DOI 10.37640/ice.x04.1443
In Proceedings of the 4th International Conference on Education (ICE 2025), pages 8-16
e-ISSN 2964-7479
Copyright © 2025 by STKIP Kusuma Negara Press. All rights reserved

Implementation of the Problem Based Learning (PBL) Model to Improve Students' Mathematical Understanding

Reinaldi Aprian[1]*, Yatha Yuni[2], Aris Budiyanto[3]
[1,2,3] Mathematics Education Study Program, STKIP Kusuma Negara, Jakarta, Indonesia
*reinaldiaprian@stkipkusumanegara.ac.id

Abstract

Understanding mathematical concepts is an important foundation for students in learning further material. However, many students still have difficulty with the concept of integers.This study aims to improve students' mathematical conceptual understanding of integers through the application of the Problem-Based Learning (PBL) model. The research was conducted at MTs Nurul Huda Depok with 27 seventh-grade students as participants. The method employed was Classroom Action Research (CAR), which consisted of two cycles, each comprising three meetings. The research instruments included a conceptual understanding test, observation sheets for teacher and student activities, interviews, and field notes. The results showed an improvement in students' mathematical conceptual understanding after the implementation of the PBL model. Initially, the average student score was 61%, indicating a low level of mastery. After the first cycle, the average score increased, although it had not yet met the success indicator. In the second cycle, however, the average score rose significantly, achieving over 80% classical mastery in line with the established success criteria. Thus, it can be concluded that the implementation of the Problem-Based Learning (PBL) model is effective in enhancing students' mathematical conceptual understanding of integers in the seventh grade at MTs Nurul Huda Depok.

Keywords: classroom action research, conceptual understanding, problem based learning.

1. INTRODUCTION

Mathematics education is a discipline that plays an important role in various aspects of life (Zulmaulida, R., Husna, M., & Saputra, E., 2024). Mathematics not only serves as a tool in other sciences, but also shapes logical, systematic, and critical thinking (Nasution, A., Tanjung, R. S., Ritonga, E. S., & Khoyan, M., 2025). Therefore, mathematics learning in schools must be designed effectively so that students can obtain optimal benefits in understanding mathematics learning (Arnidha, Y., & Fatahillah, F., 2021).

Integers are one of the basic subjects taught in junior high school, especially in seventh grade. Understanding integers is an important foundation for learning further mathematics subjects such as algebraic operations, linear equations, and statistics. However, many students have difficulty understanding the concept of integers, especially in relation to arithmetic operations and their application in everyday life. This can lead to low mathematical comprehension skills among students.

The ability to understand mathematics is a fundamental skill that plays an important role in the learning process (Safari, Y., & Nurhida, P., 2024). This skill includes the ability to remember and apply mathematical formulas and concepts in various situations, both simple and complex (Mulyono, B., & Hapizah, H., 2018). In addition, mathematical understanding also includes the ability to estimate the truth of a statement and utilize formulas and theorems to solve various problems (Anisa, R. N., Ruswana, A. M., & Zamnah, L. N., 2021). Comprehension skills play a central role for individuals (Yani, E., Pujiastuti, H., & Anriani, N., 2019). Mathematical comprehension is a very important component in the principles of mathematics learning, and its value increases when students learn

mathematics on their own (Ruqoyyah, S., Murni, S., & Linda, L., 2020). Therefore, comprehension skills cannot be forced upon students. Even though teachers have explained various mathematical concepts and logic, students who forget the algorithms or formulas they have learned will have difficulty solving mathematical problems.

Both in the learning process and in everyday life, the ability to solve mathematical problems arises after students understand the problems they face. The understanding gained through the learning process becomes the main foundation for developing new knowledge that can be applied in solving various problems (Safari, Y., & Nurhida, P., 2024). When students have a good understanding of a concept, they are able to express their opinions and explain the concept clearly and logically.

The concept of a deeper understanding of mathematics is emphasized by NCTM, which includes formulating concepts in words and writing, producing examples that are not part of the concept, presenting concepts through models, diagrams, and symbols, converting representations from one form to another, understanding variations in meaning and interpretation of concepts, identifying characteristics of concepts and understanding the standards that describe them, as well as comparing and contrasting concepts with one another (NCTM., 2000).

Problem-Based Learning (PBL) is a learning model that focuses on presenting real-world problems to stimulate students to construct their own knowledge through group work, investigation, and reflection (Kurniasih., 2014). This model is oriented towards the problem-solving process that encourages critical thinking, cooperation, and responsibility among students in learning (Kurniasih., 2014). The Problem-Based Learning (PBL) model was developed based on an idea introduced by Jerome Bruner, namely the concept of discovery learning (Sanjaya, W., 2013). This concept became the theoretical basis for the development of the PBL model, which focuses on skills in processing and understanding information (Sanjaya, W., 2013). PBL can develop higher-order thinking skills because, through problem-based learning, students learn to solve real-world problems in a structured manner to construct their knowledge (Hamdani, A. D., Nurhafsah, N., & Rustini, T., 2022).

PBL is a learning model that presents various real-life problems in students' daily lives (contextual in nature) to stimulate students to learn. PBL is designed to help students understand concepts through problem-solving processes that are relevant to their lives. Teachers act as facilitators who guide students in finding solutions, rather than as sole providers of information.

The learning process in the classroom is designed with specific goals in mind. The goal of Problem-Based Learning (PBL) is to help students develop critical, analytical, systematic, and logical thinking skills in finding alternative solutions to problems through empirical data exploration, thereby fostering a scientific attitude.

In addition, PBL encourages students to identify problems, seek relevant information, and apply the knowledge they have acquired to find effective solutions. This process not only improves conceptual understanding but also prepares students to face complex challenges in the real world.

Thus, integrating PBL into learning can be an effective strategy for improving students' understanding of the subject matter while developing other essential skills.

Based on the results of observations conducted by researchers on July 17, 2025, in class VII of MTs Nurul Huda, it was found that students who had just entered junior high school seemed to have difficulty understanding basic material such as integers. From interviews with class VII students, it was found that in their previous schools, students were not accustomed to relating mathematical concepts to real-life problems they encountered in their daily lives. In addition, the learning model used tended to be conventional and did not provide opportunities for students to actively explore and solve problems independently or in groups. In fact, understanding mathematical concepts cannot be obtained solely through memorization and example questions, but requires a process of deep and contextual thinking.

Mathematics learning, especially in the subject of integers in grade VII at MTs Nurul Huda, has not been optimal and has not met expectations. Therefore, improvements and innovations are needed in the learning process so that students' understanding of mathematics can improve and achieve maximum results. It can be concluded that mathematics learning in class VII MTs Nurul Huda has not been running optimally as expected. Therefore, improvement and innovation in the learning process are needed so that students' understanding of mathematics can improve and achieve maximum results. One alternative that can be used to overcome this problem is to implement a student-centered learning model and provide meaningful learning experiences, such as the Problem-Based Learning (PBL) model (Shoimin, A., 2017). The PBL model emphasizes the learning process through contextual problem solving, so that students are encouraged to think critically and actively construct their own knowledge. The application of the PBL model is expected to help students understand the concept of integers more deeply and increase their involvement in the learning process.

Based on the background described above, the author conducted research aimed at improving learning through classroom action research entitled "The Application of the Problem-Based Learning (PBL) Model to Improve Students' Mathematical Comprehension of Integer Material in Grade VII at MTs Nurul Huda Rumbut Depok".

2. RESEARCH METHODS

This study used a classroom action research (CAR) approach that aimed to improve students' mathematical comprehension skills through the application of the Problem-Based Learning (PBL) model. The CAR was conducted in two cycles, beginning with observations and pre-cycle tests. The research design referred to the spiral CAR model developed by Kemmis and McTaggart (Suharsimi Arikunto, Supardi, Suhardjono, 2021), in which each cycle consisted of four main stages and continued to the next cycle until optimal results were achieved.

The research subjects were 27 active seventh-grade students at MTs. Nurul Huda in the 2025/2026 academic year. The data collection techniques used in conducting classroom action research included tests, observations, interviews, documentation, and were reinforced by distributing questionnaires to determine student responses to the implementation of the PBL learning model. The instruments used for data collection were validated by experts, namely mathematics teachers and lecturers. Tests used to measure students' understanding of mathematics used essay questions.

The validity of the data in this study used the triangulation technique, which is comparing various data sources and data collection methods to improve the accuracy and validity of the research results. The achievement target in this classroom action research (CAR) was set at 80% of the total research subjects achieving a minimum score of 75.

3. RESULT AND DISCUSSION

The preliminary research data is preliminary information collected by researchers as a basis for consideration in designing and implementing research actions. This data serves as a reference for identifying learning problems that occur in the classroom. The preliminary data obtained relates to the number of students in class VII MTs Nurul Huda, which is the subject of this study. The research subject data is presented in Table 1.

Tabel 1. Data Subjek Penelitian

Kelas	Jumlah Siswa		Total
	Laki-laki	Perempuan	
VII	14	13	27
Persentase	52%	48%	100%

3.1 Fre-cycle data

The researchers also conducted preliminary tests on integer material with seventh-grade students at MTs Nurul Huda Rumbut in Cimanggis District, Depok City, before using Problem-Based Learning as follows:

Tabel 2. Distribusi Frekuensi Hasil Tes Siswa (Pra-Siklus)

No	Value Range	Test Result	
		Number of Student (F)	Presentase (%)
1	20-40	6	22%
2	50-65	11	41%
3	75-90	10	37%
Total		27	100%

When illustrated in graph form, the achievements are as follows:

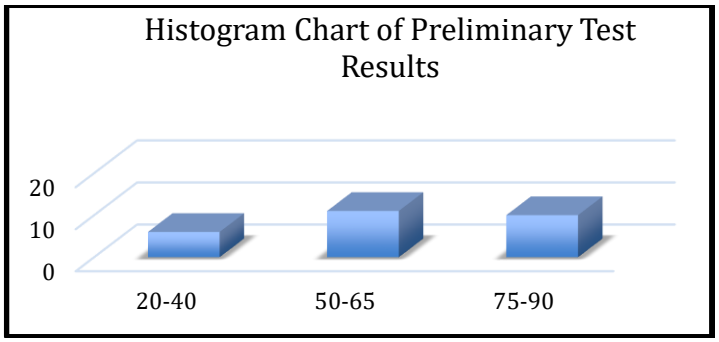

Figure 1. Histogram of Student Test Results (Pre-Cycle)

It appears that only 10 students or 37% have reached the new minimum competency standard. The majority of students' comprehension scores were in the range of 50-65, with 11 students or 41%.

3.2 Description of Cycle I Results Data

Cycle I was conducted and completed in three meetings, with the first meeting held on Thursday, July 31, 2025, the second meeting on Saturday, August 2, 2025, and the third meeting on Thursday, August 7, 2025. The time allocation was reduced to 2x40 minutes. Cycle I was conducted after conducting an observation to determine whether the material being studied was integers, of course with the permission of the Principal. This was followed by a discussion with the seventh-grade mathematics teacher at MTs Nurul Huda about the Teaching Module and the stages of the action research that would be carried out.

Mathematics lessons in class VII MTs Nurul Huda are held every Thursday and Saturday. Cycle I consists of three meetings with material on integers. The researcher and collaborating teachers jointly apply the Problem-Based Learning model, and in the third meeting, a learning outcome test or final test will be held to measure student learning outcomes after applying the Problem-Based Learning model.

The evaluation of learning outcomes in Cycle I shows the development of students' ability to understand the concept of integers after using the Problem-Based Learning (PBL) model. The scores obtained by the students show an improvement compared to the initial conditions, where most students are now in the moderate to fairly high category.

However, there are still a number of students who are unable to complete questions that require deeper reasoning. The main difficulty is seen when students are asked to explain the reasons for using certain steps or to relate the concept of integers to contextual

problems, which has an impact on the overall failure to achieve the Minimum Completion Criteria (KKM).

The data obtained in cycle I is as follows:

1. Test Result

Tabel 3. Distribusi Frekuensi Hasil Tes Siswa Siklus I

No	Value Range	Test Result	
		Number of Student (F)	Presentase (%)
1	40 – 59	4	15%
2	60 – 74	8	30%
3	75 – 89	14	52%
4	90 – 100	1	4%
Total		27	100%

Or presented in graphic form as follows:

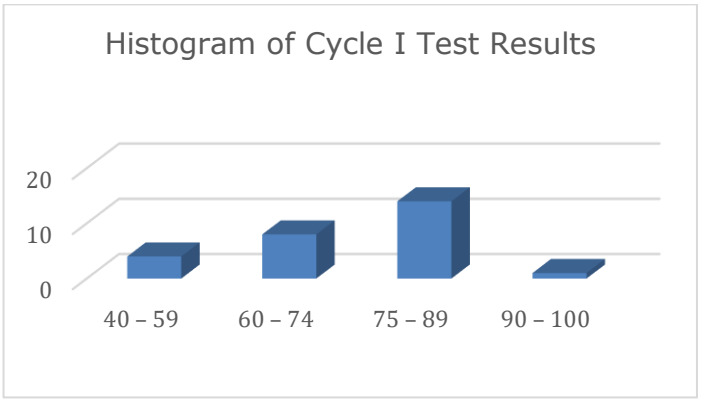

Figure 2. Histogram Graph of Cycle I Test Results

In cycle I, only 56% of students achieved the minimum passing grade, falling short of the target.

2. Student Observation Results

Meanwhile, the results of observations of student activities during teaching and learning activities in cycle I are presented in Table 4..

Table 4. Observation Results for Students in Cycle I

No	observed aspects	Score			
		1	2	3	4
1	Attendance				✓
2	Curiosity in learning mathematics		✓		
3	Creativity in the mathematics learning process			✓	
4	The courage to ask and answer questions			✓	
5	Response to questions from teachers or other students		✓		
6	Collaboration in solving math problems			✓	

7	Ability to understand and solve mathematical problems	✓	
8	Ability to reflect on the answers to the questions worked on		✓
	Score Total	22	

The average observation score for students was 22/32×100%=68%, which is considered adequate. This percentage shows that student engagement in the mathematics learning process using the Problem-Based Learning (PBL) model has begun to emerge, although it is still in the adequate category. Student attendance was relatively good and showed positive initial enthusiasm. Students' curiosity began to be aroused when faced with contextual problems, but not all students showed equal involvement. Creativity in solving mathematical problems only emerged in a small number of active students, while the majority still tended to wait for directions from the teacher or their groupmates. The courage to ask and answer questions was also still low, as only a few students seemed confident enough to express their opinions in front of the class.

The results of observations and test analyses, reinforced by interviews, show that the implementation of learning in cycle I was not yet fully optimal. Students began to show interest in the problem-based learning approach, but their active involvement in the learning process was still limited. Some students appeared passive during group discussions, so that interaction was not evenly distributed among group members. In addition, understanding the concept of integer operations was still a challenge, as indicated by errors in solving problems that required the application of the concepts of integer addition and subtraction. This condition indicated the need for more intensive mentoring strategies, both in terms of managing group discussions and providing concrete examples, so that students would be more focused in understanding the material and able to participate actively in the learning process.

Based on these findings, it can be concluded that in cycle I, the learning process still requires several improvements in order to achieve maximum results. Teachers still need to clarify the direction in each stage of Problem-Based Learning, increase student involvement in discussions, and provide more intensive guidance to students who are still experiencing difficulties. With this reflection, the researchers obtained a clear picture of the aspects that need to be improved and used as a basis for designing more effective actions in cycle II.

3.3 Description of Cycle II Results Data

Cycle II planning was based on the results of reflection on cycle I, where students' understanding of integer operations still needed to be improved. In cycle II, learning was focused on integer multiplication and division operations using the Problem-Based Learning (PBL) model. The researcher and collaborating teachers developed teaching modules, student worksheets, and other learning instruments based on the ATP for cycle II.

In the planning stage, teachers prepared contextual questions related to everyday life, such as calculating business profits and losses, steps up and down, and problems involving negative numbers. The aim was for students to be able to construct mathematical models and learn the concepts of multiplication and division of integers through real-life experiences. In addition, provoking questions are also prepared to encourage critical thinking, such as how negative numbers are used in everyday life, what strategies are appropriate for solving problems, and how to visualize the results of integer operations.

The learning activities were designed in three sessions. The first session focused on developing mathematical models from contextual problems. The second session was directed at presentations, feedback, and revisions of the solutions that had been created. The third session focused on individual tests to improve conceptual understanding, followed by personal reflection by the students. The media and tools used include worksheets, number lines, whiteboards, projectors, and classrooms arranged in groups to support

discussion. With this careful planning, Cycle II is expected to increase student engagement while strengthening their understanding of integer concepts.

Cycle 2 was conducted in three meetings on August 9, 2025, August 14, 2025, and August 16, 2025, with material on multiplication and division of integers. The researcher and collaborating teachers jointly applied the Problem-Based Learning method, and in the third meeting, a final test was held to measure students' understanding of the concepts after applying the Problem-Based Learning method.

1. Test Results

The results of cycle II tests can be seen in Table 5..

Table 5. Frequency Distribution of Student Test Results in Cycle II

No	Value Range	Result Test	
		Number of Students (F)	Presentase (%)
1	70-74	3	11%
2	75-79	10	37%
3	80-84	12	44%
4	85-89	1	4%
5	90-100	1	4%
Total		22	100%

As shown in Table 5, 89% of students achieved the minimum passing grade, which is higher than the research target of 80%. Only 11% of students did not fully understand the material on integer operations.

The data in Table 5 is illustrated in the graph presented in Figure 3.

Or if presented in graphic form as follows:

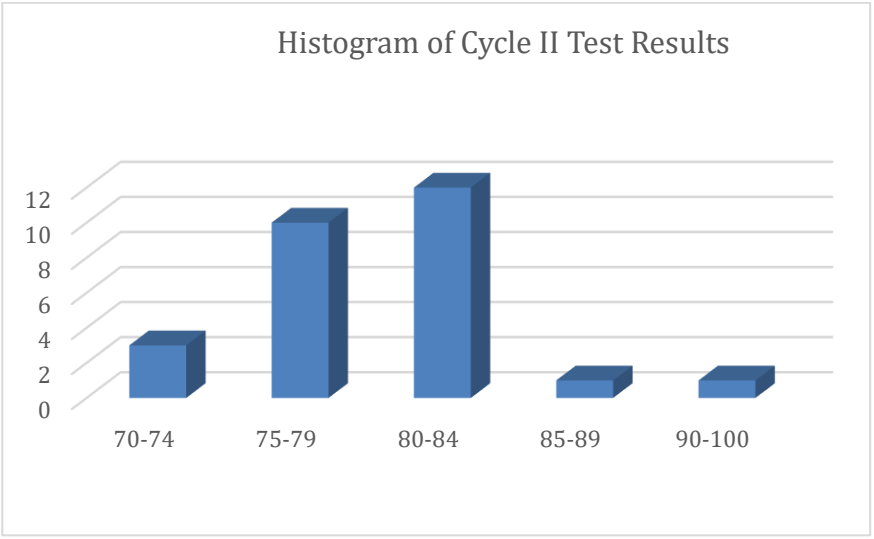

Figure 5. Frequency Distribution of Student Test Results in Cycle II

2. Student Observation Results

The results of observations of student activities during teaching and learning activities in cycle II are presented in Table 6.

Table 6. Observation Results for Students in Cycle II

No	Observed Aspects	Score			
		1	2	3	4
1	Attendance			✓	
2	Curiosity in learning mathematics				✓
3	Creativity in the mathematics learning process			✓	
4	The courage to ask and answer questions				✓
5	Response to questions from teachers or other students				✓
6	Collaboration in solving math problems			✓	
7	Ability to understand and solve mathematical problems				✓
8	Ability to reflect on the answers to the questions worked on			✓	
	Score Total	28			

The average observation score for students was 28/32 x 100% = 87%. The results of student activity observations in cycle II showed a significant improvement compared to cycle I. Of the 32 indicators observed, 28 indicators (87%) were implemented well. This achievement is much higher than the previous cycle, which was still in the adequate category. This improvement can be seen from the students' increased activity in participating in each stage of learning, from discussing in groups, expressing opinions, constructing mathematical models, to conducting independent reflection. The students' enthusiasm was also evident when they presented their group work and provided feedback on other groups' presentations. With these results, it can be concluded that the application of the Problem-Based Learning model to integer material has successfully encouraged students' active involvement in the learning process and supported optimal learning outcomes.

Reflection is an evaluation activity carried out by researchers on the results obtained during cycle 2. The implementation of learning in cycle II went better than cycle I. The observation results showed that teacher activity reached 84%, while student activity reached 87%, both of which were in the good category. This indicates that teachers have implemented learning in accordance with the Problem-Based Learning (PBL) stages, starting from providing contextual problems, guiding discussions, to reinforcing solution strategies. Students were also more active in participating in learning, as seen from their courage in expressing their opinions, constructing mathematical models, discussing, and conducting independent reflection.

In terms of conceptual understanding, the test in cycle II showed a significant improvement compared to cycle I. A total of 24 students (89%) achieved mastery with an average score of 79%, a sharp increase from cycle I, which only reached 55% with an average of 72%. This proves that the PBL model is able to help students understand integer concepts more deeply, both through discussion activities, strategy development, and application in solving contextual problems.

Based on these achievements, the researchers and observers agreed that the actions in cycle II had met the research success indicators. Therefore, the research was terminated in cycle II because the main objective, which was to improve the understanding of integer concepts among seventh-grade students at MTs Nurul Huda, had been achieved.

4 CONCLUSION

From the results of the recapitulation of cycles I and II, including test results, observation of student activities, and interviews, it is clear that learning with the Problem-Based Learning method can improve students' understanding of mathematical concepts in integer material in class VII MTs. Nurul Huda Depok. The increase in student understanding of integer material from cycle I to cycle II was 34%. This improvement is quite high, even though there are still 11% or 3 students who have not reached the minimum passing grade. Since the research target has been achieved, this action research was stopped in cycle II.

5 REFERENCES

Anisa, R. N., Ruswana, A. M., & Zamnah, L. N. (2021). Analisis kemampuan pemahaman konsep matematis peserta didik SMP pada materi aljabar. J-*KIP (Jurnal Keguruan Dan Ilmu Pendidikan)*, 2(3), 2nctm37-242.

Arnidha, Y., & Fatahillah, F. (2021). Membentuk Karakter Logis, Kritis, Kreatif dan Inovatif dalam Pembelajaran Matematika Melalui Pendekatan Saintifik. *JURNAL e-DuMath*, 7(1), 35-41.

Hamdani, A. D., Nurhafsah, N., & Rustini, T. (2022). Pengaruh Penerapan Model Problem Based Learning (PBL) dalam Pembelajaran IPS terhadap Kemampuan Berpikir Tingkat Tinggi (HOTS) pada Siswa Sekolah Dasar. *Journal on Education*, 5(1), 460-468.

Kurniasih. (2014). *Model-model pembelajaran dan implementasinya*. Jakarta: Kata Pena

Mulyono, B., & Hapizah, H. (2018). Pemahaman konsep dalam pembelajaran matematika. *Kalamatika: Jurnal Pendidikan Matematika*, 3(2), 103-122.

Nasution, A., Tanjung, R. S., Ritonga, E. S., & Khoyan, M. (2025). Membangun Pemikiran Ilmiah yang Kritis melalui Logika. *CIVITAS* (*Jurnal Pembelajaran Dan Ilmu Civic*), 11(1), 18-22.

NCTM. (2000). *Principles and Standards for School Mathematics*. Reston, VA: National Council of Teachers of Mathematics

Ruqoyyah, S., Murni, S., & Linda, L. (2020). *Kemampuan pemahaman konsep dan resiliensi matematika dengan VBA microsoft excel*. Purwakarta: Tre Alea Jacta Pedagogie.

Safari, Y., & Nurhida, P. (2024). Pentingnya Pemahaman Konsep Dasar Matematika dalam Pembelajaran Matematika. *Karimah Tauhid*, 3(9), 9817-9824.

Sanjaya, W. (2013). *Strategi Pembelajaran Berorientasi Standar Proses Pendidikan*. Jakarta: Kencana

Shoimin, A. (2017). Pembelajaran Berbasis Problem Solving untuk Meningkatkan Kreativitas Siswa. *Jurnal Pendidikan*, 8(2), 124–130.

Suharsimi Arikunto, Supardi, Suhardjono (2021). *Penelitian Tindakan Kelas*. Jakarta: Bumi Aksara

Yani, E., Pujiastuti, H., & Anriani, N. (2019). Analisis Kemampuan Pemahaman Matematis Siswa SMP Ditinjau Dari Minat Belajar. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, 3(2), 2736-2744.

Zulmaulida, R., Husna, M., & Saputra, E. (2024). Ontologi Matematika. *JUMPER: Journal of Educational Multidisciplinary Research*, 3(1), 62-73.