Research Article

The Implementation of Problem-based Learning (PBL) to Improve Contextual Mathematics Problem-solving Ability in Students XI-B3 Senior High School 3 Malang

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Abstract.
Based on the results of the dialog by a researcher with a mathematics teacher of grade XI-B3 Senior High School 3 Malang, most students in the class had difficulty solving the contextual problem. This fact was also supported by the result of preliminary research in grade XI-B3 Senior High School 3 Malang, which shows the students also found difficulty when converting contextual problems into mathematical form and determining which concepts should be used in solving the problem. Therefore, a renewal strategy and learning model were needed to improve students' ability to solve contextual problems, for example, by using the learning model problem-based learning (PBL). This research aims to describe learning steps using the PBL model that can improve the contextual problem-solving abilities of XI-B3 students at SMA Negeri 3 Malang. The type of research is classroom action research, which is carried out in 2 cycles. Each cycle consists of 4 stages, planning, action, observation, and reflection. The research was conducted in class XI-B3 of SMA Negeri 3 Malang with 36 students as subjects consisting of 14 boys and 22 girls. The results of the research in cycle 1 showed that students who were able to solve mathematical contextual problems increased from 52.9% to 76.4% in cycle 2 or increased by 23.5%. The results of observing teacher activities and observing student activities have increased and are in the "Very Good" category. It can be concluded that the use of the PBL model can improve students' mathematical contextual problem-solving abilities.

Keywords: mathematics learning model, PBL, contextual issues, classroom action research

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1. INTRODUCTION

Mathematics subjects are given to students starting from elementary school to equip students with the ability to think logically, analytically, systematically, critically, and creatively as well as the ability to work together. One of the objectives of mathematics learning listed in Permendikbud No.36 of 2018 is to shape the ability of students to solve a problem systematically. Polya (Wahyudi, 2017) said that problem-solving is a process of overcoming the difficulties encountered to achieve the expected goals. The purpose

of solving mathematical problems is to develop mathematical power in learners as a strategy to transfer a concept or skill to a new situation so that learners are trained to interpret the concepts, theorems, and skills they have learned. Basic competencies in the K13 curriculum lead students to solve mathematical problems as well as contextual problems that can be found in everyday life. Contextual problems are used as a link between abstract

mathematical forms and concrete forms so that they are expected to make it easier for students to solve mathematical problems.

The results of the dialogue with class XI mathematics teachers at SMA Negeri 3 Malang, found that most students had difficulty solving contextual problems, for example in the material of linear equation systems, systems of inequality, and linear programs. Learners have difficulty in creating mathematical models and determining mathematical concepts that should be used in solving a given problem. This is supported by the results of diagnostic observations of students. As many as 55% of students in the class only write down information that is known from the problems given and there are still errors in the excuses. The excuse error results in students not being able to correctly write down the mathematical form of the problem, so they cannot find a solution to the problem. The author also made class observations that were carried out when the teacher of class XI-B3 taught. Mathematics learning in the classroom begins with teaching the material without relating it to contextual problems, then giving examples of contextual problems related to the concepts that have been taught. When learning takes place some learners tend to chat and play with gadgets when the teacher explains the material in front and are inactive when the teacher asks students to answer questions related to the material that has been described. When the less-active learners are given questions, they do not answer immediately and ask their friends for answers. From the exposure that has been given, it is necessary to update strategies or use learning models to improve contextual problem-solving skills in students.

One of the cooperative learning models that can be chosen to improve contextual *problem-solving skills is the problem-based learning* (PBL) model. Rusman (2018) problem scenarios and sequences in PBL help learners develop cognitive connections that are key to contextual problem-solving. According to Jacobsen, Enggen, and Kauchak (Wahyuni, 2015), PBL has three objectives that are related to each other, the first goal is to develop the ability of learners to be able to systematically investigate a question or problem, the second goal is to develop self-directed learning, the third goal is acquisition (mastery). Some studies related to the PBL model such as those conducted by Sariningsih and Firdaus, et al. Sariningsih conducted research on Mathematics

Education students of STKIP Siliwangi Bandung in grades A1, A2, and A3 in general algebra courses for the 2015/2016 academic year. Analysis of the study using the average difference test. The results of the study came to conclusions: (i) Achievement and improvement of problem-solving skills who received PBL learning better than students who received expository learning. The research conducted by Firdaus et al was carried out in class VIII of Al Minhaj Integrated Junior High School at the Numeracy AKM in 2020. The results showed that PBL can improve students' mathematical literacy skills.

2. METHODE

This type of research is Classroom Action Research (PTK). This class action research was carried out in class XI-B3 SMA Negeri 3 Malang. The subjects in this study were students of class XI-B3 SMA Negeri 3 Malang for the 20 22/20 23 school year and researchers who also acted as model teachers. The number of learners in the classroom is 36 learners consisting of 14 men and 22 women. While the object of research is the entire learning process in the application of the PBL learning model. The data used in this study is data on the PBL learning process carried out to improve students' mathematical contextual problem-solving ability as well as data on students' mathematical contextual problem-solving ability obtained after following the learning process. PBL. The main data sources in this study are students, teachers, observations of students and teachers during the implementation of actions in the classroom, test results, and additional data in the form of photo documentation.

The data analyzed qualitatively in this study are data from class observations and the results of assessing the ability to solve mathematical contextual problems. The data obtained from the observation sheet of teacher activity and student activity are calculated with the following calculation guidelines:

$$achievement = \frac{thenumberofscoresobtained}{maximumscore} \times 100$$

The following categories of teacher and student activities will be obtained from these values.

Source : Saur, M Tampubolon (2014)

Data on students' mathematical contextual problem-solving ability is determined based on scores obtained from the assessment of indicators 1, 2, and 3 on the test at the end of the cycle. With the following calculations.

TABLE 1: Criteria for the Level of Implementation of Teacher Activities and Participant Activities Educate.

Achievement criteria	Effectiveness Rate
81-100	Excellent
61-80	Good
41-60	Enough
21-40	Less
0-20	Very Less

$$Ketercapaian = \frac{jumlahskoryangdidapat}{skormakstimal} \times 100$$

From this value, a category will be obtained capable of solving contextual problems if it gets a score above KKM, which is 70. The percentage of many students who understand the concept is as follows.

$$P = \frac{BPK}{banyakpesertadidik} \times 100\%$$

P= presentation of the number of learners who can solve contextual problems BPP = Number of students who score above KKM

This class action research is carried out through several cycles where each cycle consists of four stages according to Kurt Lewin in Tampubolon (2014), namely (1) action planning, (2) *action* implementation, (3) observation/observation (*observing*), and (4) reflection (*reflecting*).

3. RESULTS AND DISCUSSION

3.1. Research Results

Before conducting the study, the authors made preliminary observations in class XI-B3 and conducted interviews with mathematics teachers of class XI-B3. Based on the results of preliminary observations and interviews, the author decided to choose linear program material as described in the background. The research began to be carried out on September 1, 2022, with lessons for class XI-B3 being Monday at 2-3 o'clock and Thursday at 1-2 o'clock.

3.1.1. Cycle 1

Cycle 1 research was carried out in 2 meetings, namely on September 1, 2,022, and September 5, 2022. The following Table 3.1 shows a description of the learning objectives in cycle 1.

TABLE 2: Description of Cycle 1 Learning Objectives.

Meeting to-	Date	Learning Objectives
1	1 September 2022	Create at least one mathematical model of a given contextual problem. Describes the area of the set of finishes of a given contextual problem.
2	5 September 2022	Create at least one mathematical model of a given contextual problem. Describes the area of the set of finishes of a given contextual problem. Test End of Cycle 1

The author applies the PBL learning model assisted by two observers to observe the activities of students and teachers during learning activities as a level of learning implementation**.** The following are the results of observations of student activities in cycle 1.

Observation of Student

4. Meeting Observer

Activities

TABLE 3: Results of Observation of Student Activity Cycle 1.

		Shoes	Category
	1	84,3	Excellent
1	2	76,5	Good
2	1	87,5	Excellent
2		87,5	Excellent
Average		83,9	Excellent

Table 3.2 it is shown that the activity of learners during the learning process resulted in an average score of

83.9. This means that the level of success of student activities during learning is included in the ”Excellent” category. The following are the results of observations of teacher activities in cycle 1.

Observation of Student Activities

Table 4: Results of Observation of Teacher Activity Cycle 1.

Meeting	Observer	Shoes	Category
	1	93,7	Excellent
1	2	85,9	Excellent
	1	93,7	Excellent
2	2	89	Excellent
Average		**90,5**	**Excellent**

Table 3.3 it is shown that the teacher's activity during the learning process resulted in an average score of

90.5. This means that the level of success of the teacher's activities during learning falls into the category of "Excellent".

The cycle 1 learning outcomes test was held on September 5, 2022, and was attended by 34 XI-B3 students. 2 students did not participate in learning activities from the first meeting to the cycle test so the assessment data of the two students were not taken into account. The overall data of the assessment is presented in the appendix. Students are said to be able to solve contextual problems if they get an assessment above the KKM, which is 70. The results of the student assessment can be seen in the following table.

Table 5: Results of Mathematical Contextual Problem-Solving Ability.

Completeness	Many Learners	Percentage
>KKM	18	52,9%
≤KKM	16	47,1%

Based on the cycle 1 research data that has been presented, it was found that the activities of teachers and students in PBL learning have met the minimum criteria of "Good". However, the percentage of students who received an assessment above KKM did not meet the criteria of 34 students, so the authors needed to continue the cycle 2 research to achieve the predetermined success criteria75%.

4.1. 2. Cycle 2

Cycle 2 research was carried out in 2 meetings, namely on September 8, 2022, and September 12, 2022. Table 3. The following 5 shows a description of the learning objectives in cycle 2.

2. Determine the completion of contextual problems related to linear programs.

TABLE 6: Description of Cycle 2 Learning Objectives.

Meeting to-	Date	Learning Objectives
1	8 September 2022	Create at least one mathematical model of a given contextual problem. Determine all corner points of the area where contextual problems related to linear programs are solved.
2	12 September 2022	1. Describes the steps of the method of solving contextual problems related to linear programs.

4. End Test Cycle 2

The author applies the PBL learning model assisted by two observers to observe the activities of students and teachers during learning activities as a level of learning implementation. The following are the results of observations of student activities in cycle 2.

5. Table 3.6 Results of Observation of Student Activity Cycle 2

Observation of Student

6. Meeting Observer

Activities Shoes Category

1. (a) i. 93,7 Excellent

1

ii. 87,5 Excellent

2. 93,7 Excellent

2

3. 90,6 Excellent

7. Average 91,3 Excellent

Table 3.6 it is shown that the activity of learners during the learning process resulted in an average score of

91.3. This means that the level of success of student activities during learning is included in the ”Excellent” category. The following are the results of observations of teacher activities in cycle 2.

Observation of Student Activities

Table 7: Results of Observation of Teacher Activity Cycle 2.

Meeting	Observer	Shoes	Category
	1	93,7	Excellent
1	2	89	Excellent
	1	93,7	Excellent
2	2	90,6	Excellent
Average		**91,7**	**Excellent**

Table 3.7 it is shown that the teacher’s activity during the learning process resulted in an average score of

91.7. This means that the level of success of the teacher’s activities during learning falls into the category of ”Excellent”.

The cycle 2 learning outcomes test was held on September 12, 2022, and was attended by 34 XI-B3 students. 2 students did not participate in learning activities from the first meeting to the cycle test so the assessment data of the two students were not taken into account. The overall data of the assessment is presented in the appendix. Students are said to be able to solve contextual problems if they get an assessment above the KKM, which is 70. The results of the student assessment can be seen in the following table.

Table 8: Results of Mathematical Contextual Problem-Solving Ability.

Completeness	Many Learners	Percentage
>KKM	26	76.4%
≤KKM	8	23,6%

Based on the cycle 2 research data that has been presented, it was found that the application of the PBL model can improve the mathematical contextual problem-solving ability of class XI-B3 students. This is shown by the percentage of learners who get a score above KKM of. In addition, the results of observations of student activity and teacher activity show an ”excellent” category. So based on this, the research conducted stopped in cycle 2 because it met the criteria for success of the action.78,4%

7.1. Discussion

The application of the PBL model applied to be able to improve the ability to solve contextual problems in mathematics XI-B3 SMA Negeri 3 Malang consists of 5 stages of activities, namely (1) orienting to problems, (2) organizing, (3) guiding problem solving, (4) presenting work, and (5) analyzing and evaluating the problem-solving process.

7.1.1. Orienting to the problem

The teacher displays the problem on PowerPoint. The problem presented is a contextual problem relating to linear programs. Students are asked to observe the problem and identify important information on the problem presented.

7.1.2. Organizing

The teacher divides the learners into 9 groups. Each group consists of 4 students consisting of 1-2 men. In the first cycle, teachers divide groups based on the learning outcomes of students in the previous material. In the second cycle, the teacher divided the groups based on the test results of cycle 1. In the second cycle, the group members consisted of 3-4 students with a total of 34 students, because 2 students did not participate in learning in cycle 1, so there could be no changes in their problem-solving ability. After the division of groups, students are asked to sit according to their respective groups. One of the group members was asked to take the LKPD to be completed.

7.1.3. Guiding problem solving

Teachers guide problem-solving through LKPD. In each cycle, there are two LKPD. LKPD in cycle 1 guides students to create a mathematical model of contextual problems related to linear programs and draw the completion area. In cycle 2, LKPD 1 guides students to determine a mathematical model in which there is a function of the purpose of the contextual problem related to linear programs, drawing the completion area, and determining the coordinates of the corner point of the complete area that has been depicted. The teacher asks students to ask questions when there are obstacles in completing LKPD. Teachers guide learners in solving problems with *scaffolding*.

7.1.4. Presenting the work

The teacher asks one of the learners from one of the groups to present the results of his group discussion. The appointment of one of the group members is aimed at knowing the readiness and understanding of each group member. After the presenter has finished presenting the results of his discussion, the teacher asks other group members to ask questions or provide responses. In cycle 1, students who did not present were still busy working on LKPD so they were less focused on paying attention to the presentation, which resulted in not being able to respond to the presentation results. In cycle 2, teachers make improvements to presentation activities by asking each group to collect their LKPD first before the presentation activities begin so that presentation activities are more conducive.

7.1.5. Analyze and evaluate the problem-solving process.

The teacher asked 3 learners to give a conclusion on the material that had been studied. After that, the teacher reinforces the conclusions that have been conveyed by the learners. The teacher also asked students to reflect on the learning activities of the day, this activity ended by doing an evaluation quiz. The evaluation quiz at the second meeting of each cycle is the end of the cycle test.

At the final test stage, learners are given question sheets and answers individually. The teacher adjusts the seating distance of the learners so that they are not close to each other and asks the learners to collect gadgets at the teacher's desk. This is so that there is no cheating committed by students. In cycle 1 learner are given 1 essay question. The completeness of students' contextual problem-solving ability in cycle 1 was 52.9% or as many as 18 students out of 34 students who scored above KKM. While in cycle 2, students are given 1 essay question in the final test. The completion of understanding the concept of students was 76.4% or as many as 26 students got a score above KKM. This shows that learners' mathematical contextual problem-solving skills are improving.

8. CONCLUSION

Based on the results of data exposure and discussion, it was found that in cycle 1 student who was able to solve mathematical contextual problems increased from 52.9% to 76.4% in cycle 2, or an increase of 23.5%. The results of teacher activity observations and student activity observations have increased and are in the "Excellent" category.

So it can be concluded that the application of the PBL model can improve mathematical contextual problem-solving skills in students XI-B3 SMA Negeri 3 Malang with two research cycles. The activities of the PBL model that can improve the ability to solve mathematical contextual problems in students XI-B3 SMA Negeri 3 Malang, namely (1) orienting to problems, (2) organizing, (3) guiding problem solving, (4) presenting work, and (5) analyzing and evaluating the problem-solving process.

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