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The Effect of Problem-Based Learning (PBL) Model Assisted by Musical Board Media on the Ability to Solve Story Problems in Fifth Grade Elementary School Students

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Abstract. This study aims to test the effectiveness of the Problem Based Learning (PBL) model assisted by the media of the musi board in improving students' ability to solve mathematical story problems, especially in the material of the Smallest Common Multiple (KPK) and the Largest Common Factor (FPB) in elementary schools. This study used a quasi-experimental design with two groups, namely the experimental group that applied the PBL model assisted by the musi board and the control group that used conventional learning. Data was collected through a post-test in the form of essay questions, which were then analyzed with a descriptive statistical test and an independent t-test to test the difference in learning outcomes between the two groups. The results showed that students who participated in learning with the PBL model assisted by the musi board showed a significant improvement in their ability to solve math story problems compared to students who participated in conventional learning. Musi board media helps students visualize abstract mathematical concepts, which in turn makes it easier for students to understand. The implication of these findings is the importance of applying the PBL model with relevant media in mathematics learning to improve student learning outcomes. Problem-based learning that supports students' active engagement can be an effective alternative to improving math comprehension and skills at the elementary school level.

Keywords: PBL; Musi Board; Media; Story Problem; Solving Skills.

1. INTRODUCTION

A person's life and future are greatly influenced by their education. Teaching mathematics is one of the core components of education since it serves as the foundation for the growth of students' logical and analytical abilities. Students in elementary school need to have a solid grasp of mathematical concepts such LCM (Least Common Multiple) and GCF (Greatest Common Factor (Lim-Teo, 2002). However a lot of students find it difficult to comprehend this content, particularly when they are presented with word problems that call on them to use mathematical ideas in practical situations (Aurpa et al., 2024). Low student involvement in the learning process, which frequently focuses on the teacher and fails to adequately include learning experiences applicable to everyday life, is the cause of this (Bharathi et al., 2024; Lerum et al., 2021).

The main problem encountered in mathematics learning is the low ability of students to solve word problems, especially those related to abstract mathematical concepts such as LCM and GCF. Conventional learning models,

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such as lectures, are often ineffective in overcoming this problem (Sutiah & Supriyono, 2024). Additionally, the lack of utilization of media that can visualize mathematical concepts concretely is one of the factors hindering students' understanding of the material (Wilkie & Hopkins, 2024). Previous research has shown that learning that does not actively involve students, especially in applying mathematical concepts in real-life situations, can reduce students' interest and motivation to learn (Rezai et al., 2025).

As a solution to overcome these problems, the application of a media-assisted Problem Based Learning (PBL) model, such as a music board, can be an effective choice. The PBL model prioritizes problem-based learning that directs students to think critically and apply the concepts they have learned in real-life situations (J.-W. Huang & Liao, 2024). The use of music boards as a learning medium also helps students visualize abstract mathematical concepts, making them easier to understand (J. Huang et al., 2024). By integrating media such as music boards into the PBL model, it is hoped that students will become more actively engaged in the learning process and improve their ability to solve mathematical word problems (Likhanov et al., 2024).

There are still unanswered questions despite the fact that the PBL paradigm has been used to mathematics education in a number of studies. This is particularly true when it comes to the use of more concrete and contextual learning tools like musical boards. Prior research, such that done by Haque & Sharif, (2021), has concentrated more on the use of PBL without delving further into educational materials that can help students grasp abstract mathematical ideas. Yang & Lin, (2024), emphasized the PBL model's ability to boost student engagement, they did not discuss how straightforward and visual learning materials might help elementary school students learn mathematics. Schoenherr et al., (2024),emphasizes the value of innovative media in tackling difficulties in mathematics education, but it doesn't assess the effect of visual media like music boards on enhancing problem-solving abilities. In order to close this gap, this study will investigate how music boards might be used to teach mathematics, specifically for LCM and GCF themes, and assess how they affect students' ability to solve mathematical word problems.

The use of musical boards, which have not been extensively employed in elementary school mathematics research, is innovative in this work. As visual aids, musical boards can help students grasp challenging mathematical ideas and give abstract ideas a more tangible, approachable feel (Çakıroğlu & Yıldırım, 2024). The utilization of the PBL paradigm, which links the content to students' real-world experiences in addition to addressing theoretical problems, is another distinctive feature (Li et al., 2024). This is consistent with research showing that the PBL paradigm can improve students' critical thinking abilities and conceptual knowledge (Dias-Oliveira et al., 2024).

This study sought to ascertain if using the Problem Based Learning (PBL)

approach with the aid of musical board media may enhance fifth-grade elementary school pupils' capacity to solve mathematical story problems. The purpose of this research is to enhance the body of knowledge regarding the use of contextual learning media in primary school mathematics instruction and to aid in the creation of more creative and successful learning models (Sajnani et al., 2020).

2. METHOD

This study employs a quasi-experimental design and a quantitative methodology. Using research tools like post-tests, the quantitative approach measures and analyzes data objectively before statistical analysis. By contrasting two groups the experimental group and the control group this study seeks to determine how the independent variable the problem-based learning model affects the dependent variable, the capacity to solve mathematical story problems.

A pretest was administered to both the experimental and control groups to gauge the students' starting skills as part of the pretest-posttest control group research design. After that, the experimental group received the treatment exclusively, while the control group received traditional instruction. To assess the variations in learning results, the identical post-test was administered to both groups following the conclusion of the treatment. An outline of the research design that was employed is provided below:

Table 1. Research Design

Group	Treatment (X)	Post-test (O)
Experiment (E)	Problem-Based Learning (PBL) Model	Final test (Post-test)
Control (K)	Conventional Learning	Final test (Post-test)

Description:
E: Experimental class
K: Control class
X: Treatment given to the experimental class, namely the use of the Problem-Based Learning (PBL) model
-: Conventional learning without the PBL model treatment
O: Final test (post-test) given to both groups at the end of the study

2.1 Population and Sample

The population in this study was all fifth-grade students at Public Elementary School 1 Sumberkolak and Public Elementary School 2 Sumberkolak, Panarukan Subdistrict, Situbondo Regency, which is an area with similar characteristics in mathematics learning. Based on these characteristics, the sample was selected using purposive sampling, where the fifth-grade class at Public Elementary School 1 Sumberkolak was chosen as the experimental class receiving treatment using

the PBL model, and the fifth-grade class at Public Elementary School 2 Sumberkolak was chosen as the control class receiving conventional instruction. The sample consisted of 14 students in the experimental class and 24 students in the control class.

2.2 Place and Time of Research

This study was conducted at Public Elementary School 1 Sumberkolak and Public Elementary School 2 Sumberkolak, Panarukan Subdistrict, Situbondo Regency. The study was conducted in the 2024/2025 academic year, second semester.

2.3 Research Instruments

Seven essay-style post-test questions that have undergone validity and reliability testing were used to gather the data for this investigation. To make sure the tool could accurately assess students' proficiency in solving mathematical story problems, these questions were examined. Microsoft Excel and SPSS 30.0 were used for reliability testing to determine the questions' reliability coefficient.

2.4 Data Collection Techniques

A post-test that was given to both groups following the treatment was used to collect data. The purpose of this post-test was to gauge how much students' proficiency in solving mathematical narrative problems had improved following their involvement in the applied learning paradigm.

2.5 Data Analysis Techniques

To characterize the students' learning outcomes generally, the post-test data were subjected to descriptive statistical analysis. Additionally, before doing the hypothesis test, the data was checked to make sure it satisfied the required assumptions using the normality and homogeneity tests. To ascertain whether the two groups had the same variance, the homogeneity test was conducted using the F-test, and the normality test was conducted using the Liliefors test. An independent sample t-test was employed at a significance level of 0.05 to examine the variation in the mean post-test scores between the experimental and control groups (Sugiyono, 2019).

3. RESULTS

Based on the results of the study, data was obtained on the final scores or post-test scores of students regarding their ability to solve mathematical story problems using the Problem-Based Learning (PBL) model in fifth-grade students at Public Elementary School 1 Sumberkolak. The following are the post-test scores from the experimental class:

Table 1. Descriptive Statistics of the Experimental Class

Statistics	Value
N	11
Valid	11
Missing	0
Mean	82.462
Median	83.00
Mode	61
Std. Deviation	14.280
Variance	203.905
Range	39
Minimum	61
Maximum	100
Sum	884

From this data, the lowest score obtained by students was 61, and the highest score was 100, with an overall average score of 82.462 and a standard deviation of 14.280. Furthermore, for students in Public Elementary School 2 Sumberkolak (control class), post-test scores using the cooperative learning model were obtained. The following is a description of the post-test scores from the control class:

Table 2. Descriptive Statistics of the Control Class

Statistics	Value
N	25
Valid	25
Missing	0
Mean	62.60
Median	66.00
Mode	73
Std. Deviation	14.43
Variance	208.238
Range	40
Minimum	40
Maximum	80
Sum	1565

From the descriptive statistics for the control class, the lowest score obtained by students was 40, and the highest score was 80, with an overall average score of 62.60 and a standard deviation of 14.43.

3.1 Normality Test

The results of the normality test using the Liliefors test on the experimental class and control class show that both groups have a normal data distribution. The results of the normality test can be seen in Table 3:

Table 3. Normality Test Results

Variable	N	Lcalculated	Ltable	Description
Experimental	14	0.136	0.227	Normally distributed
Control	24	0.089	0.180	Normally distributed

3.2 Homogeneity Test

The results of the homogeneity test using the F-test (Two-Sample for Variances) show that the variance between the experimental class and the control class is homogeneous. The results can be seen in Table 4:

Table 4. Homogeneity Test - F-Test Two-Sample for Variances

Variable	Experimental	Control
Mean	82.462	62.913
Variance	176.936	149.265
Observations	13	23
Df	12	22
F	1.185	
P(F<=f) one-tail	0.351	
F Critical one-tail	2.226	

With a P value of 0.351, which is greater than 0.05, it can be concluded that the data has homogeneous variance between the experimental group and the control group.

3.3 Hypothesis Testing

Hypothesis testing was performed using an independent t-test to test the difference in means between the experimental class and the control class. Based on the t-test results, a p-value (2-tailed) of 0.000 was obtained, which is less than 0.05. Therefore, the alternative hypothesis (Ha) was accepted, indicating a significant effect of the Problem Based Learning (PBL) model on students' ability to solve math story problems.

Table 5. Results of the t-Test Hypothesis Test for the Experimental Class and Control Class

Variable	Experimental	Control
Mean	82.462	62.913
Variance	176.936	149.265
Observations	13	23
Df	34	
t Stat	4.467	
P(T<=t) two-tail	0.000	
t Critical two-tail	2.032	

Based on the t-test results, it can be concluded that the Problem Based Learning (PBL) model has a significant effect on the ability to solve mathematical story problems in fifth grade students at Public Elementary School 1 Sumberkolak. This can be seen from the difference in the average post-test scores between the experimental class (82.46) and the control class (62.91).

4. DISCUSSION

This study shows that the application of the Problem-Based Learning (PBL) model assisted by a musical board can improve students' ability to solve mathematical story problems, particularly in the areas of Least Common Multiple (LCM) and Greatest Common Factor (GCF). These findings are consistent with the research conducted by (Klein et al., 2025), which showed that PBL not only optimizes conceptual understanding but also enhances students' critical thinking skills in solving mathematical problems. Problem-based learning allows students to engage more deeply with the material, helping them apply mathematical theories in real-life contexts (Berthet & Villalba, 2017).

Learning is also made more successful by the usage of music boards as visual aids. According to (Y.-T. Liu & Tseng, 2024), using the right visual aids can help students better understand abstract ideas by assisting them in creating distinct mental images of them. In the Cognitive Theory of Multimedia studying (Wang et al., 2024) highlights the value of using media that aids students in developing comprehension through visuals and illustrations. This is especially pertinent when studying mathematical concepts like LCM and GCF. The music board is a tool used in this study that helps students visualize complex mathematical ideas, which facilitates understanding and memory.

Despite the effectiveness of the PBL methodology and music boards, this study also discovered that some students still struggle to apply these ideas to story problems. According to Gill et al., (2024), students' comprehension may be hampered by an excessive cognitive load when attempting to solve complicated problems, particularly when they must relate abstract ideas to actual circumstances. This supports ("Abstracts of the XXIII rd World Congress of Psychiatric Genetics (WCPG): Poster abstracts," 2017) Cognitive Load Theory, which holds that learning can be hampered by disorganized or overwhelming information, especially in challenging topics like mathematics.

Students who engaged in PBL with the help of music boards performed better than those who engaged in traditional instruction. According to Jin et al. (2018), the PBL paradigm offers benefits for raising student involvement since it enables them to gain firsthand experience in resolving actual issues. This is consistent with the findings of (Bulut Ates & Aktamis, 2024), who discovered that PBL and other active learning techniques can improve students' critical thinking and problem-solving skills. Students can work independently or in groups using the PBL model with the use of a music board, which increases their engagement with

the material.

The study's conclusions also highlight how crucial teamwork is to learning. Clark & Davis Kenaley, (2011), contend that when students work together to solve PBL-based challenges, they can exchange ideas and improve their comprehension of the subject matter. According to Hadiyati & Jaya (2021), group projects in active learning also help students become more receptive to new ideas, which speeds up their comprehension of more difficult subjects. According to (Oo et al., 2024), problem-based learning collaboration helps students acquire critical social skills including cooperation and communication.

This study's conclusion suggests that using the Problem-Based Learning (PBL) paradigm in conjunction with musical boards can be a successful method of teaching arithmetic in elementary schools. According to C.-Y. Liu & Wu, (2025), problem-based learning can assist students in comprehending complex ideas in a more contextualized manner. In order to enhance students' comprehension of mathematics, the PBL model with visual media support ought to be implemented more extensively in elementary schools. Additionally, Kurniawati et al. (2021) stress the value of teacher preparation in utilizing cutting-edge learning models to boost student engagement and enhance their educational experiences.

5. CONCLUSION

This study demonstrates that using a musical board in conjunction with the Problem-Based Learning (PBL) approach can greatly enhance students' proficiency in solving mathematical word problems, especially those involving the Least Common Multiple (LCM) and Greatest Common Factor (GCF). These results are consistent with learning theories that stress problem-based learning and the use of pertinent visual aids to improve comprehension of abstract ideas. Students can interact more actively with the content and relate mathematical ideas to real-world scenarios thanks to the PBL approach, which emphasizes problem-solving in the actual world. This helps them grasp the topic more thoroughly. Students' comprehension of GCD and LCM concepts improved when they were able to picture difficult mathematical ideas with the aid of a music board, which was an effective visual aid. Some students, however, continued to have difficulty applying these ideas to word problems, suggesting that personal characteristics like cognitive capacity and learning preferences also affect learning results. Therefore, to account for variations in student ability, a more varied strategy is required. Overall, this study finds that the PBL model with the help of a music board can be a useful learning tool for raising primary school pupils' mathematical proficiency. Thus, it is necessary to support the adoption of this learning paradigm in elementary schools and provide teachers with training so they can make the most of it. Problem-based learning and relevant media are key to fostering students' critical thinking, creativity, and real-world application of knowledge.

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