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Implementation of Problem-Based Learning (PBL) Model to Improve Students' Learning Outcomes in Two-Dimensional Geometric Shapes Material

Fadhila Tawassalna [1], Hasnita [2]
[1] Universitas Riau, INDONESIA
[2] SMP Negeri 34 Pekanbaru, INDONESIA

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ABSTRACT

This study aims to improve the process and mathematics learning outcomes for class VIII students. 7 SMP Negeri 34 Pekanbaru through applying the Problem-Based Learning model. The subjects of this study were students of class VIII. 7 SMP Negeri 34 Pekanbaru, a total of 39 students consisting of 21 male and 18 female students. This is a classroom action research (CAR) consisting of 2 cycles. The data collection instrument consists of an observation sheet and a learning outcome test sheet that has been analyzed. Furthermore, the data analysis technique used is descriptive data analysis in the form of qualitative and quantitative data analysis. The observation sheet at each meeting shows an improvement in the process, and based on learning outcomes, there is an increase in learning, as seen from the number of students who reached the KKTP and the average student learning outcomes in mathematics. So, it can be concluded that applying the Problem-based Learning model can improve the process and mathematics learning outcomes for students in class VIII. 7 SMP Negeri 34 Pekanbaru.

Corresponding address:

Fadhila Tawassalna,
E-mail: fadhilatawassalnaa@gmail.com

INTRODUCTION

Education has a very important role in human life because it is a process that can help humans develop the potential that exists within themselves so that humans can keep up with current developments. The high and low quality of education is one of the benchmarks for the progress of a nation. One of the efforts that can be made to improve the quality of education in Indonesia is to update or develop the learning process.

Learning comes from word instruction, interpreted as a process of interaction between the teacher and the recipient of the student's message. Learning is a term that describes the process of teaching and learning activities [1]. One of the subjects that always appears in learning activities at all levels of education is mathematics.

Mathematics is a science that has an important role in all aspects of human life. Therefore, mathematics is taught at all levels of education, from elementary school to tertiary institutions, to develop students' ability to solve problems in everyday life. In line with the opinion above, Mashuri stated that mathematics is a universal science that plays a role in various fields of scientific disciplines and develops the power of human thinking. Formal education in mathematics contributes to building a strong foundation of knowledge, problem-solving skills, and analytical thinking that are beneficial in various professions and life domains [2]. Therefore, mathematics subjects need to be given to all students from elementary to high school [3]. In line with this, according to Sujono, mathematics is an

exact and systematically organized branch of knowledge, mathematics is part of human knowledge about numbers and calculations, mathematics helps people interpret correctly various ideas and conclusions, mathematics is the science of logical reasoning and problems involving numbers, mathematics is concerned with quantitative facts and issues of space and shape, and mathematics is the science of quantity and space [4].

However, mathematics is often complained of as a difficult, boring subject for some students, mathematics is scary. Generally, students' learning outcomes in mathematics are lower when compared to other subjects.

Most teachers so far still apply learning patterns with lecture and note-taking methods. Learning by using the lecture and note-taking method will make students passive because they sit, be silent, listen to the teacher's explanation, and record things that are considered important so that students tend to be required to justify what the teacher says without trying to find the truth. With the conventional method, the teacher is the only source of teaching and learning that will feel boring. So far, teachers are only asked to learn but rarely teach students how to learn. As a result, students find it difficult to solve problems, make decisions, and think critically and creatively. There has been a change: learning mathematics is no longer teacher-centered but student-centered. This change is marked by various learning techniques or models that further activate students in learning. Not only the teacher who provides information but also students can find the lesson information to be achieved by themselves.

Education has undergone various innovations and developments, encompassing the adoption of pedagogical theories, approaches, teaching methods, instructional techniques, educational tools, learning processes, and institutional structures [5]. In the Kurikulum Merdeka, learning is no longer centered on the teacher but on students. So, students must be active in the learning process, while the teacher is only a facilitator who accompanies students in the learning process [6]. Based on this, the teacher as a facilitator must be able to choose a student-centered learning model so that students are active during the learning process [7]. One of the learner-centered learning models is *the* Problem-Based Learning (PBL) model.

The Problem-Based Learning (PBL) model aims to enable students to participate actively in the ongoing learning process. Through this model, it is hoped that students can be more actively involved in the thought process and exchange opinions with colleagues to understand the concept of learning material and improve student learning outcomes. PBL is learning using problems related to the real world. This problem is raised so that students can understand problems, develop the ability to convey information or communicate ideas, analyze and evaluate mathematical thinking, and draw conclusions from what has been learned [8].

The Problem-Based Learning Model has several characteristics. The characteristics of the PBL model are as follows: 1) The learning process is carried out by presenting students' authentic problems; 2) Learning is designed to be student-centered; 3) Students collaborate in small groups to find the various information needed; 4) Educators only act as facilitators and ensure that the process and learning objectives are achieved; 5) There is a process of delivering results in the form of a product or project [9].

The steps in the Problem-Based Learning (PBL) model can increase the active role of students in the learning process. The steps of the learning process using the PBL model are 1) Providing orientation on the problems in learning, at this stage the teacher conveys the material to be learned, the learning objectives to be achieved, conducts apperception and motivation by giving initial

problems to students so that they can arouse the active role of students in the process of solving problems; 2) Organizing students for learning, at this stage the participants have been divided into several groups consisting of 4-5 people and the teacher gives LKPD to the students then the students carry out group discussions; 3) Guiding group investigations, at this stage students carry out discussions to solve problems found in LKPD and the teacher's role is to guide students in finding solutions to the problems given; 4) Developing and presenting the work, after students complete their discussion tasks, one group will make a presentation and the other group responds or provides comments to the group presenting; 5) Analyzing and evaluating the problem-solving process, students and teachers reflect on and evaluate the learning process.

The benefits of learning using the PBL model are increasing student learning activities, fostering student independence to understand and solve problems, improving collaboration and communication skills, and increasing student interest and learning motivation [9].

The results of observations in class VIII .7 SMPN 34 Pekanbaru in the subject of mathematics show that:

1. When given an apperception by the teacher, only smart students answered, while other students were silent and did not pay attention to the teacher.
2. The teacher forgot to convey motivation before learning and material information to be discussed at the next meeting.
3. Students are not actively involved in the learning process; they tend to be silent and reluctant to ask questions when there is material they do not understand.
4. When the learning process was in progress, some students were not focused, daydreamed, did not listen to the teacher's explanation, and played with their peers.
5. Teachers do not involve students in learning activities, so students become passive.
6. Teachers still apply learning patterns with lecture and note-taking methods.

Based on the teacher's information, students could solve math problems by being guided. Students can solve problems whose completion requires memorizing mathematical formulas. They have not been able to hone their knowledge and skills to solve math problems in the form of story problems, the learning activities carried out have not used Problem-Based Learning, and students do not solve a problem in their way but imitate the examples given by the teacher. This statement is reinforced by the results of student interviews, which show that learning mathematics is carried out by conveying material, giving sample questions, and working on practice questions. It can be seen from the description of the student's answers. They cannot analyze the questions given. They have difficulty understanding what is known from the questions and what is being asked from the questions. In actuality, through the observations and experiences of [10] with students enrolled in integral calculus, it was discovered that these students continue encountering difficulties when solving the assigned problems. This can be caused by a number of things, for example, the lack of problem-solving skills and students' attention when learning, inappropriate learning methods or models, and environmental conditions that do not support students' receiving lessons. Furthermore, the results of the previous research also stated that the available mathematics teaching materials are still predominantly designed to enhance conceptual understanding [11]. For this reason, teachers must be wise in finding a model that can develop problem-solving skills by being given problems that require students to think creatively.

From the interviews, information was obtained that some students were difficult to direct to learn and paid little attention to the material presented, thus encouraging negative behavior of

students in class when learning took place. When the teacher asked for group discussions, only a few students were working on it, and other students were engrossed in talking to themselves with other friends. It can be seen that the teacher carries out learning by lecturing, giving assignments, and sometimes asking questions and answering them with students. In addition, students' ability to solve math problems is still low. Students learning outcomes evidence this during the daily KKM problem-solving abilities that have not yet reached the Mathematics 80 Learning Objectives Completeness Criteria (KKTP). Out of 39 students, as much as 49%, or 19 students, achieved the KKTP score. Of all students in class VIII.7, 51% of 20 students have not reached the KKTP. Situations like this should be addressed immediately by following up on student performance or the learning model used during the mathematics learning process.

The problems above need to be corrected in the direction of learning, which illustrates the following:

1. Teachers can ask questions that guide and explore so that a process of thinking occurs and activates students in
2. Students dare to ask when they do not understand the material being studied.
3. Students can construct their concepts from the material being studied.
4. Teachers can guide students to increase curiosity, foster self-confidence, and train them to solve problems.
5. All students can answer the questions given by the teacher.

The findings of this study are consistent with the research conducted by [12], indicating an improvement in the learning process and an enhancement of problem-solving skills among the participants. This is evident in the increased number of students achieving a very good qualification, totaling 27 individuals, a suitable qualification with 9 individuals, and a sufficient qualification with 3 individuals. Notably, no students fell into less than satisfactory or unsatisfactory qualification categories. The point of distinction with the conducted research lies in the educational levels investigated. Specifically, the research was conducted at the junior high school (SMP) and senior high school (SMA) levels.

Other research studies have also yielded similar outcomes. The findings of this study indicate that adopting Problem-Based Learning (PBL) enhanced the learning process and the students' proficiency in mathematical problem-solving. The average score for students' mathematical problem-solving skills in the first cycle, 72.09, increased to 85.67 in the second cycle. Improvement is also observed in the average scores for indicators related to identifying the problem, formulating a plan to solve the problem, executing the strategy to solve the problem, and interpreting the solution [13]. The point of differentiation from the conducted research lies in the educational levels investigated. Specifically, the research was conducted at the junior high school (SMP) and vocational high school (SMK) levels.

Similar outcomes have been obtained not only in action research studies but also in other experimental research. The findings of this research demonstrate that the enhancement of students' mathematical learning outcomes, achieved through the Problem-Based Learning (PBL) model, surpasses those of students engaged in conventional learning with a scientific approach [14]. The distinction from the conducted research lies in the educational levels investigated. Specifically, the research was conducted at the junior high school (SMP) and senior high school (SMA) levels. Another difference is the research design employed: action research (PTK) instead of experimental research.

Based on the description of the problem, a suitable learning model applied by teachers who can

develop students' problem-solving abilities is the Problem-Based Learning model (PBL) because the PBL model is a model that can facilitate students to develop their problem-solving skills so that they can familiarize students with facing and solving problems skillfully. Therefore, researchers are interested in conducting research titled "Implementation of Problem-Based Learning (PBL) Model to Improve Student Learning Outcomes on Two-Dimensional Geometric Shapes." The purpose of this research is to enhance students' learning outcomes through the implementation of the Problem-Based Learning model on the subject of two-dimensional geometric shapes.

METHODS

The research method to be carried out is Classroom Action Research (PTK), which has the nature of collaboration between field supervisors, subject teachers, and researchers to improve student learning outcomes in grade 8.7 on flat-sided geometric shapes using the Problem-Based Learning (PBL) model.

Classroom action research is research conducted by teachers in classrooms or teaching places by exploring the refinement or improvement of practices and processes in learning. Classroom action research is observation in the form of action on learning activities that are deliberately raised and occur in a class simultaneously. The teacher gives this, or directions from the teacher carried out by students [9].

This research was located at SMP Negeri 34 Pekanbaru and was conducted in the even semester. The subjects of this study were 39, consisting of 21 male students and 18 female students. The research procedure was carried out based on 4 main stages: 1) the planning stage, 2) the action stage, 3) the observation stage, and 4) the reflection stage. The four stages are related to each other, called a cycle [15]. The action research (PTK) cycle based on [16] consists of the following stages. The first cycle comprises Planning, Implementation, Observation, and Reflection. Similarly, the second cycle consists of Planning, Implementation, Observation, and Reflection.

At the planning stage, the researcher tries to formulate a learning plan that will be carried out in teaching and learning activities, namely in the form of teaching modules. In this case, researchers collaborated with class teachers in compiling learning tools, determining appropriate learning methods for learning materials and processes to run effectively, and compiling observation sheets of teacher activities and student responses that are useful for observing the learning process.

The next stage is the action stage. At this stage, it is the implementation of the previous stage. The teacher carries out the action stage by applying the Problem-Based Learning (PBL) model to improve student learning outcomes. The learning process is carried out according to the mathematics learning schedule in class VIII.7. Before starting learning activities, the teacher first explains the process of learning activities that will be carried out.

The observation stage is carried out during the learning process. At this stage, the researcher made observations during the learning process. The researcher made direct observations with reference to the observation sheet provided. The researcher recorded everything that happened during the action. Observations were made to observe the implementation of the action by applying the Problem-Based Learning (PBL) model to find out what needs to be improved in the learning process.

The final stage is reflection. In this activity, the researcher analyzed the actions taken to find weaknesses in the learning process that had been carried out. This reflection activity will draw conclusions about the successes and deficiencies in the actions carried out in cycle I. If the expected results are not appropriate, then improvements will be made in cycle II.

Data collection techniques used in this study are technical tests and observation techniques. The test technique is used to measure the ability of students after carrying out the learning process. The observation technique is done by observing research subjects during the learning process.

Data analysis techniques in this study used descriptive statistical data analysis. Descriptive statistics can be used to process data characteristics related to adding up the average, looking for the percentage of learning success, and so on [16].

The learning mastery of individual students is determined as follows.

$$KI = \frac{SS}{SMI} \text{ x100} \qquad [17]$$

Information:

KI : Individual completeness

SS : Score of student learning outcomes

SMI : Ideal maximum score

In this study, students were said to have completed individually if their learning outcomes reached KKTP ≥ 80. The learning mastery of students is classically determined as follows.

$$KK = \frac{JST}{JS} \text{ x100} \qquad [17]$$

Information :

KK : Percentage of classical completeness

ANN : The number of students who complete

JS : The total number of students

The average student learning outcomes are determined as follows.

$$\overline{x} = \frac{\sum Xi}{n} \qquad [18]$$

Information:

$\overline{x}$: Average *(mean)*

$\sum Xi$: The total value of all students

n : Many students

In this study, the criterion for the success of the action was an improvement in the learning process after the action was taken. This can be seen from the exercise activity sheets from cycles 1 and 2 that have been carried out.

RESULTS AND DISCUSSION

Before the implementation of the cycle in learning mathematics in class VIII.7 SMPN 34 Pekanbaru, the problem was that the learning process was still centered on the teacher because the teacher still used the lecture method. This, of course, makes students bored and drains the teacher's energy, so the teacher cannot convey learning to the fullest. In addition, the lecture method will make students unable to develop their knowledge. Teachers must use a variety of learning models and methods that can improve the quality of the learning process. In choosing a model, the teacher must also adapt it to the learning material to be delivered, learning objectives, time, and matters related to learning. Before carrying out research actions, researchers first make observations during the learning process. In addition, the researcher also asked for data on students' daily test scores to determine the level of success of the learning that had been carried out.

Based on the results obtained from the pre-cycle, the level of students' understanding of the learning material is still low. This can be proven by data on student learning outcomes, which show that many students still have not reached the Minimum Completeness Criteria (KKTP), namely 80.

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The data on student learning outcomes before action are as follows:

Table 1. Learning Outcomes Before Action

No	Mark	Completeness	Frequency	Percentage
1.	≥ 80	complete	12	30.76%
2.	≤ 80	Not Completed	27	69.24%
Amount			39	
The highest score			83	
Lowest value			15	
Average			39.50	

Based on the table above, it can be seen that the initial data on the learning outcomes of class VIII.7 students in mathematics is an average value of 39.50. The data showed that 27 students (69.24 %) had not completed it, while 12 (30.76%) out of 39 students had completed mathematics. In the initial conditions before being given research action, the highest score obtained by students was 83, while the lowest score was 15. From the learning outcomes data, the researcher felt the need to improve mathematics learning by applying the Problem-Based Learning (PBL) model to enhance students' learning outcomes. After being given action in cycle I, the student's learning outcomes in class VIII.7 SMPN 34 Pekanbaru using the Problem-Based Learning (PBL) learning model are as follows.

Table 2. Learning Outcomes After Cycle I

No	Mark	Completeness	Frequency	Percentage
1.	≥ 80	complete	19	48.71%
2.	≤ 80	Not Completed	20	51.29%
Amount			39	
The highest score			88	
Lowest value			40	
Average			63,90	

Based on the table above, it can be seen that the initial data on the learning outcomes of class VIII.7 students in mathematics after being given action in cycle I was an average value of 63.90. The data shows that 20 students (51.29 %) have not completed it, while 19 (48.71%) out of 39 students have completed mathematics. Even though there was an increase in the completeness of students' learning outcomes after being given action in cycle I, it was discovered that this learning completeness was not maximized because it was still below 50% of the total students who achieved the minimum KKTP. This proves that the use of *the* Problem-Based Learning (PBL) model can improve students' mathematics learning outcomes, so cycle II must be carried out, which aims to improve students' mathematics learning outcomes in class VIII.7. After being given action in cycle II, the learning outcomes of students in class VIII.7 SMPN 34 Pekanbaru using the Problem-Based Learning (PBL) learning model are as follows.

Table 3. Learning outcomes after cycle II

No	Mark	Completeness	Frequency	Percentage
1.	≥ 80	complete	30	76.92%
2.	≤ 80	Not Completed	9	23.18%
Amount			39	
The highest score			93	
Lowest value			70	
Average			80,92	

Based on the table above, it can be seen that the initial data on student learning outcomes in

class VIII.7 in mathematics after being given action in cycle II was an average value of 80.72. The data shows that 9 students (23.18 %) have not completed it, while 30 (23.18%) out of 39 students have completed mathematics. This indicates that students' learning outcomes after being given action in cycle II have increased in terms of the students' completeness. The highest score obtained was 93, while the lowest score was 70. This proves that using the Problem-Based Learning (PBL) model can improve the mathematics learning outcomes of class VIII.7 students.

Thus, the learning outcomes of students in class VIII.7 SMP Negeri 34 Pekanbaru, it can be said that learning outcomes can be improved by applying the problem-based learning (PBL) learning model. This is in accordance with the opinion that the percentage of completeness before and after the action is compared. If there is an increase, the action succeeds [18].

This classroom action research focused on applying the Problem-Based Learning (PBL) model to improve student learning outcomes in flat-sided shapes. This research was conducted in class VIII.7 SMPN 34 Pekanbaru. The results of the study showed an increase in learning outcomes in mathematics. The application of the Problem-Based Learning (PBL) model is carried out at the orientation stage, namely, the teacher gives Student Worksheets (LKPD) to each member of the group in which there are problems to be solved by students, and then students pay attention to problems through the learning media displayed by the teacher use info. The teacher conducts questions and answers with students regarding the problems displayed in the learning media. In the second stage, namely organizing for learning, students will discuss in their respective groups to solve problems found in LKKPD. The third stage guides individual and group investigations, followed by the teacher encouraging students to collect the information needed to solve the given problem. Stage 4 is developing and presenting the work of students, dividing the tasks to prepare the results of their discussions to be presented, presenting them to the class, and discussing class solutions to problems that have been found.

During the research activities, there were several obstacles. In cycle I, students were still not enthusiastic about the new learning model. Students are still confused about the LKPD distributed by the teacher and are still hesitant to answer questions from the teacher. But for the next meeting, students are getting used to the learning model used. Students also have started to be brave in answering questions from the teacher.

This can be seen from the average learning outcomes, although the increase is not too large. In cycle I, some students answered completely and correctly. Students who responded wholly and correctly would get a full score for the questions answered. Some other students responded correctly but were incomplete, so that student got a score according to the answer.

The learning outcomes of students who experienced a decrease from cycle I to cycle II. For example, students in cycle I scored 81, and in cycle II, they got 75. This is because students do not write complete answers when answering questions. The questions also influenced student errors in answering in cycle II because the answers were too long, so there was not enough time to answer all the questions.

The findings of this study are consistent with the research conducted by [12], indicating an improvement in the learning process and an enhancement of problem-solving skills among the participants. This is evident in the increased number of students achieving a very good qualification, totaling 27 individuals, a good qualification with 9 individuals, and a sufficient qualification with 3 individuals. Notably, no students fell into less than satisfactory or unsatisfactory qualification categories.

Other research studies have also yielded similar outcomes. The findings of this study indicate that adopting Problem-Based Learning (PBL) enhanced the learning process and the students' proficiency in mathematical problem-solving. The average score for students' mathematical problem-solving skills in the first cycle, 72.09, increased to 85.67 in the second cycle. Improvement is also observed in the average scores for indicators related to identifying the problem, formulating a plan to solve the problem, executing the strategy to solve the problem, and interpreting the solution [13].

Similar outcomes have been obtained not only in action research studies but also in other experimental research. The findings of this research demonstrate that the enhancement of students' mathematical learning outcomes, achieved through the Problem-Based Learning (PBL) model, surpasses those of students engaged in conventional learning with a scientific approach [14].

The learning outcomes of students experienced an increase. This can be seen before being given the actions of students who completed out of 39 students were 12 people. After being given actions in cycle I, there was an increase of 7 students; in cycle II, it became 11 people. This shows that after the action, there is an increase in learning outcomes for the better. Thus, it can be concluded that applying the problem-based learning model can improve students' learning outcomes in class VIII.7 SMPN 34 Pekanbaru.

CONCLUSIONS AND SUGGESTIONS

Based on the results of the Classroom Action Research that the researchers conducted, the application of Problem-Based Learning (PBL) could improve the process and the mathematics learning outcomes of class VIII.7 students of SMP Negeri 34 Pekanbaru on the material Flat Sided Buildings. The increase in student learning outcomes was seen based on the classical average value before the action, which was 39.50; cycle 1 increased to 63.90, and cycle II increased to 70.03. While the completeness of students' learning outcomes before being given action was 30.76 % after the action was carried out in cycle I, it increased to 48.71%, and in cycle II, it increased to 76.92%.

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BIOGRAPHY

Fadhila Tawassalna
She obtained her Strata-1 (S1) at Universitas Islam Riau. Subsequently, she completed the Professional Teacher Education Program at the University of Riau. Email: fadhilatawassalnaa@gmail.com.

Hasnita
Hasnita is a junior high school teacher at SMPN 34 Pekanbaru, Indonesia. Email: hasita19@guru.smp.belajar.id