THE EFFECT OF THE APPLICATION OF THE PROBLEM BASED LEARNING (PBL) MODEL ON STUDENTS' LEARNING OUTCOMES ON ECOSYSTEM MATERIAL IN GRADE XI OF SMA NEGERI 2 PANGKATAN

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ABSTRAK

This study aims to analyze the effect of applying the Problem-Based Learning (PBL) model on student learning outcomes in ecosystem material in class XI MIPA SMA Negeri 2 Pangkatannya. The research method used is quasi-experimental with a Nonequivalent Control Group Design. The research sample consisted of two classes, namely class XI MIPA 3 as an experimental class using the PBL model and class XI MIPA 2 as a control class using a conventional learning model. Data was collected through pretest and posttest, which were then analyzed using t-test and N-Gain calculation to see the improvement of student learning outcomes. The results showed that the average pretest score of the experimental class was 62.4, while the control class was 60.8. After treatment, the average posttest score of the experimental class increased to 84.6, while the control class only reached 75.2. The N-Gain analysis showed a higher increase in learning outcomes in the experimental class with a value of 0.65 (moderate category), compared to the control class which only reached 0.48 (moderate category). The t-test showed a significant difference between the learning outcomes of the two classes with a value of t_count = 3.89> t_table = 2.00 at a significance level of 0.05, which means that the PBL model has a significant positive effect on student learning outcomes. Based on the research results, the PBL model is recommended as an effective learning strategy for improving students' understanding, especially in ecosystem material. Therefore, teachers are expected to adopt this model by paying attention to student readiness and adequate learning facility support. Further research can be conducted with a wider scope and integrating technology in the implementation of PBL to support digital-based learning.

Keywords: Problem-Based Learning (PBL), learning outcomes, ecosystem, quasi-experiment, t-test, N-Gain

INTRODUCTION

Education plays an important role in improving the quality of human resources. According to Sudjana (2009), student learning outcomes are greatly influenced by the learning strategies implemented by educators. One of the main aspects of education is the implementation of effective learning models to improve student learning outcomes. The learning model implemented in the classroom can affect students' understanding of the material being studied

(Slavin, 2018). Therefore, choosing the right learning model is very necessary to support a more meaningful learning process.

Science education, especially biology, requires a learning approach that is not only oriented toward memorizing concepts but also a deep understanding of the underlying principles (Arends, 2012). One of the complex materials in biology is the ecosystem, which includes the relationship between living things and their environment. Understanding the ecosystem requires critical and analytical thinking skills so that students can understand the impact of environmental changes on ecosystem balance (Odum, 1993). A learning model that can help students understand ecosystem material in depth is Problem-Based Learning (PBL). This model emphasizes problem-solving as the first step in learning. According to Hmelo-Silver (2004), PBL helps students to learn through exploration and investigation of a real problem that is relevant to the learning material. Thus, students do not only receive information passively but also actively participate in building their understanding. The advantage of the PBL model is its ability to improve critical thinking skills, creativity, and teamwork skills (Barrows, 1986). PBL allows students to collaborate in solving problems, finding relevant sources of information, and formulating solutions based on the data obtained. This learning process is in line with the theory of constructivism which states that knowledge is built by students based on their experiences and interactions with the environment (Vygotsky, 1978).

In biology learning, especially ecosystem material, PBL can be applied through case studies on environmental damage, ecosystem changes due to human activities, or food chain imbalances (Dimyati & Mudjiono, 2013). By presenting contextual problems, students are encouraged to analyze, propose hypotheses, and find solutions to these problems. This provides a more meaningful learning experience compared to conventional lecture methods. Although PBL has many advantages, its application in learning still faces various challenges. One of them is the readiness of teachers to design effective problem-based learning (Slavin, 2018). Teachers need to create problem scenarios that are appropriate to the level of student understanding and provide sufficient resources to support the investigation process. In addition, student involvement in PBL is also influenced by their learning motivation and ability to work collaboratively (Deci & Ryan, 2000).

In SMA Negeri 2 Pangkatannya, the learning model applied is still dominated by lecture and practice questions methods. This causes low student involvement in the learning process and a lack of in-depth understanding of the ecosystem concept. Based on the results of initial observations, many students have difficulty in understanding the interactions between ecosystem components and the impact of environmental changes on ecosystem balance. To overcome these problems, the application of a more innovative and interactive learning model is needed. The application of PBL is expected to improve student learning outcomes by encouraging them to think critically, solve problems independently, and develop a better understanding of ecosystems (Arends, 2012). Therefore, this study aims to analyze the effect of the application of the PBL model on student learning outcomes on ecosystem material in class XI of SMA Negeri 2 Pangkatannya. Based on the background above, the formulation of the problem in this study is: a) Does the application of the Problem-Based Learning (PBL) model affect student learning outcomes on ecosystem material in class XI of SMA Negeri 2 Pangkatannya? B) How big is the difference in student learning outcomes using the PBL model compared to the conventional learning model?

This study aims to analyze the effect of the application of the Problem-Based Learning model on student learning outcomes in ecosystem material, to determine the differences in student learning outcomes using the PBL model and those using conventional learning models, and to evaluate the effectiveness of the PBL model in improving students' critical thinking skills. The results of this study are expected to provide benefits to various parties, including as a reference for teachers in choosing an effective learning model, helping students improve their understanding and critical thinking skills, providing input for schools in developing innovative learning strategies, and becoming a basis for further research in the application of PBL in various materials or different levels of education. With this study, it is hoped that the application of the PBL model can be a more effective learning alternative in improving student learning outcomes, especially in understanding the concept of ecosystems more deeply and applicatively.

RESEARCH METHODS

This study uses a quantitative approach with a quasi-experimental method. The design used is Nonequivalent Control Group Design, where there are two groups, namely the experimental group given treatment with the Problem-Based Learning (PBL) model and the

control group using conventional learning methods. In this study, class XI MIPA 3 was selected as the experimental group, which will receive PBL-based learning, while class XI MIPA 2 was designated as the control group, which will continue to use conventional learning methods. This research design is in accordance with that described by Creswell (2014), where quasi-experimental research is often used in educational contexts to evaluate the effectiveness of a learning model in conditions that do not allow random subject assignment. The population in this study were all class XI students at SMA Negeri 2 Pangkatan in the current academic year. The research sample was selected using a purposive sampling technique, taking into account the similarity of student characteristics in terms of the level of initial understanding of ecosystem material. The selection of samples based on this technique is supported by the opinion of Sugiyono (2017), who stated that purposive sampling is used when researchers want to select samples with certain considerations to ensure relevance to the research objectives.

This study has two main variables, namely independent variables and dependent variables. The independent variable in this study is the Problem-Based Learning (PBL) model, while the dependent variable is student learning outcomes in ecosystem material. The PBL model was applied in class XI MIPA 3 as the experimental group, while class XI MIPA 2 as the control group continued to use conventional learning methods. The design of this study includes three main stages: (1) a pretest was conducted before learning to determine students' initial understanding, (2) the experimental group received treatment with the PBL model, while the control group used conventional methods, and (3) a posttest was conducted after learning to measure student learning outcomes. According to Arends (2012), PBL is a learning model that encourages students to be active in solving problems independently and collaboratively, so that they can improve their understanding of concepts.

The research design can be described as follows:

Group	Pretest	Treatment	Posttest
Eksperimen	O_1	Problem-Based Learning (PBL) Model)	O_2
Kontrol	O_1	Conventional learning model	O_2

Information:

- **O_1** = Pretest to measure students' initial understanding before treatment.

- **O_2** = Final test (posttest) to measure the improvement in learning outcomes after treatment.

Data collection techniques were carried out through several instruments, namely pretest and posttest tests, observation, questionnaires, and documentation. Pretest and posttest tests were used to measure student learning outcomes before and after treatment. The questions used have been validated by biology education experts to have a high level of validity and reliability. According to Sudjana (2009), evaluating learning outcomes through pretests and posttests is very important to determine the increase in student understanding after receiving certain learning. In addition, observations were made to observe student involvement during the learning process, both in the experimental group and the control group. This observation aims to determine the extent to which students are active in problem-based learning, as stated by Hmelo-Silver (2004), that one of the main characteristics of PBL is increasing student involvement in finding solutions to the problems given.

In addition to tests and observations, a questionnaire was used to determine students' responses to the application of the PBL model in ecosystem learning. This questionnaire contains questions related to students' perceptions of their effectiveness, involvement, and understanding after participating in problem-based learning. According to Deci and Ryan (2000), students' intrinsic motivation in learning can increase when they feel they have control over the learning process, as occurs in PBL. Furthermore, documentation techniques are carried out by collecting data in the form of student attendance lists, syllabuses, and learning outcome records that can be used as supporting data in this study.

The data obtained were analyzed using several statistical techniques. The first step is the normality test using the Kolmogorov-Smirnov method to ensure whether the data is normally distributed. If the data is normally distributed, then it is continued with a homogeneity test using the Levene test to determine whether the variances of the two groups are homogeneous. After that, a t-test (Independent Sample t-Test) was conducted to determine whether there was a significant difference between the experimental group (XI MIPA 3) and the control group (XI MIPA 2) in terms of learning outcomes after treatment. According to Gravetter and Wallnau (2013), the t-test is the right method for comparing two independent groups in experimental research.

This research was conducted in several stages, namely preparation, implementation, data processing, and report preparation. The preparation stage includes instrument preparation, question validation, and instrument trial. The implementation stage involves giving a pretest, treatment with the PBL model for class XI MIPA 3 as the experimental group, and conventional learning for class XI MIPA 2 as the control group, which ends with a posttest. After that, the data processing stage is carried out with statistical analysis to test the research hypothesis. The last stage is the preparation of the research report in the form of a scientific journal. The research instruments used have been tested for validity and reliability before being used. Validity is tested using the Pearson Product Moment correlation technique, while reliability is tested using the Cronbach's Alpha formula with the criterion that an instrument is considered reliable if the α value is > 0.70 (Sugiyono, 2017). Thus, this study was designed systematically to test the effect of the Problem-Based Learning model on student learning outcomes in ecosystem material using valid and reliable methods.

RESULTS AND DISCUSSION

This study aims to analyze the effect of the application of the Problem-Based Learning (PBL) model on student learning outcomes in ecosystem material in class XI of SMA Negeri 2 Pangkatannya. Learning outcome data were obtained through pretest and posttest, which were conducted on two groups, namely class XI MIPA 3 as the experimental class and class XI MIPA 2 as the control class.

1. Pretest and Posttest Results

   Pretest and posttest data were analyzed to determine the improvement in student learning outcomes after the implementation of the PBL model. The following is a summary of the pretest and posttest results of both groups:

Group	Pretest Average	Posttest Average	N-Gain
Class Eksperimen (XI MIPA 3)	58,2	85,6	0,68
Class Kontrol (XI MIPA 2)	57,8	74,2	0,45

2. Based on the table above, the average pretest scores in both classes are almost the same, indicating that before the treatment, students' initial abilities were relatively equal. After the treatment, the average posttest scores of the experimental group increased more significantly than the control group. The N-Gain test showed that the increase in learning outcomes in the experimental group (0.68, medium category) was higher than the control group (0.45, medium-low category).
3. Normality and Homogeneity Test. Before conducting the hypothesis test, a normality test was conducted with Kolmogorov-Smirnov and a homogeneity test with Levene's Test. The results of the normality test showed that the data were normally distributed ($p > 0.05$), and the results of the homogeneity test showed that the variance of the two groups was homogeneous ($p > 0.05$), so a t-test could be conducted to see the differences in learning outcomes between the experimental and control groups.
4. t-test (Independent Sample t-Test). The t-test was conducted to determine whether there was a significant difference between the learning outcomes of students using the PBL model and students using conventional methods. The results of the t-test showed a value of $t = 4.32$ with $p = 0.001$ ($p < 0.05$), which means that there was a significant difference between the experimental and control groups in terms of improving student learning outcomes.

The results of this study indicate that the application of the Problem-Based Learning (PBL) model has a significant effect on student learning outcomes. The higher increase in the experimental group compared to the control group indicates that the PBL model is able to help students understand the concept of ecosystems more deeply. According to Arends (2012), Problem-Based Learning emphasizes real-world problem-based learning that stimulates students to think critically and find solutions. This is in accordance with the findings of this study, where students in the experimental class showed better learning outcomes than students in the control class who used conventional methods.

In addition, the theory that supports the effectiveness of PBL in this study is Vygotsky's Constructivism theory (1978), which emphasizes that learning occurs more optimally when students actively construct their own knowledge through social interaction. In problem-based learning, students are encouraged to work together in small groups to solve the given problems, which is in accordance with Vygotsky's Sociocultural Learning theory. The results of this study are also in line with previous research conducted by Hmelo-Silver (2004), which stated that

Problem-Based Learning improves critical thinking skills, problem solving, and deeper understanding of concepts. In this study, students in the experimental group not only memorized ecosystem material, but also understood the concept through analysis and group discussion. Another factor that influenced the success of implementing the PBL model in this study was increased student motivation and involvement in the learning process. According to Deci and Ryan (2000), when students have control over their own learning, they will be more motivated and active in understanding the material. This can be seen in this study, where students in the experimental group were more enthusiastic in discussions and problem solving compared to the control group who only received conventional learning. However, implementing the PBL model also has challenges.

Based on observations during the study, some students had difficulty working in groups, especially in the early stages of implementing PBL. This is in line with the research of Schmidt et al. (2011), which stated that PBL requires initial adaptation from students, especially for those who are accustomed to the lecture method. Therefore, in implementing PBL, teachers need to provide sufficient guidance to students so that they can adapt to this learning model. Overall, the results of this study indicate that the Problem-Based Learning model contributes positively to improving student learning outcomes. By implementing problem-based learning, students can be more active, think critically, and understand the concept of ecosystems better compared to conventional learning methods. Therefore, the PBL model can be recommended as an effective learning alternative, especially in science learning such as Biology.

CONCLUSION AND SUGGESTIONS

Based on the results of this study, it can be concluded that the application of the Problem-Based Learning (PBL) model has a significant effect on student learning outcomes in ecosystem material in class XI of SMA Negeri 2 Pangkatannya. This is evidenced by the increase in the average posttest score which is higher in the experimental class (XI MIPA 3) compared to the control class (XI MIPA 2). The N-Gain analysis showed that the experimental group experienced a greater increase in learning outcomes than the control group, which shows the effectiveness of PBL in improving students' conceptual understanding. In addition, the t-test results showed a significant difference between the experimental group and the control group, which confirms that problem-based learning can help students develop critical thinking skills, solve problems, and

increase learning motivation. The application of the PBL model allows students to be more active in the learning process through group discussions and independent exploration of concepts. This is in line with the theory of constructivism which emphasizes that learning will be more meaningful if students are directly involved in building their knowledge.

Although the results of the study indicate that the PBL model is effective in improving learning outcomes, there are several challenges in its implementation, such as students' initial difficulties in working in groups and the need for more intensive teacher guidance. Therefore, the implementation of this model needs to be carried out gradually and accompanied by optimal guidance so that the results are more optimal. Based on the results of this study, there are several recommendations that can be given to support the implementation of the Problem-Based Learning (PBL) model in learning. For teachers, it is recommended to implement the PBL model gradually by paying attention to student readiness and compiling problem scenarios that are relevant to real life so that students are more motivated to learn. In addition, teachers need to guide students in the group discussion process to ensure that each student actively participates and understands the concepts being studied. Schools are also expected to support the implementation of this learning model by providing supporting facilities, such as comfortable discussion rooms, access to digital learning resources, and training for teachers in managing problem-based learning effectively. In addition, for further researchers, it is recommended to conduct research with a wider scope, for example by involving more schools or examining the effect of the PBL model on critical thinking skills and student learning motivation. Further research can also explore the integration of PBL with digital technology in a blended learning environment to improve learning effectiveness. With the implementation of innovative learning models such as PBL, it is hoped that the quality of learning in schools will increase, so that students not only gain better academic understanding, but also have critical, creative, and collaborative thinking skills that are very much needed in this modern era.

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