



The Effect of Thinking-Based STEM Learning on Students' Critical Thinking Ability

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Abstract. The purpose of this study was to examine the differences in the improvement of students' critical thinking skills between students who received treatment using the MIKiR-based STEM learning approach and students who only used conventional learning at the 191 Pekanbaru State Elementary School in science learning material energy sources. The research method used is a quantitative research method that uses an experimental design using 2 classes as the control group and the experimental group. Each class will be given a pre-test before being given treatment and a post-test given treatment. The results showed that there was a significant effect of the application of MIKiR-based STEM learning on the critical thinking skills of fourth grade students at SDN 191 Pekanbaru in science learning where the significance value was $0.000 < 0.05$. Therefore, it can be said that there is a significant effect on the application of MIKiR-based STEM learning on students' critical thinking skills on energy source materials.

Keywords: STEM Learning, MIKiR, Critical Thinking Ability

INTRODUCTION

The 21st century is an era where the development of science and technology occurs very rapidly in various countries, not only developments in the field of science and technology but also in global competition that spreads to various fields such as economics, social, politics and education is no exception (Falentina et al., 2018). The hope of the Indonesian state in the field of education in the 21st century is to increase the quality of education in Indonesia every year, especially in the fields of science and mathematics

(Artobatama, 2019, Fuadi et al., 2020).

Meanwhile, judging from the 2015 Trends in International Mathematics and Science Study (TIMSS) test coordinated by The International of Evaluation of Education Achievement (IEA) which discusses Mathematics abilities aged 9-13 years, Indonesia is ranked 44th in Mathematics mastery from 49 countries. participants with an average score of 397 out of an average International score of 500 (Hadi, 2019). Meanwhile, when viewed from the results of the Program for International Student Assessment (PISA) study in 2018 that Indonesia's mathematical literacy and science performance

ability ranks 72 out of 79 participating countries and with the achievement of scores of 379 and 396 (Munaji & Setiawahyu, 2020).

The results of the research above show that the mathematics and science abilities of Indonesian students are still very low. This happens because of several factors such as: (1) students lack focus and get bored easily in participating in learning, (2) students' low memory, (3) lack of confidence in students to ask questions, (4) critical thinking skills of elementary school students. still low because it has not been handled systematically, (5) students pay less attention to the teacher when delivering subject matter, (6) the selection of teaching materials is only limited to textbooks or texts instead of direct learning, (7) learning that is not contextual or do not link knowledge with everyday life, (8) teachers are still lacking in utilizing LKPD during the learning process, (9) LKPD made is still very simple and only contains solving cognitive problems (Simatupang et al., 2020, Fuadi et al. ., 2020, Yuliati, 2017, Sukmana, 2018, Amatullah et al., 2019, Febri et al., 2020).

Teachers are the main key in improving the quality of education and the challenge for a teacher is to provide a learning system that will produce the best graduates by keeping up with the times, utilizing technological and scientific developments so that they are able to integrate their knowledge and skills and have competitiveness (Falentina et al. ., 2018, Firdaus, et al., 2020, Subakti et al., 2021, Asrizal et al., 2018). The goal in each learning process is to develop every potential that students have and can provide space for students to play an active role in the learning process without feeling afraid or hesitant in expressing their own opinions (Febri et al., 2020).

The solution that can be done to overcome problems in learning is the use of learning approaches that can assist teachers in creating a quality generation, such as the STEM (Science, Technology, Engineering, and Mathematics) approach (Simatupang et al., 2020). STEM is an integrated learning approach that can help improve education in the 21st century.

One aspect that can be added to STEM learning to create active learning is the MIKiR concept. MIKiR stands for experiencing, interacting, communicating and reflecting. MIKiR-based STEM learning is one of the efforts to answer the challenges of the times in the 21st century and also to achieve learning goals that

want to create active and competitive students. MIKiR-based STEM learning provides access to every student in carrying out the teaching and learning process in elementary schools (Rofek et al., 2020).

Based on the background of the problem above, the formulation of the problem in this study is "Is there any effect of the application of MIKiR-based STEM learning on the critical thinking skills of fourth grade students at SDN 191 Pekanbaru in science learning about energy sources?"

This study aims to examine the differences in the improvement of students' critical thinking skills between students who received treatment using the MIKiR-based STEM learning approach and students who only used conventional learning at the 191 Pekanbaru State Elementary School in science learning material energy sources.

METHOD

This type of research is quantitative research, using a quasi-experimental design, which aims to determine the effect of the application of the MIKiR learning approach on the critical thinking skills of fourth grade students at SDN 191 Pekanbaru. The population of this research is students in grades IV A and IV B at SDN 191 Pekanbaru in the academic year 2021/2022, totaling 60 students. The sample in this study was predetermined and not taken at random.

The data collection of this research used a test instrument which was conducted twice, namely pretest and a posttest. The pretest aims to determine the level of students' critical thinking skills before being given treatment and the posttest is conducted to determine the students' abilities after being given treatment with the application of MIKiR-based STEM learning. To measure the validation, reliability, level of difficulty and discriminating power of the questions, a test was conducted on 20 students who were different from the sample to be used. After getting the data, it will be processed using Rasch modeling with ministep application.

Before being given treatment in the experimental class, a diagnostic assessment will be carried out first to group students based on 3 levels of understanding, namely complete understanding, partial understanding and not understanding. After that these three groups of students will be given different treatment in the

learning process based on the differentiation lesson plan.

Data analysis techniques include: (1) Descriptive statistics function to describe the object under study through sample data. Description of the number of samples, average, minimum and maximum value and standard deviation; (2) Inferential analysis, in this study using IBM SPSS 20. The analysis is data normality test, homogeneity test and hypothesis testing (t test).

RESULTS AND DISCUSSION

Results

This research was carried out at SDN 191 Pekanbaru for fourth grade students in the 2021/2022 academic year. The learning process is carried out offline with a limited face-to-face system. This is done to comply with government regulations and to comply with health protocols. The sample in this study consisted of 2 classes, namely, class IV b as the experimental class and class IV an as the control class. There were 60 students involved in this research. The material to be taught is the alternative energy source material. The researcher taught the material to the experimental class and control class in 4 meetings.

In accordance with the research objectives above, the presentation of the results of this study includes a comparison of improving the critical thinking skills of fourth grade students at SDN 191 Pekanbaru in science subjects based on data on: (1) students' critical thinking skills in science, (2) data analysis students' critical thinking skills in science, (3) hypothesis testing. In addition, the difference in the average critical thinking ability of students in the experimental class will be presented according to the ability level of students who have been grouped based on the results of the diagnostic assessment. This diagnostic assessment is carried out to determine the student's initial abilities and the factors that cause them. After that, students will be divided based on three categories, namely the category of complete understanding, partial understanding and not understanding.

The stages of MIKiR-based STEM learning in the experimental class consist of several stages. The stages at the first meeting include: Problem orientation. At this stage the teacher provides a problem that occurs in everyday life related to the material to be studied,

namely alternative energy sources. Then students can ask things that are not clear to the teacher. Alternative solution. Students analyze solutions to the problems that have been discussed and determine the right solution for the given problem. Solution design. After analyzing the solutions, students choose the given solution and design a framework for solving the given problem.

The pretest and posttest tested to students in the experimental class and the control class consisted of a Critical Thinking Ability Test. Each of these tests has an ideal score of 16. Following are the results of descriptive statistical analysis carried out to describe the research data which includes the amount of data, maximum value, minimum value, average value and standard deviation. The results of descriptive analysis using SPSS in this study are as in table 1.

Table 1 Results of descriptive statistical analysis

	N	Min.	Max.	Mean	STD. Deviation
Pre-Eks	30	3	8	5,03	1,402
Post-Eks	30	4	13	9,57	2,269
Pre-Con	30	2	8	4,33	1,709
Post-Cont	30	4	18	6,97	2,442
Valid N	30				

From the data above, it can be seen that the experimental pretest value with a total of 30 data, has a minimum value of 3 and a maximum value of 8, with an average value of 5.03 and a standard deviation of 1.402. Furthermore, the posttest value of the experimental class with 30 data, a minimum value of 4 and the maximum value of 13, the average is 9.57 and the standard deviation is 2.269. For the pretest value in the control class with the same amount of data as the experimental class, namely 30, the minimum value is 1 and the maximum value is 8, with an average value of 4.33 and a standard deviation of 1.709. And lastly, the posttest value for the control class has 30 data, the minimum value is 4 and the maximum value is 13, the average value is 6.97 and the standard deviation value is 2.442. The following is a histogram of the mean pretest and posttest scores of student's critical thinking abilities in both research classes made with the help of the excel program.

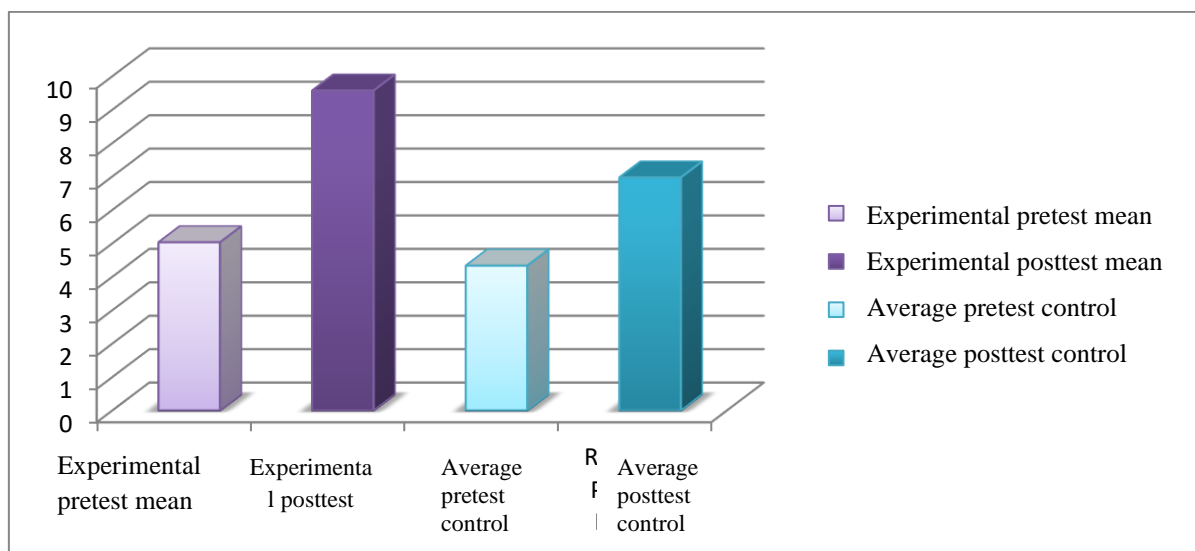


Diagram 1. Average pretest and posttest scores of students' critical thinking skills for the two research classes

From diagram 1 above, it can be seen that there is an average difference between the two research classes. There was an increase in the average before and after giving treatment to the research class. Meanwhile, the comparison of the average, standard deviation, minimum and maximum values of students' critical thinking abilities from the three experimental class groups is shown in table 2.

Table 2. The mean and standard deviation of the experimental class's critical thinking ability

Group	N	Mean	Std. Deviation	Min.	Max
High	5	10,40	2,702	7	13
current	17	10,00	1,871	7	13
Low	8	8,13	2,416	4	11

By paying attention to table 2, it can be concluded that the final mean of critical thinking ability of the three groups is relatively different. The mean group has a relatively higher mean than the other groups.

Discussion

The normality test was carried out to determine whether the accurate sample had a normal distribution or not. The data used is the data from the students' pretest and posttest results in the experimental class and the control class.

The results of the normality test that has been carried out are as in table 3.

Table 3. Normality test

Class		Shapiro-Wilk		
		Statistic	df	Sig.
Results of critical thinking skills	Pretest-Ex	0,933	30	0,60
	Posttest-Cont	0,40	30	0,90
	Pretest-Ex	0,896	30	0,07
	Posttest-Cont	0,922	30	0,31

From the table above, it can be seen that the results of the normality test of the pretest and posttest data in the experimental class and control class obtained significant results with each > 0.05 , so it can be concluded that each class is normally distributed.

The purpose of the homogeneity test is to find out whether a data variant from two groups is homogeneous (same) or heterogeneous (not the same). The homogeneity test is not one of the conditions (not an absolute requirement) which is carried out before testing the hypothesis or independent test of the sample t test. In this study, a homogeneity test was conducted to determine whether the post-test data variance in the experimental class and control class was homogeneous or not. The results of the homogeneity test using SPSS that have been carried out are as in table 4.

Table 4. Homogeneity test

Levene Statistic	df1	df2	Sig.
0.560	1	58	0,457

Based on the table above, the significance value of the posttest data is 0.457, where the result is > 0.05 . So it can be concluded that the variance of the posttest data of the experimental class and the control class is the same or homogeneous.

Hypothesis Test. After conducting the normality test and homogeneity test, it can be concluded that the data are normally distributed and homogeneous. Furthermore, a hypothesis test will be carried out using a T test or an independent sample t test using SPSS 20, then the results of the sig hypothesis test will be obtained. (2-tailed) is 0.000.

Based on the results of the independent sample t test, the use of MIKiR-based STEM learning on students' critical thinking skills obtained a significance value (2-tailed) of 0.000. Then obtained a significance value < 0.05 , then H_0 is rejected and H_a is accepted so that it can be concluded that there is an effect of MIKiR-based STEM learning on students' critical thinking skills.

CONCLUSIONS AND SUGGESTIONS

Based on the results of the research and discussion that have been explained about the effect of MIKiR-based STEM learning on the critical thinking skills of fourth-grade students at SDN 191 Pekanbaru, it can be concluded that: There is an effect of STEM learning on critical thinking skills of fourth-grade students at SDN 191 Pekanbaru.

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