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THE IMPLEMENTATION OF PROBLEM-BASED LEARNING TO IMPROVE MATHEMATICAL PROBLEM SOLVING ABILITY: A CASE ON SOCIAL ARITHMETICS

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ABSTRACT

Mathematics plays a crucial role in fostering students' logical, systematic, and critical thinking skills. However, many students still struggle to understand mathematical concepts that are closely related to real-life situations, such as social arithmetic. This study aims to improve students' mathematical problem-solving skills through the implementation of the Problem-Based Learning (PBL) model. This research was conducted as Classroom Action Research (CAR) in class VII-1 of MTs. Negeri 1 Boalemo, involving 30 students. The study followed the Kemmis and McTaggart model, consisting of two cycles, each with four phases: planning, implementation, observation, and reflection. Data were collected using observation sheets to measure teacher and student activities, and problem-solving tests developed based on Polya's indicators: understanding the problem, planning a solution, implementing the solution, and reviewing the result. The collected data were analyzed descriptively and quantitatively to determine the level of improvement. The results showed a significant increase in the learning process and student achievement. The teacher's ability to manage learning increased from 55.56% in Cycle I to 88.89% in Cycle II. Student activity rose from 37.50% to 87.50%, and the number of students achieving mastery increased from 53.33% to 90%. Therefore, the PBL model effectively enhances students' mathematical problem-solving abilities and promotes active, collaborative learning in the classroom.

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INTRODUCTION

Education plays an important role in determining the quality of a nation. In formal education, mathematics is one of the fields studied by students. Mathematics is one of the essential disciplines taught across all levels of education and plays a vital role in developing students' logical, critical, and systematic thinking skills. Boaler (2020) stated that mathematical understanding contributes to shaping students' cognitive abilities, which are necessary in

academic and everyday contexts. In the era of globalization and rapid technological advancement, the ability to solve problems becomes increasingly important. Damayanti et al. (2023) emphasized that learning should align with students' needs and support meaningful engagement to improve learning outcomes. In learning, students need learning that suits their needs, in order to understand the material provided by educators.

Permendikbud No. 16 of 2022 concerning Elementary and Secondary Education Process Standards, states that learning must be designed to be more interactive, inspiring, challenging, and motivating for students to actively participate. Students' activeness in the learning process will affect student learning achievement. If the activity of learning mathematics is low, then mastery of mathematics is also lacking, as a result the ability to solve mathematical problems is also low. This is the reason why student learning activities greatly influence learning success.

Mathematical problem-solving ability is not only a fundamental competency in mathematics education but also a key to students' success in applying mathematical concepts in various contexts. Pauweni & Iskandar (2021) argued that solving mathematical problems helps students train logical reasoning and analytical skills. In addition, Habuke dkk, (2022) found that problem-solving abilities could be enhanced through interactive and context-based learning media. Problem-solving ability is a basic competency that must be mastered by students (Idrus et al., 2023). In problem-solving abilities, students are required to be able to think critically to solve problems related to real life (Oroh, 2021). Therefore, through mathematics learning, students have the opportunity to develop their problem-solving abilities (Suna et al. 2022). This opinion is supported by (K. Usman et al., 2021) who state that problem-solving abilities for students need to be pursued so that students are able to find solutions to various problems, both in the field of mathematics and problems in everyday life that are increasingly complex.

However, numerous studies and national assessments have revealed that students in Indonesia still perform poorly in solving non-routine mathematical problems. Idrus et al. (2023) highlighted that many students struggle to identify and execute effective strategies in problem solving. According to PISA data, Indonesian students often find it difficult to deal with contextual questions requiring critical thinking. This issue is also evident at MTs. Negeri 1 Boalemo. Preliminary test results show that out of 30 students in class VII-1, only 9 reached the minimum passing grade on social arithmetic problems. The rest failed to understand and apply basic concepts related to profit-loss, discounts, taxes, and interest. Nurwan & Daud (2017) observed that teacher-centered approaches tend to limit student participation and engagement. Hidayati et al. (2023) also reported that low student confidence and limited interaction during mathematics instruction contribute to poor performance.

This shows that the learning approach used is still not effective in improving students' problem-solving skills. This problem arises because the learning applied is still teacher-centered, so that students tend to be passive and less able to construct understanding through exploration and their own experiences. For this reason, the Problem-based learning (PBL) learning model is proposed as a solution. Problem-based learning is a learning model that presents authentic and meaningful problem situations to encourage students' investigation and inquiry processes (Arends, 2019). This model emphasizes the learning process that starts from providing real contextual problems, requiring students to collaborate, explore knowledge, and find solutions through discussion and investigation. PBL has been empirically proven in various studies to be able to improve students' conceptual understanding and high-level thinking skills.

To overcome this problem, Problem-Based Learning (PBL) is introduced as an effective pedagogical approach. PBL engages students in solving authentic problems collaboratively, thereby enhancing their conceptual understanding and problem-solving skills. Hmelo-Silver

(2004) explained that PBL supports the development of critical and analytical thinking. Setiawan & Sari (2021) found that students taught with PBL show improved mathematical performance. Putri et al. (2020) also concluded that PBL enhances concept understanding compared to conventional methods. Similarly, Siagian, Saragih, and Sinaga (2019) found that problem-based learning-based materials also enhanced students' mathematical problem-solving and metacognitive skills. Fatimah & Ardiansyah (2023) demonstrated that PBL improves students' mathematical reasoning. Lestari & Wulandari (2022) found that PBL-based learning environments led to higher student engagement and better outcomes in mathematical problem solving. This is in line with the opinion of (Yusri, 2018), namely that the Problem Based Learning Model provides students with the skills they need to solve real-life problems independently and in groups.

Therefore, this study aims to investigate the implementation of the Problem-Based Learning model in improving students' mathematical problem-solving skills, particularly in the topic of social arithmetic at class VII-1 MTs. Negeri 1 Boalemo.

METHOD

This study employed a Classroom Action Research (CAR) method based on the Kemmis and McTaggart model. The purpose of this method is to improve teaching and learning practices in a real classroom setting through iterative cycles of planning, action, observation, and reflection. The participants in this study were 30 students of class VII-1 at MTs. Negeri 1 Boalemo in the academic year 2024/2025, consisting of 15 male students and 15 female students. The research was conducted over the course of two cycles, with each cycle comprising four meetings.

The instruments used in this research included: (1) Observation sheets to assess teacher performance and student activity during the learning process, (2) A problem-solving ability test developed based on Polya's four stages: understanding the problem, devising a plan, carrying out the plan, and looking back.

The step-by-step procedure for each cycle was carried out through four main stages, namely planning, action, observation, and reflection. In the planning stage, the researcher designed the lesson plan based on the Problem-Based Learning model, prepared supporting materials, and developed observation instruments. During the action stage, the learning process was implemented according to the prepared plan using PBL strategies. In the observation stage, teacher and student activities were monitored and documented using observation sheets. Finally, in the reflection stage, the results obtained from the learning implementation and observations were evaluated to determine the effectiveness of the actions taken and to formulate improvements for the next cycle.

Data analysis was conducted using descriptive quantitative methods. The percentage of teacher performance, student activity, and student test results were calculated and compared between cycles to determine the level of improvement in mathematical problem-solving ability.

RESULTS AND DISCUSSION

Results

This Classroom Action Research (CAR) was conducted in class VII-1 MTs. Negeri 1 Boalemo from May to June 2025 in the 2024/2025 academic year. The subjects in this study were 30 students, consisting of 15 male students and 15 female students, with diverse ability backgrounds.

This Classroom Action Research (CAR) was conducted in two cycles, because the results of students' mathematical problem solving abilities in cycle I had not reached the established success indicators, so the research continued to cycle II. Each cycle in this research includes four stages, namely: (1) planning, (2) implementation of action, (3) observation and (4) reflection. Learning activities in each cycle use the Problem Based Learning (PBL) learning model.

The results of the study showed a significant increase between cycle I and cycle II. In cycle I, the implementation of learning with the PBL model has not run optimally because students are not yet accustomed to problem-based learning.

Results of Cycle I Action Research

Table 1. Percentage of Observation Results of Teacher Activities in Cycle I

Aspects that are observed	Category
Pose problems and guide students to express ideas.	Good
Encourage students to solve problems.	Good
Directing students to seek information.	Good
Guide students to hone problem solving skills.	Pretty good
Encourage collaboration in solving problems.	Good
Guide students to solve problems.	Pretty good
Guide students to solve problems in groups.	Good
Help students review problem solving.	Pretty good
Guiding students who have not finished.	Pretty good
Average *(P)*	**Amount**
Good (5) 55,56% Pretty good (4) 44,44%	(9) 100%

Based on Table 1, it can be seen that the average ability of teachers in managing learning using the Problem Based Learning (PBL) model at the first and second meetings obtained results with the following details: Good category (G) with 5 indicators or 55.56%, and Pretty good category (PG) with 4 indicators or 44.44%. Thus, the level of achievement of teachers' ability in implementing the Problem Based Learning model has only reached 55.56%, still at the minimum criterion of "Good". This shows that teachers' ability in managing learning with the Problem Based Learning model has not met the success criteria set, which is a minimum of 85% in the "Good" and "Very Good" categories.

Table 2. Percentage of Student Activity Observation Results in Cycle I

Aspects that are observed	Category
Pay attention to the teacher's explanation.	Quite Active
Observing teaching materials/problem solving.	Quite Active
Work together to solve problems.	Quite Active
Discuss and ask questions to teachers/friends.	Quite Active
Find a solution.	Active
Presenting the solution results.	Active
Review the process/solution.	Quite Active

Summarize learning outcomes.	Active
Average *(P)*	**Amount**
Active (3) 37,50% Quite Active (4) 62,50%	(8) 100%

Based on Table 2, the average student activity during learning using the Problem Based Learning (PBL) model is obtained. Of the 8 aspects of activity observed during 2 meetings, the results show that students are in the Active (A) category for 3 aspects or 37.50%, and the Quite Active (QA) category for 5 aspects or 62.50%. Thus, the level of student activity that reaches the Active category is only 37.50%, which is still at the minimum criterion of "Active". This shows that student activity in Problem Based Learning-based learning has not met the established success criteria, which is a minimum of 85% in the "Active" and "Very Active" categories.

Table 3. Recapitulation of Completion of Problem Solving Ability Test Cycle I

Test Scores	Number of Students	Percentage Complete
≥ 65 (Complete)	16 person	53,33%
< 65 (Incomplete)	14 person	46,67%
Total	30 person	100%

In cycle I, the researcher gave a mathematical problem-solving ability test related to the material that had been taught to students. The test given consisted of 5 questions, with a minimum individual completion score of 65. After the evaluation in cycle I, the results of the mathematical problem-solving ability test of 30 students who took the test can be seen in Table 3. Of that number, there were 16 students or around 53.33% who scored above the Minimum Completion Criteria (KKM), namely a score above 65. Meanwhile, 14 students or around 46.67% scored below the KKM / not complete. Thus, it can be concluded that students' mathematical problem-solving ability in cycle I has not met the success indicators, namely a minimum of 85% of students achieving a complete score.

Results of Cycle II Action Research

Observations of teacher activities in the learning process in cycle II were carried out using the same procedure as in cycle I, namely by the teacher acting as an observer during the learning activities.

Table 4. Percentage of Observation Results of Teacher Activities in Cycle II

Aspects that are observed	Category
Pose problems and guide students to express ideas.	Good
Encourage students to solve problems.	Good
Directing students to seek information.	Good
Guide students to hone problem solving skills.	Good
Encourage collaboration in solving problems.	Good
Guide students to solve problems.	Good
Guide students to solve problems in groups.	Good
Help students review problem solving.	Pretty good
Guiding students who have not finished.	Very good

Average *(P)*	Amount
VG (1) 11,11% G (7) 77,78% PG (1) 11,11%	(9) 100%

Based on Table 4, the average of the observation results of teacher activities in managing the Problem Based Learning model at the third and fourth meetings showed that 1 aspect (11.11%) was in the Very Good (VG) category, 7 aspects (77.78%) were in the Good (G) category, and 1 aspect (11.11%) was in the Pretty Good (PG) category. Thus, it can be concluded that teacher skills in managing learning with the Problem Based Learning model have reached the minimum criteria of Good, with a success percentage reaching 88.89%. This percentage indicates that the set success indicators have been achieved.

Based on field notes in cycle I, the mathematics learning process using the Problem Based Learning (PBL) model has not run optimally. This is caused by several factors, including: students are still not used to the problem-based learning approach and do not fully understand the stages in problem solving, so students have difficulty in following the learning flow. In addition, learning that is being carried out for the first time by a new teacher is also a challenge in itself, because students are still in the adaptation stage and are not yet confident enough to interact actively in the learning process.

Table 5. Percentage of Student Activity Observation Results in Cycle II

Aspects that are observed	Category
Pay attention to the teacher's explanation.	Active
Observing teaching materials/problem solving.	Active
Work together to solve problems.	Active
Discuss and ask questions to teachers/friends.	Active
Find a solution.	Active
Presenting the solution results.	Active
Review the process/solution.	Quite Active
Summarize learning outcomes.	Very Active
Average *(P)*	**Amount**
VA (1) 12,50% A (6) 75,00% QA (1) 12,50%	(8) 100%

Based on Table 5, the average observation results of student activities in learning using the Problem Based Learning (PBL) model show that of all aspects observed at each meeting, 1 aspect (12.50%) is in the Very Active (VA) category, 6 aspects (75.00%) in the Active (A) category, and 1 aspect (12.50%) in the Quite Active (QA) category. Thus, the percentage of student activity achievement included in the minimum Active and Very Active categories reached 87.50%. These results indicate that student activities during the learning process using the Problem Based Learning (PBL) model have met the established success indicators, namely a minimum of 85% in the "Active" and "Very Active" categories.

Table 6. Recapitulation of Completion of Problem Solving Ability Test Cycle II

Test Scores	Number of Students	Percentage Complete
≥ 65 (Complete)	27 person	90%
< 65 (Incomplete)	3 person	10%

Total	30 person	100%

Based on Table 4.6, the average results of the mathematical problem-solving ability test in cycle II show that out of 30 students who took the test, 27 students (90%) scored above the KKM score, while 3 students (10%) were still below the KKM score or had not achieved completion. These results indicate an increase in students' mathematical problem-solving ability from cycle I to cycle II, and have met the established success indicators, namely at least 85% of students achieving completion.

The results of observations of teacher activities in cycle II showed that 88.89% of each aspect of the assessment had achieved the established criteria, namely in the "Good" and "Very Good" categories. Likewise, the results of observations of student activities showed an achievement of 87.50% which was included in the minimum category of "Active" and "Very Active". In addition, the results of the students' mathematical problem-solving ability test have also met the success indicators, with 90% of students obtaining scores above the Minimum Completion Criteria (KKM). When compared to cycle I which only reached 53.33% of students completed, then in cycle II there has been a significant increase of 36.67%.

Discussions

The purpose of this study was to improve students' mathematical problem-solving skills through the application of the Problem-Based Learning (PBL) model on social arithmetic material in class VII-1 MTs. Negeri 1 Boalemo. The results showed a significant increase in all aspects: teacher performance, student activity, and students' problem-solving test scores. In cycle I, only 53.33% of students met the minimum criteria, while in cycle II this increased to 90%.

These findings are in line with several previous studies. Research by Khairun Nisak (2020) at SMPN 2 Indra Jaya Sigli demonstrated that applying the PBL model to geometry material increased student mastery from 78% to 95.65%. The study concluded that PBL could improve student understanding through collaboration and contextual learning activities, which is also reflected in the results of this study. Another relevant study by Adita Dwi Safirah and Moh. Irfan Abdillah (2021) showed that PBL significantly improved elementary school students' mathematical problem-solving skills compared to traditional methods. Their research confirmed that PBL encourages students to actively construct knowledge and become more confident in solving mathematical problems, supporting the increase seen in this study. A classroom action research conducted by Muhammad Yusuf (2021) at SMPN 9 Padangsidimpuan also found that students' mathematical problem-solving ability improved significantly after using the PBL model in class VII. The study highlighted that student participation, motivation, and learning outcomes improved due to the use of real-life problems and cooperative learning, which aligns with the current findings. In addition, previous research in study includes the work of Zahra Amelia (2020), who conducted classroom action research in junior high school. Her findings confirmed that the PBL model could enhance learning outcomes in general mathematics subjects. These studies emphasized that repeated cycles of planning and reflection in classroom action research contribute to increased student performance. Lastly, research by Putri, Yuliani, and Haris (2020) reported that students taught using the PBL model achieved better conceptual understanding than those taught using conventional methods. Their findings indicate that PBL improves students' ability to connect mathematical concepts with real-life applications, which mirrors the improvement observed in this study.

Therefore, the findings of this study reinforce that the Problem-Based Learning model is effective in enhancing students' mathematical problem-solving abilities. It also promotes active

participation, collaboration, and reflective thinking, all of which are essential components of meaningful mathematics learning. Overall, reinforce that the PBL model not only improves academic performance but also encourages active learning and fosters students' confidence and autonomy in learning mathematics. The alignment between this study and other research supports the effectiveness of PBL in developing students' mathematical problem-solving skills.

Based on the results of the study, the implementation of classroom actions carried out up to two cycles showed a significant increase in the quality of learning. This is because in cycle I, the implementation of learning using the Problem Based Learning (PBL) model has not achieved the performance indicators that have been set. After reflecting on the learning process in cycle I, improvements were made to the actions in cycle II. These improvements include improving the quality of teacher activities in managing learning, increasing student activity during the learning process, and improving the results of mathematical problem-solving ability tests. The results in cycle II showed that all of these aspects experienced positive developments and had met the specified success indicators. Thus, learning can be said to be effective. This is in line with Salim's (2020) opinion, which states that learning is said to be effective if the learning outcomes and activities of students who participate in problem-solving-based learning are better than students who participate in conventional learning, especially in achieving learning completeness. Therefore, the action hypothesis in this study which states that the application of the Problem Based Learning (PBL) learning model to social arithmetic material can improve students' mathematical problem-solving abilities is proven to be true and can be accepted scientifically.

CONCLUSION

Based on the results of the research and discussion that has been done, it can be concluded that learning using the Problem Based Learning (PBL) model can improve the ability to solve mathematical problems in the social arithmetic material of class VII-1 students of MTs. Negeri 1 Boalemo. This increase is shown through three main aspects, namely: (1) the ability of teachers in managing learning with the Problem Based Learning (PBL) model has increased from 55.56% in cycle I to 88.89% in cycle II, both of which are in the categories "Good" and "Very Good", (2) student activity during learning also showed a significant increase, from 37.50% in cycle I to 87.50% in cycle II in the categories "Active" and "Very Active", and (3) the results of the students' mathematical problem solving ability test showed an increase from 53.33% who achieved completion in cycle I to 90% who completed in cycle II. Thus, the application of the Problem Based Learning (PBL) model has proven effective in improving students' mathematical problem solving abilities in the material taught.

This study proves that the Problem Based Learning (PBL) learning model can improve students' mathematical problem-solving abilities in social arithmetic material. This improvement is not only reflected in learning outcomes, but also in student engagement and the quality of learning interactions. In other words, the hypothesis that PBL is effective in improving students' mathematical problem-solving abilities is proven and scientifically acceptable.

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