Journal of Educational Sciences
Journal homepage: https://jes.ejournal.unri.ac.id/index.php/JES

P-ISSN 2581-1657
E-ISSN 2581-2203

Application of The Problem Based Learning Model to Improve Mathematical Representation Capability Class X.2 Students of SMAN 6 Pekanbaru

Soni Ezra Ridwana Saragih*, Syarifah Nur Siregar, Atma Murni
FKIP, Universitas Riau, Pekanbaru, 28294, Indonesia.

ARTICLE INFO

Article history:

Received: 20 Dec 2024
Revised: 14 March 2025
Accepted: 16 March 2025
Published online: 24 March 2025

Keywords:

Classroom Action Research,
Mathematical Representation Skills,
Problem Based Learning,
Systems of Linear Equations and Inequalities

* *Corresponding author:*

E-mail: syarifahnur.siregar@lecturer.unri.ac.id

Article Doi:

Doi: https://doi.org/10.31258/jes.9.2.p.626-635

A B S T R A C T

This research aims to improve the learning process and increase students' Mathematical Representation Ability (MRA) through the application of the Problem Based Learning (PBL) model. The form of this research is Classroom Action Research (CAR) with 2 cycles carried out in class The research instrument consists of learning tools (learning objective flow and teaching modules) and data collection instruments (observation sheets and MRA tests). Based on the results of the analysis of teacher and student activities as a whole, it was found that there was an improvement in the quality of the implementation of the learning process. The results of the MRA test analysis show that the average MRA score of students in the initial test was 40.85 in the low category and increased in cycle 1 to an average of 54.81 in the medium category and in cycle 2 the average gain in MRA scores amounting to 75.69 in the high category. Based on the results of the analysis, it was found that the PBL model can improve the quality of implementation of the learning process and increase students' MRA.

1. Introduction

The role of mathematics is never separated from various aspects of life. Without us realizing it, the mathematical concepts we have studied at school are always applied in various activities. One of the abilities that students must have to understand mathematics is the ability to present mathematical ideas. The ability to re-present notations, symbols, tables, images, graphs, diagrams, equations, or other mathematical expressions into new forms is known as mathematical representation ability (Pratiwi et al, 2019). MRA is very important for students and is closely related to communication and problem solving skills, because to solve mathematical problems, the ability to create mathematical models and

interpret the solutions is required. Mathematical representation indicators, namely; (1) symbolic representation, namely creating mathematical equations or models and solving problems involving mathematical expressions; (2) visual representation, namely presenting data or information back into a diagram, graph or table representation; (3) verbal representation, namely answering questions using words or written text.

Through mathematical representation, students can develop and deepen their understanding of mathematical concepts and help students communicate their thoughts (Yusnani, 2016). However, in reality, MRA among students is still relatively low. This is in line with research by Sella et al., (2021) which states that students have low MRA based on the overall score obtained with an average of 47.24. Data obtained on the visual representation indicators of students having moderate abilities, the reason is that students have not been able to present data or information from a representation to a tabular representation. Meanwhile, the indicators for symbolic representation and verbal representation are included in low ability. This is because in symbolic representation students are not yet able to make conjectures from the data provided, and in verbal representation, students are not yet able to create problem situations based on the data or representations provided, and are not yet able to construct steps to solve mathematical problems using words. say.

Research conducted by Susilawati et al, (2019), researchers explained that the increase in MRA can be seen from the increase in students' MRA achievements in the end-of-cycle tests. In the final test of cycle I, there were 16 out of 26 students or 61.5% who obtained MRA achievements of at least level 3. In cycle II it increased to 23 out of 26 students or 88.46% who obtained MRA achievements of at least level 3. In addition Therefore, the increase in learning outcomes in cycle II is also influenced by the activities of students and teachers in the PBL learning process. The results of observing teacher activities in the first cycle were 75.53% in the good category, the second cycle was 85.83% in the very good category. There is also research by Sabrina (2015), the researcher explained that students who received learning using the PBL model significantly had better mathematical representation abilities than students who received conventional learning. The quality of improving MRA for students who receive learning using the PBL model is included in the high category.

Based on the results of interviews with mathematics teachers at SMAN 6 Pekanbaru, information was obtained that the students' low ability to solve problems was because students were less active in the learning process, no one asked or discussed the material being taught so the learning process tended to be monotonous and some students did not follow instructions. teacher for talking to friends when the teacher explains. Lack of understanding of students' basic mathematical concepts such as arithmetic and algebra operations. Apart from that, the teacher said that he had not accustomed students to solving problems with various representations, such as changing problems into mathematical representations in the form of equations, graphs or tables, and visualizing mathematical concepts such as understanding the relationship between variables

and identifying patterns, so that students were only focused on solving steps. questions taught by the teacher.

Based on the results of interviews with students in class (2) students have difficulty visualizing images or tables presented in the material they have studied; (3) lack of ability to solve problems in everyday life into other representations such as equations, graphs or tables. This is supported by the results of observations made by researchers in class X.2 at SMAN 6 Pekanbaru. Based on the results of observations when the teacher was teaching in class, it was found that during the learning process, there were no problems. Students pay attention to the teacher's explanation of the material being taught with steps to solve it using formulas, then students take notes and do exercises from mathematics books which are a source of learning without mathematical problem solving.

In response to this, to find out more about the MRA of students at school, researchers gave an initial MRA ability test to 36 students in class X.2 at SMAN 6 Pekanbaru with material on systems of linear equations in two variables. The results of measuring students' MRA tests in the initial test showed that the percentage of students who met the maximum score was still low in the three indicators measured. The average MRA score of students on the symbolic representation indicator is 53.47%, classified as low qualifications, the average MRA score of students on the indicator of visual representation is 40.28%, classified as low qualifications, and the average MRA score of students on the verbal representation indicator is 28.81% in the very low qualification category. This shows that students' MRA still needs to be improved in these three MRA aspects.

Based on the results of interviews and observations made on teachers and students as well as the results of the initial MRA test of students, it can be concluded that the MRA of students is low. Efforts to improve the learning process and increase the MRA of class X.2 students at SMAN 6 Pekanbaru require learning innovations that can familiarize students with solving problems related to MRA. The Problem Based Learning (PBL) learning model was chosen by researchers to improve students' MRA. In the PBL model, students play an active role so that students can express representations of problem solving according to the ideas they have and the teacher acts as a facilitator (Chakrabarty & Mohamed, 2018). According to Arends (Sumartini, 2016) the PBL model is designed primarily to help students develop thinking skills, intellectual skills and problem solving skills.

The problem based learning model is related to mathematical representation because the reasoning process requires the ability to connect facts to solve problems. According to Anugraheni (2018) the PBL learning model is a learning model that involves students in learning activities and prioritizes real problems in the home, school and community environments as a basis for acquiring knowledge and concepts through skills in critical thinking and problem solving. In addition, by presenting real problems, it is hoped that students will find it easier to carry out investigations both independently and in groups. develop and be able to present the results of their work in various forms, such as pictures, diagrams,

mathematical expressions, or words or written tests. So, indirectly students have used their mathematical representation abilities through expressing mathematical ideas.

In this research, researchers measured students' mathematical representation abilities on systems of linear equations and inequalities. The material on linear equations and inequalities contains various problems that are closely related to everyday life so it is hoped that it will foster independence in solving problems that train mathematical representation skills. Thus, it is hoped that the implementation of the PBL model can improve the learning process and increase the Mathematical Representation Skills of class X.2 students at SMAN 6 Pekanbaru.

2. Methodology

This research is collaborative Class Action Research (CAR) in carrying out the action in collaboration with mathematics teachers who teach in class X.2 SMAN 6 Pekanbaru. This research involved 36 students as subjects, consisting of 17 male students and 19 female students in class This classroom action research aims to improve the learning process and increase the mathematical representation abilities of class X.2 students at SMAN 6 Pekanbaru by taking action in the form of implementing the PBL model. Classroom action research is a form of scientific activity and method carried out by research teachers in the classroom using actions to improve learning processes and outcomes.

According to Arikunto (2015) CAR is implemented through four stages, namely planning, implementation, observation and reflection. The implementation of this research consisted of two cycles, cycle I which consisted of 3 meetings, after cycle I the MRA I test was carried out. Meanwhile, cycle II consisted of 2 meetings and after cycle II the MRA II test was carried out. At the planning stage, researchers prepared research instruments in the form of learning tools and data collection instruments in the form of student observation sheets and MRA tests. The researcher planned the application of the PBL model to material on systems of linear equations and inequalities. The researcher prepared learning tools through teaching modules and activity sheets for teachers and students. The implementation of the action is the implementation of the planning stage which is guided by the teaching-1 module and which is carried out for cycle I, the teaching-2 module which is implemented for cycle II which is adapted to the Problem Based Learning model and data collection instruments. Observations were carried out on the activities of teachers and students during the learning process. Observation activities aim to determine the quality of implementation of actions and things that need to be improved so that the actions taken achieve the desired goals.

At this stage, the person acting as an observer of the teacher's activities was the class X.2 mathematics teacher at SMAN 6 Pekanbaru and the observers of the students' activities were fellow researchers. Reflection is an activity to review and

evaluate learning activities that have been carried out. Reflection is carried out after the action of each cycle ends. This stage is the stage of reviewing the quality of implementation of activities and planning efforts to improve the learning process obtained from the observation sheet. The strengths found are maintained in cycle II and the weaknesses or deficiencies found are used as guidelines for planning improvements or alternative solutions in cycle II. The results of the reflection are used as the basis for preparing an improvement plan to be implemented in the next cycle.

The research instrument is a learning tool which includes a Learning Objectives Flow (ATP), Teaching Module, as well as a data collection instrument containing observation sheets of teacher and student activities as well as MRA tests. The technique used to collect data on teacher and student activities is the observation technique through teacher and student activity observation sheets, while the data collection technique regarding mathematical connection abilities is collected through written tests which are carried out twice. The data analysis techniques used are, (1) Analysis of data resulting from observations of teacher and student activities. Data obtained from teacher and student activity observation sheets are qualitative data and analyzed using narrative descriptive analysis techniques; (2) Analysis of the test results of students' mathematical representation abilities is analyzed quantitatively which includes analysis of the achievement of MRA aspects, analysis of students' MRA qualifications before and after the action, as well as classical analysis.

The MRA values obtained are then qualified according to the Learning Goal Achievement Criteria (KKTP) which can be seen in Table 1.

Table 1. Qualification of Students' Mathematical Representation Ability

Mark	Mathematical Representation Ability Category
$N \geq 90$	Very High
$75 \leq N < 90$	Tall
$60 \leq N < 75$	Currently
$40 \leq N < 60$	Low
$N < 40$	Very Low

The criteria for the success of the action in this research is if there is improvement in the shortcomings of learning activities, so that an improvement plan can be carried out obtained from the teacher and student activity sheets through the results of reflection on learning activities in cycle I. In cycle II reflection, there is an increase in the quality of implementation of the learning process and deficiencies. learning activities are decreasing. MRA is said to have increased if the achievement of MRA aspects in cycle I and cycle II increases as seen from the percentage of students who get the maximum score. The number of students who achieved very high and high qualification scores increased, while students who achieved moderate and low qualification scores decreased from before the action to after the action. Apart from that, there was a classical increase in MRA from the initial test score to the MRA cycle I test score and the MRA cycle II test score.

3. Results and Discussion

The research lasted for 7 meetings, 5 meetings to carry out actions in cycle I and cycle II and 2 meetings to carry out MRA tests in cycle I and cycle II. Data obtained from these actions are collected and analyzed. The research results were analyzed from teacher and student activity sheets during the learning process and the results of the students' MRA tests in cycle I and cycle II.

Analysis of teacher and student activities

Teacher and student activities are analyzed to assess the extent of the quality of implementation and effectiveness of the PBL model steps that have been planned during the learning process. The results of reflection in cycle I found weaknesses in teacher and student activities as well as alternative solutions carried out by researchers to improve actions in cycle II, so that the implementation of learning in cycle II was designed according to the results of reflection in cycle I and improvements were made in cycle II. The deficiencies and weaknesses that occur during the learning process are increasingly reduced as the actions of cycle II are implemented, so that the learning process carried out continues to improve until the end of cycle II. Learning activities as in figure 1.

Figure 1. Guiding Individual and Group Inquiry

The core activities are carried out in accordance with the PBL phases. In each phase of PBL in cycle I, improvements are made, because there are still shortcomings and weaknesses in each phase. In cycle I, the phase of student orientation to the problem, there were students who did not follow the researcher's instructions to observe the problem. So, as improvements are made in cycle II, students have followed the directions/instructions to observe problems and begin to understand the problems given. In the phase of guiding individual and group investigations, students looked confused when gathering information from the problems in the LKPD and in the first and second meetings, students had difficulty solving problems with symbolic and verbal representations. Students

also still work individually. In line with improvements made in cycle II, students can collect information using both symbolic, visual and verbal representations. In the phase of developing and presenting their work in cycle I, no groups volunteered for presentations and when presenting they still focused on reading. In cycle II, students present the results of their discussions, not just focusing on reading. In the analyzing and evaluating phase of the problem solving process in cycle I, in providing responses and evaluating students' answers there were still difficulties so the researcher guided the students. In cycle II, participants were enthusiastic and active in providing responses and evaluating the presenting group's answers.

The results of reflection from cycle I and cycle II show that there has been an improvement in the learning process as seen from the quality of the implementation of student activities which has become better during the learning process. The deficiencies that occur during the learning process decrease along with the implementation of cycle I and cycle II actions, so that the learning process carried out continues to improve until the end of cycle II. Students become more actively involved during the learning process, so that the learning process in core activities gets better at each meeting, resulting in an increase in students' MRA which can also be seen from the results of students' discussions with their groups when working on LKPD. Based on the results of the analysis of teacher and student activities during the research, overall it can be said that the quality of the implementation of the learning process is getting better at each meeting until the end of cycle II.

Analysis of MRA Test Result

The following are the results of the MRA score analysis of class X.2 students at SMAN 6 Pekanbaru after applying the PBL model to the material Systems of Linear Equations and Inequalities. The increase in MRA is seen from the achievement of MRA aspects after the action. The achievement of the MRA aspect can be seen from the increase in the percentage of students who obtained the maximum score in cycle I and cycle II as follows.

Table 2. Average of Students Who Get the Maximum Score on Each Aspect of MRA Cycle I

Information	Aspects of MRA that are measured						
	Symbolic (max score 4)			Visual (max score 4)	Verbal (max score 4)		
	Question Number						
	1	2	3	2	1	2	3
Number of students with max score	23	12	0	10	12	7	2
Average	63,88	33,33	0	27,77	33,33	19,44	5,55

Table 2 shows that there was an increase in students' mathematical representation abilities for each aspect of MRA measured compared to students' MRA in the initial test. This is because students have begun to understand and solve problems using their mathematical representation skills, although there are still mistakes

made by students and difficulty solving one of the questions on symbolic indicators so that no student gets the maximum score.

Table 3. Average of Students Who Get the Maximum Score on Each Aspect of MRA Cycle II

Information	Aspects of MRA that are measured					
	Symbolic (max score 4)		Symbolic (max score 4)		Symbolic (max score 4)	
	Question Number					
	1	2	1	2	1	2
Number of students with max score	31	13	17	4	10	4
Average	86,11	36,11	47,22	11,11	27,77	11,11

Table 3 shows that there has been an increase in students' MRA for each aspect. Even though it has not yet reached 100%, there has been an increase in the percentage of students who got the maximum score compared to cycle I. This is because students are able to use their mathematical representation skills in solving problems. Based on the analysis of the MRA test results, the increase in students' MRA is also shown in table 4 below.

Table 4. Qualification of students' MRA before and after the action

Qualification	FirstTest	Cycle I	Cycle II
$\boldsymbol{N \geq 90}$ (Very High)	-	-	5
$\boldsymbol{75 \leq N < 90}$ (High)	1	6	14
$\boldsymbol{60 \leq N < 75}$ (Currently)	5	4	14
$\boldsymbol{40 \leq N < 60}$ (Low)	15	17	1
$\boldsymbol{N < 40}$ (Very Low)	15	9	2

Based on Table 4, it can be seen that the number of students with MRA qualifications increased from the initial test to cycle I and cycle I to cycle II. In very low and low qualifications, there was a decrease in the number of students who obtained the maximum score from the initial test to cycle I and then cycle II. In medium, high and very high qualifications, there was an increase in the number of students who obtained the maximum score from the initial test to cycle I and then cycle II. Based on the scores obtained by students in cycle I and cycle II, there was an increase in classical MRA for students in each aspect of MRA, which can be seen in Table 5.

Table 5. Average increase in classical student MRA scores

Information	Student MRA Values		
	First Test	Cycle I	Cycle II
Average Student MRA Score	40,85	54,81	75,69
Improvement		13,96	15,88

In Table 5, information is obtained that the average value of each student's MRA indicator has increased from the initial test, cycle I, cycle II. The average initial MRA ability score of students before the action, cycle I and cycle II was 40.85; 54.81; and 75.69. The increase in the average MRA score of students shows that

there has been an increase in the representational abilities of students for each MRA indicator, namely symbolic, visual and verbal.

Based on the results of the analysis of teacher and student activities, as well as the results of the analysis of students' MRA tests after the action, it can be concluded that there has been an improvement in the learning process and an increase in students' mathematical representation abilities. The results of this analysis can be concluded to support the proposed action hypothesis. Thus, the application of the Problem Based Learning model can improve the learning process and increase the mathematical connection abilities of students in class.

4. Conclusion

Based on the results of the research and discussion, there was an improvement in the learning process as seen from the quality of implementation of teacher and student activities at each meeting up to cycle II. Students' MRA also experienced an increase from the initial test to cycle I and cycle I to cycle II, seen from the achievement of the frequency of obtaining maximum scores and students' classical MRA scores. This means that the MRA of students increases with the application of the PBL model, so it can be concluded that the application of the PBL model can improve the learning process and increase the MRA of students in class

References

Anugraheni, I. (2018). Meta Analisis Model Pembelajaran Problem Based Learning dalam Meningkatkan Keterampilan Berpikir Kritis di Sekolah Dasar. *Jurnal Ilmiah*, 14(1), 9-18.

Arikunto, S., & Suhardjono, S. (2015). Penelitian Tindakan Kelas Edisi Revisi. Jakarta: PT. Bumi Aksara.

Chakrabarty, S., & Mohamed, N. (2018). Problem Based Learning: Cultural Diverse Students 'Engagement, Learning and Contextualized Problem Solving in a Mathematics Class. *WCIK E-Journal of Inegration Knowledge*, 38–49.

Pratiwi, N. K. A., Yusmin, E., & Yani, A. (2019). Kemampuan representasi matematis menyelesaikan soal segi empat ditinjau dari self-efficacy di madrasah tsanawiyah. *Jurnal Pendidikan Dan Pembelajaran Khatulistiwa*, 8(9), 1–8.

Sabrina, F. (2015). Penerapan Model Problem Based Learning (PBL) Untuk Meningkatkan Kemampuan Representasi Matematis Siswa SMP. Skripsi tidak dipublikasikan. Universitas Pendidikan Indonesia. Bandung

Sella, M., Nurmaningsih., & Haryadi, R. (2021). Analisis Kemampuan Representasi Matematis Siswa Pada Materi Penyajian Data. *Jurnal Riset Rumpun Matematika Dan Ilmu Pengetahuan Alam,* 1(1), 40-49.

Sumartini, T. S. (2016). Kemampuan Pemecahan Masalah Matematis Siswa Melalui Pembelajaran Berbasis Pbl. *JUPE : Jurnal Pendidikan Mandala*, 7(2).

Susilawati., Daniel, T., & Abadyo. (2019). Kemampuan Representasi Matematis Siswa Kelas XI Melalui Penerapan Model Problem Based Learning. *Jurnal Pendidikan: Teori, Penelitian, & Pengembangan*, 4(9).

Yusnani. H. (2016). Penerapan Model Discovery Learning Terhadap Kemampuan Representasi Matematis dan Self Efficacy Siswa. Skripsi tidak dipublikasikan. FKIP Universitas Lampung. Bandar Lampung.

How to cite this article:

Saragih, S. E. R., Siregar, S. N., & Murni, A. (2025). Application of The Problem Based Learning Model To Improve Mathematical Representation Capability Class X.2 Students Of SMAN 6 Pekanbaru. *Journal of Educational Sciences*, *9(2)*, 626-635.