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Implementation of Problem-Based LKPD to Improve Critical Thinking Skills in Mathematics of Grade VII Students on Social Arithmetic Material

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Abstract: *One of the directions of National Education is to produce individuals who are able to overcome problems and emphasize active learning. Therefore, students must have communication skills. One of them is mathematical communication skills, namely the ability to express ideas or ideas in the form of tables, diagrams, or spoken language to express mathematical ideas and arguments precisely, concisely, and logically. There are several problems, one of which is students' difficulties in arithmetic material. This research uses the Classroom Action Research (CAR) method. The application of problem-based LKPD aims to improve the critical thinking skills in mathematics of class VII students in social arithmetic material at SMP Negeri 2 Madiun. This increase can be seen from the increase in student learning collaboration questionnaire results starting from the pre-cycle, cycle 1, and cycle 2 stages which show an increase in the percentage of student learning collaboration from 16%, 25%, to 53% at the high critical thinking stage.*

Keywords— Learning; Problem-based LKPD; Critical thinking

1. INTRODUCTION

Education is a crucial aspect of human resource development. According to Article 3 of Law No. 20 of 2003, the purpose of national education is to develop the capabilities and character of a dignified nation to enhance the intellectual life of the nation. It also aims to produce citizens who are devout and pious to God Almighty, possess noble character, and are healthy, knowledgeable, skilled, creative, independent, and democratic (Sabila & Darmawan, 2021). A robust educational system is essential for the success of national education. The curriculum has been revised as part of the government's efforts to improve the education system. The current curriculum in use is the Merdeka Curriculum. This curriculum is designed to support the realization of intelligent education through the enhancement and equalization of educational quality, expansion of access, and the use of technology to achieve a world-class education that fosters collaboration, communication, critical thinking, and creativity (Sherly et al., 2021).

Mathematics is one of the most important subjects taught in schools. According to Johnson and Rising (as cited in Suherman, 2001: 19), mathematics is a method for logically proving and organizing ideas. Mathematics serves as a language that employs dense symbols and terms that are precisely, clearly, and accurately defined. Mathematics not only discusses ideas through symbolic language but also plays a crucial role in daily life (Pawartani & Rufina, 2024). Therefore, students must study mathematics to develop logical and structured thinking skills that are valuable across various aspects of their lives.

Mathematics is a fundamental science essential for the advancement of knowledge and technology. Due to its significant role, mathematics is often referred to as the root of science. This is evidenced by the high demand for mathematical skills. According to Fathani (2016), mathematical ability encompasses not only computational skills but also the capacity for logical and critical thinking in problem-solving. This includes the ability to think logically and critically in solving problems, extending beyond routine issues to everyday challenges.

Mathematics is a critical subject for all students because it aids in the development of logical, analytical, systematic, critical, and creative thinking skills, as well as collaborative skills (Depdiknas, 2007). These competencies are essential for students to acquire, manage, and utilize information in an ever-evolving world. Contemporary mathematics education in Indonesia requires active student participation in the learning process as well as proficiency in processing data provided by teachers. The skills necessary for mathematics education extend beyond mere computation to include advanced thinking abilities.

Instructional innovations by teachers must align with the curriculum and the student's abilities to achieve learning objectives and competencies (Prastowo, 2014:203). While developing teaching materials is not inherently challenging, limited literature availability often results in teachers relying on pre-made teaching materials. These pre-made materials include Student Worksheets (LKPD). According to Prastowo (2012), the use of pre-made materials can be problematic if they are not contextual, engaging, monotonous, or do not meet students' needs (Prastowo, 2012:6).

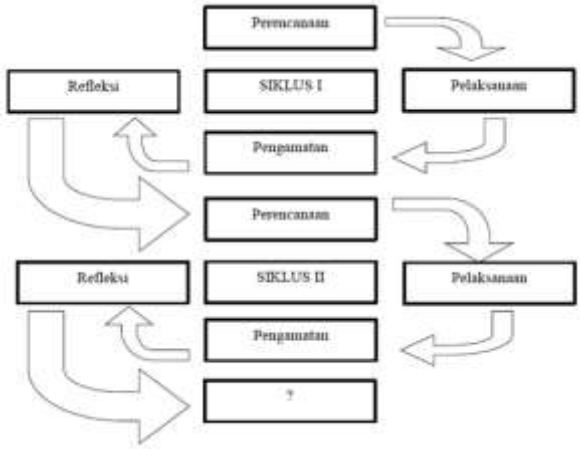
One commonly purchased teaching resource by educational institutions is Student Worksheets (LKPD), which includes learning materials and questions designed to assist students in understanding classroom concepts (Hayati, 2024). However, it is important to recognize that learning resources extend beyond textbooks to include various media such as newspapers, short stories, the internet, and interactions with individuals and the environment. Teachers play a critical role in sourcing and selecting additional resources that enhance learning, utilizing information technology to access more comprehensive and up-to-date materials. By using LKPD, students can actively engage in learning, making the educational process more dynamic and interactive, and aiding in the development of critical, creative, and analytical thinking skills that are crucial for daily life and future endeavors (Fajri & Chusni, 2024).

Based on the researcher’s experience and structured interviews with seventh-grade teachers at SMP NEGERI 2 Madiun, the LKPDs currently in use are generic and lack a problem-solving orientation. Problem-solving-based LKPDs are needed to effectively understand Social Arithmetic. Social Arithmetic is a subject in the seventh-grade curriculum. Daily test results indicate that the average student scores remain low, with many students failing to meet the Minimum Completeness Criteria (KKM). Class VII B has the lowest average score among the three classes, with an average of 72.33 in knowledge and 11 out of 32 students, approximately 34.37%, not yet meeting the required standards.

These findings suggest that students' abilities to think critically and solve Social Arithmetic problems are insufficient. The poor performance in daily tests may be attributed to ineffective teaching methods. Social Arithmetic is well-suited for a problem-based approach. Consequently, researchers need to develop problem-based instructional materials for seventh-grade students. To achieve this, an understanding of the specific needs of seventh-grade students is necessary. Seventh-grade students are approximately 13-15 years old, which corresponds to the formal operational stage, according to Hurlock (2003). Early adolescence spans from 13 to 16 or 17 years, while late adolescence ranges from 16 or 17 to 18 years (Izzaty, 2013: 122). According to Piaget, students' capacity to employ formal operations depends on their familiarity with the material. When students are acquainted with the material, they are more likely to use formal operations. Conversely, unfamiliar material tends to lead students to rely on concrete reasoning patterns and infrequently use their ideas (Slavin, 2008: 113).

2. RESEARCH METHODS

This study employs a Classroom Action Research (CAR) methodology, incorporating multiple cycles, to implement problem-based Student Worksheets (LKPD) to enhance the critical thinking skills of seventh-grade students in Social Arithmetic at SMP NEGERI 2 Madiun. Classroom Action Research (CAR) is an investigatory approach specifically designed to improve educational practices through a systematic, iterative process involving reflection, action, and evaluation (Kemmis & McTaggart, 2014).



Picture 1. Classroom Action Research Cycle

The subjects of this study were students in class VII B at SMP Negeri 2 Madiun which consisted of two classes. The total number of students in the two classes was 32 students. CAR can be carried out by teachers in the context of their classes to improve learning practices and student learning outcomes and improve learning practices that have previously been carried out in the classroom (Mills, 2019).

The instruments used in this study included initial tests, formative tests, and classroom observations. The initial test was used to measure students' initial understanding of arithmetic concepts. Formative tests were used to evaluate student progress during the CAR cycle. Classroom observations were conducted to record the implementation of learning in the classroom. Appropriate research instruments

will help collect relevant and accurate data to support proper analysis and interpretation (Fraenkel et al., 2019).

This study was conducted in several cycles, starting with planning, implementation, observation, reflection, and corrective action. In each cycle, problem-based LKPD was applied in arithmetic learning. After each cycle, data was collected and analyzed to evaluate the effectiveness of the learning model. PTK involves a continuous process of reflection and action cycles, where teachers are actively involved in improving students' learning practices in the classroom (Mertler & Charles, 2020).

3. Results and Discussion

Result

a. Pre cycle

The pre-cycle was held in class VII B of SMP Negeri 2 Madiun on Wednesday, May 1, 2024. At this stage, the researcher saw the problems that existed with the mathematics learning process in class VII B. In class VII B, mathematics is taught using a direct learning model that is still conventional and teacher-centered. As a result, student learning outcomes in the class are low. In addition, differentiated learning does not occur when learning takes place without considering students' learning profiles. When it is done, students are not asked to participate in learning activities in groups.

The majority of class VII B students face several problems at this stage. Among them are that they can only answer questions but cannot explain the reasons for their answers; they continue to make mistakes in writing and explaining mathematical terms and symbols, which negatively impacts their abilities.

Tabel 1. Initial Diagnostic Test Results for Grade VII B Students

No	Ability	Total	Presentase
1	High	5	16%
2	Medium	11	34%
3	Low	16	50%
	Total	32	100%

Based on the results of the initial cognitive diagnostic test conducted at the beginning of the learning process, students were divided into three groups: those who were proficient, those who understood partially, and those who understood a little. They were placed in the high group, or around 16%, 11 people were placed in the medium group, or around 34%, and 16 people were placed in the group. Based on the results of the observations made, it was revealed that only 5 students showed high abilities in learning mathematics. This indicates that most students have initial abilities that are below average. To overcome this problem, researchers together with observers designed student-centered learning, with the aim that they can be more active in the learning process and be able to construct their understanding through discussion and problem-solving. Therefore, researchers decided to design further learning using a method that involves the active role of students, namely by implementing problem-based LKPD. This step is expected to improve students' critical thinking skills in mathematics.

b. Cycle 1

Friday, May 3, 2024, is the date of the first cycle. Cycle I carries out three actions. The first action is carried out at the first meeting, with the material of addition, subtraction, and multiplication, and the second action is carried out at the second meeting, with an estimated time of 2 times 40 minutes. The division material is also used at the second meeting. This study conducted a problem-based LKPD with a problem-based learning model. All stages of learning consist of an introductory stage where the teacher opens the lesson with greetings and prayers. They also convey the objectives, stages, and learning flow to ensure that students are ready. At this point, students actively participate in open discussions in class to respond to the teacher's opinions and encourage them.

The next stage is the core activity with the following steps from PBL learning.

1. Orientation of students to the problem: At this stage, the teacher presents problems to students to improve their understanding of the material to be studied. During this process, the teacher encourages students to actively participate in responding to the material provided. The teacher also provides positive support to maintain student enthusiasm.
2. Organizing students in the learning process: At this stage, students are divided into groups. In the first cycle, students are grouped based on their interests in topics that interest them and they want to discuss. 3. Guiding individual and group investigations: At this stage, students see, study, and talk about the problems given. As needed, the teacher guides students and groups. During the discussion, the teacher observes the mathematical interactions of students both in group discussions and open discussions in class.
3. Creating and delivering work: At this stage, students actively talk about the problems given by the teacher and then deliver the results of their group discussions. The teacher sees how students communicate mathematically when they deliver the results of their group discussions to friends who come to their desks.
4. Analyzing and evaluating the problem-solving process: At this stage, the teacher allows students to actively ask questions and talk about the results of the discussion. The teacher sees how students communicate mathematically, including conveying criticism, suggestions, questions, and objections. The teacher and students reflect on and evaluate the problem.

The final stage in the learning process is the closing activity, where students conclude the results of the activities that have been carried out, both in writing and orally. In this stage, the teacher plays an important role by helping students summarize the main points that have been learned during the session. After that, the teacher closes the learning session by providing constructive direction and feedback. Furthermore,

the teacher and students reflect and evaluate the problems that have been discussed. This reflection involves a discussion of what has been learned, how the learning process took place, and what difficulties were faced by students. This evaluation aims to assess the extent to which learning objectives have been achieved and to identify areas that require further improvement or reinforcement. Thus, the closing activity not only functions as a summary but also as a means to improve and enhance the learning process in the future. The test results data from cycle I were analyzed by calculating the scores obtained by students according to the assessment rubric. The analysis of test results from cycle I test data can be seen in Table 1 below:

Table 2. Results of Cycle I Test for Class VII B Students

No	Ability	Total	Presentase
1	High	8	25%
2	Medium	16	50%
3	Low	8	25%
	Total	32	100%

Based on the results of the observation, it was found that 25% or 8 students had high abilities, 50% or 16 students were at a medium level of ability, and 25% or 8 students had low abilities. From this data, an increase in student learning outcomes in cycle I can be seen. Students began to adapt to mathematics learning through group discussions based on their respective interests. Most students have been actively involved in group discussions and applied the instructions in the LKPD provided. They began to take the initiative to open discussions, talk about mathematical concepts, and find ways to solve the problems given. However, several students remained passive and only listened without responding to group discussions.

In the stage of developing and presenting results, it was seen that there were still few students who were able to communicate the results of their group discussions. Many of them had difficulty conveying ideas and findings effectively. In addition, some students also still had difficulty responding to what was conveyed by other students. This shows that there are challenges in communication skills that need to be overcome so that students can be more confident and effective in interacting during group discussions. Improvement efforts may include communication exercises, presentations, and activities that encourage active participation and responsiveness among students.

c. Cycle 2

The second cycle took place on Wednesday and Thursday, May 15-16, 2024. Actions in cycle II were carried out three times, with the first action carried out at the first meeting with an estimated time (2 x 40 minutes) on the addition, subtraction, and multiplication sub-material. The second action was carried out at the second meeting with an estimated time (1 x 40 minutes) on the division sub-material. Based on the analysis of the problems in cycle I, the teacher needs to take several corrective actions in cycle II. These corrective actions are a reference for teachers in designing learning plans in cycle II. At this stage, the researcher focused on overcoming the difficulties experienced by students in cycle I. The researcher prepared a learning plan and prepared questions that were by the material.

In the preliminary activities, the researcher checked the completeness and readiness of students to learn before starting learning, adjusted the learning content with the teaching modules that had been prepared, provided initial motivation so that students were more focused on following the learning, delivered the material clearly and systematically to students, and motivated them to be active in learning activities.

The next stage is the core activity with the following steps from PBL learning.

1. At the stage of student orientation to the problem, the teacher presents data in the form of graphs and diagrams. The teacher raises several problems for students and provides an understanding of the material to be studied. Students are encouraged to remain active in learning so that they can solve the questions given. The teacher motivates students to remain enthusiastic during learning.
2. At the stage of organizing learning, the teacher groups students into several groups based on learning outcomes in cycle I. Groups that have understood the material become the core group, while students with low and medium abilities are put into groups with students with high abilities. The teacher provides Student Worksheets (LKPD) to be worked on. Group members who have not understood the material are given peer tutoring assistance and additional explanations from the teacher systematically.
3. At the stage of individual and group investigation guidance, students are given practice questions according to the needs of each group. They are invited to discuss in their groups. The teacher observes the interactions between group members.
4. At the stage of developing and presenting the results of the work, students actively discuss to solve the questions given by the teacher. After that, they present the results of their group discussions. The groups are reshuffled so that each group consists of members who work on different problems. The teacher observes the activeness of students in presenting their work to students from other groups.
5. At the analysis and evaluation stage of the problem-solving process, the teacher guides students to actively ask questions and discuss in delivering the results of the discussion. The teacher observes the mathematical communication of students during the discussion. Together with the students, the teacher reflects and evaluates the problems faced.

The last stage is the closing activity, where the teacher and students reflect on the activities that have been carried out. The teacher asks students about the series of activities that have been carried out and the feelings they experienced during the learning process. After the reflection session, students conclude the results of the activities carried out, both

in writing and orally. This stage ends with the teacher closing the learning, providing directions for the next activities, and ensuring that all students understand the material that has been studied.

The data from the cycle II test results were analyzed by calculating the scores obtained by students according to the assessment rubric. The analysis of the test results from the cycle I test data can be seen in Table 1 below:

Table 3. Results of Cycle II Test for Class VII B Students

No	Ability	Total	Presentase
1	High	17	53 %
2	Medium	12	38 %
3	Low	3	9 %
	Total	32	100%

Based on the results of the observation, the percentage of students with high scores increased to 53% or 17 students, 12 students or around 38% in the medium category, and 9% in the low category, leaving 3 students. From the data above, it can be seen that there is an increase in the percentage of student learning outcomes both in writing and orally. In this second cycle, students can understand statistics material more easily with their study groups. In one group, there is quite good interaction between group members. Students discuss with each other to solve problems given by the teacher. In addition, students dare to ask their group members when they have difficulty solving problems. However, in cycle II, there are still some passive students in their groups. Students are reluctant to discuss with their group members. In addition, some students are less able to present the results of the discussion clearly and systematically. However, the results of the study above show that the Implementation of Problem-Based LKPD Implementation to Improve Critical Thinking Skills in Mathematics in Arithmetic Material. The increase in the percentage of completion and category of student abilities can be seen in the table below:

Table 4. Comparison of the Percentage of Completeness of Test Results for All Cycles of Class VII B Students

No	Ability	Pre Cycle	Cycle 1	Cycle 2
1	High	16%	25%	53 %
2	Medium	34%	50%	38 %
3	Low	50%	25%	9 %

The results of classroom action research show that improving critical thinking skills in mathematics through the application of problem-based LKPD is beneficial. Educational institutions often purchase student worksheets (LKPD). LKPD is a ready-to-use student worksheet that contains learning materials and questions. Not only books can be a source of learning, but they can also come from various types of media, such as newspapers, short stories, the internet, individuals, the environment, and so on. Hopefully, students' knowledge is not limited by this book. Here, the role of the teacher is expected. To support learning, teachers must find additional sources. We have the opportunity to encourage students to actively participate in the topics discussed with LKPD. A more active learning process can be achieved through LKPD. Active learning gives students direct experience, freeing them from the limitations of their knowledge.

Discussion

The pre-cycle was held in class VII B of SMP Negeri 2 Madiun on Wednesday, May 1, 2024. Mathematics was taught directly and centered on the teacher, causing low student learning outcomes. Learning was not differentiated and students did not participate in group activities. The majority of students experienced problems, such as only answering without explaining the reasons and making mistakes in writing mathematical symbols. This hurts their abilities. This study aims to improve the mathematics learning process in class VII B by implementing more interactive methods and paying attention to student learning profiles. This pre-cycle was carried out to find solutions to the problems faced by students in learning mathematics. It is hoped that with the new method, mathematics learning in class VII B can be more effective and students can improve their understanding.

On Friday, May 3, 2024, the first cycle was carried out, where the action was carried out three times. The first action took place at the first meeting with the material on addition, subtraction, and multiplication, while the second action took place at the second meeting with an estimated time of 2 times 40 minutes, where the material on division was also included. This study uses problem-based LKPD with a problem-based learning model, where the learning stages begin with an introductory stage where the teacher opens the lesson, and provides objectives, stages, and learning flow. Furthermore, students participate in open discussions to respond to the teacher's opinions.

The core activity stages consist of several steps, namely:

1. Orienting students to the problem: The teacher introduces the problem to students encourages active participation and provides positive support.
2. Organizing students in the learning process: Students are grouped based on their interests in interesting topics.
3. Guiding individual and group investigations: Students study the problems given while receiving guidance from the teacher.
4. Creating and delivering work: Students discuss the problem and deliver the results of their group discussions.
5. Analyzing and evaluating problem-solving: Students are allowed to ask questions, speak, and reflect.

The last stage is the closing activity where students summarize the results of the activities, the teacher provides direction and feedback, and reflection and evaluation of learning are carried out. From observations, there was an increase in student learning outcomes, where 25% had high abilities, 50% were at a moderate level of ability, and 25% had low abilities. Students begin to adapt to mathematics learning through group discussions based on their respective interests.

Although most students are active in group discussions, there are still several students who are passive. In developing and presenting results, there are still some students who have difficulty communicating and responding effectively. Therefore, efforts are needed to improve communication skills so that students are more confident and effective in interacting during group discussions. Communication exercises, presentations, and activities that encourage active participation can be solutions to overcome these challenges.

The second cycle took place on Wednesday and Thursday, May 15-16, 2024, with three actions taken. The first action focused on addition, subtraction, and multiplication, while the second action focused on division. The teacher took corrective actions based on the analysis from the first cycle to improve the second cycle learning plan. The researcher focused on overcoming student difficulties from the first cycle by designing appropriate learning plans and questions.

Preliminary activities include checking student completeness, presenting learning content, providing motivation, delivering material, and encouraging student involvement in learning. Core activities involve several steps, such as problem orientation, organizing, individual and group guidance, developing and presenting work results, and analyzing and evaluating the problem-solving process. The teacher groups students based on the results of the previous cycle and provides LKPD to be worked on, provides peer tutoring assistance to those in need, and observes group interactions.

So this is in line with a study (Istni et al., 2022) which was able to show that there were students who used a problem-based learning model that could be driven by LKPD with an average of 80-90% critical thinking skills. 62% of students have known their skills in thinking more critically and very well 9% or equivalent to 3 students have very good critical thinking skills, in a percentage of 1% or 1 student is in a low group and there are no students who are in a very bad group. From the similarities with this study, it uses a problem-based learning model (PBL) assisted by LKPD and also on skills in thinking more critically.

In addition, students actively discuss to solve problems and present the results of the discussion. The teacher observes their activeness in presenting the results of their work and provides guidance when students actively ask questions and discuss. The closing stage involves reflection on the activities that have been carried out, questions to students about the learning process, and conclusions about the results of the activities both in writing and orally. The teacher closes the learning by providing directions for the next activity and ensuring students' understanding of the material that has been studied. This is by Resty's research (2023) which explains the level of effectiveness of the PBL model treatment assisted by problem-based e-LKPD on students' critical thinking skills, an eta square value of 0.421 is obtained, where if interpreted into a cohen value, an effect size value of 1.704 is obtained with a high category. The greatest increase occurred in the strategies and tactics indicator with an n-gain value of 0.986, which is included in the high category. Monika, et al, (2021) also explained that the use of E-LKPD based on problem-based learning accompanied by interactive mathematics quizzes to improve critical thinking skills that were developed turned out to be quite effective as seen from the achievement of KKM students, namely in large-scale trials obtaining a level of 86% where this has increased from the previous value, namely obtaining a percentage of completion of 81% in the initial test. Students have demonstrated critical thinking skills through critical thinking ability test questions with scoring guidelines following critical thinking indicators, namely identifying, organizing, and implementing strategies and techniques, evaluating, and making conclusions. This increase in ability data occurs if the use of LKPD as a learning medium is carried out optimally, namely being used as a source of information acquisition and media in practicing questions (Sapitri, et al., 2022). The implementation of the process skills approach is carried out according to the learning design chart with a process skills approach through LKPD. The learning process is carried out by first dividing students into groups. Learning is carried out using various methods, namely the concept discovery method, discussion method, and practice question method. The application of each learning method is adjusted to the characteristics of the subject matter at each meeting

4. CONCLUSION

Through two cycles of classroom action research, it is proven that the implementation of problem-based LKPD is effective in improving the critical thinking skills of grade VII students in mathematics on social arithmetic material at SMP Negeri 2 Madiun. The research process involves continuous adjustments in the presentation of materials and support provided to students. Each research cycle involves systematic planning, implementation, observation, and reflection, which aims to identify and overcome learning obstacles and improve teaching strategies. Adjustments made include the use of various methods and techniques to facilitate student understanding, such as group discussions, collaborative problem-solving, and providing constructive feedback. The support given to students is not only in the form of academic guidance but also motivation and encouragement to think critically and creatively. This helps improve the effectiveness of learning and makes students more involved and motivated in the learning process.

5. RECOMMENDATION

The discussion above provides an overview of how the classroom action research cycle can be implemented in the context of implementing problem-based LKPD. With this approach, teachers can be actively involved in improving their learning practices. Teachers have the opportunity to continuously improve and adjust teaching methods based on feedback and observation results from each cycle. This not only improves the quality of learning but also creates a more

inclusive and responsive environment to the needs of learners. Finally, this approach allows teachers to create a more effective learning environment and support the development of student's critical thinking skills significantly.

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