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THE EFFECT OF THE PROBLEM BASED LEARNING MODEL ON UNDERSTANDING OF FRACT ADDITION

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ABSTRACT

BACKGROUND

This research is motivated by the low understanding of students regarding the topic of fraction addition, as evidenced by the number of students who have not met the Minimum Mastery Criteria.

PURPOSE

This study aims to determine the effect of the Problem-Based Learning (PBL) model on the understanding of fraction addition among fourth-grade students at UPTD SDN Mandung 3, Kokop Subdistrict.

RESEARCH METHODOLOGY

The research method used is quantitative with a pre-experimental design of the one-group pretest-posttest type. The instrument used was a 20-item multiple-choice test that had been tested for validity and reliability. Data analysis was performed using the Paired Sample T-Test with the assistance of SPSS software.

RESULT

The results indicate that there was an increase in the average score from the pretest to the posttest after the application of the PBL learning model. Based on hypothesis testing, a significance value of 0.000 < 0.05 was obtained, meaning that the alternative hypothesis (Ha) is accepted and the null hypothesis (H0) is rejected.

CONCLUSION

It can be concluded that the Problem-Based Learning model has a significant effect on the understanding of fraction addition among fourth-grade students. The PBL model has been proven to enhance student engagement and provide a deeper understanding of fraction concepts.

KEYWORDS

Problem-Based Learning, Understanding, Fraction Addition

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INTRODUCTION

Education is a deliberate and planned effort to influence others or individuals in order to help improve students' achievements and benefit themselves and those around them (Anugraheni, 2018). Education also plays an important role in improving the quality of education, especially in producing high-quality students (Rahman et al., 2022). Based on this description, it can be concluded that education is a systematic process designed to educate, guide, and develop individual abilities. Therefore, education plays a vital role in human life. Learning is a positive interaction between students and their surroundings, leading to improved behavior compared to before (Gunawan et al., 2017). A teacher has the task and role of managing the learning environment to support significant changes through the students' learning process (Ardianti et al., 2022). Learning can be understood as a conscious effort by an educator to provide knowledge, theory, and information to students so that they can learn according to their abilities, capacities, and needs (Kistian, 2019). Learning is an activity aimed at integrating the curriculum of an educational institution in such a way that learning objectives can be achieved in accordance with its specifications (Konferensi et al., 2023).

One of the subjects that students in grade IV learn is mathematics, specifically the topic of fraction addition. According to research at UPTD SDN Mandung 3, Kokop District, fourth-grade students face difficulties in learning the material of fraction addition and have low understanding of the topic, especially those requiring high abstraction. Fraction addition is one of the essential competencies that must be mastered by fourth-grade students (Handayani & Koeswanti, 2021). However, based on field findings, this material is often considered difficult to understand because it involves several stages of abstraction, such as finding common denominators and solving fraction addition problems (Novianti et al., 2020). Many students experience difficulty in understanding these procedures, which results in low academic performance.

Based on the results of daily evaluations (Learning Outcomes), it was found that 23 out of 33 fourth-grade students scored below the Minimum Mastery Criteria (KKM), while 10 students scored at the KKM level. The KKM score for this class is 70. From the total of 33 students, the majority of students did not meet the KKM, indicating that their learning outcomes were below the expected standard. This is attributed to several factors, including an immature understanding of the concepts, a lack of practice in real-life contexts, and teaching methods that do not encourage active student participation. To address these issues, I am employing the Problem-Based Learning (PBL) model as a solution (Pertiwi et al., 2023). The Problem-Based Learning (PBL) model is an innovative teaching approach that emphasizes active student involvement in solving problems (Nurlaelah & Sakkir, 2020). PBL is a model based on real-life problems that are relevant to students' daily lives, making them more motivated to actively participate in learning (Permatasari et al., 2019). PBL improves students' motivation and understanding, as the teacher acts as a facilitator to help students find solutions to the problems presented, rather than just conveying information (Qomariyah et al., 2019).

Based on the explanation above, the researcher intends to conduct a study titled: "The Effect of the Problem-Based Learning (PBL) Model on Students' Understanding of Fraction Addition in Fourth Grade at UPTD SDN Mandung 3, Kokop Subdistrict." This research aims to explore how the PBL model, which involves real-world problems relevant to students' lives, can enhance engagement and improve comprehension of fraction addition. By encouraging active participation

and facilitating problem-solving, the PBL approach is expected to overcome challenges in understanding abstract concepts, thereby improving students' academic performance and fostering a deeper grasp of mathematical principles.

RESEARCH METHODOLOGY

This study uses an experimental approach with a Pre-Experimental Design of the One Group Pretest-Posttest type, aimed at measuring students' understanding of fraction addition using the Problem-Based Learning (PBL) model. This pre-experimental design is not fully controlled because there are no control variables and the sample was not randomly selected, which means that external variables could influence the experiment's results. The study was conducted at UPTD SDN Mandung 3, Kokop District, with 33 Grade IV students as the sample, consisting of 15 female and 18 male students. The instrument used was an objective multiple-choice test with 20 items, whose validity and reliability were tested using IBM SPSS Statistics 21. This test measured students' understanding before and after the PBL method was applied, with the goal of observing significant differences between the pretest and posttest results.

Data analysis was performed using normality tests with the Kolmogorov-Smirnov test and hypothesis testing with the Paired Sample T-test. The normality test ensured that the data followed a normal distribution, while the hypothesis test was used to determine if there was a significant effect of the PBL model on students' understanding of fraction addition. The hypothesis test results indicated that if the significance value (2-tailed) was less than 0.05, there was a significant effect between the initial (pretest) and final (posttest) variables. This study aims to identify the effectiveness of the Problem-Based Learning model in improving students' mathematical understanding, particularly in the topic of fraction addition.

RESULT AND DISCUSSION

Validity Test

The validity test is used to assess the accuracy of a measurement tool in measuring the data obtained. The data from the instrument trial test, conducted with 22 respondents, were analyzed using IBM SPSS Statistics 21 for Windows. Based on the validity test of the 20 multiple-choice items, all of these items were considered valid because the calculated r-value (r-hitung) was higher than the table r-value (r-tabel). Therefore, the researcher used all 20 items to be tested on the students in the sample for the study.

Table 1. Results of the Validity Test of the Items

Item	R Table	R Calculate	Description
1	0.432	0.566	Valid
2	0.432	0.469	Valid
3	0.432	0.476	Valid
4	0.432	0.521	Valid
5	0.432	0.543	Valid
6	0.432	0.512	Valid
7	0.432	0.637	Valid
8	0.432	0.468	Valid

9	0.432	0.457	Valid
10	0.432	0.525	Valid
11	0.432	0.540	Valid
12	0.432	0.478	Valid
13	0.432	0.585	Valid
14	0.432	0.439	Valid
15	0.432	0.488	Valid
16	0.432	0.454	Valid
17	0.432	0.476	Valid
18	0.432	0.486	Valid
19	0.432	0.594	Valid
20	0.432	0.682	Valid

Reliability Test

The reliability test involves processing or analyzing the data from the instrument trial conducted with the test sample using IBM SPSS Statistics 21 for Windows. The instrument trial, consisting of 20 questions tested on 22 respondents, was analyzed as follows:

Table 2. Reliability Test

Cronbach's Alpha	N of Items
.739	20

Based on the reliability test in the table above, the Cronbach's Alpha value is 0.739. This indicates that the students' understanding has a reliable level, as the reliability test criterion is met where the alpha value (r alpha) is greater than the table value (r table). Specifically, 0.739 > 0.432. The calculation results from the test items and data processing using IBM SPSS Statistics 21 for Windows show whether an instrument is normally distributed, which is called the normality test. The significance level used is 0.05. If the significance obtained is greater than 0.05, the sample is assumed to come from a normally distributed population. However, if the significance is less than 0.05, the sample is assumed not to come from a normally distributed population.

Table 3. Normality Test

One-Sample Kolmogorov-Smirnov Test	
	Unstandardized Residual
N	33
Normal Parameters[a,b]	Mean
	Std. Deviation
Most Extreme Differences	Absolute
	Positive
	Negative
Kolmogorov-Smirnov Z	.594
Asymp. Sig. (2-tailed)	.872

Based on the table above, the significance value of the influence of the Problem-Based Learning (PBL) model on the understanding of fraction addition by 4th-grade students at UPTD SDN Mandung 3, Kokop District, is obtained (Asymp. Sig = 0.872), which is greater than the table value (0.05). Therefore, the data from this variable are normally distributed.

Hypothesis Testing

The purpose of this hypothesis test is to determine whether there is an effect of the Problem-Based Learning model on the understanding of fraction addition by 4th-grade students at UPTD SDN Mandung 3, Kokop District. The hypothesis test used in this study is the Paired Sample T-test, which is employed to assess the effect of the PBL model on students' understanding of fraction addition. The criteria for hypothesis testing in this study are as follows: If the significance value (2-tailed) < 0.05, it indicates a significant effect between the initial and final variables. In this case, H0 is rejected and Ha is accepted. If the significance value (2-tailed) > 0.05, it indicates no significant effect between the initial and final variables. In this case, H0 is accepted and Ha is rejected. The hypothesis outlined in this study is that the Problem-Based Learning model has an effect on the understanding of fraction addition by 4th-grade students at UPTD SDN Mandung 3, Kokop District. The analysis results can be seen in the following table:

Table 4. Hypothesis Test (Paired Sample T Test)

Paired Samples Test									
Paired Differences				t	df	Sig. (2-tailed)			
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference					
				Lower	Upper				
Pair 1	Understanding of fraction addition - Understanding of fraction addition	-17.576	9.852	1.715	-21.069	-14.082	-10.248	32	.000

Based on the table above, the Paired Sample T-test shows a significance value (2-tailed) < 0.05, or in other words, 0.000 < 0.05. Therefore, H0 is rejected and Ha is accepted, indicating that there is an effect of the Problem-Based Learning (PBL) model on the understanding of fraction addition among 4th-grade students at UPTD SDN Mandung 3, Kokop District. In the research conducted, the researcher selected 33 4th-grade students at UPTD SDN Mandung 3, consisting of 18 male students and 15 female students, as the research sample. The study used two measurements: a pretest and a posttest. The pretest was administered before the intervention, and the posttest was given after the intervention using the PBL model. The study focused on the subject of mathematics, specifically on fraction addition, with a test consisting of 20 multiple-choice questions administered to the 4th-grade students at UPTD SDN Mandung 3, Kokop District. After administering the test, the results showed that the PBL model significantly influenced students' understanding of fraction addition in mathematics. This was confirmed through the Paired Sample T-test, where the significance value was 0.000 < 0.05, leading to the rejection of H0 and acceptance of Ha. This suggests that the PBL model positively impacted students' understanding, as the significance value (2-tailed) was smaller than 0.05. This study provides insight into how the PBL model can be used as a reference for teachers to improve students' understanding, thus preventing boredom in learning and allowing students to respond more freely to lessons.

The Problem-Based Learning (PBL) model has been shown to be effective in enhancing students' understanding of fraction addition. A study in Demak District indicated that the implementation of PBL positively affected mathematics learning outcomes, with a t-test value of 2.199 > 2.000 and an N-gain percentage of 61.73, indicating a relatively high level of effectiveness

(Masriah et al., 2023). Furthermore, the application of Polya's problem-solving steps within PBL also significantly improved learning outcomes related to fraction addition. Observations and assessments demonstrated significant improvements in both teaching and student learning outcomes (Ningsih et al., 2019). A meta-analysis covering a 30-year period found that PBL has a greater effect on students' cognitive and affective learning outcomes compared to other methods, with an average effect size of g = 0.726 (Koçoğlu & Kanadlı, 2025). In addition, PBL contributed to improvements in student behavior, including increased discipline, cooperation, confidence, and enthusiasm (Sukmanasa et al., 2019).

The Problem-Based Learning (PBL) model has been proven effective in enhancing critical thinking skills, which are essential for the development of student competencies across various educational levels. Several studies have shown that PBL improves critical thinking processes from elementary to tertiary education (Bonafide et al., 2021). Moreover, PBL contributes to better academic achievement, with numerous studies indicating that students engaged in PBL environments achieve higher grades compared to those learning through traditional methods (Muerza et al., 2024). In this context, the application of PBL can enhance learning outcomes in various subjects such as genetics, biochemistry, and geography (Hincapié Parra et al., 2018).

PBL not only focuses on academic achievement but also fosters the development of crucial skills such as problem-solving, teamwork, communication, and self-regulated learning (Wynn, 2022). These skills are highly relevant for future professional success and are often inadequately developed through traditional teaching methods (Wilder, 2015). Additionally, PBL has been shown to increase student motivation and engagement, largely due to the real-world relevance of the problems they address and the collaborative nature of the learning process (Maksum et al., 2025). However, the implementation of PBL also presents challenges, particularly in terms of the additional burden on instructors, who require significant preparation and facilitation skills (Gonzalez, 2019).

CONCLUSION

Based on the data analysis and discussion, it can be concluded that the Problem-Based Learning (PBL) model has a significant impact on the understanding of fraction addition among 4th-grade students at UPTD SDN Mandung 3, Kokop District. This impact is supported by the results of the Paired Sample T-test, where the obtained significance value (2-tailed) is 0.000, which is smaller than 0.05. This indicates that the PBL model has a positive effect on enhancing students' understanding of fraction addition. The results of the Paired Sample T-test show a significant difference between the pretest and posttest scores after the PBL model was applied. Therefore, it can be concluded that the implementation of the PBL model successfully improved students' understanding of fraction addition, demonstrating the effectiveness of problem-based learning in helping students comprehend more complex mathematical concepts. This study also highlights the importance of using more interactive and applied methods, such as PBL, to improve the quality of learning in elementary schools, especially in mathematics. The PBL model encourages students to be more active in learning, think critically, and engage directly in problem-solving, which ultimately leads to improved learning outcomes.

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AUTHORS' CONTRIBUTION

Author 1 : Conceptualization forms research ideas, the researcher designs studies, methodology defines approaches, data curation organizes data.

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