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Problem-Based Learning Using Media Quizizz to Enhance Critical Thinking SD N 1 Kembaran Kulon Academic Year 2024/2025

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ABSTRACT

The purpose of this study is to investigate the impact of problem-based learning using quiz media on the critical thinking skills of SD Negeri 1 Kembaran Kulon students in the 2024/2025 academic year. This is an experimental study that uses a pretest-posttest control group design. The cluster random sampling technique was used. The cluster random sampling technique was used. This study included all fourth-grade pupils at SD N 1 Kembaran Kulon, using samples from class IV a (experimental class) and class IV b (control class). The instrument utilized was a science process skills test consisting of multiple-choice reasoned questions that were initially validated for validity, reliability, discrimination power, and question difficulty level. The pretest homogeneity test revealed that the experimental and control classes had similar baseline abilities, implying that the treatment's effect was determined by the posttest. The analysis equipment test revealed that the posttest data were normally distributed and homogeneous, so the parametric t-test pooled variance statistic with two-tailed t-test criteria was used, with the t count of 5.38 and the t table of 1.99 at a 5% significance level. If - ttable < tcount > + ttable, Ho is rejected while Ha is approved. As a result, it is possible to conclude that problem-based learning through quiz media has an impact on the critical thinking abilities of SD Negeri 1 Kembaran Kulon during the 2024/2025 academic year.

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1. INTRODUCTION

Law Number 20 of 2003 concerning the National Education System, Article 3 states that national education aims to develop the potential of students to become human beings who believe in and fear God Almighty, have noble morals, are healthy, knowledgeable, capable, creative, independent, and become democratic and responsible citizens. In this objective, three aspects that should be present in learning activities are reflected, namely aspects of knowledge, skills, and attitudes. The development of an independent curriculum in the national education system seeks that aspects of knowledge, skills, and attitudes reflected in the national education objectives can be implemented in every learning process. Mathematics provides tools and frameworks for critical thinking in measuring, analyzing, and predicting natural phenomena so that mathematics is not only the mastery of a collection of knowledge in the form of facts, concepts, or principles but also a process of discovery (Bahtiar et al., 2020).

Fractions are an important part of mathematics that express a value as part of a whole. Fractions are expressed in the form a/b, where a is the numerator and b is the denominator. Fractions can be improper fractions, mixed fractions, decimal fractions, or percents. Therefore, in learning mathematics, learning activities are not only emphasized on the product aspect, but must also be balanced with the process aspect. Fractions are used for various arithmetic operations, such as addition, subtraction, multiplication, and division (Ritawati et al., 2024). In critical thinking learning there are special skills that must be possessed as a form of critical thinking as a process, which is called critical thinking process skills. Critical thinking process skills are scientific skills that are carried out in the process of finding critical thinking products, including mathematics. These skills include the skills of observing, making hypotheses, planning research, controlling variables, interpreting data, drawing temporary conclusions, predicting, applying, and communicating (Anzelina et al., 2024).

These skills can be cultivated, trained, and even developed through experimental activities at school. Based on the description above, critical thinking process skills are a requirement in the mathematics learning process in the independent curriculum, and are the essence of mathematics as a process, so that in mathematics learning, these process skills must also be integrated with mathematical products. However, the reality in the field is that mathematics learning still does not integrate process skills in its learning process. As a result, students are not trained in applying scientific skills in the learning process, especially in experimental activities. From this, it can be seen that mathematics learning has not integrated one of the essences of mathematics itself, namely mathematics as a process in the form of critical thinking process skills. Based on the results of observations conducted covering aspects of attitude, knowledge, and skills have been implemented in the learning process.

However, in the aspect of skills, teachers have not yet conducted specific training and assessment of critical thinking process skills. The development of students' critical thinking process skills has not yet been systematically arranged and in the learning process teachers have not focused on learning critical thinking process skills. This can be seen in experimental activities, teachers have not focused on aspects of students' critical thinking process skills. In observations conducted by researchers at SD N 1 Kembaran Kulon, teachers are still fixated on the use of the scientific approach recommended by the government to be used in the independent curriculum. From the results of observations, the scientific approach used by teachers has not been developed to train students' critical thinking process skills. Teachers are still more focused on how students are able to understand the material. This makes learning more inclined towards the end result (product) rather than the process. One of the learning activities that is considered suitable for developing critical thinking process skills is problem-solving activities.

In problem-solving activities, students are given a problem and then have to find the answer to the problem through a scientific process. Problem-based learning allows students to develop critical thinking process skills through the scientific process they carry out. These skills include observation, measurement, classification, prediction, and communication (Kelas et al., 2023). Through PBL, students learn to guide themselves in understanding and solving problems, so that their critical thinking process skills are further honed. According to (Syarifah et al., 2020) problems can encourage seriousness of inquiry and thinking in a meaningful way. Problem based learning is a suitable model to encourage students' curiosity and train students in solving problems to develop their inquiry skills.

In accordance with the problems formulated above, the purpose of this study is to determine the effect of problem-based learning through experimental methods on the critical thinking process skills of students in mathematics at SD N 1 Kembaran Kulon in the 2024/2025 academic year. The results of this study are expected to be useful for the development of learning activities in mathematics subjects to train critical thinking process skills in mathematics and can be useful for teachers, students, schools and researchers who want to take the same study to improve students' critical thinking process skills in mathematics.

2. RESEARCH METHODS

This type of research is experimental research, which is a research method used to find the effect of certain treatments on others under controlled conditions (Zyra et al., 2022). This research was conducted from September 2024 to April 2025, located at SD N 1 Kembaran Kulon. In this study, there are three variables that are the focus of the research, namely the independent variable, the control variable, and the dependent variable.

The independent variable in this study is problem-based learning through experimental methods, the dependent variable is students' critical thinking skills in mathematics, and the control variables are materials, learning objectives, instruments, time allocation and assessment methods.

The research design uses a pretest-posttest control group design that aims to obtain differences in students' critical thinking skills in mathematics between the experimental and control classes, so that in the end they will get the influence of the learning model used. In a diagram, this research design is depicted in **Table 1**:

Tabel 1. Research Design *Pretest-Posttest Control Group Design*

Group	*Pretest*	Treatment	*Posttest*
Experiment	O_1	X	O_2
Control	O_1	-	O_2

(Adapted from: Sugiyono, 2014)

Information :

O_1 = Administration of pretest to experimental and control groups

O_2 = Posttest administration to experimental and control groups

X = Treatment in the form of using problem-based learning with experimental methods in the experimental class

\- = Conventional learning in the control class

The sampling technique used is cluster random sampling. Through cluster random sampling, two classes were selected randomly. Then, from the two classes, they were randomized again to select the experimental class and the control class. The sample results obtained were class IV a with 16 people as the experimental group and class IV b students with 16 people as the control group. The research activity procedure is carried out in three stages, namely:

1. Preparation Stage

In the preparation stage, the researcher prepared everything needed during the research, including: (1) Conducting observations at school related to teaching and learning activities at SD N 1 Kembaran Kulon; (2) Determining the research sample; (3) Determining the main material to be taught with problem-based learning through the experimental method; (4) Creating research instruments, in the form of ATP, Teaching Modules, Instruments (5) Validating the instruments with expert validation; (6) Testing the instruments to test the validity and reliability of the instruments, as well as analyzing the test items; (7) Analyzing the results of the instrument trials.

2. Hold Execution

At the research implementation stage, the researcher will apply the learning model that will be tested. This stage is also the stage for the researcher in collecting research data. The steps taken during the research implementation are: (1) Providing a pretest to both sample groups; (2) Providing treatment to the experimental class in the form of problem-based learning through experimental methods and the control class in the form of conventional learning at school; (3) Providing a posttest to both sample groups.

3. Final Stage

At this final stage, research data analysis is carried out, research data is concluded, and research results reports are prepared. The data collection technique was carried out using a test method using a critical thinking process skills test in mathematics. The critical thinking process skills data in mathematics were pretest data before treatment was given and posttest data after treatment.

Pretest and posttest data were obtained using an instrument that had been tested on 32 fourth grade students who had received previous fraction material, then the test results were analyzed by testing the validity, reliability, level of difficulty and discrimination of the questions. Based on the results of the trial of 3 questions, 2 good questions were obtained for the pretest and posttest.

The validity analysis of the questions uses the product moment formula and for the reliability test of the questions uses the Spearman-Brown formula, the difficulty index of the questions for the level of difficulty of the questions and the discrimination index for the discrimination power of the questions.

Data analysis uses parametric statistics t-test polled variance with two-party test criteria, which have previously been tested for data normality using the Chi Square test and data homogeneity using the F test. Meanwhile, to determine the increase in students' critical thinking skills in mathematics, the normalized gain (g) test is used.

3. RESULTS AND DISCUSSIONS

The results of the study are in the form of a description of the data on students' critical thinking process skills in mathematics from the pretest and posttest using homogeneity tests, normality tests and hypothesis tests (polled variance t-test with two-party test criteria). The data on the results of the pretest of critical thinking process skills in mathematics in the experimental class and control class on the material of temperature, heat, and heat transfer can be seen in Table 2 below:

Table 2. Recapitulation of Pretest Data in Both Sample Classes

Component	Fraction Learning Outcome Data	
	Experimental Class	Control Class
Number of students	16	16
The Highest Score	64	53
Lowest Value	13	12
Average	31,97	28,51
Standard Deviation (SD)	9,78	9,34
Homogeneity Test	Homogen	

The pretest result data shows that the average value of the initial test of students in both samples is 31.97 for the control class and 28.51 for the experimental class with an average difference of 3.46. Table 2 shows that the experimental class and the control class are homogeneous, which means that both sample classes have the same initial ability of critical thinking process skills. Based on these results, the effect of treatment is carried out by analyzing the posttest data. After the pretest was conducted, the two sample classes were given different treatments, then a posttest was conducted. The posttest data of critical thinking process skills in mathematics in the experimental class and the control class on the material of temperature, heat, and heat transfer can be seen in Table 3 below:

Table 3. Posttest Data Recapitulation for Both Sample Classes

Komponen	Fraction Learning Outcome Data	
	Kelas Eksperimen	Kelas Kontrol
Number of students	16	16
The Highest Score	82	63
Lowest Value	34	26
Average	56,47	43,77
Standard Deviation (SD)	10,56	8,56
Normality Test	Normal	Normal
Homogeneity Test	Homogen	
Hypothesis Test	-ttable < tcount > +ttable, H0 is rejected and Ha is accepted	

In Table 3. above, it can be seen that the average value of the experimental class after the posttest is also higher than the control class, namely the average value of the experimental class is 56.47 and the average value of the control class is 43.77, with a greater average difference than the pretest results, namely 12.70. Based on the posttest results, both the experimental and control classes experienced an increase, which indicates an increase in students' critical thinking skills in mathematics. The experimental class experienced an increase in the average value of 24.5, while the control class experienced an increase of 15.26. The results above show that the increase in the average value experienced by the experimental class was higher than the increase in the average value of the control class. Furthermore, the posttest results were analyzed to determine the effect of problem based learning (PBM) through the experimental method applied in the experimental class on students' critical thinking skills in mathematics.

Based on the results of the posttest data normality and homogeneity tests, it showed that the data was normally distributed and homogeneous, so the effect of PBM through this experimental method was tested using the polled variance t-test formula. After the data was analyzed using the polled variance t-test, the results obtained were $thitung$ = 5.38 and $ttabel$ = 1.99 at 69 degrees of freedom with a significance level of 5%. The results of the calculation with the two-tailed test criteria showed that the t-count value was greater than + ttable and - ttable, namely $-1.99 < 5.38 > +1.99$. Based on the two-tailed test criteria that if -ttable ≤ tcount ≤ +ttable, then H0 is accepted and Ha is rejected, then the test results above indicate the influence of PBM through experimental methods on the critical thinking process skills of mathematics of grade IV students of SD N 1 Kembaran Kulon Purbalingga in the 2024/2025 academic year.

To determine the level of influence of the PBM treatment through the experimental method on students' critical mathematical thinking process skills, the normalized gain (g) test was used, which is a difference between the pretest and posttest results, with the aim of determining the level of significance of the increase in students' critical mathematical thinking process skills after being given treatment. The percentage of increase in students' critical mathematical thinking process skills is grouped into three categories, namely low (g <30%), medium (30%

≤ g <70%), and high (g ≥ 70%). The comparison of the increase in students' critical mathematical thinking process skills per aspect and total is presented in the histogram in Figure 1.

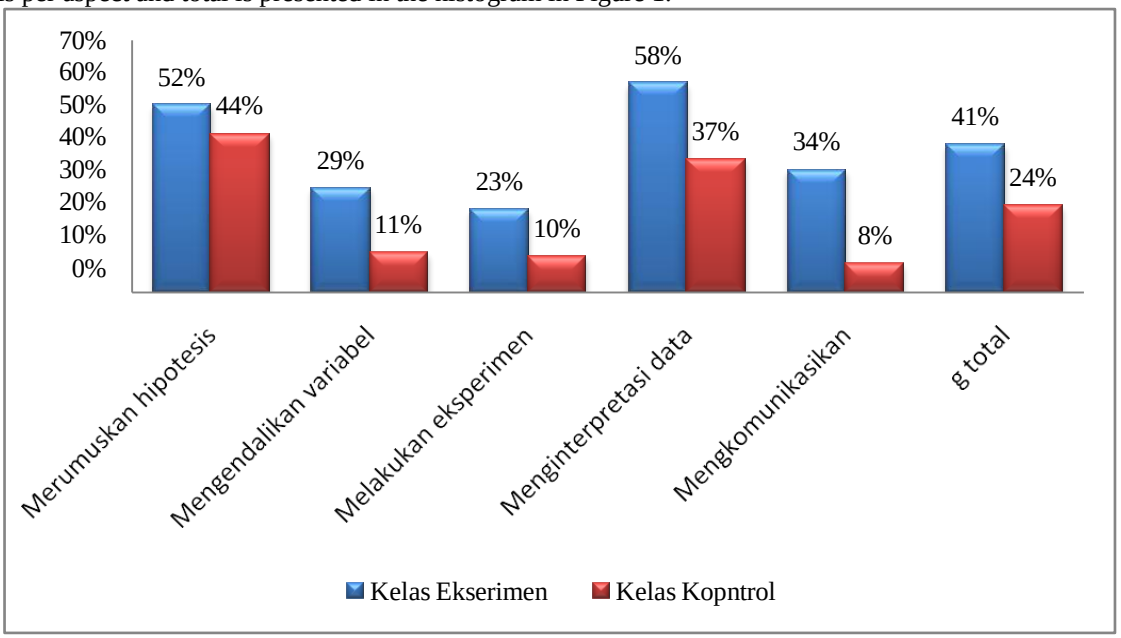

Figure 1. Histogram of Normalized Gain of Students' Critical Thinking Process Skills in Physics

Overall, the experimental class experienced an increase of 41%, which is in the medium category, while the control class experienced an increase of 24% which is in the low category. When viewed per aspect of the critical thinking process skills studied, the experimental class experienced a higher increase per aspect compared to the control class. The pretest and posttest data, as well as the g value, showed that the experimental class experienced a higher increase in critical thinking skills in mathematics than the control class. This increase was due to the influence during learning. During the learning of temperature, heat and heat transfer materials, students carried out 5 practicum meetings. In each practicum carried out, students were required to fill out a problem-based worksheet. The worksheet used required a problem-solving process in problem-based learning that included five aspects of students' critical thinking skills that were being studied and were designed according to the practicum being carried out.

Thus, in carrying out experimental activities, students carried out the problem-solving process in problem-based learning using the critical thinking skills that were being studied. Indirectly, this process trains students' critical thinking skills to be better. The above phenomenon shows that the experimental class that was given treatment in the form of problem-based learning through the experimental method had higher mathematical critical thinking process skills than the control class. This is because problem-based learning with the experimental method provides an opportunity for students to solve a problem through a scientific thinking process that simultaneously trains their critical thinking process skills. According to Rusman (2011), problems can encourage seriousness of inquiry (curiosity). Students' curiosity about a problem is facilitated through the experimental method.

The results of this study also further strengthen the theory that through problem-based learning, students not only understand concepts that are relevant to the problem that is the center of attention, but also gain learning experiences related to the skills of applying scientific methods in problem solving and fostering critical thinking patterns (Ngalimun, 2014). In addition, the use of experimental methods in the problem-solving process in problem-based learning provides an opportunity for students to seek and find various answers to the problems they face by conducting their own experiments through scientific thinking (Rostiyah, 2008). This skill in applying scientific methods is what leads students to train their scientific process skills. The results of this study also strengthen previous studies on the PBM model. Rusnayati and Prima (2015) in their study found that there was an increase in critical thinking process skills through the application of problem-based learning with an inquiry approach.

According to (Safrina & Saminan, 2015), these process skills are trained to students at the stage of writing down the work actions carried out in the syntax of the problem-based learning model. When the process is carried out by students, many process skills are trained to students. These results are also supported by research by Rusmiati and Yulianto in (Nasution et al., 2023) which found that mastery of critical thinking process skills for

each component tends to increase through the application of the problem-based instruction model or often called problem-based learning. According to Rusmiati and Yulianto (2015) this increase shows that critical thinking process skills begin to grow and form along with the habits that are carried out and continuous practice through problem-based instruction learning.

4. CONCLUSIONS

Based on the formulation of the problem, research results, and discussion, it can be concluded that at a significance level of 5%, problem-based learning through the experimental method has a significant effect on the critical thinking process skills of students in mathematics at SD N 1 Kembaran Kulon Purbalingga in the 2024/2025 academic year.

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