steps. Although they successfully solved the problems, they tended not to document their thought processes systematically. This limitation aligns with previous studies showing that high-ability students often focus on obtaining the solution but pay less attention to written representation and evaluation of their work.

Students in the medium category demonstrated adequate ability in solving problems, but their understanding was partial. They often failed to write important information and solution plans, resulting in answers that did not fully reflect mature reasoning. During the execution stage, medium-ability students were able to complete some steps correctly, but inconsistencies were found between their verbal explanations and their written answers. This condition indicates that they are still in the developing stage of understanding problem structure and require guidance to plan solutions more systematically.

Meanwhile, students in the low category experienced difficulties in nearly all indicators. They were unable to identify essential information, could not develop solution strategies, and frequently produced answers without clear mathematical processes. Procedural and conceptual errors appeared consistently, along with an inability to interpret results accurately. This suggests that these students have not yet mastered the basic concepts of social arithmetic and are not accustomed to solving problems in a systematic manner. These findings support previous research showing that low-ability students tend to rely on guessing and lack planned strategies.

Differences in ability across categories indicate that problem solving is not only related to computational skills, but also to understanding context, planning strategies, and communicating and evaluating solutions. These results highlight the importance of instructional approaches that allow students to explore multiple solution strategies, such as through the use of Open-Ended problems. Learning that focuses solely on final answers without considering reasoning processes may hinder students' ability to develop logical thinking, representation skills, and reflective judgment.

Thus, instructional strategies that emphasize conceptual understanding, mathematical communication, and systematic problem-solving processes are required. Teachers need to provide differentiated guidance according to students' ability categories and create learning environments that foster exploration and discussion. These efforts are expected to enhance students' problem-

solving abilities, particularly in responding to Open-Ended problems that demand flexible and creative thinking.

Table 3. Summary of Problem Solving Skill Based on Student Category

Student Category	Understanding the Problem	Planing The Settelment	Implement a Solution	Interpreting Result	General Information
High	Good: Able to indentify important information	Good: Able to design strategies, even if they are not writen down completely	Good: Precise and consistent calculation	Not enough: just write the final answer	Able to solve problems, weak in write communication
Currently	Enough: understand some of the information	Enough: plans are porrly written and incossistent	Enough: Some steps are right but still wrong	Poor: does not explain the meaning of the result	Partial understanding, still need guidance in strategy
Low	Low: unable to identfy information	Low: unable to plan steps	Low: lots of procedural errors	Low: Unable to draw conclusion	Answer Are not systematic, often guessing

4. Conclusion

Based on the research findings and discussions presented, it can be concluded that students in the high category (PMH1 and PMH2) demonstrate excellent problem-solving skills. They are able to understand the context of the problem, identify important information, plan strategies logically, and execute calculations accurately and consistently. The step-by-step solutions that are clear and precise reflect their systematic thinking abilities. However, weaknesses are still evident in the aspect of written mathematical communication, especially in presenting information in a complete manner and providing in-depth interpretation of results. Therefore, while high-category students have mastered all problem-solving indicators, there is still room for improvement in reflection and written representation.

Based on the research findings and discussions, it can be concluded that students in the medium category (PMM1 and PMM2) demonstrate problem-solving skills at a satisfactory level, but their performance is not yet stable. They can understand part of the information in the problems but often fail to elaborate it fully. Their planning of solutions is still not well-structured and lacks accuracy in selecting formulas or strategies. In the implementation stage, students can complete

some calculations but still make procedural errors. Meanwhile, in the result interpretation indicator, students tend to write only the final answer without providing an explanation of its meaning or evaluating the answer. Therefore, students in the medium category require guidance in planning solution steps and deepening their interpretation of results.

Based on the research findings and discussions, it can be concluded that students in the low category (PML1 and PML2) face difficulties across all problem-solving indicators. They are unable to identify important information, do not create a solution plan, and often write down numbers directly without a clear calculation process. Conceptual errors and calculation mistakes occur consistently, and students are unable to explain the steps or reasoning behind their solutions. In the result interpretation stage, students cannot provide relevant conclusions and fail to check their work. This indicates that low-category students have not yet mastered problem-solving skills and require intensive and repeated learning interventions.

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