

The Influence of Problem-based Differentiated Learning on Critical Thinking Skills in 5th-Grade Students at Muhammadiyah Suronatan Elementary School, Yogyakarta

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ABSTRACT

This research aims to determine the effect of problem-based differentiated learning on the critical thinking skills of 5th-grade students at Muhammadiyah Suronatan Elementary School, a private elementary school in Yogyakarta. The study is quantitative, involving a sample of 28 students from the experimental class and 28 students from the control class. Data was collected using observation sheets and pretest-posttest questions. The data analysis included descriptive analysis and inferential analysis, specifically data normality testing, homogeneity testing, and hypothesis testing. The results indicate a significant relationship between problem-based differentiated learning and critical thinking skills. The t-test results show a sig. (2-tailed) value of 0.00, which is less than 0.05, with an average student graduation rate of 86%. These results suggest that implementing problem-based differentiated learning can be an effective strategy for enhancing critical thinking skills among elementary school students. Consequently, educational institutions should consider integrating this approach into their curricula to foster better critical thinking skills in their students.

Keywords: critical thinking skills, differentiated learning, elementary school, problem-solving



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INTRODUCTION

Science learning is fun learning, students can learn about themselves and the environment/nature around them. With this learning, students can find out the problems that each individual has experienced. Therefore, science is one of the problems that can stimulate students' critical thinking abilities and skills. In this case, Ref. [1] expressed his views on the meaning of natural science, which is the stages of a process carried out systematically, both searching for and formulating conditions related to the phenomena of surrounding natural objects to be used as knowledge. In this way, in implementing natural science learning activities

in schools, in learning planning it is mandatory to prioritize activities that involve students carrying out direct investigations, searches, and observations, so that understanding of concepts can be built automatically.

The implementation of education at the elementary school level has an important role in shaping students' thinking patterns, attitudes, and skills. One of the skills that must be pursued and developed is critical thinking skills. Learning implementation does not only emphasize mastery and understanding of scientific concepts but seeks to improve students' critical thinking abilities and skills. Critical thinking abilities and skills can encourage students to come up with new things to overcome problems in life.

Emphasizing critical thinking students in the implementation of learning can help familiarize students with selecting various opinions so that students can differentiate between relevant and irrelevant opinions. Critical thinking skill is the main thing in the learning process because it makes it easier for students to learn by discovery. Ref. [2] defines critical thinking skills by his view, that critical thinking is the involvement of inductive thinking skills that explain the results of the analysis of the problems being faced so that he can solve them. Agree with the previous opinion, Ref. [3] also explained his opinion regarding critical thinking which can be interpreted as an activity of analyzing ideas to be more specific to problems, through identification activities and exploring problems. This is the reason why it is important to develop critical thinking skills for elementary school students from an early age.

The diversity of individuals in the learning process in the classroom often becomes a problem for teachers in focusing students on lessons. The diversity of needs such as learning interests, learning profiles, and learning readiness for each student is different, giving rise to an indifferent attitude toward learning which is often shown by students. This is a problem in efforts to create students who think critically. Differentiated approach as an effort to accommodate students' needs in learning. Differentiated learning focuses on students' learning needs and adapts according to students' interests, profiles, and learning readiness. According to Ref. [4], learning tends to be learning that accommodates the strengths and needs of students with independent learning strategies by the concept of independent learning. The use of learning differentiation strategies can provide activities that suit student needs (student readiness, interests, and learning styles) so that student learning needs can be met.

The use of differentiated learning strategies can provide activities that suit student needs (student readiness, interests, and learning styles) so that student learning needs can be met. Ref.

[5] expressed his opinion that differentiated learning can improve critical thinking skills through analysis of students' learning abilities, interests, and learning profiles. Agree with the previous opinion, Ref. [6] also added that differentiated learning helps optimize students' critical and creative thinking skills by adjusting students' interests and skills.

Problem-based differentiated learning is one form of effort that can be made to realize students' critical thinking abilities and skills. Students can learn to solve problems in their style/way, according to their abilities, knowledge, and experience. That way, students can flexibly and actively explore the problems they are facing. Ref. [7] expressed their opinion regarding problem-based learning, which is learning that can encourage students' activeness in seeking knowledge, and understanding, developing critical thinking skills, and solving problems.

Based on the results of observations carried out at Muhammadiyah Suronatan Elementary School, it was also found that the problem of students' lack of ability and critical thinking skills was due to the diversity of students, especially in the context of 5th-grade students in science subjects. In implementing learning, teachers are not yet fully able to accommodate students' needs. This is evidenced by students who don't care and play with friends while the learning process is taking place. The science learning process is still considered as learning that is limited to rote learning rather than inviting students to think critically to solve problems. Teachers are not yet fully accustomed to implementing problem-based differentiated learning to accommodate the needs of 5th-grade students at Muhammadiyah Suronatan Elementary School. The application of learning by teachers is still conventional. Things that cause students' needs to not be met, both in terms of learning interest, profile, and student readiness. Therefore, researchers conducted experimental research to improve the critical thinking abilities and skills of students.

Based on the problems above, efforts need to be made to overcome the diversity of students who have different interests, profiles, and learning readiness for each individual. The solution that can be done to overcome this problem is to carry out problem-based differentiation learning for students. The reason researchers chose problem-based differentiated learning is because differentiated learning is learning that accommodates students' learning needs, combined with problem-based learning which requires students to think critically in solving science learning problems. Based on the description above, the objective of this research is to study the influence of problem-based differentiated learning on critical thinking skills.

METHODS

This research includes a quantitative research approach, with a type of experimental research. According to Ref. [8], experimental research is research in the form of observational actions to find out, test, and prove causal relationships between symptoms from certain treatments given under controlled conditions. The design used in this research is Quasi-Experimental Design. This design consists of two classes, namely experimental and control, which were chosen non-randomly, and then given a pretest and posttest to determine the differences in the initial and final conditions of the two groups, namely experimental and control. The experimental group was given treatment using problem-based differentiated learning.

RESULTS

This research focuses on two variables, namely the independent variable and the dependent variable. The independent variable in this research is problem-based differentiated learning and the dependent variable is critical thinking skills.

Data Description

The critical thinking skills test in this study consisted of pretest-posttest questions, which consisted of ten pretest questions and ten posttest questions in the form of descriptive questions with a maximum score of 40. The scores were accumulated into a range of values from 0 to 100. Based on statistical results, the pretest given can be seen in Table 1.

Table 1. Pretest Data Statistics for Experimental and Control Groups

Information	N	Mean	Median	Mode	Std. Deviation	Min	Max
Experiment	28	55.20	55.00	50 ^a	6.608	43	65
Control	28	48.00	48.00	48	7.912	33	68

Then we categorized the statistical results of the pretest data into high, medium, and low categories in Table 2 and Table 3.

Table 2. Categorization of Critical Thinking Skills Pretest Experiment Group

Criteria	Level	%
grade > 61.28	High	17.8
49.14 ≤ grade < 61.28	Medium	67.8
grade < 49.14	Low	14.2

Based on the results of the pretest critical thinking skills test in the experimental group, the average was 55.20 and the standard deviation was 6.608. Furthermore, the interpretation of the categorization of high, medium, and low obtained by the experimental group based on Table 2 can be concluded that it is still classified as medium with criteria between 49.14-61.14 amounting to 67.8%.

Table 3. Categorization of Critical Thinking Skills Pretest Control Group

Criteria	Level	%
grade > 68.51	High	14.2
$53.91 \leq \text{grade} < 68.51$	Medium	71.4
grade < 53.91	Low	14.2

Based on the results of the pretest critical thinking skills test in the experimental group, the average was 48.00 and the standard deviation was 7.912. Furthermore, the interpretation of the categorization of high, medium, and low obtained by the control group based on Table 3 can be concluded that it is still classified as medium with criteria between 53.91-68.51 amounting to 71.4%.

Then, after the pretest was carried out, learning was carried out by giving treatment to the experimental group through problem-based differentiated learning, and no treatment was given to the control group. The learning was carried out in two meetings, namely two meetings in the experimental group and two meetings in the control group. The implementation of learning goes through several stages, namely, in the initial stage of learning it begins with reading a prayer, before starting learning students are given cognitive and non-cognitive diagnostic sheets.

In the second stage, the researcher will ask students questions regarding the material that has been explained as well as the results of trying and observing the teaching aids. One of the student involvement in learning can be seen in Figure 1.



Figure 1. Students explain the process of the respiratory system with the help of props.

Next, in the third stage, students will be divided into study groups consisting of 5-6 students in each group. Then the researcher distributed student worksheets. In the fourth stage, after the students complete the student worksheets, the researcher provides directions and explanations to the students to convey or present the results of each group's work through group representatives. The presentation of students' work results can be seen in Figure 2.



Figure 2. Students present the results of group work

In the fifth stage, after each group representative explained the results of their work, the researcher and the students gave appreciation to the results of each group's work in learning. Students and researchers conclude the material on the respiratory system and digestive systems. After the learning implementation is complete, posttest questions are then distributed to students to determine students' critical thinking skills after being treated with problem-based differentiated learning. The questions consist of 10 descriptive questions with a maximum score of 40. The scores are accumulated into a range of values from 0 to 100. The results of the pretest data can be seen based on the statistical results of the posttest test which can be seen in Table 4.

Table 4. Posttest Data Statistics for Experimental and Control Groupes

Group	N	Mean	Median	Mode	Std. Deviation	Min	Max
Experiment	28	72.00	70.00	70 ^a	6.224	63	88
Control	28	61.21	61.50	58	7.305	48	75

Then we categorized the statistical results of the pretest data into high, medium, and low categories in Table 5 and Table 6.

Table 5. Categorization of Critical Thinking Skills Posttest Experiment Group

Criteria	Level	%
grade > 78.22	High	10.7
65.78 ≤ grade < 78.22	Medium	75
grade < 65.78	Low	14.2

Based on the results of the critical thinking skills post-test in the experimental group, the average was 72.00 and the standard deviation was 6.224. Furthermore, the interpretation of the high, medium, and low categorization obtained by the experimental group based on Table 2 can be concluded to have increased with an average value between 65.78 and 72.00, and the medium category is 75%. And students with a criteria score of more than 78.22 are 10.7 %.

Table 6. Categorization of Critical Thinking Skills Posttest Control Group

Criteria	Level of Critical Thinking Skills	Percentage
> 68.51	High	14.2 %
$53.91 \leq \text{Grade} < 68.51$	Medium	71.4 %
< 53.91	Low	14.2 %

Based on the results of the critical thinking skills post-test in the control group, the average was 61.21 and the standard deviation was 7.305. Furthermore, the interpretation of the high, medium, and low categorization obtained by the control group is based on Table 6. It is in the medium categorization between 53.91 and 68.51.

Prerequisite Test Analysis

The normality test aims to determine whether the data collected from the two-group study is normally distributed or not. In this study, testing the normality of the data used the Kolmogrov-Smirnov test. Data can be declared normal if the significance value is greater than 0.05 and vice versa if the significance value is smaller than 0.05 then the data is declared abnormal. The normality test can be seen in Table 7.

Table 7. Data Normality Test Results Critical Thinking Skills Test

Group	Results	Sig	Alpha	Decision	Remark
Experimental	Pretest	0.200	0.05	Ho Accepted	Normally Distributed Data
	Posttest	0.122	0.05	Ho Accepted	Normally Distributed Data
Control	Pretest	0.106	0.05	Ho Accepted	Normally Distributed Data
	Posttest	0.110	0.05	Ho Accepted	Normally Distributed Data

Based on Table 7, the results of the normality test of the critical thinking skills test data show that the overall pretest and posttest data in the experimental group and control group have normal distribution data, with a significance value of more than 0.05. The pretest value for the experimental group shows $0.200 > 0.05$ so it can be stated that the data is normally distributed. Then, the posttest value for the experimental group showed that it was $0.122 > 0.05$ so it could be stated that the data had a normal distribution. Furthermore, the pretest value for the control group shows that it is $0.106 > 0.05$ so it could be stated that the data was normally distributed. The control group posttest value shows $0.110 > 0.05$ so it can be stated that the data is normally distributed.

The homogeneity test is used to determine whether the two data from the experimental and control groups are the same or not. In this research, the homogeneity test calculation uses the Levene formula. With the criterion that the significance value is more than 0.05, it can be stated that the data is homogeneous or has the same distribution. The homogeneity test can be seen in Table 8.

Data	Levene Statistik	df1	df2	Sig-count	Sig-table	Information
Experimental group and control groups	1.883	1	54	0.129	0.05	Homogenous

Based on Table 8. the data above, the results of the calculation of the homogeneity test for the experimental group and control group, show that Sig-count = 0,129, so based on this data Sig-count is greater than Sig-table. So, it can be concluded that the experimental group and control group data can be declared homogeneous.

Hypothesis testing aims to compare whether the hypothesis is accepted or rejected. In this research, the hypothesis was tested using the t-test to determine the effect of using problem-based differentiation learning on critical thinking skills in 5th-grade students in science. Hypothesis testing was carried out twice. The data test results are presented in Table 9.

	Levene's Test for Equality of Variances		t-test for Equality of Means			95% Confidence Interval of the Difference Lower			
	F	Sig.	t	df	Sig. (2-tailed)		Mean Difference	Std. Error Difference	
Results	Equal variances assumed	1.506	.225	6.186	54	.000	11.143	1.801	7.531
	Equal variances not assumed			6.186	52.403	.000	11.143	1.801	7.529

Table 9 shows the sig value. (2-tailed) is 0.00 which means the value is less than 0.05. So, this shows that Ho is rejected and Ha is accepted. So, this shows that there is an influence of problem-based differentiated learning on the critical thinking skills of students.

DISCUSSION

This research was carried out to determine whether there was an influence or not from the application of problem-based differentiated learning on the critical thinking skills of students. To obtain data on whether or not there is an influence from the implementation of learning, both before and after the treatment, can be obtained from tests given to students in the form of pretest and posttest.

Based on the results of research, there were quite significant differences seen from the results of the pretest and posttest in the experimental group. These differences prove that students' critical thinking abilities have increased before and after implementing problem-based differentiation learning. The research results showed that before the problem-based differentiated learning treatment was given, students' critical thinking skills were only able to obtain an average score of 49.14-61.28. After knowing the conditions and learning needs of the students, they continued providing problem-based differentiated learning treatment in two

meetings. The results of students' critical thinking skills after being given treatment increased with an average of 65.78-78.22 and the percentage of students who got high scores above 78.22 was 10.7%. With these results, the student graduation percentage rate reached 85%.

This is because problem-based differentiated learning can accommodate students' learning needs, so it can encourage students to be actively involved in the problem-solving process. With problem-based differentiated learning, students can search, explore knowledge, and analyze every problem with their critical thinking skills to solve the problems they face. Based on this description, it can be concluded that the application of problem-based differentiated learning affects improving the science critical thinking skills of students.

In implementing learning activities, students need to pay attention to their learning needs, starting from learning readiness, and interests, to learning styles. This aims to ensure that learning activities can run optimally and students can learn effectively and optimally. Implementing good learning needs to involve students directly and experience problems directly so that students can learn to solve problems with their critical thinking skills [9], [10]. Science is learning that encourages students to be directly involved, solve problems, and seek and obtain knowledge directly. Ref. [11] believes that science is not just a collection of knowledge about objects and living things, but also requires ways of working, thinking, and problem-solving. Through problem-solving, it can encourage students' critical thinking skills.

Critical thinking is an ability that students need to have, which encourages students' confidence in solving problems they will face later. Critical thinking skills are very important to support the success of student understanding so that they will have an impact on student learning outcomes [12]. So, in learning activities, teachers need to encourage their students' critical thinking skills [13], [14]. What teachers can do to encourage critical thinking skills is to accommodate students' learning needs, including learning needs, interests, and learning styles [9], [10]. So, teachers need a learning model that can accommodate students' learning needs. One learning model that can accommodate students' learning needs and improve students' critical thinking skills is problem-based differentiated learning [15]–[19].

Problem-based differentiated learning is learning that focuses on learning that focuses on meeting students' learning needs combined with problems which can later encourage students' critical thinking abilities [20], [21]. Analysis activities in critical thinking indicators in the thinking framework can encourage students to carry out investigations and solve existing problems [22], [23]. Indicators in critical thinking encourage students to carry out activities of

interpreting, analyzing, evaluating, and making decisions to solve problems [24]. Critical thinking is the cognitive process of students in analyzing problems systematically and concretely, distinguishing problems carefully, and identifying and considering information to plan problem-solving strategies [25]. According to Ref. [26] that critical thinking skills can encourage students to analyze and evaluate related information or problems.

It is hoped that problem-based differentiated learning can help teachers encourage critical thinking skills by centering students. The components contained in problem-based differentiated learning are content, process, product, and learning environment [27]–[29] According to Ref. [30] revealed that the teacher's role in problem-based differentiated learning is to prepare students' readiness through various means, reading and interpreting students' interest tendencies and learning preferences. They also, create various ways so that students can gather information and ideas, develop various ways so that students can explore and have ideas, presenting various means for students so they can express and expand their understanding. These parameters show that the provision of learning needs to be carried out so that students can develop critical thinking skills and freely explore in seeking knowledge.

CONCLUSION

Problem-based differentiated learning provides an increase in the critical thinking skills of fifth-grade science students at Muhammadiyah Suronatan Elementary School. The research was conducted in four meetings, namely two learning sessions with treatment. Students experienced an increase before the treatment received an average score of 55.20 (Low) and after treatment with an average score of 72 (Medium) obtained by the students. The research results showed that based on data analysis the critical thinking skills of the experimental group experienced a significant increase with a pass percentage of 85% after being given treatment. From this percentage, it can be seen that 24 students out of 28 students were able to reach the minimum completeness criteria and 4 students had not reached the criteria. Thus, it can be concluded that lazy-based differentiation learning influences improving critical thinking skills in science for 5th-grade elementary school students.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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