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The Influence of the Problem-Based Learning Model Assisted by the Firing Line on Critical Thinking Skills in the Science Subject of 4th Grade Elementary School Students

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Abstract

The research at this time aims to analyze the ability of each student in the type of critical thinking by using a problem-based learning model supported by the firing line. The research method used is a quantitative research approach with a pretest-posttest research design of a non-equivalent control group design. 31 students are declared as the experimental class while 31 students who will be the control class will be randomly selected. This study used an instrument containing 12 essay questions. The final result of this study shows the paired-sample t-test analysis that the significance value (two-tailed) is 0.000, which is less than 0.05. In addition, the N-gain test displays the average of the N-gain for the experimental class which is 0.7490 can be categorized as "high", and for the control class N-gain which is 0.6522 can be categorized as "medium". Therefore, the conclusion from the explanation above is that there is an increase in students' critical thinking skills, namely the acceptance of the hypothesis when applying a problem-solving-based learning model with the help of the firing line in IPAS learning for grade 4th elementary school students, in other words, the hypothesis is accepted..

1. INTRODUCTION

Education has a very important role in an individual's life because, through education, humans can hone their potential and abilities. The learning outcomes of national education are to achieve the improvement of learners' skills so that they are religious, noble, knowledgeable, hardworking, intelligent, creative, resilient, and able to contribute to society. Thus education can help learners become more knowledgeable to improve their abilities, strengths, and personal development for the better so that it is beneficial for themselves and the surrounding environment (Guarango, 2022).

This world of education has a connection with everyday life, as well as IPAS has a broad relationship with human life and also nature of course (Aprida & Mayarni, 2023). IPAS is one of the

subjects taught from elementary to high school level (Guarango, 2022). Many students think that IPAS subjects are learning in the form of concepts and memorizing so many students consider IPAS learning difficult and difficult to understand. In this case, students should be familiarised with critical thinking (Maslakhatunni'mah et al., 2019).

Students who can think critically is an important thing that must be owned by learners, which can help students formulate reasonable and logical conclusions from various sources. With the ability to think critically, students can strengthen as well as assess the views of others with their own opinions. Thus, school education should provide students with the skills and knowledge to critically seek, identify, and evaluate information. According to Spliter (1991), students who have critical thinking can analyze problems, assess and structure arguments, and can find accurate solutions (Mahmuzah, 2015). In the IPAS learning process, students are expected to analyze and demonstrate whether or not they can formulate problems, formulate solutions, implement problem solutions, and observe progress or assess the problem-solving process that has been carried out (Mayarni et al., 2023).

The facts presented in a study state that students' critical thinking skills are still low (Maslakhatunni'mah et al., 2019). Another opinion says that critical thinking skills in science material are still not good, this happens because of the inability of students to clearly understand the problems presented, and have difficulty in formulating problems that encourage students to think critically (Tresnawati et al., 2017). Skills in critical thinking are poor due to learning to memorize and understand the material, so the lack of knowledge can affect the way students think (Wahyu Ariyani & Prasetyo, 2021). Furthermore, Windarti et al in a study argued that the decline in students' critical thinking skills was because teachers still applied learning patterns that were too rigid and did not encourage students to actively participate in class activities, this resulted in low critical thinking skills (Wulan Dari & Ahmad, 2020)

The low critical thinking skills of students certainly have certain aspects, one of which is less than optimal in the teaching stage. The lack of a suitable learning model is one aspect of low critical thinking skills (Cahyaningsih & Nahdi, 2020). Problem-based learning or Problem solving is a model in learning to improve students in their critical thinking skills which is also very important in building an interesting and useful learning atmosphere and arousing student interest. The paradigm of problem-based learning or Problem-solving goes into the process of improving students' ability to critically analyze and solve problems (Nazilah & Mayarni, 2023). Problem-Based Learning explains that the issues discussed are related to the real world and life. Applying the Problem-Based Learning teaching model, students will learn and practice critical thinking skills to improve their understanding of the subject matter (Satwika et al., 2018). This is the reason why the Problem-Based Learning model can be seen as the best alternative to encourage students to think critically and work rather than just memorizing and listening to the teacher's explanation (Septiana & Kurniawan, 2018)

In the learning model, of course, as educators, we need strategies to make the teaching and learning process make students interested in learning and not boring and able to increase student participation in learning activities. Siberman in the study said that The Firing Line is an example of a strategy that can be applied to motivate students to be more enthusiastic about learning (Lestari, 2023). A study states that the use of The Firing Line learning strategy with Discovery can foster students' critical thinking skills (Daulay, 2014). When the questions are there, learning becomes interactive and can extend the critical thinking skills needed to answer the questions based on the information provided (Sari, 2016). In line with Vygotsky & Suherman state that learning situations in a team format can encourage relationships with the team, so there is interaction between students, especially when dealing with critical problems. (Delyana et al., 2015).

The purpose of this strategy is to increase students' interest in learning and activity level during IPAS learning while providing opportunities for other students to ask questions about other types of problems. In addition, this teaching strategy may help students to understand the concepts in the subject they have learned. Thus, the ability to understand IPAS concepts can be improved.

Based on the results of Restu Fristadi & Haninda Bharata's research, students' ability to think critically can be improved if there is an application of a problem-based learning approach in KBM (Fristadi & Bharata, 2015). Rina Guslani in the study stated that students showed an understanding of concepts in mathematics through the use of The Firing Line strategy and students were willing to try this strategy to achieve learning targets (Sari, 2016). From the research above, it

is the same thing as what the author will research, namely the application of The Firing Line strategy in student learning activities. The low knowledge of students, especially from IPAS learning, is known to be caused by several factors. For example, in choosing the learning model chosen by the teacher, sometimes it is still conventional with the dominant lecture so that when learning students do not necessarily understand the learning delivered by the teacher. Then the lecture learning model can cause boredom in students because they hear too much. In this case, students have no motivation to learn because they already have a stigma that learning is difficult to understand and boring.

Based on the background of the problems raised, this research is intended to make problem-based learning assisted by the firing line a basis for consideration and convincing in improving students' critical thinking skills.

2. METHOD

The researcher determined the location of SDN Tengah 07 Pagi as the research site in the second half of the 2023/2024 academic year in May 2024. The population studied was grade 4 students. The research sample consisted of 31 students in the experimental group and 31 students in the control group. The sample was taken using a random sampling technique, namely by sampling through the smallest sub-group (Ulya et al., 2018).

The researcher will use a quantitative approach system as a research strategy that emphasizes quantitative data collection and analysis (Rahman, 2016). The method applied is the Quasy Experiment. Quasy Experiment is an experimental method where this method has a control class but is not able to regulate external factors to influence in carrying out of activities in the experimental class (Aditiany & Pratiwi, 2021).

The design of the research at this time is a Nonequivalent Control Group Design, chosen because during the research process, the researcher's inability to identify each existing variable. The design can be seen below (Ilah & Nurmayanti, 2020):

Table 1. Research Design

Class	Pretest	Treatment	Posttest
Experiment	0_1	X	0_2
Control	0_3	-	0_3

Table 1 shows that there are experimental and control groups that will be used as a test in the form of pretest questions to see the extent of students' initial knowledge. The experimental class is given treatment (X), namely using a learning model, namely Problem-Based Learning assisted by The Firing Line during the learning process, and for the control class using a traditional learning model. Finally, the two classes were given a posttest so that researchers knew the effect when the class was given treatment.

. Quantitative data obtained by researchers about students' ability to think critically. This data was collected using a test instrument in the form of 12 essay questions about the ability to think critically adjusted to the indicators of critical thinking skills.

Before conducting research, the instrument was tested on students. The trials were carried out using validity and reliability testing. Validity testing aims to determine the feasibility of the instrument to be used (Janna & Herianto, 2021). The decision criterion is if the t-value > 0.361. The reliability test is used to determine the feasibility of questions to be tested. The reliability test uses the Alpa Cronbach formula. The decision criterion is if the t-value > 0.70.

Explaining The results of the validity test of 12 essay questions obtained all instruments in the form of 12 essay questions are valid and the reliability test obtained reliable instruments. The results of the instrument reliability test are in Table 2 below.

Table 2. Instrument Reliability Test

KRITERIA PENGUJIAN		
Nilai	Cronbach’s Alpha	Conclusion
0.70	0.76	Reliable

Table 2 above is the result of the reliability test obtained rxy value = 0.76 then the rxy value is compared with r-table = 0.70 so, the question is considered reliable with a "high" category. Then the instrument is suitable for use.

Then, in the research hypothesis testing system, pretest and posttest data regarding students' abilities in critical thinking were used. This testing process includes N-gain, normality test, homogeneity test, and paired sample t-test.

The N-gain test is used to evaluate the improvement in student performance when the treatment is given. When the N-gain value obtained is high, the greater the progress achieved through the treatment. Furthermore, the N-gain obtained is categorized based on the following scale:

Table 3. N-gain Index Range Categories

Range of N-gain Index	Improvement Category
G > 0.70	High
0,30 > G < 0.70	Medium
G > 0.30	Low

The normality test is used in order to ascertain whether the data obtained is normal or not (Haniah, 2013). This normality test uses the Liliefors method to test the research data. The decision criteria if the significance value > 0.05 indicates normal data.

The homogeneity test is used to ascertain whether the variations in the population are parallel or not (Sianturi, 2022). The provisions in the homogeneity test in this study if the significant value (sig) > 0.05 then the data has homogeneity of variance, and if the significance value is less than 0.05, then the data is considered not homogeneous.

Hypothesis testing will use a paired sample t-test to compare the average critical thinking skills of students between experimental and control classes. The decision criteria are H0 will be rejected if the importance value <0.05, then H1 will be accepted. t-value > 1.671

After conducting all tests to determine whether there is a difference in the results of students' ability to think critically between the use of Problem-Based Learning models with the help of The Firing Line and conventional learning models, the results are concluded using statistical hypothesis testing.

3. RESULTS AND DISCUSSION

N-gain Test

To see the level of student achievement after undergoing teaching using a problem-based learning model with the support of the firing line implemented. The following are the results of descriptive statistics for the N-gain test :

Table 4. Experiment Class N-Gain

	Minimum Value	Maximum Value	Mean
N-gain Score	0.44	1	0.7490
N-Gain Percent	43.75	100	74.8970

Table 5. Control Class N-Gain

	Minimum Value	Maximum Value	Mean
N-gain Score	0.31	0.94	0.6552
N-Gain Percent	31.25	93.75	65.2210

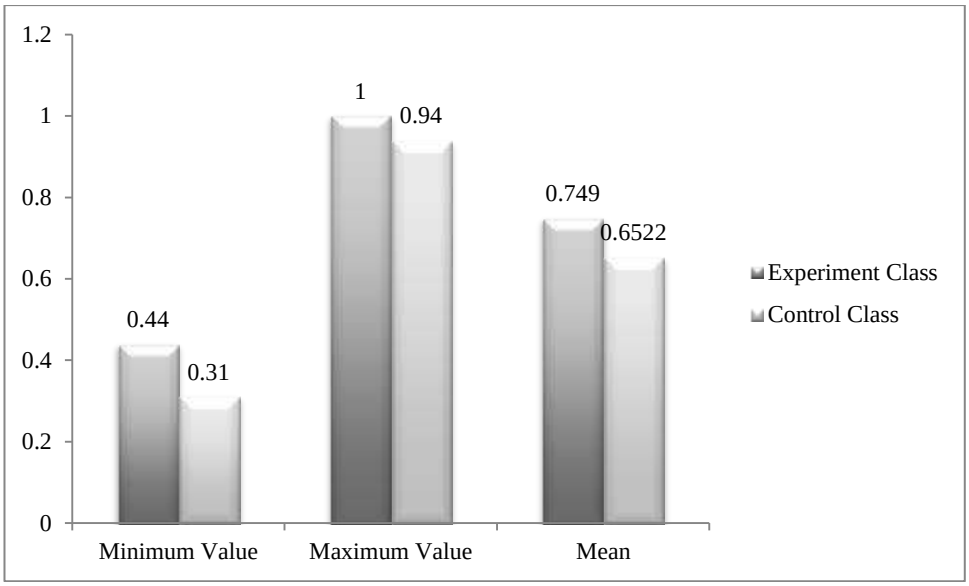

Figure 1. Comparison of the Means Experiment Class and Control Class

Tables 4, 5, and Figure 1 show that the average increase in N-Gain of the experimental class is higher than the control class. The N-Gain value of the experimental class is 0.7490, included in the "high" category, while the control class of 0.6522 is included in the "medium" category. The conclusion from this research is that the problem-solving learning model helps improve students' thinking skills.

According to the results of research conducted by Meli Junia and colleagues, it was seen that students' ability to think critically could increase significantly in the experimental class, with N-gain reaching 0.73, which was categorized as high. On the other hand, in the control class, the N-gain only reached 0.37, categorized as medium (Dinissjah et al., 2019). Another study by Yanti et al stated that the improvement in students' ability to think critically before and after the intervention was categorized as moderate with an N-gain value of 0.513 (Yulianti et al., 2022). In addition, research conducted by Ariyatun & Dissa showed that there was an increase in critical thinking skills (Ariyatun & Octavianelis, 2020).

To determine the normality of the data, normality and homogeneity tests were carried out. Normality and homogeneity tests are presented in Tables 6 and 7.

Table 6. Normality Test.

	Class	Statistic	df	sig
Critical Thinking Students'	Pretest Experiment Class (PBL-assisted TFL)	0.146	31	0.089
	Posttest Experiment Class (PBL assisted TFL)	0.111	31	0.200
	Pretest Control Class (conventional)	0.156	31	0.053
	Posttest Control Class (conventional)	0.130	31	0.194

Table 6 contains the results of the normality test. From the table, it can be seen that the pre-test significance value (sig) for the experimental class is 0.089 (>0.05), the significance value (sig) for the pre-test is 0.053 (>0.05) the post-test value is 0.194 (greater than 0.05). It can be concluded that the initial data in this study showed a normal distribution in the experimental class and the control class.

Table 7. Homogeneity Test

		Levene Statistic	df1	df2	sig
Critical Thinking Students'	Based on Mean	3.994	1	60	0.52
	Based on Median	3.661	1	60	0.60
	Based on the Median and Mean with adjusted df	3.661	1	59.098	0.61
	Based on Trimmed Mean	3.908	1	60	0.53

Table 7, shows that the significance value (sig) in the column is 0.052 (greater than 0.05). This shows that the distribution of data between the experimental group and the control group is homogeneous.

Hypothesis Test

Table 8. Paired Sample T-Test

Paired Sample T-Test

		Mean	N	Std. Dev	*Lower*	*Upper*	t	df	Sig. (*2-tailed*)
Pre-test	Experiment	64.19	31	3.459	-29.199	-24.478	-23.222	30	0.000
Pos-test	Class	91.03	31	5.805					

Furthermore, to determine the research hypothesis test, a paired sample t-test was used to assess the difference in critical thinking skills between the control and experimental classes. In Table 8, the significance value (2-tailed) is a significance value of 0.000, which is less than 0.05. Therefore, based on the paired sample t-test, H_0 is rejected and H_1 is accepted. This indicates that students' critical thinking skills improved significantly by using the problem-based learning model. With the support of the firing line in IPAS subject" in other words, the hypothesis is accepted.

This is reinforced by the results of research by Nova where the t-test (paired sample t-test) sig. (2-tailed) of 0.000 < 0.05, so that students' ability to think critically increased (Sitompul, 2021). Then, Rizki et al. also that the significance value (2-tailed) is 0.000, which is lower than the 0.05 obtained based on the paired sample t-test results with a significance level of 0.5%. It can be concluded that the Problem-Based Learning learning model has a significant impact on improving students' critical thinking skills (Wulandari et al., 2020). According to Yoana et al, the results of the paired sample t-test showed a significant increase in students' critical thinking skills with a significance value of less than 0.5 (Kristiyani et al., 2020).

Thus, it can be concluded that the student's ability to think critically in the experimental class that applied the problem-based learning model with the support of The Firing Line was higher than in the control class with the application of a simple learning model. The conclusion is that there is an "Effect of Problem-Based Learning Model Assisted by The Firing Line on Critical Thinking Ability in IPAS Subjects for Grade 4 Students of SDN Tengah 07 Pagi".

The effect is because learning with a problem-based learning-focused learning model supported by The Firing Line is more effective and exciting for students, which can increase their motivation. In addition, it can improve collaboration and mutual respect when students discuss to find answers together in groups. On the other hand, the traditional learning model is only suitable for students who have a good ability to listen and understand the material well. The opinion above is in line with a study conducted by Fatya, which shows that the implementation of the Active Learning type The Firing Line can enhance students' critical thinking skills (Rahmatika, 2023).

4. CONCLUSION

Based on the results of research on the use of the Problem-Based Learning Model assisted by The Firing to improve critical thinking skills possessed by students in both classes, namely control and experimental classes, there are differences before using the problem-based learning model assisted by the firing line and after using the problem-based learning model assisted by the firing

line. So the conclusion of the research hypothesis at this time is "There is an Effect of Problem-Based Learning Model Assisted by The Firing Line on Critical Thinking Ability in IPAS Subjects of 4th Grade Students of SDN Tengah 07 Pagi".

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