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Implementation of Problem Based Learning Model in Improving Elementary School Students' Mathematics Learning Outcomes

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ABSTRAK

Pembelajaran Matematika di sekolah dasar ditujukan agar peserta didik dapat menguasai ilmu dasar Matematika beserta konsep-konsep di dalamnya serta terampil untuk mengaplikasikan pada kehidupan nyata. Fakta di lapangan menunjukkan banyak siswa masih memiliki hasil belajar Matematika yang rendah. Penelitian ini bertujuan untuk menganalisis pengaruh model pembelajaran problem based learning terhadap hasil belajar Matematika siswa kelas lima sekolah dasar. Desain penelitian yang digunakan adalah Quasi Experimental Research dengan jenis Non Equivalent Control Group Pre-test Post-test Design. Populasi dalam penelitian ini adalah 144 siswa kelas lima sekolah dasar yang tersebar di sembilan sekolah. Pengambilan sampel dalam penelitian ini menggunakan teknik Cluster Random Sampling dengan 16 siswa sebagai kelompok eksperimen dan 22 siswa sebagai kelompok kontrol. Teknik pengumpulan data hasil belajar Matematika dilakukan menggunakan tes pilihan ganda yang terdiri atas 20 soal. Selanjutnya, data tersebut dianalisis menggunakan uji-t. Diperoleh hasil t_{hitung} = 8,14 dan t_{tabel} = 1,69. Kriteria pengujian menunjukan t_{hitung} (8,24) > t_{tabel} (0,69) maka H_1 diterima dan H_0 ditolak. Hal tersebut mengindikasikan bahwa, terdapat pengaruh yang signifikan model pembelajaran problem based learning terhadap hasil belajar Matematika siswa kelas lima sekolah dasar. Informasi terbaru pada penelitian berimplikasi pada penggunaannya sebagai referensi bagi guru untuk memperbaiki pembelajaran agar hasil belajar Matematika siswa sesuai harapan.

ABSTRACT

Mathematics learning in elementary schools is intended so that students can master basic Mathematics knowledge and concepts in it and are skilled in applying it to real life. Facts in the field show that many students still have low Mathematics learning outcomes. This study aims to analyze the effect of the problem based learning model on the Mathematics learning outcomes of fifth grade elementary school students. The research design used is Quasi Experimental Research with the type of Non Equivalent Control Group Pre-test Post-test Design. The population in this study was 144 fifth grade elementary school students spread across nine schools. Sampling in this study used the Cluster Random Sampling technique with 16 students as the experimental group and 22 students as the control group. The technique of collecting Mathematics learning outcome data was carried out using a multiple-choice test consisting of 20 questions. Furthermore, the data was analyzed using the t-test. The results obtained were t count = 8.14 and t_{table} = 1.69. The test criteria showed t_{count} (8.24) > t_{table} (0.69) so H_1 was accepted and H_0 was rejected. This indicates that there is a significant influence of the problem-based learning model on the Mathematics learning outcomes of fifth-grade elementary school students. The latest information in the study has implications for its use as a reference for teachers to improve learning so that students' Mathematics learning outcomes are as expected.

1. INTRODUCTION

Throughout human life, education will not be separated. Education is a process of changing the attitudes and behavior of a person or group in an effort to mature humans through teaching or training (Sinaga et al., 2022; Basa & Hudaidah, 2021). Education is the most important thing in human life (Dewi & Putra, 2018; Pratama et al., 2018; Wijaya et al., 2018). Education allows a person to live a good life through

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the development of individual skills through various training, so that they can face challenges in the future. Therefore, education is something that is very important and everyone has the right to get it. Education can be obtained anytime and anywhere. Education is an effort to draw something from within a human being as an effort to provide various programmed learning experiences in the form of formal, non-formal and informal education in schools and outside of school, which last a lifetime and aim to optimize individual abilities so that in the future they can live their lives appropriately (Aminah et al., 2022; Triyanto, 2014). A person will get their first education since they were born, namely in the family environment or called informal education. Then, education is continued in the community environment, before finally entering formal education in educational institutions or school environments.

One of the subjects taught in educational institutions is Mathematics. Mathematics is a discipline that studies patterns of relationships, art, language, and systematic thinking patterns that are studied with logic and are deductive, mathematics functions to help humans understand and master social, natural, and economic problems (Gea & Harefa, 2024; Fadilah et al., 2021). Mathematics is a science obtained from reasoning activities and is used to solve problems in everyday life by involving the calculation of a number of numbers. Mathematics is also a source of other sciences such as Gauss' statement in several studies stating that, Mathematics is the queen and servant of science (Nasution et al., 2020; Auliya, 2019). Many other branches of science such as Physics and Chemistry use Mathematical concepts in their development.

Mathematics is one of the most important sciences, so it is a must to be studied at all levels of education including the earliest, namely in elementary school (SD). This is also based on the Competency Standards and Basic Competencies for Elementary Schools/MI which state that Mathematics is a universal science and can be used as a basis for the development of modern technology, and plays an important role in various disciplines and advances human thinking. Mathematics learning in elementary schools is intended so that students can master basic mathematics and the concepts in it and are skilled in applying them to real life. Mathematics learning is a teaching and learning process built by teachers to develop students' creative thinking that can improve students' thinking skills, and can improve the ability to construct new knowledge as an effort to improve good mastery of Mathematics material. The level of students' understanding of Mathematics material in elementary school can be seen from the learning outcomes they achieve.

Facts on the ground show that there are still many elementary school students who have low Mathematics learning outcomes. A number of studies to measure Mathematics competency, especially at the elementary school level, have been widely conducted both domestically and by credible world institutions. The Ministry of Education and Culture through the Indonesia National Assessment Program (INAP) in 2016 showed that around 77.13% of elementary school students throughout Indonesia had very low Mathematics competency, namely 20.58% were sufficient and only 2.29% were in the good category. Based on research, the learning outcomes of Indonesian children in 2014 were lower than in 2000. Using data from the Indonesia Family Life Survey (IFLS) until 2014, there were still many school children who were unable to answer arithmetic questions that they should have mastered at a lower grade level. The results of the 2018 Research on Improvement of System Education (RISE) also showed that students' ability to solve simple Mathematics problems did not differ significantly between new elementary school students and those who had graduated from Senior High School (SMA). Based on data from various survey institutions, it can be concluded that the Mathematics ability of students, especially elementary school students in Indonesia, is very low.

The basic objects of Mathematics, namely facts, concepts, operations, and principles, cause Mathematics to be classified as a subject that is not simple. Students are required to reason and think critically in every problem in it, so it is common knowledge that Mathematics is seen as a difficult subject. Students often consider Mathematics to be a scary subject because it involves numbers with complicated calculations. It is not surprising that many students do not like this subject because it is considered boring and tedious, so they end up avoiding Mathematics. One of the materials in Mathematics that is considered difficult for most students is the material on fractions. Students' perceptions of the difficulty of fraction material can be caused by initial failure to understand the concepts of fractions, which can later hinder understanding of the concept in subsequent learning. Based on several studies in the field of Mathematics, there are many students who experience misconceptions in learning about fractions. UNESCO published a report from a survey of the National Council of Teachers of Mathematics (NCTM) program in 2007 which stated that students in many countries have difficulty in learning fraction material.

Based on the results of observations conducted at SD Gugus VI, Karangasem District on grade V students, it was found that student learning outcomes in Mathematics, especially on the material on fractions, were still relatively low, most of the grade V students at SD Gugus VI, Karangasem District had not completed the material on fractions. A learning activity can be said to have been successful if the number of students who achieved the completion value was at least 75% of the entire class (Bagit et al., 2022; Prakoso

et al., 2021). There are no schools with a completion value that reaches or exceeds 75%, so it can be concluded that the learning activities of grade V students of SD Gugus VI, Karangasem District on the fraction material cannot be declared successful. Learning outcomes cannot be separated from the learning process that has been carried out previously. If the learning process runs well, the results obtained will also be good, including in Mathematics subjects. There are several components in the learning process, one of which is the learning model. Finding ways to update Mathematics learning to make it more interesting and easier for students to understand is a challenge for teachers. They need to determine a learning model that is interesting and motivating for students, so that students can be active in the learning process and connect the material with everyday life (Yustina & Yahfizham, 2023; Chalis & Ariani, 2020).

The results of interviews with the principal and fifth grade teachers at SD Gugus VI, Karangasem District showed that the learning process in Mathematics subjects, especially on fractions, still uses a learning model that focuses only on the teacher. In this case, students are less involved and are passive during the learning process. Students are only used to sitting and listening to explanations from the teacher, so that learning becomes less meaningful for students. Students are less involved in class discussions, both in expressing their ideas or thoughts about something, submitting and sharing opinions, and the lack of activities that involve solving various problems. Problem solving activities are very important for students, especially in Mathematics. This is because Mathematics is closely related to everyday life. In teaching Mathematics, a learning model is needed that is able to guide students to solve a problem that may arise in everyday life by conditioning students to learn actively (Suhada & Ahmad, 2023; Rahmadani & Anugraheni, 2017). Thus, students will realize that Mathematics is an important science and not merely contains calculations or formulas. One of the learning models that can be used by teachers in the process of learning Mathematics, especially in fractional material in grade V is the PBL learning model. The problem-based learning (PBL) model is a learning model that is delivered by presenting a problem, asking various questions, facilitating investigations, and opening discussions or dialogues (Rahmatia, 2020; Ulfah et al., 2015). Problem based learning is a learning model that presents contextual problems or problems that occur in real life so that it can stimulate students in learning. This learning model can help students to be active and independent in developing their abilities in thinking and problem solving through data collection so that authentic solutions are obtained (Azzahra et al., 2023; (Prihono & Khasanah, 2020). The solution to the problem does not absolutely have one correct answer, but students are required to find alternative answers so that they become creative. Through PBL, students are expected to be able to connect learning with various aspects around them (Darmayanti et al., 2022; Jemarus, 2022).

Based on these problems, this study aims to analyze the effect of the problem-based learning model on the learning outcomes of fifth grade elementary school students in Mathematics. Theoretically, the latest information in this study is expected to increase insight into the field of learning in schools, namely the application of the PBL learning model for fifth grade Mathematics subjects, especially in fraction material. In practice, this study is expected to have a positive impact on all parties involved, including students, teachers, principals, and researchers.

2. METHOD

This research is a research with a quantitative approach. Meanwhile, the method used is an experimental method with a Quasi Experimental research design of the Non Equivalent Control Group Pre-test Post-test Design type. This study aims to analyze the effect of student learning outcomes that are taught by applying the Problem Based Learning learning model with students who are not taught by applying the PBL learning model. This study involved two classes, namely the experimental class and the control class. The population of this study was all fifth grade students of SD Negeri Gugus VI, Karangasem in the 2023/2024 academic year, consisting of 10 classes in nine schools. The population in this study was 144 students, with details that can be presented in Table 1.

Table1. The Distribution Of Population Data

No	School	Class	Number of Students
1	Tumbu 1 State Elementary School	V	16
2	Tumbu 2 Public Elementary School	V	22
3	Tumbu 3rd State Elementary School	V	11
4	Public Elementary School 1 Bukit	V	22
5	Public Elementary School 2 Bukit	V	14
6	Public Elementary School 3 Bukit	V	11
7	Public Elementary School 4 Bukit	V	5
8	State Elementary School 9 Subagan	V	13

No	School	Class	Number of Students
9	State Elementary School 3 Karangasem	VA	15
		VB	15
Total Number of Students			**144**

Before determining the research sample, it is necessary to conduct an equivalence test first using One Way Analysis of Variance (ANOVA A) so that randomization can be carried out. The equivalence test is carried out with the aim of determining whether or not there is a difference in the average score of fifth grade students in Mathematics. The testing criteria used at a significance level of 5%, if Fcount>Ftable then H1 can be accepted and H0 is rejected, which means the groups are equivalent. Sampling in this study used the Cluster Random Sampling technique. Based on the lottery that has been carried out, the fifth grade of SD Negeri 1 Tumbu which appeared first was used as the experimental class while the fifth grade of SD Negeri 2 Tumbu which appeared in the second lottery was used as the control class.

In the experimental class, learning was applied, namely the presentation of material on fractions by the teacher by applying the problem-based learning model. In contrast, the control class did not apply the problem-based learning model and was only given the usual treatment, namely by applying the conventional learning model. In the initial study, the control class and the experimental class were given pre-test questions with the aim of seeing the initial abilities of the two groups. Then both classes were given the same material, namely about fractions. In the experimental class, the material on fractions was taught using the problem-based learning model, while in the control class the material on fractions was explained using the conventional learning model. After that, at the end of the research activity, both classes were given post-test questions.

The data collected in this study were evaluation of student learning outcomes. The measurement technique in this study used a measurement tool in the form of a test with an assessment instrument in the form of multiple-choice test questions. Before being used, an instrument needs to be tested for quality by conducting a validity test and a reliability test to determine whether the instrument is suitable for use or otherwise. Instrument testing by experts was carried out before the instrument trial on several students to determine the validity of the test items using product moment correlation, reliability test using Cronbach Alpha, discriminatory power test, and difficulty level test. The results of the instrument trial showed that the 20 test items could be fully used as research instruments. The outline of the test question instrument used in the study can be presented in Table 2.

Table2. The Test Question Instrument Grid

Learning Objectives (TP)	Assessment Indicators	Cognitive Level						Number of Questions
		C1	C2	C3	C4	C5	C6	
Understanding Equivalent Fractions	Given a question, students are able to determine the equivalent fraction of a number.		1,2					2
	Given questions, students are able to analyze solutions to problems related to equivalent fractions in everyday life.				3,4			2
Comparing Fractions	Given a question, students are able to calculate the simplification of fractions.		5,6, 7					3
	Given a question, students are able to compare the sizes of various fractions with different denominators.			8,9, 10				3
	Given a question, students are able to order various fractions.			11, 12				2
Fractions, Decimals, and Whole Numbers	Given a problem, students are able to express intermediate results of dividing whole							

Learning Objectives (TP)	Assessment Indicators	Cognitive Level						Number of Questions
		C1	C2	C3	C4	C5	C6	
	numbers as fractions or decimals.							
	Given a problem, students are able to relate the relationship between fractions, decimals, and whole numbers.		13, 14					2
	Given questions, students are able to compare fractions, decimal numbers, and whole numbers.				15, 16			2
	Given questions, students are able to understand the position of fractions and decimal numbers on the number line.			17, 18				2
	Given a problem, students are able to express intermediate results of dividing whole numbers as fractions or decimals.				19 20			2

The data in this study are grouped into two, namely data on the results of cognitive learning of Mathematics of students in the experimental group at SD Negeri 1 Tumbu and cognitive learning of Mathematics of students in the control group at SD Negeri 2 Tumbu. The data obtained were then tested inferentially to test the formulated hypothesis. Before testing the hypothesis, a number of prerequisite tests were carried out first, namely the normality test and the homogeneity test.

Normality testing is carried out using the Shapiro Wilk formula on pretest and posttest data from the experimental class and control class. In order to see the position of the probability value (p). If the p value> 5%, then it can be said that the data is normally distributed. Meanwhile, if the p value <5%, then the data is not normally distributed. The homogeneity of variance test is carried out using the F test with the test criteria being if Fcount ≤ Ftable then the sample can be said to be homogeneous at a significance level of 5% (α = 0.0) with dfl = k-1 and df2 = nk. Then the hypothesis test is carried out using statistical analysis, namely the t-test. The hypothesis tested is that there is a significant influence between the cognitive learning outcomes of Mathematics of the group of students who are taught using the PBL learning model and the group of students who are not taught using the PBL learning model.

3. RESULT AND DISCUSSION

Result

The data obtained from the results of this study are data on the results of learning Mathematics of fifth grade students in the experimental class and the control class obtained from the results of the pretest and posttest. Before testing the hypothesis, a normality test was first carried out on the data that had been obtained. This was done to determine whether the distribution of student learning outcome data from each group was normally distributed or not, so that data analysis could be determined. The results of the normality test of the data on the results of learning Mathematics of students in the experimental class and the control class can be presented in Table 3.

Table3. The Results of The Normality Test of Research Data

No	Data Group	D	$\sum Xi$	$\bar{X}$	a_1(Xn-i+1-Xi)	T3	Table Values
1	Pre-test Experiment	121.75	142	8,875	10,673	0.936	0.887
2	Post-test Experiment	64	200	12.5	7.569	0.895	0.887
3	Pre-test Control	107.273	172	7,818	9.929	0.919	0.911
4	Post-test Control	56.955	221	10,045	7.234	0.919	0.911

Based on the calculation results using the Shapiro Wilk formula, the Shapiro Wilk calculated value is obtained > table value with a significance of 5%, so the pretest and posttest data in the experimental group or control group are normally distributed. Furthermore, a homogeneity test is carried out. The homogeneity test is carried out with the aim of determining whether the variance of the data population between the two groups has the same or different variance. In this study, the homogeneity test was carried out to show that the differences that occurred in the hypothesis test were not caused by differences in the groups.

Based on the calculation results, it is known that the Fcount of the pretest results of the experimental group and the control group is 1.589 while the Ftable at a significance level of 5% is 2.18. So $F_{count} < F_{table}$, namely 1.589 <2.18. This shows that the variance of the Mathematics learning outcomes data of students in the experimental group and the control group on the pretest questions is homogeneous. While the Fcount of the posttest results of the experimental group and the control group is 1.573 while the Ftable at a significance level of 5% is 2.18. So $F_{count} < F_{table}$, namely 1.573 <2.18. This shows that the variance of the Mathematics learning outcomes data of students in the experimental group and the control group on the posttest questions is homogeneous.

Based on the results of the prerequisite tests, namely the normality test and the homogeneity test, it was obtained that the Mathematics learning outcome data from the experimental group and the control group were normally and homogeneously distributed. Based on this, it can be continued to the hypothesis testing using t-test analysis. The testing criteria used are if $t_{count} > t_{table}$ then H_0 is rejected and H_1 is accepted, which means there is a significant difference. Conversely, if $t_{count} < t_{table}$ then H_0 is accepted and H_1 is rejected, which means there is no significant difference.

Based on the calculation results, it is known that t count = 8.14 and F table = 1.69 for db = 37 at a significance level of 5%. These results indicate that t count (8.14) > t_{table} (1.69), so H_0 is rejected and H_1 is accepted. Thus, it can be concluded that there is a significant difference between the results of learning Mathematics in the cognitive aspect of the group of students who are taught using the PBL model and the group of students who are not taught using the PBL model.

Discussion

Based on the research study, the PBL learning model has an influence on the Mathematics learning outcomes of fifth grade students at SD Negeri Gugus VI, Karangasem District. The results of the data analysis showed that there was a significant difference between the Mathematics learning outcomes of the cognitive aspect of the group of students who were taught using the PBL model and the group of students who were not taught using the PBL model in fifth grade students at SD Negeri Gugus VI, Karangasem District. The significant difference indicates that the PBL model has an effect on students' Mathematics learning outcomes in the cognitive aspect. The experimental group was given treatment in the form of providing learning using the PBL model which was able to provide students with a more enjoyable learning experience (Djonomiarjo & Patilanggio, 2020;)(Regarding the case of the 2020 World War II crisis, the 2020 World War II crisis has been a major cause of the 2020 World War II crisis.)

In contrast to learning activities in conventional models, in the application of the PBL model, learning activities require students to interact with other students in a study group in solving a problem. Therefore, they get a new perspective on activities during the learning process, for example, the encouragement to work together with other students so that students who previously studied individually can be happier because they can learn together with their friends (Safitri et al., 2023; Arta et al., 2020).They will have a sense of responsibility to solve problems so that they are more enthusiastic in finding solutions to existing problems. Students in the experimental group are fully involved in the learning process so that they become active and avoid boredom or saturation while learning (Putri & Fitri, 2022;Ramadhan, 2021).

The PBL learning model is able to accommodate students' needs in practicing critical thinking (Kiranadewi & Hardini, 2021;Zahroh, 2020).It can come from students' efforts in solving problems that arise with the help of learning devices in this learning model. Unlike in the control class, students in the experimental class do not just sit listening to the teacher's explanation of the material, but are actively involved in expressing their ideas or thoughts in every discussion that occurs in class. In addition, students tend to be more courageous in submitting and sharing their opinions so that learning becomes more meaningful (Faoziyah, 2022). Unlike the experimental group, students in the control group learned in a more passive condition. The monotonous learning process occurred due to the lack of interactive learning devices and variations in learning models, so students had difficulty understanding the material.

The PBL learning model can be recommended in an effort to teach students. The PBL learning model is a learning model that discusses various problems that can be found in students' real lives which can later be used as learning resources and intermediaries to train their critical thinking skills through activities to find solutions in problem solving.

The results of this study are in line with several previous research findings which revealed that the use of the PBL model is able to influence student learning outcomes in the Mathematics subject of fraction material in grade V of elementary school (Suhada & Ahmad, 2022; Istikomah, 2021). While the difference between the two lies in the research topic material.Several previous studies have also proven that,Problem-based learning (PBL) models have an effect on increasing student involvement in learning (Ambarwati & Kurniasih, 2021; Riswari & Bintoro, 2020).

Based on the explanation above, it can be concluded that the PBL model has an effect on the Mathematics learning outcomes of fifth grade students at SD Negeri Gugus VI, Karangasem District. Based on the results of the research and discussion that have been described, the implications of this study are logical consequences of the conclusions of the study which include theoretical implications and practical implications. The theoretical implications in this study are that the selection of the right learning model can affect the Mathematics learning outcomes of fifth grade students. This study proves that the PBL model is good to apply to the learning process as an effort to improve students' Mathematics learning outcomes.

The implementation of the PBL model makes students more active in solving problems, increasing students' enthusiasm for learning, discussing, and creating a pleasant learning atmosphere for students. This study provides a significant contribution in increasing understanding of the importance of choosing the right learning model. This can change their perspective on Mathematics, from something scary to a fun lesson. As a result, students will find it easier to understand the concept of the material which has a positive impact on their learning outcomes, especially in fractions in grade V.

As a learning supporter, students can encourage themselves to focus more on the learning process and learn to apply social attitudes to themselves, so that the objectives of the learning process are achieved optimally. In addition, teachers in delivering learning materials in class should be more innovative in choosing learning models by prioritizing student-centered learning, one of which is the problem-based learning model.

The latest information on the study has implications for its use as a reference for teachers to improve learning so that students' Mathematics learning outcomes are as expected. The PBL model can be applied by teachers because it has been proven to have an effect on students' Mathematics learning outcomes. The limitations of this study lie in its focus which is only on grade V of elementary school and only examines students' Mathematics learning outcomes using the PBL learning model. In fact, there are still various other learning models that can be explored to improve student learning outcomes. Further research is suggested to use this study as an additional reference in learning activities, especially in the application of problem-based learning models or similar models with dependent variables.

4. CONCLUSION

Based on the results of hypothesis testing and discussion, it can be concluded that there is a significant influence on Mathematics learning outcomes in groups of students who are taught using the PBL learning model and groups of students who are taught using the conventional learning model in grade V students at SD Negeri Gugus VI, Karangasem District. The latest information in this study can be used as a reference for teachers to improve the learning process so that students' Mathematics learning outcomes can be more optimal.

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