

Problem Based Learning Innovation Using Analog Clock Learning Media To Improve Student Learning Outcomes on Time Concept Materials in Elementary School

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Abstract

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The purpose of this study is to find out how effective the problem-based learning model (PBL) that uses analog clock media in improving student learning outcomes in time concept materials in elementary and elementary schools. This study uses an experimental method with a pre-test-post-test control group design. The experimental group that used PBL with analog clock media and the experimental group that used PBL without analog clock media consisted of two classes. The results showed that the experimental group obtained an average posttest score of 85.7, then the control group obtained a score of 74.3. As per the t-test, there was a significant difference between the two groups ($p < 0.05$). In addition, the student attendance rate in the experimental class reached 85%, while in the control class only obtained 65%. The feedback of the students was very positive, 90% of them enjoyed and benefited from the use of PBL and analog clock media, in addition to their understanding of the concept of time also improved. This study shows that the combination of PBL and concrete visual media significantly improves students' learning achievement, motivation, and interest. Therefore, it is highly recommended to teach mathematical concepts, especially those that must be visualized, in elementary school.

Keywords: *Problem Based Learning, analog clock media, learning outcomes, time concept, elementary school*

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INTRODUCTION

The development of education in Indonesia has undergone various significant changes throughout its history. Since Indonesia's independence in 1945, education has been one of the important aspects in efforts to build the nation and create a quality generation [1]. Education is a conscious effort to realize a cultural heritage from one generation to another. Education makes this generation a role model for the teaching of previous generations [2]. The development of education in Indonesia has undergone various significant changes throughout its history. Since Indonesia's independence in 1945, education has become one of the important aspects in efforts to build the nation and create a quality generation. The background of the educational journey in Indonesia includes various historical, social, economic, and political aspects that have shaped the current education system [2]. Education as an open system cannot be separated from problems, both micro and macro problems. Micro problems, which are problems that arise in the components contained in education itself as a system. Macro problems, which are problems that arise in education as a system with other systems that are broader in all human life [3].

Talking about mathematics is not appropriate if it is separated from the development of science and technology that exists today. This is mainly due to the position of mathematics as a "basic science" that supports the development of science and technology and develops along with it. Mathematics is not just a collection of formulas and calculations, but it also involves understanding concepts, logic thinking, and problem-

solving skills that are essential for students' intellectual development. However, in reality, mathematics learning in elementary school is often faced with various problems that affect students' understanding and interest in this subject. The application of Indonesian Realistic Mathematics Education (PMRI) learning adopted from Realistic Mathematics Education (RME) learning can develop students' understanding and ability to understand mathematical representations from formal reasoning. PMRI is a learning approach that starts from "real" things for students, emphasizes the "process of doing mathematics", discussing, collaborating, arguing with classmates to find out for themselves and ultimately using mathematics to solve problems both individually and in groups [4].

Problem solving is the use of methods in learning activities by training students to face various problems, both personal or individual problems and group problems to be solved alone or together. Problem-solving skills are skills that a person learns that can solve problems in a variety of ways to seek information to draw conclusions [5]. A learning model is a framework of activities that can provide a systematic overview of learning and help students and educators to achieve the goals of a desired learning. The problem-based learning model is a learning model that presents contextual problems so as to stimulate students to learn. Problem-based learning requires students to work in teams to solve real-world problems [6]. Problem-based learning (PBL) intends to provide students with free thinking space to seek concepts and solve problems related to the material taught by teachers in school [7].

The magnitude of the role of mathematics in life is not balanced by students' interest in learning mathematics. Many people state that students' interest in learning mathematics is still low [8]. Mathematics learning in schools still exists that tends to be centered on teachers and students are less active in finding concepts. In accordance with the development of the current era of rapid globalization, the integration of Information and Communication of Technology (ICT) in mathematics learning is considered appropriate to overcome students' dissatisfaction with mathematics learning [9]. In the learning process, the presence of media is very necessary, because it has a big role that affects the achievement of learning goals. This is because learning is not always only in contact with real things, both in concept and fact [10]. Learning by Using media in the teaching and learning process has two important roles, namely: (1) Media as a teaching aid or referred to as dependent media because of its position here as a tool (effectiveness), and (2) Media as a learning resource that is used by students themselves independently or called dependent media [11].

The reluctance to use the media is currently widely felt by teachers for complicated and troublesome reasons [12]. The importance of mathematics should be a consideration for teachers and schools to design the best learning so that students can understand the concept of material that is part of the mathematics subject itself [13].

At the primary education level, understanding the concept of time, including the use of clocks, is an important aspect of mathematics learning [14]. The use of analog clock media in mathematics education helps students understand the concept of time measurement which is closely related to problem solving in daily life [15]. The use of learning media such as teaching aids will bring students closer to their daily experience of mathematically realistic concepts [16]. Through the use of time board media, it is felt that it can help during learning mathematics with material on how to read the clock, this is in line with the purpose of this media being developed Because this clock media is made with a shape and use that resembles a wall clock by having a needle as a medium to show time, it's just that the difference is the machine in the wall clock [17]. Innovation in mathematics learning in low grades is needed due to low student learning outcomes and the need for additional media in learning [18].

Although the Problem Based Learning (PBL) learning model has been widely applied in mathematics learning to improve students' critical thinking skills, its implementation at the elementary school level—especially in time concept materials—is still rare. In addition, concrete media such as analog clocks that can help visualize and understand the concept of time have also not been optimally utilized in the learning process. Conventional learning, which is still dominant, is teacher-centered, causing low student engagement and motivation to learn. Therefore, an approach is needed that integrates the PBL model and the use of concrete media as a bridge for students' abstract understanding of the material of time.

The novelty of this study is in the form of the integration of the Problem Based Learning model with the use of analog clock media as an active visualization tool in the mathematics learning process at the elementary school level. In addition to testing the effectiveness of media as a visualization tool, this study also observed the impact on students' active engagement and learning motivation on learning the concept of time—an area that has not been extensively explored empirically at the primary education level.

Based on the above, there is a significant difference between the learning outcomes of students who use the PBL learning model with analog clock media compared to students who follow conventional learning on time concept materials in elementary school. In addition, the application of the PBL model with analog clock media increases students' active involvement in the learning process compared to conventional learning. And students give a more positive response to PBL-based learning with analog clock media compared to conventional learning.

METHODOLOGY

Method1 of psychological research is broadly divided into three, (1) quantitative method, (2) qualitative method, and (3) quantitative mixed method with qualitative (mixed methods) [19]. The type of research is Quasi Experimental Research or pseudo-experimental research. This study was conducted by comparing experimental classes using the Problem Based Learning (PBL) learning model [20].

This study uses a quasi-experimental method with a pretest-posttest control group design. The study was conducted to measure the effectiveness of the application of the Problem Based Learning (PBL) learning model with analog clock media in improving student learning outcomes in time concept materials. The study population was the entire student of a specific class in the relevant elementary school, while the sample was taken by purposive sampling, involving two classes.

The population in this study is all grade II students in one of the elementary schools who are determined purposively. The research sample consisted of two classes that had similar characteristics. The sample was determined using purposive sampling by considering the homogeneity of the initial ability based on the pretest results. One class was designated as an experimental group using PBL-based learning with analog clock media, and another class as a control group that followed conventional learning methods.

The inclusion criteria for sample selection are students who have never used analog clock media in learning the concept of time and have homogeneous initial learning outcomes based on pretests. The exclusion criteria are students who do not take the pretest and/or posttest. Students who have significant learning barriers based on homeroom teacher information and school psychological records

The research procedure is carried out in three stages, namely preparation, implementation, and analysis. The preparation stage includes the preparation of PBL-based learning tools, the creation of analog clock media, and the preparation of research instruments such as learning outcome test questions, observation sheets, and student response questionnaires. All instruments are tested for validity and reliability before use.

At the implementation stage, the research began with giving a pretest to both groups to measure students' initial ability. Furthermore, the experimental group was given learning with the PBL model and analog clock media, while the control group followed conventional learning. After the learning was completed, both groups were given a posttest to measure learning outcomes.

This study used several instruments to collect data, as summarized in the following table:

Table 1. Data Analysis Techniques

Instruments	Types of Data Collected	Purpose	Format/Skala
Learning Outcome Tests	Quantitative data in the form of pretest and posttest scores	Measuring the improvement of student learning outcomes in time concept materials	Multiple choices/descriptions
Observation Sheet	Qualitative data on student activity during learning	Observe student involvement in discussions, problem-solving, and interaction with the media	Scale Likert/Descriptif
Student Response Questionnaire	Quantitative and qualitative data on student experience	Assess students' responses to the use of analog clock media and PBL models	Likert scale

The data obtained was analyzed using steps (1) Normality Test to ensure the distribution of normal learning outcome data. (2) Homogeneity Test to check the uniformity of variance between the experimental and control groups. (3) The t-test (Independent Samples t-Test) is to compare student learning outcomes between the experimental and control groups. This research was carried out in elementary schools that have been determined for one semester, covering the stages of preparation, implementation, and data analysis.

Results and Discussion

The results of this study were obtained from pretest and posttest data, student engagement observation sheets, and student response questionnaires. Here are the key findings from the study:

Table 2. Characteristics of Research Sample Data

Group	Number of Students	Average Age (years)	Gender (L/P)	Pretest of the War-War
Experiment (PBL + Analog Jam)	25	7,8	13 / 12	55,2
Control (Conventional)	25	7,9	14 / 11	56,0

Remarks: Preliminary data show that both groups have balanced characteristics in terms of age, gender, and pretest initial scores.

Table 3 Normality Test

Group	Sig. Kolmogorov-Smirnov	Distribution
Eksperimen	0,123	Usual
Control	0,146	Usual

Table 4 Homogeneity Test

Uji Levene	Sig.	Conclusion
Varians	0,081	Homogen ($p > 0,05$)

Based on the data in tables 3 and 4, the learning outcome data in both groups met the assumptions of normality and homogeneity, so that the analysis could be continued with a t-test.

Student Learning Outcomes Analysis

Pretest and posttest data were analyzed using a t-test to determine the difference in learning outcomes between the experimental and control groups.

Table 5. Average Pretest and Posttest Scores:

Group	Pretest (Rata-rata)	Posttest (Rata-rata)	Difference
Experimental Group	55,2	85,7	30,5
Control Group	56,0	74,3	18,3

The results of the t-test analysis showed that there was a significant difference ($p < 0.05$) between the learning outcomes of the experimental and control groups. This indicates that the PBL model with analog clock media is more effective than conventional learning methods.

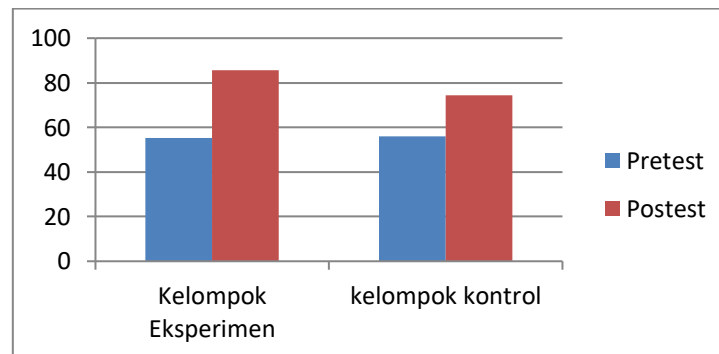
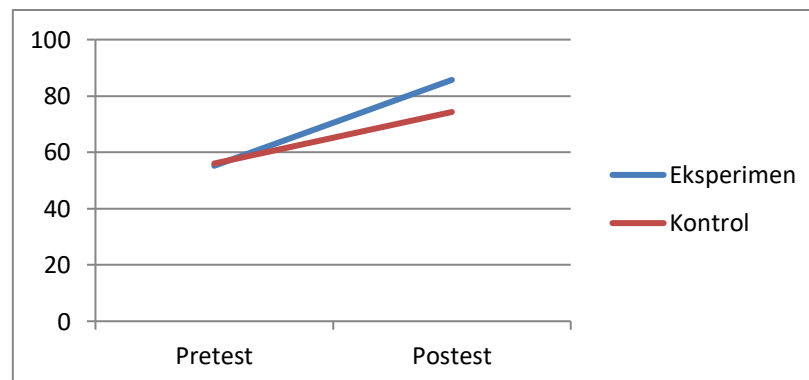


Diagram 1 Comparison of Pretest and posttest



Graph 1. Comparison of Learning Outcomes Improvement

Table 6 Learning Outcomes t-Tests

Group	t-count	Df	Sig. (2-tailed)	Information
Experiment vs. Control	4,72	48	0,000	There is a significant difference

The observation sheets showed that students in the experimental group were more actively involved in learning. They engage in group discussions, show enthusiasm in using analog clocks to solve problems, and contribute to completing tasks. The student activity percentage of the experimental group reached 85%, higher than the control group which only reached 65%.

Questionnaires given to students in the experimental group showed that 90% of students found learning using PBL with analog clock media fun and helped them understand the concept of time better. As many as 85% of students stated that they are more motivated to learn with this method compared to conventional learning.

The results of the study show that the application of the PBL model with analog clock media is effective in improving students' understanding of the concept of time. This is in line with previous research by Hidayat (2017), which showed that PBL can improve students' critical thinking skills. Analog clock media also helps to concretize the concept of time, so that students can understand the material more easily.

The active involvement of students in the experimental group proves that the PBL approach is able to encourage students to be more active in learning. The combination of real problem-solving and the use of concrete media such as analog clocks makes students more interested and engaged in learning.

The positive response of students to analog clock media shows that this media is effective as a learning tool. Visualization of time through analog clocks helps students understand abstract material such as the concept of time more concretely and funly.

This research shows that the integration of the PBL model with concrete media can be an effective solution to improve the quality of learning in elementary schools, especially in materials that require visualization such as the concept of time. This provides recommendations to teachers to adopt a similar approach to other materials.

CONCLUSION

The success of the research that has been conducted concludes that the use of the Problem Based Learning (PBL) learning model with the help of analog clock media has proven to be effective in improving student learning outcomes of time concept material at the elementary school level. The results of the data analysis showed that the experimental group using the PBL approach through analog clock media had a higher increase in learning outcomes compared to the control group using conventional methods. The average posttest score of the experimental group was 85.7, and the control group was only 74.3, indicating that there was a significant difference of 11.4 points.

In addition to improving learning outcomes, active student involvement in the learning process is also increased. Observations showed that students in the

experimental group were more active in discussing, using learning media, and completing tasks collaboratively. The level of student involvement in the experimental group reached 85%, while in the control group it was only 65%. This shows that the PBL approach can create a more interactive and participatory learning atmosphere.

The students' response to the use of analog clock media in learning was excellent. 90% of students stated that the medium made it easier for them to understand the concept of abstract time and reduced the learning process to more enjoyment. Students' motivation to learn has also increased significantly. Based on this, the PBL model side by side with concrete media such as analog clocks can be recommended to be more widely implemented in elementary schools, especially in subjects that require the process of visualization and absorption of abstract concepts. Concrete media applications interspersed with active learning strategies are not only able to expand the understanding of concepts, but also create positive student trust in the learning process.

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