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Improving Junior High School Students' Mathematical Literacy Skills Through the Application of Problem Based Learning Models

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A B S T R A C T

The learning process in the classroom can be a trigger for low Mathematical Literacy Ability (KLM) of students so that improving the learning process and increasing students' KLM through the application of the Problem Based Learning (PBL) model is the purpose of this study. The research conducted was Classroom Action Research with two cycles on 35 students of class VIII-3 SMP Negeri 5 Pekanbaru. Data acquisition through learning device instruments (teaching modules equipped with teaching materials, LKPD, Remedial and Enrichment) and data collection instruments (observation sheets and student KLM test devices). The CAR cycle process was carried out in two cycles, covering four stages (planning, action, observation, and reflection) showing an increase in the average score of students' KLM from 54.46 in cycle I to 74.06 in cycle II. These results indicate that through the application of PBL, it can improve the learning process and increase the KLM of students VIII-3 SMP Negeri 5 Pekanbaru.

1. Introduction

In general, literacy is now not only limited to reading and writing skills, but also includes skills to solve problems by using and developing critical thinking skills, analyzing, and evaluating information from various sources (Kusmiarti & Hamzah, 2019). Meanwhile, mathematical literacy according to Abidin, Muyati, & Yunansah (2018) is defined as an individual's ability to understand, formulate and use mathematics in the context of life to solve problems and be able to interpret mathematics in solving them.

Mathematical Literacy Skills (KLM) are important for students because these abilities are the foundation for understanding and developing mathematics learning. Genc & Erbas (2019) state that mathematical literacy is the skill of

students to understand and formulate problems by using methods efficiently to solve problems with mathematical knowledge, evaluate the steps taken what is done, analyze situations and draw conclusions. This is in line with the opinion of Kurniawan & Djidu (2021) that KLM can enable students to understand problems well, develop mathematical ideas and concepts, solve problems systematically, and create a responsive learning environment.

According to Wardono & Mariani (2018) students who are able to achieve good KLM will be able to read and understand well so that they can summarize information, write problem solving with the right process, determine and explain solutions (interpret) while students with fairly good KLM, even though their abilities are lower, can still solve problems using simple methods. This must be adjusted to the KLM indicators, namely: (1) formulating problems mathematically (formulate); (2) using concepts, facts, procedures, and mathematical reasoning (employ); (3) interpreting, applying, and evaluating mathematical results (interperete).

Observations were carried out directly during the learning process and students underwent an initial KLM test on the material on integer arithmetic operations and comparisons of value in this study. The results of the initial test are presented in Table 1, which shows the KLM achievements of 35 students in class VIII-3 of SMP Negeri 5 Pekanbaru.

Table 1. Number of Students Who Met the Maximum Score and the Average Test

KLM indicators measured	KLM average	Number of students who meet the maximum score and average KLM score			Overall average	Qualification
		Soal 1	Soal 2a	Soal 2b		
Formulate mathematical problems in the context of real situations		24	13	2		
	$\bar{x}$	83,80	37,14	16,19	49,2	Worthy
Using mathematical concepts and procedures (*employ)*		2	2	2		Newly developed
	$\bar{x}$	49,28	31,42	23,57	35,23	
Interpreting mathematical results in the form of conclusions (*interperete*)		4	7	1		Newly developed
	$\bar{x}$	39,04	32,38	14,28	28,25	

Table 1 shows that the KLM of class VIII-3 students of SMP Negeri 5 Pekanbaru is still in the category of just developing or low. This can be seen from the three indicators, only the indicator of formulating mathematical problems in the context of real situations (formulate) is in the decent category, while the other two indicators are in the developing category. This shows that the KLM possessed by class VIII-3 students of SMP Negeri 5 Pekanbaru is still low. In the indicator of formulating mathematical problems in the context of real situations, there are still students who have not been able to organize the information that is known and asked completely. Students also have difficulty in the indicator of using mathematical concepts and procedures due to a lack of understanding of the

instructions for the questions. This can be seen from the many students who do not use the concept of comparison of value, but instead directly use ordinary arithmetic operations. Although some use the correct concept, many students are less able to solve problems correctly. In the indicator of interpreting mathematical results in the form of conclusions, students are not used to drawing conclusions so they do not write conclusions from the answers they have obtained.

The results of the initial KLM test analysis previously presented, it can be seen that the KLM obtained by two of the three KLM indicators are in the newly developing category so that it can be said that the KLM of class VIII-3 students at SMP Negeri 5 Pekanbaru is classified as lacking or newly developing. Dinata & Analisa (2022) stated that in developing and improving students' KLM, the application of the right learning model is needed, namely the Problem Based Learning (PBL) learning model. PBL is a learning model that actively involves students in the problem-solving process through scientific stages so that students can acquire knowledge effectively (Mayasari, Arifudin, & Juliawati, 2022).

The PBL model can be a model that challenges students to "learn how to learn". This model encourages students to work together in groups to find solutions to real problems that encourage their curiosity about learning, develop higher skills, independence and increase student self-confidence. PBL is carried out collaboratively, namely students are divided into facilitated study groups, to work together to collect the information provided. Through this process, students can build new knowledge by processing the information they already have, creating an active learning environment because students are directly involved in finding solutions to the problems given. So that PBL can have an influence on improving KLM. This is in line with research conducted by Wulandari & Azka (2023) which found that the PBL learning model is effective in improving students' KLM.

Based on the description above, the application of PBL in the learning process is expected to improve the learning process and improve the KLM of class VIII-3 students at SMP Negeri 5 Pekanbaru. The material chosen in this study is social arithmetic because it allows the application of the PBL model to learning. Social arithmetic emphasizes students' ability to solve contextual problems that describe real situations by understanding concepts and using mathematics (Ahmad et al., 2023).

According to Marlina & Setiawan (2021), there are four types of common student errors in solving social arithmetic problems, namely errors in understanding questions, errors in transforming process abilities, and determining solutions. This shows that students do not understand the correct procedure when solving problems, resulting in students often experiencing difficulties and making mistakes. Therefore, it is necessary to apply the Problem Based Learning model in learning to improve the KLM of class VIII-3 students of SMP Negeri 5 Pekanbaru on social arithmetic material in the odd semester of the 2024/2025 academic year.

2. Methodology

This study uses the Classroom Action Research (CAR) method based on problems found during teaching and learning activities. CAR is a scientific process carried out by teachers in their own classes by designing, implementing, observing and reflecting on actions through several cycles collaboratively and participatively, with the aim of improving the learning process (Pahleviannur et al., 2021). This study consists of two cycles, in cycle I and cycle II which consist of two meetings each cycle and at the end of each cycle a summative test (KLM test) will be carried out. Arikunto, et al. (2019) stated that in general, CAR is carried out in four stages, namely planning, implementing actions, observing and reflecting.

Indicator	Evaluation Criteria	Score	Shoes Max
Understand how to formulate mathematical problems in the context of real situations (Formulate) and	Didn't answer	0	3
	Misunderstanding and formulating mathematical problems in the context of real situations	1	
	Correctly understands and formulates mathematical problems in the context of real situations but is incomplete	2	
	Correctly understand and formulate mathematical problems in the context of real situations completely	3	
Using mathematical concepts and procedures (Employ)	No answer	0	4
	There is an answer but using irrelevant information, failing to identify important parts. The strategy used is inappropriate, difficult to identify or not systematic.	1	
	Identifies some important parts of the problem but shows little understanding of the relationship between the parts, shows a calculation process but is incomplete and unsystematic	2	
	Using relevant information, identifying several parts and showing the general relationship between the parts, providing a clear and systematic calculation process, the answer is close to correct.	3	
	Using relevant information, identifying all important parts and showing the general relationship between the parts, providing a clear, systematic calculation process and correct answers.	4	
Interpreting mathematics in the form of conclusions (Interprete)	Does not provide conclusions	0	3
	Gives a conclusion but is inaccurate or wrong	1	
	Gives a conclusion but is incomplete	2	
	Provide a conclusion that is correct and complete	3	
Shoes Total			10

Figure 1. KLM Scoring Guidelines

The subjects in this study were 35 students of class VIII-3 SMP Negeri 5 Pekanbaru with heterogeneous academic ability levels. The study started from August 6, 2024 to August 27, 2024. The learning tools applied were the Learning Objective Flow (ATP), teaching modules equipped with teaching materials and Student Worksheets (LKPD) as well as remedial and enrichment questions. Data collection instruments consist of observation sheets and KLM test devices.

Data processing of teacher and student activities from observation sheets is analyzed using narrative descriptive techniques. The learning process improves when each step of learning experiences an increase in each meeting while student KLM data is collected by conducting a written KLM test and analyzed quantitatively. The results of the KLM test cycles I and II are then evaluated using an assessment based on indicators that have been set to evaluate student KLM. Figure 1. is a scoring guideline for each KLM indicator.

Quantitative analysis of student KLM data, namely: (1) analysis of KLM achievement for each indicator; (2) classical KLM analysis. The procedures carried out include: (a) determining student answer scores based on the scoring guidelines used, then converting them into student KLM scores on a scale of 0-100; (b) qualifying student KLM scores according to the Learning Objective Achievement Criteria (KKTP); finding the average student KLM score and determining the increase in classical KLM. KLM scores are converted using the formula:

$$N = \frac{SP}{SM} \times 100$$

Description:
N : Final score
SP : Score obtained by the student (individual)
SM: Maximum score

Table 3 below is the KLM qualification according to the Learning Objective Achievement Criteria (KKTP) because the KLM test device was created based on the Learning Objectives (TP) to be achieved in this study and to improve students' KLM.

Table 2. Student KLM Qualifications (KKTP)

Qualification	KLM's Achievements
Proficient	$86 \leq N \leq 100$
Speak	$66 \leq N < 86$
Worthy	$41 \leq N < 66$
Newly Developed	$20 \leq N < 41$

Source : Permendikbud, No 21 Tahun 2022

To find the average KLM value of students in cycle I and cycle II, the formula used is:

$$\bar{x} = \frac{\sum x_i}{j}$$

Description:
$\bar{x}$: Average KLM score per indicator
x_i : Total KLM score per indicator
j : Total indicator score per question

If the problem being studied is increasingly focused with the actions taken in each cycle, then PTK is considered successful. This success is achieved when the PBL model applied can improve the learning process and increase students' KLM. Improvements in the learning process can be seen from the increase in teacher and student activities in each cycle. The steps for implementing the Problem Based Learning model that have been planned in accordance with the teaching module during the implementation of the action, can be seen from the results of the analysis of teacher and student activities. The increase in students' KLM can be seen from the analysis of students' KLM tests, namely if the average achievement in each indicator and classically KLM has increased from each cycle.

3. Results and Discussion

The actions that have been implemented in cycle I and cycle II show an increase in student activities that are getting better during the learning process. The deficiencies found are corrected so that they decrease along with the implementation of actions in cycle I and cycle II. Thus, the learning process is getting better until the end of cycle II. Table 3 below is the average value of each student's KLM indicator after the actions in cycle I.

Table 3. Average Value for Each KLM Indicator in Cycle I

No	KLM Indicator	Student KLM Score			Average KLM Students ($\bar{x}$)	KLM Qualification
		Question Number				
		1	2	3		
1	Formulate mathematical problems in the context of real situations (formulate)	84,76	81,90	58,09	74,91	Speak
2	Using mathematical concepts and procedures (employ)	74,28	51,42	26,42	50,7	Worthy
3	Interpreting mathematical results in the form of conclusions (interpretation).	50,47	43,80	19,04	37,7	Newly Developed

Table 4 shows that the average KLM in cycle I increased compared to the initial KLM value of students before the PBL model was applied, namely from 37.66 to 54.46. The KLM indicator that showed a relatively high increase was formulating mathematical problems in the context of real situations. Students were able to

identify problems well so that it had a good impact on improving indicators two and three of the KLM, namely improving in using mathematical concepts and procedures with qualifications before the action was just developing into feasible. Although the qualification of the indicator interpreting mathematical results in the form of conclusions was still developing, the average value increased. Table 5 below is the average value of each student's KLM indicator after the action in cycle II.

Table 5. Average Student Score for Each KLM Indicator After Cycle II

No	KLM Indicator	Student KLM Score			Average KLM Students ($\bar{x}$)	KLM Qualification
		Nomor Soal				
		1	2	3		
1	Formulate mathematical problems in the context of real situations (formulate)	95,23	89,52	70,47	85,07	Proficient
2	Using mathematical concepts and procedures (employ)	82,14	72,14	50,71	68,33	Speak
3	Interpreting mathematical results in the form of conclusions (interpretation).	78,09	68,57	44,76	68,8	Speak
		Average			74,06	Speak

Table 5 shows that in cycle II all KLM indicators experienced an average increase so that the qualification of each indicator also improved compared to cycle I. Students were able to formulate mathematical problems in the context of real situations, namely writing known and asked or identifying problems very well so that it had a good impact on the indicator of using mathematical concepts and procedures and the indicator of interpreting mathematical results in the form of conclusions. Table 6 below shows the number of students in each KLM qualification.

Table 6. Increase in the Number of Students in Each KLM Qualification

Value Interval	Number of students in			KLM Qualifications
	Initial Test	Cycle I	Cycle II	
$86 \leq N \leq 100$	0	1	12	Proficient
$66 \leq N < 86$	2	6	8	Speak
$41 \leq N < 66$	10	19	13	Worthy
$20 \leq N < 41$	23	9	2	Newly Developed

Table 6 shows that the KLM of students in each qualification has increased after the implementation of PBL. The increase in KLM of students can be seen from the number of students in the advanced and proficient qualifications increasing in

cycles I and II, while in the adequate and newly developing qualifications in cycles I and II, the number of students is decreasing. Table 7 below shows the increase in the average KLM of students from the initial test, cycle I, and cycle II.

Table 7. Average KLM Indicators in the Initial Test, Cycle I, and Cycle II

No	KLM Indicator	KLM Average		
		Initial Test	Cycle I	Cycle II
1	Formulate mathematical problems in the context of real situations (formulate)	49,2 (Worthy)	74,91 (Speak)	85,07 (Speak)
2	Using mathematical concepts and procedures (employ)	35,23 (Baru Berkembang)	50,7 (Worthy)	68,33 (Speak)
3	Interpreting mathematical results in the form of conclusions (interpretation).	28,25 (Newly Developed)	37,77 (Newly Developed)	68,8 (Speak)

Table 7 shows the average increase in each student's KLM indicator in cycle II compared to cycle I and the initial test. The highest KLM indicator is the indicator of formulating mathematical problems in the context of real situations. In this indicator, students write down what is known and what is asked from the problem, which has increased in each cycle. The next highest indicator is the indicator of using concepts and mathematics. Although students' abilities in this indicator increase in each cycle, there are still weaknesses, namely incorrect or incomplete in making the calculation process. The indicator of interpreting mathematical results in the form of conclusions also increases, but there are shortcomings, namely students do not make any conclusions and the conclusions made are incomplete. Table 8 below presents the increase in KLM classically before and after the implementation of the PBL model.

Table 8. Improvement of Students' KLM Classically

	Score KLM		
	Initial Test	Cycle I	Cycle II
Average KLM score of students	37,66	54,46	74,06
Improvement		16,8	19,6

Information from Table 8, the average initial KLM scores of students before the action (initial test), cycle I, and cycle II were 37.66, 54.46, and 74.06. This shows an increase in the average KLM classically, namely an increase in cycle I of 16.8 compared to the initial test and an increase in cycle II of 19.6 compared to cycle I. Students' KLM increased overall after being given action. This shows that the action, namely the implementation of PBL, can improve students' KLM overall. The implementation of PBL provides students with the opportunity to understand the lesson and encourages students to be involved in learning with group discussions to find solutions to LKPD which have a positive impact on improving students' KLM. The results of the analysis of teacher and student activities and KLM results show improvements in the learning process and an increase in

students' KLM. The implementation of the PBL model that is carried out provides students with the opportunity to understand the subject matter better and increases student involvement in the learning process, students are actively involved in seeking their own knowledge making learning meaningful and the knowledge gained more durable. In line with Arends' opinion in Hotimah (2020) which states that through PBL, students can construct knowledge independently, develop higher-level thinking skills, and become more independent and confident in solving problems. So that PBL has a positive impact on improving the learning process and increasing students' KLM. Thus, it can be concluded that the actions implemented were successful, because after the implementation of PBL there was an improvement in the learning process and an increase in the KLM of class VIII-3 students of SMP Negeri 5 Pekanbaru.

4. Conclusion

Conclusion of the research is presented briefly in the conclusion part. It should not be less than 100 words. Please conclude your work incorporating your most important findings as well as future works (if any). Conclusion should answer the research objective and inform about the success of the research. The statistics data should not appear in the conclusion.

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