The influence of the problem based learning (PBL) model through the traditional food-based ethnomathematics approach of flat building materials on the mathematical literacy ability of grade IV students

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Abstract

Mathematical literacy is the ability of students to develop, apply, and interpret mathematical concepts to solve a problem. However, based on PISA 2022, the mathematical literacy ability of Indonesian students is still low, exacerbated by the lack of teacher innovation in using learning strategies and models. One of the solutions is the application of Problem Based Learning which can improve the ability to reason, think critically, and solve problems. This study aims to test a significant improvement in the mathematical literacy ability of students who use the PBL model with a traditional food-based ethnomathematics approach compared to conventional learning. The type of research that will be used is using a quantitative approach, the experimental research design used is Quasi Experimental Design with a Non – Equivalent Control Group Design type. The research was conducted at SD Negeri Duri Kepa 13, involving classes IV-C as an experimental class and IV-B as a control class. The results of the independent sample t-test showed a significance value of 0.000 < 0.05, so there was a significant difference between the average post-test results of the experimental and control classes. This indicates that the treatment given in the experimental class has a significant influence on the post-test results compared to the control class. In addition, based on the results of the N-Gain test, it showed a fairly effective increase in the experimental class, while the control class was ineffective. The researcher can conclude that the Problem Based Learning (PBL) model with a traditional food-based ethnomathematics approach significantly improves students' learning outcomes in pre-test and post-test compared to conventional learning.

Keywords: problem based learning; ethnomathematics; Mathematical Literacy

INTRODUCTION

Mathematics is a subject that is taught at almost all levels of education and is an important basis in the development of students' logical and analytical thinking skills. The purpose of mathematics learning is now not only limited to the ability to calculate or use formulas, but also encourages students to reason and think mathematically in solving everyday problems known as mathematical literacy (Indrawati & Wardono, 2019; Sari 2015). Mathematical literacy allows a person to use and apply mathematics in a variety of contexts (OECD, 2019). However, the mathematical literacy ability of students in Indonesia is still low. Data from the Program for International Student Assessment (PISA) shows that the mathematics score in Indonesia in 2022 was 366, lower than in 2018 which received a score of 379. Observations and interviews with SMPN 14 Padang students by Rismen et.al., (2022) also revealed the low ability of students to solve problems and draw mathematical conclusions realistically.

Low mathematical literacy can be overcome by developing reasoning, critical thinking, and problem-solving skills. One effective solution is the application of the ethnomathematics-based Problem Based Learning (PBL) model. Research by Patmara et.al., (2019) shows that PBL with ethnomathematical nuances is able to improve students' mathematical problem-solving skills. Similarly, Setiyadi's (2018) research proves that PBL with a traditional game approach is effective in improving these abilities. This learning model is a potential strategy to improve students' mathematical literacy in Indonesia. Royantoro (2018) identified several characteristics of the PBL model, including learning starting with a problem, the problem given is relevant in real life, students are responsible for their learning, learning is carried out in small groups, and learning outcomes are presented in the form of performance. The researcher collaborated the PBL model with ethnomathematics, the culture used to include mathematical concepts that are closely related to students' daily lives. One of the relevant cultural objects is traditional food. The students' daily interaction with food, especially traditional food, allows them to recognize different types of food from 38 provinces in Indonesia.

According to Masrusoh et.al., (2022) the ethnomathematics-based PBL model allows students to discuss mathematical material, analyze and group problems in depth. The results of an interview by Mustika et.al., (2024) at SDN Bugangan 03 show that learning has not integrated local wisdom. Material that is associated with local wisdom can make students more active, understand the material more easily, and be able to apply it in daily life. The ethnomathematics-based PBL model is a solution to integrate local culture in learning, while improving students' understanding of mathematical concepts. The use of ethnomathematics-based media, such as traditional food, helps students understand the material more easily because it is related to daily activities (Martyanti et.al., 2017). Flat building materials for grade IV can be collaborated with traditional foods to create more contextual learning.

METHODS

This study uses a quantitative approach with an experimental method to evaluate the influence of free variables on bound variables. The design chosen is Quasi-Experimental Design, precisely the Non-Equivalent Control Group Design type. In this design, there are two groups, namely the experimental group and the control group. Both groups were given cognitive tests in the form of a Pre-Test before treatment to measure initial ability, and a Post-Test after treatment to evaluate learning outcomes.

Tabel 1. Non – Equivalent Control Group Design

NR_1 O_1 X O_2
NR_2 O_3 O_4

NR_1 = experimental group

NR_2 = control group

O_1 & O_3 = pretest in the experimental and control groups after treatment

O_2 & O_4 = posttest in the experimental and control groups after treatment

X = perlakuan (treatment)

The two groups will be treated in this study, namely the Problem Based Learning (PBL) model through a traditional food-based ethnomathematical approach consisting of grades IV-B and the conventional learning model consisting of students in grades IV-C. After the pre-test and post-test are implemented, the data is analyzed with normality tests, homogeneity tests, mean similarity tests (t-tests), and normalized gain calculation tests (N-Gain) with the help of Windows Software Programs IBM SPSS Version 26.

RESULT AND DISCUSSION

This research was carried out at SD Negeri Duri kepa 13, West Jakarta for 2 weeks. The researcher began with observation to find out the condition of the school, curriculum, and mathematics materials taught in grade IV. Two groups were selected, namely class IV-C as an experimental class with 28 students and class IV-B as a control class with 26 students. Before the study began, the researcher conducted a test instrument test in class V, to determine whether the test questions were valid or not. The result is that All questions have a correlation value of r-count that is greater than the r-table.

Normality Test

Normality tests were carried out on pre-test and post-test data in both experimental and control classes. The researcher used Shapiro Wilk's column as a reference because the amount of data was less than 50, namely 28 students in the experimental class and 26 students in the control class.

Table 2. Pre-Test Data Normality Test

	Shapiro-WIlk		
	Statistic	**df**	**Itself.**
Pre-test control	.962	28	.381
Pre-test experiment	.936	26	.106

The Shapiro-Wilk column shows that the pre-test data in the experimental class has a significance value of 0.381 > 0.005, and the pre-test data in the control class has a significance value of 0.106 > 0.005 based on the significance value in both groups greater than 0.005, it can be concluded that the pre-test data in both classes is normally distributed.

Table 3. Post-Test Data Normality Test

	Shapiro-WIlk		
	Statistic	**df**	**Itself.**
Post-test control	.156	28	.210
Post-test experiment	.132	26	.206

Furthermore, in table 3, it is shown that the post-test data in the experimental class has a significance value of 0.210, and the post-test data in the control class has a significance value of 0.206 based on the significance value in both groups greater than 0.005, the post-test data of the two classes is normally distributed. These results are consistent with pre-test data which is

also normally distributed. Thus, the pre-test and post-test data of both classes meet the normal distribution assumptions.

Homogeneity Test

Homogeneity tests on pre-test and post-test data were carried out to ensure that both groups had balanced initial conditions before being given treatment. The researcher used the IBM SPSS Windows Software Program Version 26 to test the homogeneity of the pre-test and post-test data.

Table 4. Pre-Test Data Homogeneity Test

	Level Statistic	**df 1**	**df 2**	**Itself.**
Based on Mean	.344	1	52	.560
Based on Median	.400	1	52	.530
Based on Median and with adjusted df	.400	1	49.877	.530
Based on trimmed mean	.360	1	52	.551

Based on the results of table 4 of the pre-test data homogeneity test, it was found that the value (Sig.) in the Based on Mean column was 0.560. In accordance with the normality test decision-making criterion that is $0.560 > 0.05$, the data is considered homogeneous, meaning that there is no significant difference in variance between the groups tested.

Table 5. Post-Test Data Homogeneity Test

	Level Statistic	**df 1**	**df 2**	**Itself.**
Based on Mean	.010	1	52	.922
Based on Median	.019	1	52	.892
Based on Median and with adjusted df	.019	1	50.210	.892
Based on trimmed mean	.013	1	52	.911

Seen in the Based on Mean column, there is a significant value of 0.922. In accordance with the normality test decision-making criteria of 0.922 0.05, the data is considered homogeneous, meaning that there is no significant difference in variance between the groups tested. So that the researcher can conclude that both $>$ the pre-test and post-test data in the experimental class and the control class do not have a significant difference in variance between the groups tested.

Pre-Test and Post-Test Difference Test

This T test can find out whether the treatment given, namely the Problem Based Learning (PBL) model through a traditional food-based ethnomathematical approach in the experimental class, has a significant influence on students' mathematical literacy skills compared to conventional learning in the control class.

Table 6. T-test data pre-test

	Level Test for Equality of Variances	**T-test for Equality of Means**			
	Itself.	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Equal Variances assumed	.344	52	.103	3.901	2.352
Equal Variances not assumed		51.573	.104	3.901	2.355

In the Sig. (2-tailed) column, the average difference in the pre-test data was 0.103. According to the decision-making criterion of $0.103 > 0.05$, then Ho was accepted meaning that there was no significant difference between the average of the pre-test in the experimental class and the control class. This shows that both groups had similar initial conditions before treatment.

Table 7. T Test Data Post-Test

	Level Test for Equality of Variances	**T-test for Equality of Means**			
	Itself.	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Equal Variances assumed	.922	52	.000	14.973	2.936
Equal Variances not assumed		51.973	.000	14.973	2.930

Based on table 7 in the Sig. (2-tailed) column, the difference between the two tests is the average in the post-test data, which is 0.000. In accordance with the decision-making criterion of $0.000 < 0.05$, then Ho was rejected, meaning that there was a significant difference between the average post-test in the experimental class and the control class. This indicates that the treatment given in the experimental class has a significant effect on the post-test results compared to the control class.

Uji N-Gain

The results of the N-Gain calculation in the experimental class showed that the data from the pre-test and post-test had a moderate category interpretation, in accordance with the normalized gain criteria. In addition, as shown in the mean column in table 8, the percentage of N-gain from the pre-test and post-test data in the experimental class reached 61.72%. When

viewed in the criteria to determine the level of effectiveness, the results are included in the category of moderately effective, which means that the learning approach applied by the researcher is able to have a significant impact on improvement.

Table 8. Experimental-Grade N-Gain Test

	N	Minimum	Maximum	Mean	Std.Deviation
Ngain_Score	28	.20	1.00	.6172	.19528
Ngain_Persen	28	20.00	100.000	61.7248	19.52829
Valid N (listwise)	28				

Meanwhile, the results of the N-Gain calculation in the control class showed that the data from the pre-test and post-test had a moderate category interpretation, in accordance with the normalized gain criteria. In addition, as shown in the mean column in table 9, the percentage N-gain of the pre-test and post-test data in the control class was 35.86%. When viewed in the criteria to determine the level of effectiveness, the results fall into the category of ineffective. This shows that the use of conventional media in the control class does not provide a significant improvement in students' pre-test and post-test learning outcomes.

Table 9. Control Class N-Gain Test

	N	Minimum	Maximum	Mean	Std.Deviation
Ngain_Score	26	.08	.69	.3587	.15253
Ngain_Persen	26	7.69	69.23	35.8691	15.25290
Valid N (listwise)	26				

The Influence of the PBL Model Through a Traditional Food-Based Ethnomathematics Approach on Students' Mathematical Literacy Abilities

Based on the results of the test and data analysis that have been described above, regarding the experimental class as a class that received treatment from the Problem Based Learning (PBL) model through an ethnomathematical approach, the average gain in the experimental class was 49,285 at the pre-test and 80,357 at the post-test average. In addition, the results of the final test (post-test) in the experimental class showed different average values of 80,357 and 65 in the control class. Of these, there was a significant difference of 15,357 in the results of class tests using the Problem Based Learning (PBL) model through a traditional food-based ethnomathematical approach.

Figure 1. Introduction to Traditional Foods

Figure 2. Guidance on LKPD

Based on the results of the T-test, a significance value (2-tailed) of 0.000 was obtained. In accordance with the decision-making criteria in the statistical test, if the significance value is smaller than the set level of significance then Ho is rejected. In this context, the value is 0.000 < to 0.05 so that the researcher can conclude that there is a significant difference between the average post-test results of students in the experimental class and the control class. In other words, the treatment applied in the experimental class had a significant effect on the post-test results compared to conventional learning in the control class. The T-test results reinforce the findings of the normalized N-gain test results where the experimental class showed a greater improvement than the control class. Thus, the Problem Based Learning (PBL) model through a traditional food-based ethnomathematics approach not only provides an innovative learning experience, but has proven to be effective in significantly improving students' mathematical literacy skills. This research shows that innovations in learning methods can be a solution to improve the quality of mathematics education and help students face the challenges of mathematical literacy in the modern era.

Figure 3. Traditional Food Teaching Media

Figure 4. Discussion on LKPD

CONCLUSION

The Problem Based Learning (PBL) learning model through a traditional food-based ethnomathematics approach to flat building materials to the mathematical literacy skills of grade IV students can develop students' mathematical literacy skills. Based on the results of analysis and data processing conducted by the researcher, an average pre-test score of 49.285 was obtained in the experimental class and 45.384 in the control class. The results of these scores are still below the kriteria ketuntasan minimal (KKM). Furthermore, the average post-test score in the experimental class reached 80.357, while the control class only obtained an average of 65. This shows that the score in the experimental class is higher than the control class that remains below the kriteria ketuntasan minimal (KKM). After that, when performing a T-test to find out the average difference between the results of the post-test of the experimental class and the control class, a significant result of 0.000 was obtained. In accordance with the decision-making criterion of 0.000 < 0.05, Ho was rejected, meaning that there was a significant difference between the average post-test in the experimental class and the control class on the mathematical literacy ability of students. This proves that there is a significant influence on the difference in treatment given in the experimental class and the control class. In addition, there was an increase in the results of students' mathematical literacy ability in the experimental class obtained from the N-Gain test by 61%. When viewed in the criteria to determine the level of effectiveness, the results are included in the category of moderately

effective, which means that the learning approach applied by the researcher is able to have a significant impact on improvement. Based on this statement, the researcher can conclude that the mathematical literacy skills of students who use the Problem Based Learning (PBL) learning model through traditional food-based ethnomathematics approaches are better than students who learn using only conventional learning.

The researchers concluded that most students have achieved indicators of mathematical literacy ability. In the aspect of formulating, students are able to formulate problems into mathematical form well, in the aspect of employing students are able to apply mathematical structures when finding solutions, and in interpreting aspects, students are able to interpret the mathematical results obtained and relate them to real-life situations. These indicators have been integrated into each essay question item in the pre-test and post-test. Thus, the results of the post-test show that there is an increase in students' mathematical literacy skills compared to the beginning of the pre-test questions. This proves that students not only understand math material, but are also able to use and apply the concepts effectively in a variety of contexts, thus showing a significant improvement in their mathematical literacy skills.

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