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The Effect of Problem Based Learning (PBL) Model on Student Learning Outcomes on Unit of Weight Material in Class IV Elementary School

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Abstract

The Problem-Based Learning (PBL) methodology teaches students to think critically, be creative, and actively engage in the learning process by emphasizing real-world problems. At the Samir Public Elementary School, it appears that the learning process still based on the conventional model, which focuses on the role of the teacher. The selection of the in teaching mathematics on the subject of units of weight needs more attention so that the learning process can run smoothly and optimally. This study aimed to determine how fourth-grade elementary school students' learning results in the domain of weight units were impacted by the Problem Based Learning (PBL) approach. The research design used was a Pre-Experimental Design (One- Group Pretest-Posttest Design), which is a design that gives a pretest before the treatment is administered, and a posttest after the treatment is administered. The Data collection techniques included validity tests, reliability tests, discrimination tests, difficulty level tests difficulty, normality, and hypothesis testing. The instruments used in this study are tests and documentation. The results of the data analysis conducted the researcher showed that there was an effect of the Problem-Based Learning (PBL) model on student learning outcomes on the subject of weight units in fourth grade elementary school. The results of the t-test (Paired Sample T-Test) demonstrate that H1 is accepted since the p-value is less than 0.05. It is found that when it comes to the subject of units of weight, fourth-grade elementary school students' learning results are influenced by the Problem-Based Learning (PBL) paradigm.

Keywords: Learning Outcomes, Problem-Based Learning Model, Units of Weight

INTRODUCTION

A. Background

The success of learning in schools plays an important role in determining the quality of education. Various factors contribute to this success, including the curriculum, learning methods, the role of teachers, learning media, and available facilities [1]. One of the factors that influence the success of learning is the learning method or model used. The main purpose of learning is to equip students with the skills and abilities needed to face and solve various problems in everyday life.

In the learning process, it is important for teachers to choose the right model so that students can understand the material well. As educators, teachers have the responsibility to ensure that what is taught can be applied in solving real problems, so that students can achieve optimal results. The role of teachers is very important in transferring knowledge to students, so that they can develop the knowledge, skills and life skills needed in everyday life. The task of teachers is also to create a quality young generation, both in terms of intellectual and moral. In observations made on January 10, 2025, the fourth grade teacher stated that students had difficulty understanding, especially in the material of units of weight. In addition, there are 3 out of 20 students whose scores are below (KKM) 75. It can be seen from the formative test scores that there are scores 65, 68, 60. From the low student learning outcomes, there are several factors that cause this, namely: 1) The impact of the pandemic which hampers the development of the basics of mathematics at the lower grade level, so that it affects understanding at the upper grade level, especially in mastering abstract concepts 2) Less varied learning models from teachers, tending to still use conventional approaches in teaching basic mathematical concepts, especially unit weight material and 3) The existence of students who experience learning difficulties such as dyscalculia, which causes them to be less able to master abstract concepts, and 3) The existence of students who experience learning difficulties such as dyscalculia.

Where the teacher is seen that the learning process that takes place still refers to the conventional model, which focuses on the role of the teacher. This certainly requires maximum effort from the teacher, especially in teaching mathematics lessons on unit weight material. To achieve this goal, teachers need to choose a learning model that can improve student learning outcomes. One of the models applied in this study is Problem Based Learning (PBL), which focuses on the active involvement of students. The selection of models in learning mathematics, especially related to units of weight, needs to receive more attention so that the learning process can run smoothly and optimally.

The PBL model is a method that focuses on a problem to gather and integrate new knowledge (Fathurrohman, M, in the journal [2]). This process begins with defining the problem at hand, where students conduct discussions to balance their ideas on the topic at hand. Students formulate the goals and objectives to be achieved. In this process, the teacher's role is very important to monitor students' progress in achieving learning objectives and guide them to stay in the right position when completing the assigned tasks.

According to Duch, as expressed in the journal [3] the PBL model where students are asked to actively participate in the problem solving process. This model encourages students to be directly involved in facing challenges that exist in everyday life. Suprihatiningrum also emphasized in his journal [4], that the PBL model involves students being faced with a problem first, before students conduct a self-focused search for information. According to Marlina (2020) in jounal [5], the Problem-Based Learning (PBL) model encourages educators to innovate in the classroom learning process. This is because the implementation of the PBL model has been proven to have a positive impact on learning outcomes, participation levels, and student motivation, as well as contributing to the development of critical and analytical thinking skills, which collectively influence the effectiveness of teaching and learning. In this context, the teacher's role serves as a facilitator. Based on these theories, it can be concluded that the PBL model is a learning model that focuses on real problems, which not only encourages students to solve challenges, but also encourages students to take responsibility for their own learning process. Therefore, the selection of the right learning model determines student learning outcomes.

Learning outcomes are one of the main indicators of student success in understanding and mastering subject matter. Of course, teachers want their students to achieve learning objectives well, so that the results achieved can improve compared to before. According to Benjamin S. Bloom with the Taxonomy of education objectives in the journal [6] cognitive, emotional, and psychomotor are the three components of learning outcomes. The cognitive domain is known as knowledge comprehension, the emotive domain is linked to attitudes and conduct, and the psychomotor domain is linked to practical abilities. The level of learning outcomes achieved by students at school does not grow by itself, but is the result of the interaction of various factors that influence it. These factors include internal factors, which come from the student, and external factors, which come from the environment around the student. External factors, or circumstances outside the student, include: Family, school, and social situations. Internal factors are the state of the student. This includes physical and psychological conditions, including physical and psychological weaknesses. Regarding internal factors, the psychological state plays an important role, considering that learning is a mental process that affects student learning outcomes. This includes interest, intelligence, talent. Children's behavior is also influenced by the outside environment of the family. Bad behavior by children is a typical occurrence in both society and schools, especially in the contemporary globalized day where teachers are becoming less visible and pupils are growing more daring (Khasanah & Fauziah in the journal [7]) Another factor that affects learning outcomes is learning discipline.

Based on the problems described above, the focus of this research is to find out “The Effect of the Problem Based Learning (PBL) Model on Student Learning Outcomes in the Unit of Weight Material of Class IV Elementary School”.

B. Problem Formulation

Based on the background description above, the problem formulation in this study is as follows: Is there an effect of the Problem Based Learning (PBL) model on student learning outcomes in class IV elementary school weight unit material?

C. Reserch Objectives

Based on the formulation of the problem above, the objectives of this study are as follows: To determine the effect of the Problem Based Learning (PBL) model on student learning outcomes in class IV elementary school weight unit material.

D. Benefits of Research

The benefits of this research are as follows:

1. Theoretical Benefits

   By conducting this research, the goal of this study is to improve our knowledge of how the PBL paradigm influences students' learning outcomes in class IV primary school weight unit material.
2. Practical Benefits
   a. For researchers, to add new experiences regarding the PBL model on learning outcomes.
   b. For Schools, through this research it is hoped that it can provide and increase knowledge in improving learning using learning models, especially math lessons.
   c. For Teachers, with this research it is hoped that teachers can choose the right learning model.
   d. For Students, by using the PBL model, it is hoped that students will be more actively involved in the learning process.

RESEARCH METHOD

A. Research Types and Design

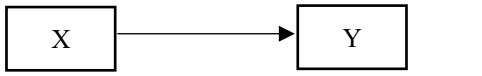
Quantitative research is a scientific study conducted systematically, focusing on existing parts and phenomena, and the cause-and-effect relationships between them. Known as a structured approach, this research involves collecting data to analyze phenomena in depth. The data obtained is then measured and analyzed using statistical, mathematical, or computational methods (in the journal [8]). The research design used in this study is Pre-Expelrilmelntal Design (One-Group Pretest-Posttest Design), which is a design that provides a pretest before being subjected to treatment, as well as a posttest after being subjected to treatment.

In this research design, it is done by giving pretest treatment, and posttest in class IV. The treatment is on the learning model used. Students are taught unit weight material using the PBL model. With this, researchers can compare the results of the pretest and posttest to see the difference in the effect of the PBL model on learning outcomes. The design of this study is as follows:

Tablel 1. Research Design

Pre-Test	Treatment	***Post-Test***
O_1	X	O_2

Description :
O_1 = Initial test before treatment (*pretest*)
O_2 = Final test after treatment (*posttest*)
X = Treatment given



Problem Based Learning Model — *Learning Outcomes*

Description:
X: *Problem Based Learning* Model (Independent Variabel)
Y: Student Learning Outcomes (Dependent Variabel)

Figure 1. Research Paradigm Diagram

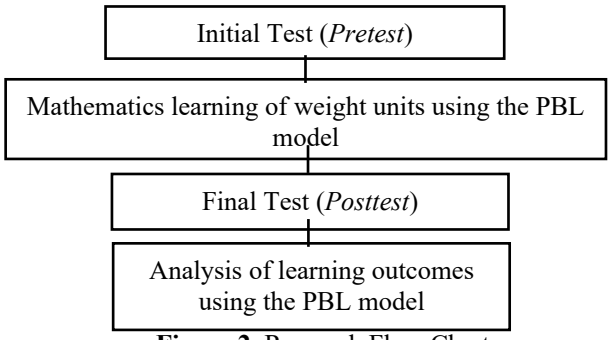


Figure 2. Reseacrh Flow Chart

B. Research Variable

According to Sugiyono, research variables are basically anything that researchers decide to study to get info about it, and then they draw conclusions [9]. The independent variable is the one that influences, creates, or gives origin to the dependent variable. The independent variable in this study is the PBL model (X). According to Sugiyono, "The dependent variable is the variable or outcome influenced by the presence of the independent variable." The dependent variable used in this study is learning outcomes (Y).

C. Population and Sample

The research population consisted of all students at Samir Public Elementary School, and the research sample consisted of 20 fourth-grade students at Samir Public Elementary School. The sampling technique used was purposive sampling.

D. Data Collection Techniques

To obtain the necessary data and information for this study, tests and documentation were used as data collection methods. The following is an illustration:

1. Test

According to Zaeinul and Nasoetion in a journal [10], a test is defined as a question or task that has been created to collect data for each question that is considered a correct or appropriate response. The types of tests used in this study include:

a. *Pretest*

The pretest is a test given before administering (treatment) in the form of a PBL model on the subject of units of weight.

b. *Posttest*

The posttest is a test given after providing (treatment) in the form of a PBL model on the subject of units of weight.

2. Documentation

According to Sugiyono in a journal [11], documentation is a collection of records of events that occur in the form of writing, images, or photographs of a person or institution. In this study, the data collection technique used was documentation in the form of teaching modules/lesson plans and photographs. The teaching modules are listed in Appendix 1.

E. Data Analysis Techniques

The Jamovi 2.3.2 program's data analysis approach was used to test the instrument. Validity was tested using the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO MSA) and Bartlett's Sphericity test.. Reliability was determined by testing the Cronbach Alpha coefficient. Normality was tested using the Shapiro-Wilk Multivariate Normality Test.

Data analysis in this study used descriptive statistics by analyzing the mean of the pretest and posttest to test a hypothesis. Hypothesis testing used the t-test (Paired Sample T-Test) to determine the significance of the difference between the pretest and posttest scores.

RESULT & DISCUSSION

A. Result

The following are the *pretest* and *posttest* data values.

Table 2. *Pretest* and *Posttest* Data

Pretest	***Posttest***
40	100
20	80
50	100
70	100
60	80
70	100
30	100
40	90
20	90
80	100
60	80
70	80
70	100

50	90
70	80
60	100
70	80
70	90
50	100
80	80

Based on the table above, it shows that when the pretest was conducted, the students' scores were generally below the minimum passing criteria (KKM). However, there were two students whose scores were above the KKM. As can be seen in the table above, the lowest score was 20 and the highest was 80. This was influenced by the students' tendency to learn through teacher-centered learning methods. However, after receiving intervention, students' learning outcomes showed a significant improvement, as evidenced by posttest scores that generally placed students' average scores above the minimum competency criteria (KKM), with the lowest score reaching 80.

This study used learning outcome instruments in the form of 10 pretest and posttest essay questions. These instruments were used to determine validity, reliability, and discriminating power. The learning outcome instruments were tested on 20 fourth-grade students at Samir Public Elementary School. Based on the results of testing the learning outcome instruments using the Jamovi 2.3.2 application, the following results were obtained:

Table 3. *Bartlett of Sphericity*

Bartlett's Test of Sphericity

χ^2	df	P
156	45	<.001

Table 4. *KMO Measure of Sampling Adequacy*

KMO Measure of Sampling Adequacy

	MSA
Overall	0.827
S1	0.801
S2	0.902
S3	0.862
S4	0.878
S5	0.878
S6	0.827
S7	0.762
S8	0.891
S9	0.750

KMO Measure of Sampling Adequacy

	MSA
S10	0.781

According to table 4, Bartlett's Sphericity is < 0.001 and the KMO Measure of Sampling Adequacy has a value > 0.50, so the items are valid and can be tested.

Table 5. *Scale Reliability Statistics*

Scale Reliability Statistics

	Mean	Cronbach's α
scale	1.24	0.883

Based on atble 5, it can be concluded that items 1 to 10 have very high reliability, as the Cronbach's Alpha value is 0.883.

Table 6. *Item Reliability Statistics*

Item Reliability Statistics

	Mean	Item-rest correlation
S1	1.40	0.716
S2	1.30	0.625
S3	1.20	0.606
S4	1.15	0.601
S5	1.40	0.560
S6	1.25	0.614
S7	1.15	0.582
S8	1.10	0.580
S9	1.35	0.620
S10	1.05	0.634

Based on table 6, all values are positive. The item-rest correlation on 10 items all have positive values, providing a strong indication of the quality of the measurement instrument. Therefore, after testing using the Jamovi 2.3.2 application, the reliability of the learning outcome test instrument is categorized as reliable.

Figure 3. *Correlations Headmap*

There are several factors in the instrument determined from the scree plot and Eigen values, resulting in a graph that shows the slope and flatness (Retnawati in the journal (Putri, 2021)). Below is the Scree Plot analysis of the learning outcome instrument.

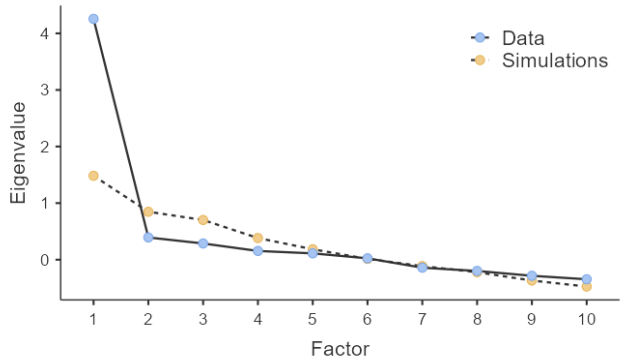


Figure 4. *Scree Plot*

When viewed from the scree plot results, there is a slope, so this test instrument can only be used to measure mathematics learning outcomes. This is also reinforced by Eigen Values, where only one factor stands out in value compared to the other factors, as shown in the table below:

Table 7. *Initial Eigenvalues* Exploratory Factor Analysis

Initial Eigenvalues	
Factor	**Eigenvalue**
1	4.3383
2	0.3734
3	0.2647
4	0.1579
5	0.1186
6	0.0232
7	-0.1388
8	-0.2125
9	-0.2436
10	-0.3429

Based on table 7, the exploratory factor analysis can be concluded that the instrument in the form of test questions is valid for measuring student learning outcomes that have been proven empirically.

Table 8. Differential Power Test

Item	*Item-Rest Correlation*	Differential Power
1	0,716	Good questions and acceptable questions
2	0,625	Good questions and acceptable questions
3	0,606	Good questions and acceptable questions
4	0,601	Good questions and acceptable questions
5	0,560	Good questions and acceptable questions
6	0,614	Good questions and acceptable questions
7	0,582	Good questions and acceptable questions
8	0,580	Good questions and acceptable questions
9	0,620	Good questions and acceptable questions
10	0,634	Good questions and acceptable questions

Based on table 8, it can be concluded that items 1 to 10 have discriminating power with good question categories and can be used, as shown in the table above in the item-rest correlation column, which shows a value above 0.40. Then, the normality test is continued.

Table 9. Normality Test

Normality Test (Shapiro-Wilk)

			W	p
Pre-test	-	**Post-test**	0.945	0.298

Note. A low p-value suggests a violation of the assumption of normality

Based on table 9, the p-value for the pretest and posttest is 0.298, which is greater than 0.05. This is evident in the normally distributed data, and H0 is accepted. The Q-Q Plot Assessing Multivariate Normality shown in the figure illustrates the distribution of normality points related to the data presented, which can be seen in the figure below:

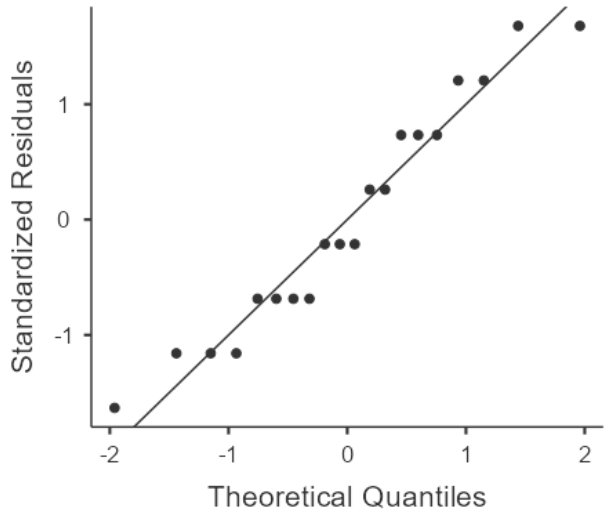


Figure 5. *Q-Q Plot Assessing Multivariate Normality Pretest-Posttest*

From figure 5, it can be seen that the points are close to the parallel line, so it can be concluded that the data is normally distributed.

Table 10. *Descriptives Statistics*

Descriptives

	Pre-test	Post-test
N	20	20
Mean	56.5	91.0
Median	60.0	90.0
Standard deviation	18.4	9.12
Minimum	20	80
Maximum	80	100

Based on table 10, the results of calculating the average student scores using the Jamovi application show that the average pretest score was 56.5, while the posttest score was 91.0. This indicates that the pretest scores increased after the treatment was administered. Therefore, it can be concluded that the PBL model had an effect on student learning outcomes. Next, a paired samples t-test was conducte.

Table 11. Hypothesis test

Paired Samples T-Test

			statistic	df	p
Pre-test	**Post-test**	**Student's t**	-7.30	19.0	<.001

Note. H_a $\mu_{Measure\ 1 - Measure\ 2} \neq 0$

Based on Table 11, the test results (Paired Sample T-Test) show that the p-value is < 0.001, which means it is ≤ lower than (< 0.05). The p-value is < 0.05, so H1 is accepted. Thus, the hypothesis test results show that there is an effect of the PBL model on student learning outcomes in the subject of weight units in fourth grade elementary school.

B. Discussion

Based on hypothesis testing and theoretical review, researchers have proven that there is an effect of using the PBL model on student learning outcomes in the subject of weight units in fourth grade elementary school. Therefore, it can be concluded that the PBL model has an effect on student learning outcomes in the subject of weight units in fourth grade elementary school.

The improvement in student learning outcomes in the subject of weight units occurred because of the learning process using the PBL model. Learning began with orienting students to the problem, organizing students to learn, and then guiding students to group experiences. Next, students are asked to develop and present their work, and they are asked to analyze and evaluate the problem-solving process. The steps of the learning process described above are supported by the opinions of Ibrahim and Nur in the journal [12], as follows:

1. Orienting students to the problem: At this stage, the teacher explains the learning context, outlines the necessary logistics, and motivates students to actively engage in problem-solving activities.
2. Organizing students for learning: The teacher plays a role in helping students define and plan learning tasks related to the problem at hand.
3. Guiding individual or group experiences: In this step, students are encouraged to gather relevant information, conduct experiments to obtain explanations, and solve existing problems.
4. Developing and presenting work: Teachers support student in planning and preparing approiate work, such as writing reports, and help students divide tasks among their peers.
5. Analyzing and evaluating the problem-solving process: In the final stage, teachers help students to reflect on and

evaluate the investigations they have conducted and the procedures they have applied.

Learning using the PBL model encourages students to think critically, creatively, and solve problems. This is supported by Faturrahman's opinion in a journal[13], "The purpose of this learning model is not merely to provide students with a lot of knowledge, but to develop critical thinking and problem-solving skills. Additionally, this model also aims to enhance students' ability to actively construct their own knowledge."

The use of the PBL model in teaching unit of weight can motivate students to think actively and creatively when facing real-life challenges. As a result, students will be able to solve problems in their surroundings. This is in line with Harland's opinion in the journal [14], which emphasizes that the application of the PBL model can motivate students to think actively and creatively when facing challenges in their surroundings.

The results of this study are supported by other researchers, namely [15] entitled "The Effect of the Problem-Based Learning (PBL) Model on Social Studies Learning Outcomes," which concludes that there is an effect of using the Problem-Based Learning (PBL) model on social studies learning outcomes. This type of research is a pre-experimental design (one-group pretest-posttest design). The analysis of pretest and posttest data in social studies using the PBL model shows that the average pretest score was 42.75, while the posttest score was 73.75. The results of the Mann Whitney U test on the test statistics yielded a sig. (2-tailed) of 0.000 < 0.05. Therefore, H0 is rejected and H1 is accepted, meaning that there is an effect of the PBL model on the social studies learning outcomes of fifth-grade students at SDN 7 Ranomeeto.

CONCLUSION

Based on the results of the data analysis conducted by the researcher, it can be concluded that there is an influence of the Problem-Based Learning (PBL) model on students' learning outcomes in the subject of units of weight in fourth-grade elementary school. This can be seen from the results of the t-test (Paired Sample T-Test), which show a p-value of < 0.001, meaning it is ≤ lower than < 0.05. Since the p-value is < 0.05, H_0 is rejected, and H_1 is accepted.

Based on the research conducted, there are undoubtedly many shortcomings and errors throughout the study. Therefore, criticism and suggestions are greatly needed to improve future research. The author would like to express gratitude to the principal of SD Negeri Samir, the supervising lecturer, and all parties involved in this research.

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