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The Effect of Problem Based Learning Models and Analysis Skills on Mathematics Learning Outcomes in Primary Schools

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Abstract: This research aims to determine the effect of the problem based learning model and analytical skills on elementary school students' mathematics learning outcomes. This type of research is quantitative research using experimental methods with a research design using a 2x2 factorial design. The research was carried out at SDN 3 Lenek Daya. Data collection techniques use tests to determine learning outcomes and students' level of analysis. The results of the research show that 1) there is a difference in the mathematics learning outcomes of students who are taught using the Problem Based Learning (PBL) learning model and the learning outcomes of students who use the Cooperative Think-Pair-Share (TPS) model, indicated by the difference in F_{hitung} values greater than F_{table} by (17,991 > 3.44). 2) there is an interaction effect between the PBL model and analytical skills on students' mathematics learning outcomes, as evidenced by the F_{hitung} value being greater than F_{table} (4.549 > 3.44) with a Sig value < α value (0.029 < 0.05). 3) there are differences in mathematics learning outcomes for students who have a high analysis of learning using PBL and TPS, this is because F_{hitung} is greater than F_{table} (6.472 > 3.44), as well as the sig value < α value (0.030 < 0.05). 4) there are differences in mathematics learning outcomes for students who have low analytical skills who are taught using the PBL and TPS models, because the F_{hitung} value is greater than F_{table} (19,950 > 3.44) while the sig value < α value (0.001 < 0.05).

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Introduction

Education in Indonesia continues to experience development and transformation in order to meet the demands of the times. In meeting the demands of the times, as a teacher you must also be able to keep up with the changes that occur, especially in utilizing current technological advances. Changes in the educational paradigm that require innovation in the implementation of learning in elementary schools are carried out to develop students' critical thinking, creative and problem solving skills. These skills can be obtained from one of the subjects to achieve educational goals, namely Mathematics. According to Trimahesri (2019: 112) that learning Mathematics will achieve success if learning Mathematics leads to developing levels of

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thinking, developing concepts or ideas as a basis for studying and being able to master concepts so that the process really requires analytical thinking skills.

Analytical skills are students' ability to break down complex information into easily understood components. In line with the opinion of Anderson & David (2014) who stated that analytical skills are the ability to break down material into small parts and know the relationship between the parts and the components of the whole. Analytical thinking indicators according to (Fitriani 2021) are generally shortened to M3 (Differentiating, Organizing and Connecting). Gaining this experience cannot be separated from teaching and learning activities to achieve the expected learning outcomes. According to (Nugroho, 2020) the results of learning mathematics are achievement, mastery, changes in behavior and abilities of students after going through learning activities to obtain certain material and experience. The learning outcomes that are the focus in this research are cognitive learning outcomes.

Cognitive learning outcomes are a reference in achieving educational goals. Cognitive learning outcomes are the values obtained by students after experiencing the learning process through learning outcomes tests (Kusnandar, 2019). Students' intellectual abilities greatly determine success in obtaining the learning outcomes that students want. Cognitive learning outcomes can be used as an indicator of success in the teaching and learning process which is obtained from the results of evaluations carried out during or after learning activities and carried out continuously by the teacher (Febriani: 2017). According to Gunawan (2016), the cognitive domain in Bloom's taxonomy levels is: (1) knowledge; (2) understanding (comprehension); (3) application; (4) analysis; (5) synthesis; and (6) evaluation or often called C1, C2, C3, C4, C5 and C6. In the research carried out, the cognitive domains that will be measured are C4 and C5. However, in reality the mathematics learning outcomes obtained by students are still low. Mathematics learning outcomes obtained by class IV students are still low. This can be seen from the many students who still get scores below the Minimum Completeness Criteria.

The low learning outcomes experienced by students are caused by learning that tends not to involve students so that most students do not listen to the teacher's explanation so that this condition can affect the level of students' understanding which has an impact on the results obtained. Apart from that, students also experience difficulty in understanding information in resolving or solving problems in mathematics learning. In an effort to obtain optimal learning outcomes, teachers need to apply learning models that suit student needs. The right learning model can facilitate students in developing critical and analytical thinking skills that are well designed and not only present material theoretically but also involve students actively in the learning process. The Problem Based Learning (PBL) learning model can be an effort to improve mathematics learning outcomes. In line with the opinion of (Sari & Hardini, 2020) that one learning model that can improve students' understanding and learning outcomes in mathematics is the Problem Based Learning model. According to Trianto (2014) Problem-Based Learning (PBL) is a learning model that uses problems as the first step in collecting and integrating new knowledge based on students' experiences in solving these problems.

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The Problem Based Learning (PBL) learning model makes problems the focus of learning with the aim of training students to have analytical skills. With this model, students can find their own way or way to solve the problem given. The PBL learning model is very effective in improving student learning outcomes. This is because learning activities carried out based on the PBL model syntax orient students to problems which will hone students' abilities in reading and understanding problems and being able to solve them (Mainake, 2021). Problem Based Learning is carried out starting from the teacher giving a problem related to the real world, students then actively identify the problem with their knowledge, relate the material to the problem, and ultimately make conclusions and solutions to the problem that has been given.

Therefore, this research aims to determine the influence of the application of the Problem Based Learning (PBL) learning model and analytical skills on elementary school students' Mathematics learning outcomes.

Research Methods

This research was conducted on class IV students at SD Negeri 3 Lenek Daya, Lenek District, East Lombok Regency. The research was conducted from September to October 2024. This type of research is quantitative research using experimental methods with a research design using a 2x2 factorial design. This design is where two independent variables are manipulated simultaneously to investigate their effect on the dependent variable. The sampling technique used in this research is a non-probability sampling technique with saturated sampling. Saturated sampling is a sample determination technique that is carried out when the entire population is sampled. This was done because the population was relatively small or less than 30 people (Sutikno et al, 2020). In this study, considering the population was 34 people, the entire population was used as the research sample. Therefore, the sample used in this research was all class IV students at SDN 3 Lenek Daya with a total of 34 students consisting of class IV-A totaling 17 students who were used as the experimental class and class IV-B totaling 17 students who were used as the experimental class. control.

Data collection techniques are methods or methods used by researchers to collect information or data needed in a study. With appropriate data collection techniques, researchers can obtain accurate and relevant data to achieve research objectives. The data collection technique used in this research is tests. The test in this study was used to determine the level of analytical skills and student learning outcomes. The test used to determine the level of students' analytical skills is in the form of questions in the form of descriptions containing indicators of analytical skills with 10 questions. Meanwhile, to find out students' learning outcomes, they use a test in the form of multiple choice questions with 20 questions. The analysis test is given before the pretest and posttest. The pretest was given before giving treatment to the experimental class and control class. Meanwhile, the posttest was carried out after giving treatment to the experimental class and control class.

Before giving the test to respondents, the researcher carried out a validation test on the test instrument to be used. The validity of test questions is used to ensure that the test questions really measure the competency or skill you want to assess. Researchers conducted trials to get an idea of the feasibility of each question item. The trial was carried out on class V students at SDN 3 Lenek Daya. Then the test results were analyzed using the product moment correlation

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formula. Based on the results of the validation test carried out on the knowledge test instrument, there were 13 questions that were declared valid and for the student analysis level test there were 7 questions that were declared valid. Data analysis in this research uses prerequisite tests, namely the normality test and homogeneity test. The technique used to test this research hypothesis is the t-test.

Results and Discussion

The data in this study includes student learning outcomes which were measured through tests before and after treatment. The research subjects involved two classes of students consisting of class IV A as the experimental class which was taught using the Problem-Based Learning (PBL) learning model and class IV B as the control class which was taught using the Think Piar Share (TPS) learning model. The aim of this research is to determine the influence caused by the two learning models and the level of student analysis on mathematics learning outcomes. The data collected was then analyzed using statistical tests to determine whether there were differences between the two groups as well as interactions between the learning model and the level of analysis on student learning outcomes.

The ANOVA test is used to determine whether there are differences between the experimental and control groups, as well as to determine whether or not there is an interaction between the two independent variables. The results of this hypothesis test will then be used to draw conclusions regarding the influence of each variable on student learning outcomes. The following results of the anova test are presented in table 1.

Table 1 Results of 2x2 Anova calculations

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3570.006[a]	3	1190.002	26.805	<.001
Intercept	132704.343	1	132704.343	2989.215	<.001
Kelas	798.683	1	798.683	17.991	<.001
Tingkat Analisis	2524.986	1	2524.986	56.876	<.001
Kelas*Tingkat Analisis	246.336	1	246.336	4.549	0.029
Error	887.888	20	44.394		
Total	137162.237	24			
Corrected Total	4457.894	23			

Based on the results of data analysis using ANOVA, it shows that there are differences in the mathematics learning outcomes of students who are taught using the Problem Based Learning (PBL) learning model and the learning outcomes of students who use the Cooperative Think-Pair-Share (TPS) model. Based on table 1, it is found that F_{hitung} = 17,991 and F_{table}, it is known that df1 = 2 and df 2 = 22 is 3.44 compared to the F_{hitung} value which is greater than the F_{table} value (17,991 > 3.44). Thus, the Sig value > α value (0.05 > 0.001). This means that there are differences between the mathematics learning outcomes of students who are taught using

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the PBL model and the TPS model. The mathematics learning outcomes of students who use PBL are higher than students who use TPS. The Problem Based Learning (PBL) model can improve students' way of thinking in solving problems. Because through presenting problems students are required to solve problems with their abilities. This means that this model gives students the freedom to explore and discover new knowledge. The impact of the PBL model on students is very significant. This model helps students improve problem solving abilities. In accordance with the opinion expressed by Susanti et al., (2021), that PBL requires students to think and solve problems while the teacher continues to act as a guide and facilitator in the learning process. So it can be concluded that there is an influence of the Problem Based Learning model on improving learning outcomes. These results are in line with the opinion of Lestari (2018) who said that problem-based learning is considered to be able to improve learning outcomes because this model helps students organize their own knowledge, thereby creating meaningful learning.

Furthermore, the results of the analysis also show the influence of the interaction between the use of the Problem Based Learning (PBL) learning model and analytical skills on students' mathematics learning outcomes. Based on table 2, it is found that $F_{hitung} = 4.549$ and F_{table} shows that df1 = 2 and df 2 = 22 is 3.44. when compared, the F_{hitung} value is greater than the F_{table} value (4.549 > 3.44) and the Sig value > α value (0.05 > 0.029). This means that there is an interaction effect between the PBL learning model and the level of analysis on student learning outcomes. The interaction between the Problem Based Learning (PBL) learning model and the level of analysis also shows that there is an interaction. This interaction reveals that the influence of the Problem Based Learning (PBL) model on learning outcomes is stronger for students with a high level of analysis than for students with a low level of analysis. Students with a high level of analysis are better able to exploit the potential of problem-based learning because they have better analytical skills to solve problems and explore various solutions. However, students with a low level of analysis also showed an increase in learning outcomes after being given learning using the Problem Based Learning (PBL) model, although this increase was not as big as students with a high level of analysis. This indicates that although the Problem Based Learning (PBL) model is more effective on students with better analytical skills, students with low analytical skills can also benefit from applying this method. Judging from the average results of the Pretest and Posttest, it shows an increase in learning outcomes.

Then, to find out the differences in mathematics learning outcomes for students who have high analytical skills who were taught using the PBL learning model and using the TPS learning model, an ANOVA test was carried out with the results in table 2.

Table 2 ANOVA Calculation Results A_1B_1 dan A_2B_1

	Sum of Squer	df	Mean Square	F	Sig.
Between Groups	177.639	1	177.639	6.427	0.030
Within Grops	267.379	10	627.638		
Total	454.018	11			

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Based on table 2 above, it is obtained that F_{hitung} = 6.427 and F_{table} shows that df1 = 2 and df 2= 22 is 3.44. when compared, the F_{hitung} value is greater than the F_{table} value (6.427 > 3.44) and the Sig value > α value (0.05 > 0.030). This means that there are differences in mathematics learning outcomes for students who have high analytical skills who are taught using the PBL learning model and using the TPS learning model. Students with a high level of analysis tend to get better learning outcomes compared to students who have a low level of analysis. This indicates that students' analytical abilities are an important factor in the learning process, especially in understanding complex material and solving problems independently. A high level of analysis helps students connect concepts, analyze information in more depth, and apply knowledge effectively. These results are in line with the opinion of Eka (2021) that students need to have analytical thinking skills, because by using analytical thinking skills students will be able to solve the problems presented by the teacher.

Meanwhile, the results of the analysis test of differences in mathematics learning outcomes for students who have low analytical skills who are taught using the PBL learning model and using the TPS learning model can be seen in table 3.

Table 3 ANOVA Calculation Results A_1B_2 dan A_2B_2

	Sum of Squer	Df	Mean Square	F	Sig.
Between Groups	966.069	1	966.069	19.950	0.001
Within Grops	493.134	10	49.313		
Total	1459.203	11			

Based on table 3 above, it is obtained that F_{hitung} = 80,860 and F_{table} shows that df1 = 2 and df 2= 22 is 3.44. when compared, the F_{hitung} value is greater than the F_{table} value (19,950 > 3.44) and the Sig value > α value (0.05 > 0.001). This means that there are differences in mathematics learning outcomes for students who have low analytical skills who are taught using the PBL learning model and using the TPS learning model.

Students with a high level of analysis are better able to exploit the potential of problem-based learning because they have better analytical skills to solve problems and explore various solutions. However, students with a low level of analysis also showed an increase in learning outcomes after being given learning using the Problem Based Learning (PBL) model, although this increase was not as big as students with a high level of analysis. This indicates that although the Problem Based Learning (PBL) model is more effective on students with better analytical skills, students with low analytical skills can also benefit from applying this method. Judging from the average results of the Pretest and Posttest, it shows an increase in learning outcomes.

These findings provide important implications for educators, especially in terms of selecting learning models that suit student characteristics. For students with a high level of analysis, the Problem Based Learning (PBL) model can be optimized to further challenge their analytical skills and deepen their understanding of the material. Meanwhile, for students with a low level of analysis, teachers need to provide additional direction or guidance so that they can adapt to the PBL learning method and improve their analytical skills.

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Conclusion

Based on research entitled " The Effect of Problem Based Learning Models and Analysis Skills on Mathematics Learning Outcomes in Primary Schools " it can be concluded that the application of the problem-based learning model (Problem Based Learning) has an influence on improving students' mathematics learning outcomes. Students who learn using this model show a deeper understanding of concepts, higher involvement in the learning process, and better problem solving abilities. This model not only encourages students to be more active and critical in solving problems, but also develops analytical skills that are important in understanding mathematical concepts. Students' analytical skills are also proven to have an impact on mathematics learning outcomes. These analytical skills are key in the mathematics learning process which requires the ability to think critically and logically. The research results show that students with good analytical skills obtain good learning outcomes. The Problem Based Learning (PBL) model has proven to be an effective learning model, especially when combined with the development of students' analytical skills. Thus, it is hoped that the results of this research can make a significant contribution to the development of learning models that are more effective and relevant to the needs of students in the 21st century.

Recommendation

Based on the results of this research, there are several recommendations including:

1. This research suggests that problem-based learning models and the development of analytical skills be applied more often in elementary schools to improve students' mathematics learning outcomes, considering the positive results obtained in this research.
2. It is necessary to develop more varied learning methods to adapt to students' different analytical abilities, so that each student can be more facilitated in the learning process.
3. It is recommended that teachers use learning models that suit students' learning needs in learning.
4. Further research is recommended to try applying the problem-based learning model and analytical skills to other subjects at the elementary school level to test whether this model is also effective in improving learning outcomes in fields of study other than mathematics.

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