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Improving Science Learning Outcomes by Applying Problem-Based Learning Model

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Abstract – *This study aims to improve students' learning outcomes and figure out their responses to the application of the problem-based learning model in learning natural sciences. This study is a classroom action research. The subjects of this study were 16 students of class VII SMP Negeri 1 Gunungsari in the odd semester of the 2022–2023 academic year. This research was conducted in two learning cycles, with the stages in each cycle including planning, action, observation/evaluation, and reflection. The data collection was carried out using two instruments, namely tests in the form of a pre-test (cycle 1) and a post-test (cycle 2) to examine the student learning outcomes after implementing PBL and a questionnaire to find out the student responses to the application of PBL. The data that have been collected were then analyzed descriptively. Based on the data analysis, the results showed that after the application of the problem-based learning model, there was an increase of 60.2% in students' science learning outcomes. The average value of students' learning outcomes in cycle I was 33, while that of in cycle II increased to 83. In addition, students' responses are in the positive category. This study concluded that the application of the problem-based learning model could improve students' learning outcomes in class VII at SMP Negeri 1 Gunungsari.*

Keywords: *learning model; natural science; problem-based learning; science learning outcomes*

I. INTRODUCTION

The Law No. 20 of 2003 concerning the Indonesian National Education System in Article 1 states that education is a conscious and planned effort to create a learning atmosphere and learning process in which students actively develop their potential (Hasanah et al., 2021). Education is allegedly one of the factors that require special attention in national development because education plays an important role in educating the nation's life, and it will improve the quality of human resources, which are the main agent in a nation's development (Djonomiarjo, 2019). The figure that plays the most important role in creating an ideal education is the teacher.

Natural science studies natural phenomena, including living and non-living things or science about life and science about

the physical world (Ratnasari et al., 2020; Fatima et al., 2014). Science learning emphasizes direct experience to develop competencies so that students are able to understand the natural surroundings (Fahrezi et al., 2020). The importance of mastering science in elementary schools, namely: (1) the development of science takes place very quickly so that it is no longer possible to teach facts and concepts to students, (2) students will understand abstract concepts more easily if they learn through concrete objects and immediately do it themselves, (3) science has discovered that the nature of truth is relative. (4) in the teaching and learning process, concept development cannot be separated from the development of attitudes and values (Juniati & Widiana, 2017; Nurazmi & Bancong, 2021).

The teacher is an important component in the teaching and learning process, which plays a role in efforts to form potential human resources; the teacher has a role in the development of the intelligence of each student (Arianti, 2018). As the front-line in education, teachers are responsible for teaching, educating, providing direction and guidance, training, and providing assessments and evaluations to provide moral and mental support to students (Putria et al., 2020). These directions and guidance are usually given by the teacher in the classroom in the teaching and learning process, but not all of these directions and guidance are well received by students. Most students still have difficulties in the learning process because the teacher acts as the only source of information (Azmar & Ali, 2022). At the same time, students only actively receive information, so learning outcomes are only visible from students' ability to memorize material in the short term (Harizah et al., 2021; Amini et al., 2019).

Based on the results of preliminary interviews with science subject teachers at SMP Negeri 1 Gunungsari, it is known that student learning outcomes are still relatively low. Students who actively think in solving problems are classified as low, and the level of thinking in understanding lessons, especially science, is still low. In addition, the researcher also conducted interviews with students, and most of them stated that science subjects, especially physics, were difficult subjects because they had so many complicated formulas. Students have not realized that what they are learning is a form of what is happening in their daily life. Students are more likely to prefer biology sub-materials that test their memorization skills compared to analyzing problems. Thus, if students are given problems that emphasize more on their analysis, they will have difficulties in solving them. As a result, students do not have an interest in learning physics, and the learning outcomes achieved are still low.

One alternative to address this issue is by choosing a learning model that emphasizes the activeness of students. One of which is a learning model that teachers can use to support the success of the learning process and

improve students' learning outcomes which is the problem-based learning model (Yew & Goh, 2016; Saad et al., 2019; Nurazmi & Bancong, 2021). Problem-based learning was first implemented by Howard Barrows in 1969 to overcome or solve problems in the health sector at McMaster University School of Medicine, Canada (Parwati et al., 2019). Only then was this model adopted by many schools in terms of increasing learning outcomes (Anggraini, 2019).

The problem-based learning model is a learning model that demands students' activity in order to solve every problem encountered (Suminar & Meilani, 2016). In problem-based learning, learning is no longer teacher-centered but student-centered. When the teacher is only a facilitator and mentor, the students have broad opportunities to develop their abilities, such as expressing opinions, critical thinking, and conveying ideas or arguments (Asrifah et al., 2020). Problem-based learning has been widely adopted in various educational fields and contexts to promote critical thinking and problem-solving in authentic learning situations (Yew & Goh, 2016; Saad et al., 2019). The problem-based learning model has several advantages, including (1) can increase students' activity in the learning process and (2) can provide opportunities for students to apply the knowledge they have into the real world (Sutinah & Widodo, 2020). This can be an alternative learning model, especially if the teaching and learning process is related to science which requires special handling (Gomoll et al., 2020).

This has been studied by Novianti et al. (2020), who examined the effect of applying the problem-based learning model on the activities and learning outcomes of students in integrated thematic learning in elementary school. The research data were collected using the pre-test and post-test. Based on this research, it was found that there was an influence of the problem-based learning model on students' learning activities and outcomes in integrated thematic learning in elementary school. Similar research was also conducted by Khotimah et al. (2019), who examined the effect of the problem-based learning model on students' civics learning outcomes. The research method used was quantitative with a simple experimental design (post-test only control group design). This study involved two groups, namely the control class and the experimental class. The results of their research showed that the experimental class scored higher than the control class. Other research was also conducted by Fitriyyah and Wulandari (2019), which aims to see the effect of the problem-based learning model on students' critical thinking skills. Based on their research, it can be concluded that there is an effect of using the problem-based learning model on students' critical thinking abilities.

Based on several previous studies, it can be seen that the application of the problem-based learning model is very influential both in terms of student learning outcomes and

students' critical thinking. This learning model is very appropriate when applied in schools to create active and innovative students (Molnar, 2015). Therefore, this study aims to improve student learning outcomes at SMP Negeri 1 Gunungsari West Lombok by applying a problem-based learning model. The research questions are

1) Does the application of the problem-based learning models improve student learning outcomes at SMP Negeri 1 Gunungsari West Lombok?
2) How do students respond to the implementation of the problem-based learning models at SMP Negeri 1 Gunungsari West Lombok?

II. METHODS

This research is a class action research with four main stages carried out in repeated cycles: (1) planning; (2) action; (3) observation/evaluation; and (4) reflection (Atweh et al., 2005). Respondents in this study were students in class VII at Negeri 1 Gunungsari West Lombok. This research was conducted from September to October 2022 for the 2022/2023 academic year.

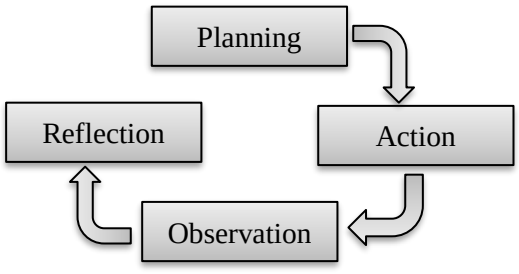

Figure 1. Classroom action research cycles

Data collection procedures in this study consisted of observations, tests, and questionnaires. Observations were made during the learning process using research instruments that had been made with the aim of obtaining data about how the use of problem-based learning models can affect student learning outcomes. Tests are used to measure students' understanding in following the learning process. Then the questionnaire is used to obtain data about student responses to the problem-based learning model.

The data on students' learning outcomes were analyzed descriptively. The students' scores were divided into two, namely formative scores and summative scores (Arikunto, 2021). Formative scores are scores obtained by students at each meeting, while summative scores are scores obtained by students based on the results of the learning outcomes test at the end of each cycle (Ali & Zaini, 2020).

Student responses to the application of the problem-based learning model were collected using a questionnaire, and the average score ($\bar{x}$) was calculated. The problem-based learning model is said to be successful and effective if it has a minimal positive response (Ali et al., 2021).

Table 1. Guidelines for classifying the responses of students

No	Criteria	Category
1	$80.1 \leq \bar{x}$	Very positive
2	$66.7 \leq \bar{x} < 80.1$	Positive
3	$53.3 \leq \bar{x} < 66.7$	Pretty positive
4	$39.9 \leq \bar{x} < 53.3$	Less positive
5	$\bar{x} < 39.9$	Very less positive

III. RESULTS AND DISCUSSION

This study aims to see an increase in the learning outcomes of class VII students at SMP Negeri 1 Gunungsari with the application of the problem-based learning model in science subjects. Based on Figure 2 below, in cycle 1 it was found that the average score for the learning outcomes test was 33. In cycle 2, with the application of the problem-based learning model in class, the average score increased to 83.

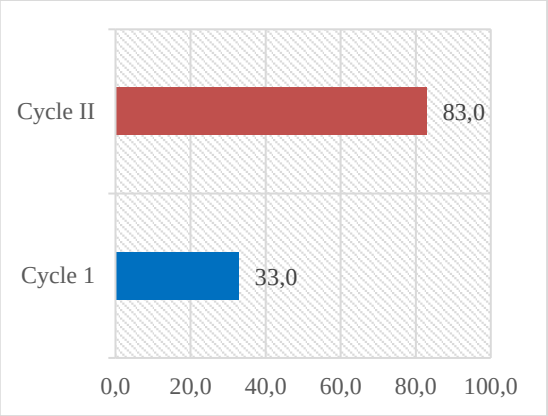

Figure 2. Data on the results of cycles 1 and 2

Figure 2 indicates that the treatment given to class VII has an influence on student learning outcomes. There are several factors that cause the effect of giving treatment on student learning outcomes. One of them is the provision of treatment in the form of a problem-based learning model using experimental methods in the experimental class, while the control class uses conventional learning with the discussion method. The tools and materials used are adapted to the real conditions of students to make it easier to learn and understand the material being taught.

Meanwhile, student responses to the application of the problem-based learning model in this study were collected based on a response questionnaire given at the end of cycle II. Based on the results of the analysis of student response scores, the average student response was 38.9 (77.8%), with a standard deviation of 2.3. The distribution of students' response scores in each category is shown in Table 2.

Table 2. Distribution of student response scores to the problem-based learning model

No	Criteria	Frequency	Percentage	Category
1	$80.1 \leq \bar{x}$	3.00	18.75	Very positive
2	$66.7 \leq \bar{x} < 80.1$	13.00	81.25	Positive
3	$53.3 \leq \bar{x} < 66.7$	0.00	0.00	Pretty positive
4	$39.9 \leq \bar{x} < 53.3$	0.00	0.00	Less positive
5	$\bar{x} < 39.9$	0.00	0.00	Very less positive

Note: the number of students in class VII = 16 people

Table 2 illustrates that student responses belong to the positive category. This means that the application of the problem-based learning model is said to be successful. The distribution of student responses to the application of the problem-based learning

model is presented in a diagram as shown in Figure 3.

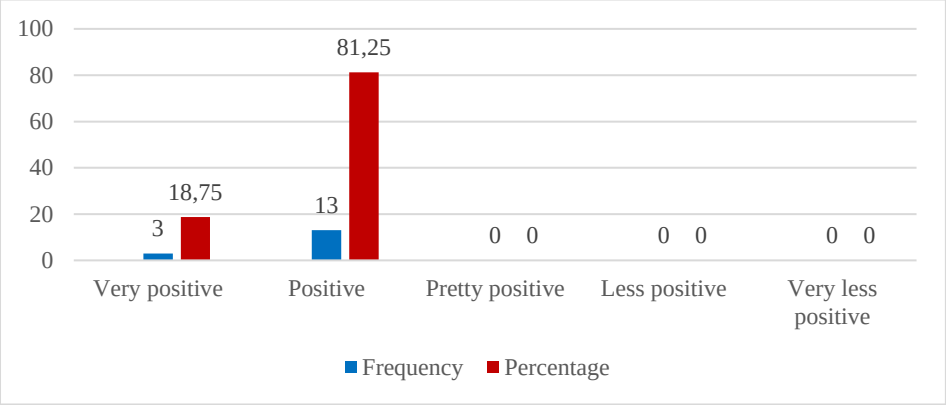

Figure 3. Graph of student responses

Based on the results of data analysis, it was obtained that the student responses were very positive at 18.75%, positive at 81.25%, pretty positive at 0%, less positive at 0%, and very less positive at 0%. In general, the average response value of students in class VII SMP N 1 Gunungsari to the application of the problem-based learning model is in the positive category. The data analysis of cycle I and cycle II show that there was an increase in the average value of student learning outcomes. The classical completeness in cycle I was 33.0, and that in cycle II was 83.0, so there was an increase of 60.2%. This indicates that the application of a problem-based learning model can improve students' learning outcomes in learning natural sciences at SMP Negeri 1 Gunungsari with positive students responses.

Learning outcomes are a better level of mental development when compared to the situation before they learn. This level of mental development is meant by the types of learning outcomes, namely cognitive, affective, and psychomotor aspects (Tafonao, 2018). Learning outcomes can be interpreted as the extent to which students can gain knowledge in the learning process and in obtaining learning experiences oriented toward learning objectives (Ningtiyas & Surjanti, 2021). The abilities possessed by students after learning are created from learning experiences. Therefore, there is a process that influences these learning outcomes, namely the interest and motivation to learn owned by students, which takes place repeatedly and continuously (Laras & Rifai, 2019). Learning outcomes can be used as a measure in determining the abilities or competencies possessed by students after obtaining learning experience (Ningtiyas & Surjanti, 2021).

The problem-based learning model is based on constructivism theory. This means a learning approach that uses real-world problems as a context for students to learn

about critical thinking and problem-solving skills and acquire knowledge and concepts that are the essence of the subject matter (Yasa & Bhoke, 2019). The problem-based learning model must begin with an awareness of the problem to be solved. In this activity, the teacher is able to guide students if there are gaps felt by students or their social environment. The ability that students can have in this activity is that students are able to choose or accept the gaps that exist from various existing activities. The application of this model gives flexibility to students in implementing their experiences to solve problems so that they can influence learning outcomes (Ariyani & Kristin, 2021).

The problem-based learning model applied to the experimental class has the advantage of having students get used to dealing with and solving problems skillfully and can stimulate and develop creative and comprehensive thinking skills in the learning process. Students are trained to highlight problems from various aspects (Helyandari et al., 2020). In addition to learning methods, to improve learning achievement, it is also necessary to pay attention to factors from within students (intrinsic factors). Intrinsic factors are factors that come from within students, such as motivation, talent, interest, mastery of basic concepts, learning styles, and independence. As an illustration, if students do not have motivation for a lesson, it is likely that their learning outcomes will be low (Sujatmika, 2017).

The results of this study are in line with research conducted by Novianti et al. (2020), who examined the effect of applying the problem-based learning model on the activities and learning outcomes of students in integrated thematic learning in elementary school. The research data were collected using pre-test and post-test. Based on this research, it was found that there was influence of the problem-based learning model on student learning activities and achievements in integrated thematic learning in elementary school. Similar research was also conducted by Khotimah et al. (2019), who examined the effect of the problem-based learning model on students' civics learning outcomes. The research method used was quantitative with a simple experimental design (post-test only control group design). This study involved two groups, namely the control and experimental classes. The results of their research showed that the experimental class scored higher than the control class. Other research was also conducted by Fitriyyah and Wulandari (2019), which aims to see the effect of the problem-based learning model on students' critical thinking skills. Another research was also conducted by Fitriyyah and Wulandari (2019), which aims to see the effect of the problem-based learning model on students' critical thinking skills. Based on their research, it can be concluded that there is an effect of using the problem-based learning model on students' critical thinking abilities.

IV. CONCLUSION AND SUGGESTION

The conclusion of this study is that the learning outcomes of students in class VII at SMP Negeri 1 Gunungsari have increased by applying a problem-based learning model. The average value of student learning outcomes after the application of problem-based learning models is 83, and student responses to the application of problem-based learning models are in the positive category.

This study has several weaknesses, such as only focusing on measuring student learning outcomes and responses. Therefore, for further research, we suggest measuring other variables in implementing problem-based learning models such as attitudes, interests, and critical thinking skills. The results of this study are also not universal because the respondents involved were relatively small. Therefore, we also suggest that the problem-based learning model be applied to a large number of respondents so that the results obtained are more accurate.

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