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The Effect Of The Problem-Based Learning Model Through A Differentiated Approach To Motion Material On The Learning Outcomes Of Students In Grade VII Of MTS Nurul Bahri Kabila Bone

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Abstract

This study was conducted to determine the effect of applying the Problem-Based Learning (PBL) model through a differentiated approach on students' learning outcomes in the subject of Motion. The type of research used was an experiment with a One Group Pretest-Posttest Design. The research population included all seventh-grade students at MTs Nurul Bahri Kabila Bone, while the research sample consisted of three classes, namely the experimental class, replication 1, and replication 2, which were determined using the Cluster Random Sampling technique. The research instruments included learning style tests, teaching modules, Student Worksheets (LKPD), teaching materials, and written tests in the form of pre tests and post-tests used to measure student learning outcomes. The data obtained were analyzed using descriptive and inferential statistics, including normality tests, hypothesis tests, and N-gain analysis. The results showed that the average learning outcome score of students in the experimental class was 83.92, in replication class 1 was 83.67, and in replication class 2 was 82.92. Based on the normality test results, the data was declared to be normally distributed. The N-gain analysis showed that the increase in learning outcomes was in the high and moderate categories. The hypothesis test showed that the t-count values for each class, namely 26.422 for the experimental class, 10.52 for replication class 1, and 18.877 for replication class 2, were greater than the t-table. Thus, it can be concluded that the application of the Problem-Based Learning (PBL) model through a differentiated approach has a significant effect on student learning outcomes.

Keyword: Problem-Based Learning (PBL), Differentiated Learning, Learning Outcomes

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INTRODUCTION

According to Ki Hadjar Dewantara, the essence of education lies in the effort to direct all of a child's potential so that they can achieve complete safety and happiness, both as individuals and as members of society. In his view, education is a vessel that nurtures and cultivates cultural seeds. Therefore, an educator must possess strong inner wealth, including mental, moral, and spiritual integrity. Ki Hadjar Dewantara's thoughts were later reflected in the idea of independent learning, which is an education system that places students at the center of learning through a holistic approach. This approach emphasizes the balanced development of students' potential covering intellectual, emotional, physical, social, artistic, and spiritual in a balanced manner (Fitria Novita Sarie, 2022).

In realizing quality education, all elements of the school community are required to be innovative. Teachers, as the spearhead of education, play an important role in setting an example, as well as being required to be creative and innovative in every learning process. Careful planning of the learning process is key to ensuring that teaching and learning activities are carried out in accordance with the needs of students, so that learning objectives can be achieved optimally. Therefore, the motivation and learning needs of students need to be assessed based on various learning profile indicators, so that each student has the opportunity to learn in a natural, effective, and meaningful way (Faiz et al., 2022).

The quality of education is essentially reflected in how the learning system is designed and implemented. Learning is a process of guidance provided by educators so that students are able to understand, master, and develop their knowledge and skills. In the modern era, teachers face various challenges, such as differences in student characteristics, the complexity of the material, high standards for the learning process, and the need to develop critical thinking skills. Therefore, teachers need to continuously improve their competence, choose the right learning strategies, and manage the classroom effectively so that the learning process can take place optimally (Afilin, K. M., 2023).

Subject has an important contribution in supporting the success of the learning process and improving the quality of the school. Therefore, interactive, creative, innovative, and interesting learning is required for students. Innovation in learning is necessary so that learning activities do not become monotonous. The use of relevant teaching materials, technology, and learning media is expected to increase students' interest in learning. Well-designed learning will help students develop their creativity, build independence in accordance with their talents and interests, as well as achieve well-being in learning (Afilin,

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K. M., 2023).

Furthermore, Ki Hadjar Dewantara emphasized that education is a human process that helps individuals understand themselves and their environment. Education must provide space for students to recognize their identity as unique individuals who are different from one another (Herwina, 2022). One concrete manifestation of this thinking is embodied in the concept of differentiated learning, which is an approach that tailors the learning process to the individual needs of students. This adaptation includes their interests, readiness, and learning profiles. With this approach, teachers can provide learning services that are in line with the characteristics of each student. In this context, teachers act as facilitators who understand diversity without making learning individualistic, but rather inclusive of different learning needs (Afilin, K. M., 2023).

A learning model that provides space for students to be creative, both individually and collaboratively, is Problem-Based Learning (PBL). This model emphasizes learning experiences through the creation of real project-based work, so that students not only understand concepts, but are also able to apply them in real life contexts. Problem Based Learning is based on constructivist theory, which places students as active subjects in constructing knowledge through direct experience (Amini et al., 2019:158). The quality of learning can be seen from the teacher's planning and the learning outcomes achieved by the students. The improvement in learning outcomes is greatly influenced by the effectiveness of the learning process, the availability of adequate facilities and infrastructure, as well as the motivation and professionalism of teachers in managing the classroom and presenting learning materials (Afilin, K. M., 2023).

However, the reality in the field shows that the motivation of some teachers in implementing innovative learning models is still low. The learning process tends to be monotonous, focusing only on lectures without accompanying strategies and supporting media, which often causes boredom and reduces student participation. This condition makes it difficult for students to understand and recall the material that has been learned, thereby limiting their involvement in the learning process (Afilin, K. M., 2023).

METHOD

This study uses a quantitative approach with experimental methods. The research design applied is One Group Pretest-Posttest Design, which allows researchers to accurately measure data regarding changes in learning outcomes after treatment is administered and

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assess the extent of the treatment's influence. The research sample consisted of one experimental class and two replication classes. The research was conducted at MTs Nurul Bahri Kabila Boine , Boine Boilango District, Gorontalo Province, for approximately two weeks. The research activities were adjusted to the Natural Sciences (IPA) teaching materials for Grade VII that were currently being taught. The research population included all 53 Grade VII students. Sampling was conducted using random cluster sampling, so that class VII B was selected as the experimental class, class VII A as replication 1, and class VII C as replication 2. The instrument used in data collection was a learning outcome test consisting of ten questions. These questions had undergone a validation process by experts. The tests were administered twice, namely a pretest and a posttest. The pretest was conducted at the beginning of the meeting to measure the initial knowledge of the participants in the three classes before receiving the learning treatment, while the post-test was administered at the end of the meeting to determine the learning outcomes after the learning process took place. This test focused on measuring the cognitive domain of the students. Data analysis in this study includes normality tests, homogeneity tests, and hypothesis tests. The normality test was used to determine whether the data was normally distributed or not using the Kolmogorov Smirnov test with the help of Microsoft Excel software. Once the data is declared to be normally distributed, a homogeneity of variance test is performed to ensure the similarity of variance between groups. Next, hypothesis testing was performed using the ttest to determine the effect of the Problem Based Learning model on student learning outcomes (Muhid, 2019).

$$t = \frac{\bar{x} - \mu_o}{\frac{s}{\sqrt{n}}} \quad \textbf{(1)}$$

Explanation:

t = Calculated

t-value = Average value of xi

µo = Hypothesized value

s = Standard deviation

n = Number of research subjects

The statistical hypothesis used is:

H_o (null hypothesis) : states that there is no significant difference in the average learning outcomes of seventh grade students after applying the Problem-Based Learning (PBL)

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model.

H_a (alternative hypothesis): states that there is a significant difference in the average learning outcomes of seventh grade students after the implementation of the Problem-Based Learning (PBL) model.

This study utilizes instruments in the form of pre-tests and post-tests that are analyzed based on the learning scores of the participants. To measure the level of improvement in learning outcomes, an analysis of the normalized gain course average, single student normalized gain, and N-gain for each indicator was used. The calculation of this improvement refers to the formula proposed by Hake (1998) as follows:

$$N\ Gain = \frac{\text{Skor Posttest} - \text{Skor Pretest}}{\text{Skor Ideal} - \text{Skor Pretest}}$$

After the calculation is done, the categorization of the N-gain value obtained can be determined based on the criteria according to Hakeì (1999), in the following table;

Table 1. ***Categories Of N-Gain Values***

N-Gain Value	Criteria
g > 0,70	Hight
0,30 < g < 0,70	Moderate
g < 0,30	Low

RESULTS AND DISCUSSION

Research Result

This study was conducted with the aim of determining the effect of the Problem Based Learning model on Movement material on the learning outcomes of seventh grade students at MTs Nurul Bahri Kabila Bone. The sampling technique used was Cluster Random Sampling with a sample consisting of 3 classes, namely class VII B as the experimental class, Class VII A as replication class 1, and Class VII C as replication class 2. Replication classes are used in experimental research, where replication is a repetition of the experiment to ensure the consistency of the learning outcomes of the students being studied. This can be seen in the following table:

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Table 2. Average values for the experimental class, replication 1 and Replication 2.

NO	CLASS/SAMPLE	AVERAGE VALUE	
		PRE-TEST	POST-TEST
1	EKSPERIMENTAL	44,92	83,92
2	REPLICATION 1	47,42	83,67
3	REPLICATION 2	42,33	82,92

Based on the results of the analysis in Table 2, it can be seen that there is a difference in the average scores between the pre-test and post-test results in the three classes, namely the experimental class, replication 1, and replication 2. The average pre-test score in the experimental class was 44.92, while the average post-test score increased to 82.92. In replication class 1, the average pre-test score was 47.42 and increased to 83.67 on the post-test. Meanwhile, replication class 2 showed a pre-test average score of 42.33 and a post-test average score of 82.92. From these results, it can be concluded that there was a significant increase in the post-test average score compared to the pre-test in all three classes, both in the experimental class, replication 1, and replication 2. Data normality testing is conducted to determine whether the research data is normally distributed or not. In this study, normality testing used the Kolmogorov Smirnov formula as described in the research methodology, and the calculation process was carried out using Microsoft Excel. This normality test, as shown in Table 3, was applied to all groups, namely the experimental group, replication 1 group, and replication 2 group, to ensure that the data met the prerequisites for further statistical analysis. The results obtained from the statistical test can be seen in the table. The normality test shows that the data is normally distributed for both the Experiment class and Replication 1 and Replication 2 classes.

Table 3. Normality test

Class	D	K	Status
Experiment	0.132	0.31	Normally Distributed
Replication 1	0.094	0.32	Normally Distributed
Replication 2	0.089	0.31	Normally Distributed

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The N-gain test aims to see the improvement in student learning outcomes through pre-tests and post-tests. The n-gain scores for student learning outcomes can be seen in the following table.

Table 4. N-gain test

Class	N-Gain	Criteria
Experiment	**0.73**	**High**
Replication 1	**0.66**	**Medium**
Replication 2	**0.72**	**High**

Based on Table 4, the n-gain obtained for the experimental class, which is 0.73, is included in the high criteria. For the n-gain analysis of replication 1, the result obtained was 0.66, which is classified as moderate. And for the n-gain analysis of replication 2, the result obtained was 0.72, which is classified as high. It can be concluded that the improvement in student learning outcomes for each class, whether experimental, replication 1, or replication 2, is moderate to high.

Data Analysis of Hypothesis Testing

Table 5. Hypothesis Testing

Class	tcalculated	ttable	Status
Experiment	**26.242**	**2.109**	**Ha Accepted**
Replication 1	**10.052**	**2.119**	**Ha Accepted**
Replication 2	**18.877**	**2.109**	**Ha Accepted**

Based on Table 5, which shows the hypothesis test calculation, for the experimental class, tcalculated is 26.242, while for ttabel is estimated at 2.109, for replication class 1, tcountis estimated at 10.052, while for ttabel is estimated at 2.119, for replication 2, t is estimated atcalculated 18.877, while for ttabel it is 2.109, it can be concluded based on the hypothesis testing of the experimental class, replication 1 and replication 2, that tcalculated > ttabel for a significance level of α = 5%. Therefore, Ha is accepted and H0 is rejected.

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DISCUSSION

This study was conducted with the aim of determining the effect of the Problem-Based Learning model on Movement material on the learning outcomes of seventh grade students at MTs Nurul Bahri Kabila Boine. There were 53 seventh grade students, consisting of 17, 18, and 18 students in each class, namely classes VII A, VII B, and VII C. This research has a real contribution to the learning system because it can support more dynamic and meaningful teaching and learning activities. Through the application of the learning model used, the classroom atmosphere becomes more lively and less monotonous, so that students can be actively involved in all stages of learning. In addition, this model also encourages students' critical thinking skills in solving problems that arise during the learning process. The research was conducted in four meetings. The stages of the activity began with the administration of a pre-test and a learning style test at the first meeting. Subsequently, the learning process was carried out during two meetings using the Problem-Based Learning (PBL) model combined with a differentiated approach. The second meeting focused on presenting material about the concept of movement in everyday life, while the third meeting continued the discussion of the same material with more in-depth exploration activities. Each meeting was scheduled for two hours of instruction. In learning activities, students are divided into several groups based on their respective learning styles. This division is intended so that students can discuss and conduct experiments according to their learning characteristics. In the experiment, replication 1, and replication 2, the learning model applied was Problem-Based Learning with a differentiated approach to the subject matter of "Motion". The replication class was used in the experimental research, where replication is a repetition of the experiment, to ensure the consistency of the learning outcomes of the participants (Abdjul et al., 2022). After all stages of learning were completed, the fourth meeting was used to conduct a post-test to measure the learning outcomes of the participants. Data analysis was conducted by comparing the number of students based on learning style tendencies with the total number of students in each class. The results of the analysis showed that in the experimental class, the visual learning style reached 33.33%, auditory 27.77%, and kinesthetic 38.88%. In replication class 1, the visual learning style was 41.17%, auditory 29.41%, and kinesthetic 29.41%. Meanwhile, replication class 2 showed a percentage of visual learning styles of 38.88%, auditory learning styles of 27.77%, and kinesthetic learning styles of 33.33%. Based on these results, it can be concluded that the majority of students tend to have visual and kinesthetic learning styles. This is in line

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with Cognitive Load Theory, which emphasizes the importance of reducing cognitive load for optimal learning (Ceken, B., 2022). As a result, many students feel that learning with visual aids is "lighter" and easier to remember than text-based learning. Hypothesis testing was conducted to determine the effect of implementing the Problem-Based Learning model through a differentiated approach on student learning outcomes. The test results show that the t-value in the experimental class is 26.242; 10.052 in replication class 1; and 18.877 in replication class 2, with table t values of 2.1098 and 2.1199. Because all of the calculated t values are greater than the t table values, the null hypothesis (H_o) is rejected and the alternative hypothesis (H_a) is accepted. This study proves that the implementation of the Problem-Based Learning model with a differentiated approach has a significant effect on improving student learning outcomes in the subject of Movement in Grade VII. This success is due to the characteristics of the PBL learning model, which places problems as the starting point for learning. Students are encouraged to identify problems, conduct group discussions, design solutions, and gather information from various sources such as books, the internet, and observations. Through these stages, students not only acquire conceptual knowledge, but also develop critical and collaborative thinking skills that are essential in science learning. This is in line with the opinion (Putri et al., 2023) that learning using the Problem-Based Learning model influences the cognitive abilities of students because they are encouraged to be actively involved in solving the problems presented.

CONCLUSION

Based on the results of research conducted through experimental methods involving experimental classes, replication 1, and replication 2, it was found that the application of the Problem-Based Learning (PBL) model through a differentiated approach to the subject of Movement had a significant effect on the learning outcomes of students. This is proven through the results of hypothesis testing, where the t-value for the experimental class is 26.242, which is greater than the ttable value of 2.1098. in replication class 1, the t-value of 10.052 was also greater than the t-table value of 2.1199; and in replication class 2, the t-value of 18.877 exceeded the t- table value of 2.1098. Thus, in all classes, the results show that the t-value is greater than the t-table, which indicates that the Problem Based Learning model with a differentiated approach has a positive effect on improving student learning outcomes.

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