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The Effectiveness of Problem-Based Learning Model Towards Students' Learning Outcomes of Natural Science Class V Elementary School in Gugus Gajah Mada Sub-District Bonang, Demak Regency

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Abstract: Most of the learning still being carried out in the Gajah Mada Cluster is still teacher center, not using learning media, so learning in learning is not optimal. In this study, the researcher uses the Problem Based learning model as an alternative in realizing learning that develops students to be more creative, think critically, and make learning more fun and meaningful. This study aims to analyze the effectiveness of the Problem Based Learning model and direct learning on the science learning outcomes of fifth-grade students of Food Webs in the Gajah Mada Group, Bonang District. Researchers used experimental quantitative research methods with research techniques through tests and documentation. The instrument used is the test results on the pretest and posttest. The study population was fifth-grade students in the Gajah Mada group, with a sample of fifth-grade students at Public Elementary School No. 1 Purworejo, Public Elementary School No. 2 Purworejo, and Public Elementary School No. 1 Tridonorejo. The sampling technique used was purposive sampling. The test instrument uses a validity test and reliability test. The prerequisite test data analysis technique is in the form of a normality test and a homogeneity test. Hypothesis test using t-test, independent sample t-test through SPSS 25 for windows. This study concludes that the problem-based learning model is more effectively used in improving science learning outcomes for class V on the ecosystem theme when compared to direct learning. This can be seen in the class average with the Problem Based Learning model of 85.45 and indirect learning, and the class average is 74.00, the Sig. value is 0.000 <0.05 and the t-value is 4.137 > t-table 2.006.

Keywords: Learning outcomes, problem-based learning, science education

1. Introduction

In preparing human resources that can overcome the challenges of the times in the world of education, the government uses the implementation of the 2013 Curriculum to optimize and realize the goals of national education in Indonesia (Maharani, Mahtari, & Suyidno, 2021). Implementation of the 2013 curriculum is carried out with a scientific approach that applies three domains in learning: attitudes, knowledge, and skills. The scientific approach to learning includes observing, asking, trying, processing data, presenting data, analyzing, reasoning, concluding, and creating (Wiyanto & Widiyatmoko, 2016). Implementing the 2013 curriculum with a scientific approach is intended to provide understanding to students in recognizing various materials and information that does not depend on the teacher. By applying the scientific process, students can do many activities that motivate them to find and understand concepts with thematic learning.

Implementing the 2013 curriculum, especially in science subjects, follows the scientific approach. In addition, this learning requires accurate strategies and collaboration with various parties to create students who are characterized and think critically, creatively, and innovatively. Tahir, Haron, & Singh (2019) state that the learning paradigm must be changed from knowledge transfer to students learning and compiling their knowledge. The paradigm shift requires teachers to have creativity and innovation in planning and implementing learning so that science as a product and process appears in learning activities, for example, by using learning media. The use of media in education is very supportive of the learning process that occurs. With the media, it can activate students, making it easier for teachers to convey material or information while making it easier for students to capture the information given (Buchori & Setyawati, 2015). Meanwhile, according to Suchyadi, Safitri, & Sunardi (2020), the central aspect that is mastered in science learning is that children can realize the limitations of their knowledge, arouse curiosity to explore new knowledge, and apply it in everyday life based on the information that has been learned.

However, based on the learning outcomes of middle semester assessment, the content of science lessons is less than optimal. From the results of the group meeting that was held primarily for fifth-grade teachers, that science content learning in the Gajah Mada Cluster was still below the minimum completeness and based on observations from the Gajah Mada cluster teacher, this was because learning at that time was still online with various obstacles, which is now being continued. With blended learning, which requires adaptation of learning for both students and teachers, the teaching carried out is still teacher center, not yet able to activate students. Knowledge has not built students to find and apply concepts independently, so students' understanding lasts for a while, lacks meaning in learning, and is boring.

To overcome these problems, the researchers applied a learning model as an alternative to solving these problems. According to Utaminingsih, Widjanarko, & Ismaya (2022), PBL is a learning model that accommodates student involvement in authentic learning and problem-solving. Meanwhile, according to Muhamad et al. (2021), PBL is a learning model that provides opportunities for students to explore authentic experiences to encourage them to learn actively, construct knowledge, and integrate the context of learning in school and real-life scientifically.

The researchers used the Problem Based Learning model to improve the learning outcomes of fifth-grade science in the Gajah Mada group. Based on the relevant research, the researcher hypothesizes that the problem-based learning model is more effective than direct learning in improving the science learning outcomes of fifth-grade students on ecosystem materials in the Gajah Mada Gugus, Bonang District, Demak Regency.

Based on the description above, the researcher conducted a study to determine the effectiveness of using the Problem Based Learning model. Therefore, the authors took the study title: "The Effectiveness of Problem Based Learning and Problem Based Learning Models on Student Learning Outcomes of Science Subjects in Class V Elementary School in the Gajah Mada Group, Bonang District, Demak Regency."

2. Literature Review

As receivers and interpreters, humans learn to construct their interpretations of the physical world through cognitive, interpretive activities that construct mental models. The defining process involves new ideas and phenomena with confidence from existing knowledge representations (Marra et al., 2014). The knowledge constructed by the learner does not only consist of ideas (content), but also knowledge about the context in which the knowledge is acquired, what the knower does in the environment, and what is meant by the knower from that environment. Fundamentally, PBL is based on constructivist assumptions about learning, which can be described as the five principles of knowledge, meaning-making, and learning.

Problem-based learning (PBL) is an instructional method in which student learning focuses more on the context of authentic problem-solving. Problems are an important aspect of PBL. They embody the nature of PBL and are the basis for knowledge construction (Newman, 2005). They exist to trigger the learning process and form the basis for student learning activities. Creating effective problems is, thus, critical to the success of PBL.

The main characteristic of the PBL learning environment is that it is problem-focused. Students begin to learn by tackling authentic and unstructured problem simulations. The content and skills to be learned are organized around problems rather than as a hierarchical list of topics (Kubiatko & Vaculová, 2011). Thus, knowledge is learned in the context problem, and there is a reciprocal relationship between knowledge and the problem. Knowledge building is stimulated by the problem and applied back to the problem. Another characteristic of PBL is that it is student-centered. The teacher does not dictate the course of learning activities but only as a facilitator and a supporting role. Self-directed: Students individually and collaboratively assume responsibility for generating learning problems and processes through self-assessment and peer-assessment and access their experiential knowledge and learning materials (Yew & Goh, 2016). Required tasks are rarely assigned. Self-reflective: Learners monitor their understanding and learn to adapt strategies for learning. Facilitative: Instructors are facilitators (not lecturers) who support and model the reasoning process that facilitates group processes and interpersonal dynamics, and investigate student knowledge in depth but do not insert content or provide direct answers to questions.

Problem-based learning, according to Dita et al. (2021), is an interaction between stimulus and response, which is the relationship between two learning directions and the environment. Based on some of the opinions above, Problem Based Learning (PBL) is learning that presents contextual problems, knows how to construct a problem framework, organizes and investigates issues, collects and analyzes data, compiles facts, creates arguments about problem-solving, works individually, or collaborates in solving problems.

According to Pulungan, Toybah, & Suganda (2021), learning-oriented to higher-order thinking skills involve three aspects: transfer of knowledge, critical and creative thinking, and problem-solving. In line with that, Suratmi et al. (2021) state that through higher order thinking skills or HOTS, students will be able to think critically, creatively, thoroughly, solve problems and make decisions, and have good character. Ishartono et al. (2021) state that HOTS assessment in mathematics learning has a significant effect on the student's critical thinking skills in learning mathematics.

In line with the research by Putra & Abdullah (2019), which stated that the using of HOTS questions to stimulate the learner's thinking skills is essential to meet the challenge of the 21st century, the test developers need to provide adequate portions of HOTS-based items to help students to have good thinking skill to meet the challenge of 21st century.

3. Methodology

This research is included in experimental quantitative analysis. The research design used is a pretest-posttest control group design. Quantitative research is an experiment or experiment that is systematically and tightly controlled in the form of functional and factorial designs (Ross & Morrison, 2013). Quantitative research focuses more on outcome research than process research. The research method used in this study is experimental. The reason for using an experimental study is that the goal is to compare the outcome of a given treatment with different treatments (Ledyard, 2020).

The population in this study were fifth-grade students in the Gajah Mada Group, Bonang District, Demak Regency. The sample selection was purposive sampling for the following reasons: students have different characteristics, namely near the highway and the beach. Parents have different backgrounds and have other middle semester test averages. The samples of this study were Public Elementary School No. 2 Purworejo and Public Elementary School No. 1 Tridonorejo. The data collection technique was in the form of a written test, namely the initial test (pretest) and the final test (posttest). The research instrument used was a written test and lesson plans as supporting mechanisms. The test is used as a data collection tool, so each test item must meet reasonable requirements regarding discriminating power, level of difficulty, validity, and reliability—instrument validation, difference power, difficulty test, reliability, using the SPSS for windows 25 calculator. The normality and homogeneity prerequisite test technique uses an excel calculation tool. The hypothesis test in this study uses the t-test, namely the independent sample t-test.

4. Findings and Discussion

The pretest and post-test results can be seen in table 1, which shows the results of activities before and after learning activities in the control and experimental classes.

Table 1. Comparison of test between control and problem-based learning class

	Control		**Problem-based**	
	Pretest	**Post-test**	**Pre-test**	**Post-test**
Std. Deviation	13.566	10.222	13.563	8.2078
Valid	30	30	22	22
Average	64.333	77.000	63.636	82.273
Alfa	0.050	0.050	0.05	0.05
Lilifors	0.886	0.886	0.886	0.886
Lt (L table)	0.162	0.162	0.1889	0.1889
Lv (L count)	0.124	0.151	0.1608	0.0636

Based on Table 1, it is known to control class with conventional learning with a sample of 30 students. The mean pretest is 64.33, the mean post-test is 77, the standard deviation of the pretest is 13.566, and the standard deviation of the post-test is 10.222. In classes with problem-based learning, the number of samples is 22 students with a mean pretest of 63.63 and a mean pretest of 82.27, and a standard deviation of 13.563 pre-tests, post-test standard deviation of 8.2078.

4.1 Normality Test

Normality test by testing the Pretest and Posttest, in this study using the Lilliefors test using Microsoft Excel as a tool. Lilliefors normality test uses 95% confidence with the condition that if Lo count < L table, then the data distribution is normal. If the result of Lo count > L table, then the data distribution is not normal.

Based on Table 2, the pre-test control class Lo (L count) is 0.124, while the L table value is 0.162. Posttest results Lo (L count) of 0.151 < while L table 0.162. The level of L count < L table means that the control class is normally distributed. The problem-based pretest class Lo (L count) is 0.1608, while the L table value is 0.1889. The result of the post-test Lo (L count) is 0.0636<, while the L table is 0.1889. The level of L count < L table means that the control class is normally distributed.

Table 2. Normality test

	Control		Problem-based	
	Pretest	**Post-test**	**Pre-test**	**Post-test**
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Alfa	0.886	0.886	0.886	0.886
Lilifors	0.162	0.162	0.1889	0.1889
Lt (L table)	0.124	0.151	0.1608	0.0636

4.2 Homogeneity Test

The data processing sources are taken from the pretest and posttest values using Microsoft Excel calculation assistance.

Table 3. F-test two-sample for variances

	Control		Problem-based	
	Pre-test	**Post-test**	**Pre-test**	**Post-test**
Mean	64.82759	76.89655	63.333	81.42857
Variance	183.0049	107.8818	203.33	112.8571
Observations	30	30	22	22
df	29	29	21	21
F (count)	1.69634		1.8016	
P(F<=f) one-tail	0.08411		0.0983	
F Critical one-tail	1.88207		2.1241	

Based on Table 3, the control class calculated F is 1.69, while the F table is 1.88. This means that F-count < F-table, namely 1.69 <1.88, meaning that the data is said to be homogeneous. Besides problem-based learning class, the F-count of 1.80 while the F table of 2.12. This means that F count < F table, namely 1.80 < 2.12, meaning that the data is said to be homogeneous.

4.3 Hypothesis Testing

The t-test tests the learning of Problem Based Learning on students' learning outcomes in science lessons by using the independent sample t-test. To calculate the t-test utilizing the help of calculation through SPSS by calculating the results of the t-test are as follows:

Table 4. Hypothesis test

Group Statistics					
Learning	Class	N	Mean	Std. Deviation	Std. Error Mean
Outcomes	PBL	22	85.455	10.1076	2.1550
	Direct Learning	30	74.000	9.6847	1.7682

Based on the results of the "Group Statistics" output table above, it can be seen that the number of students in the Problem Based Learning model is 22, and in Direct Learning is 30. The average value of the problem-based Learning model is 85.45, and the average value of direct learning is 74.00. Thus, it can be concluded that there is an average difference between classes that use the Problem Based Learning model and direct learning.

Based on the value of Sig. (2-tailed) 0.000 < 0.05, it can be concluded that H0 is rejected and Ha is accepted, which means that there is a significant effect between the average science learning outcomes using the Problem Based Learning model and direct learning. From the results of the statistical output, it is known that the t-count value is 4.137 then, look for the t-table value with the formula (a/2); (df). Equal to 0.025: 52. based on the attachment on the t table is 2.006.

Thus, the t-count value is 4.137 > t table 2.006, so it can be concluded that H0 is rejected and Ha is accepted, which means that there is a significant difference in the effectiveness of the average science learning outcomes of grade 5 students in the Gajah Mada Group between those using the problem-based learning model and those using the direct learning.

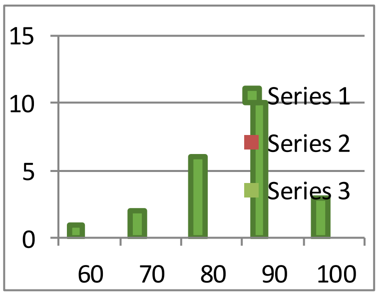

Figure 1. Experimental value diagram 1

5. Discussion

Based on the results of the post-test experimental scores, it can be concluded that the student learning outcomes in the Problem Based Learning model were successful, as expected by the researchers. This proves that the problem-based learning model is very effectively used in improving science learning outcomes in the essential competencies of food webs for class V. with students have been able to achieve a class average of 85.45 and completeness of learning outcomes of 95.4% and t arithmetic = 4.137 while the value of t table is 2.006

According to Dita et al. (2018), problem-based learning is the interaction between stimulus and response, which is the relationship between two learning directions and the environment. This learning is to the challenges of the 21st century, namely HOTS-based learning. This learning helps students process existing information into new knowledge they construct themselves. In this learning, students are asked to find solutions to authentic problems. For example, when students are given a worksheet about food webs, students creatively construct food webs with confidence. Hussain & Anwar (2017) argue that the PBL teaching strategy is advantageous in improving the students' achievement and critical thinking skills (application, analysis, synthesis, and evaluation). And also, research from Affandi & Sukyadi (2016) states that it enabled the students to explore a contextual problem creatively, work together in groups for appropriate learning sources, and especially support their critical thinking skills development.

In determining the order of food webs, students are required to think critically so that they can form several interconnected food chains. According to Afifah et al. (2019), teaching and learning by using a problem-based learning model are more effective in improving students' ability to think critically in solving a problem faced by the N-Gain test results show a class with a problem-based learning model. of 0.59 and a problem-solving class of 0.50.

Anazifa & Djukri (2017) state that using a problem-based learning model is more effective when compared to direct learning. Hence, students are more active and creative in learning by applying problem-based learning. This model is also proven to improve student learning outcomes. This is in line with the results of Sri's research (2021) under the title Application of Problem Based Learning Models to Improve Student Activities and Learning Outcomes in Science Lessons (study of fifth-grade students at Public Elementary School No. 6 Pengambangan, Banjarmasin, that through the application of learning using problem-based learning models students more active in solving a problem so that student learning outcomes always increase until the indicators have been set.

Compared to Utaminingsih et al. (2015) in applying the problem-based learning model, this research is better because students are more active, and teacher effectiveness is more visible in teaching than in previous research. In addition, learning outcomes are increasing, which can be seen from the results of the final research test. Experimental research on problem-based learning models on science learning outcomes shows that students can achieve a class average of 84.45.

6. Conclusions and Recommendations

Based on the results of the research and discussion, it can be concluded that there is the effectiveness of the problem-based learning model on the learning outcomes of ecosystem theme science in elementary school students in Class V in the Gajah Mada Group, Bonang District, Demak Regency. Problem Based Learning model is more effectively used in improving science learning outcomes for class V on the ecosystem theme when compared to direct learning. This can be seen in the class average with the problem-based learning model of 85.45. In direct learning, the class average is 74.00, and the Sig. value is 0.000 <0.05, and the t arithmetic value is 4.137 > t-table 2.006 because problem-based learning is a learning process that focuses on student activity in solving various problems faced by critical and creative thinking to find a concept that can be applied in the field.

The researcher suggests that teachers use problem-based learning models to improve student learning outcomes on the content of the ecosystem theme science lesson because problem-based learning is more optimal in building and developing ideas and concepts in solving various problems faced.

Moreover, students are encouraged to participate in different chemistry activities such as joining science fairs, seminars, and science organizations to practice their process skills and improve their knowledge. Teachers should elevate their teaching styles in teaching chemistry concepts and emphasize applying process skills related to their daily life activities. Therefore, the results of studies in teaching sciences are significant in reviewing and assessing science curricula for further improvements.

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