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The Effect of Problem Based Learning (PBL) Model on Students' Critical Thinking Skills and Responsibility Attitudes in Linear Motion at MAN 1 Kota Jambi

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ABSTRACT

The purposes of this research to determine the effect and relationship of the Problem Based Learning (PBL) model on students' critical thinking skills and responsibility attitudes in Linear Motion at MAN 1 Kota Jambi. This research employs a quantitative method with a quasi-experimental design, the sample consists of two eleventh-grade classes of 53 students selected using Simple Random Sampling. The data collection instruments include tests on critical thinking skills and questionnaires on responsibility attitudes. Data analysis used inferential statistics with MS Excel and IBM SPSS 23. The N-gain test results indicate that the critical thinking skills of students in the experimental class had a score of 0.39 and 0.32 in the control class. Meanwhile, the N-gain score for responsibility attitudes in the experimental class was 0.44 and 0.35 in the control class. These findings suggest the PBL model is more effective in enhancing critical thinking and responsibility. The paired T-test results show a significance value of $0.000 < 0.05$, meaning to rejecting the null hypothesis H_0 and acceptance of the alternative hypothesis H_1. Thus, the Problem-Based Learning (PBL) model has an effect and relationship on students' critical thinking skills and responsibility attitudes in Linear Motion at MAN 1 Kota Jambi.

1. INTRODUCTION

Education is a crucial aspect in developing high-quality human resources. One of the primary objectives of education is to foster critical thinking and a sense of responsibility among students. These two aspects are key to success in facing the increasingly complex challenges of globalization. In the context of school learning, the subject of Physics plays a strategic role in training students to think logically, analytically, and systematically. This is due to the characteristics of Physics, which require students to understand abstract concepts, conduct analysis, and solve problems scientifically.

Critical thinking skills involve the ability to objectively and critically evaluate information, recognize the assumptions underlying thoughts and actions, and draw conclusions based on evidence and in-depth analysis (Abrami et al., 2021). Critical thinking is highly important for students at all educational levels. It helps individuals navigate biases, filter important information from the irrelevant, and generate creative ideas and effective solutions to problems. Moreover, in an era where information is

abundant and often conflicting, critical thinking skills are essential for achieving a deep understanding (Novianti, 2020).

Syafitri (2017) states that responsibility is a task that can align the achievement of students' competencies. Meanwhile, Majid and Dian (2014:167) define responsibility as the attitude and behavior of an individual in carrying out duties and obligations towards oneself, society, the environment, the state, and God Almighty (Fitria, 2022). Responsibility is part of character values, which are shaped by the development of the times. Responsibility is one of the essential character traits that students must possess. According to the Indonesian Law No. 12 of 2012, higher education plays a significant role in preparing students for the workforce and society (Syifa et al., 2023). Critical thinking skills and a sense of responsibility are crucial in education, as they can help students analyze digital information more carefully, test their potential in making decisions, and take responsibility for the consequences of their decisions and actions.

The Merdeka Curriculum developing students' critical thinking skills and sense of responsibility has become increasingly relevant in addressing the demands of 21st-century learning. The Merdeka Curriculum provides teachers and students with the freedom to design a more flexible, contextual, and project-based learning process. Through this approach, students are encouraged to explore learning topics more deeply and actively engage in the learning process. The Merdeka Curriculum also emphasizes strengthening the Pancasila Student Profile, which includes aspects of critical thinking and responsibility (Kemedikbud, 2021).

Based on preliminary observations at MAN 1 Kota Jambi conducted on 13 September 2024, which involved collecting PAS scores and distributing critical thinking skill tests and responsibility attitude questionnaires, it was found that students' learning outcomes and critical thinking abilities were still relatively low, while their sense of responsibility was in the moderate category. The observational data revealed that many students scored below the Learning Achievement Criteria in the Physics PAS exam, with approximately 64% of students not meeting the standard. Additionally, students' critical thinking skills were also low, particularly in the straight motion topic, with about 43% performing poorly, whereas 67% of students demonstrated a moderately good sense of responsibility.

Based on the interviews conducted by the researcher, the issues mentioned above occur due to various factors affecting students' learning conditions in the classroom, such as students' learning styles, ineffective teaching models, and a lack of conceptual understanding of the straight motion material. The researcher needs an appropriate teaching method to address these problems.

One of the instructional strategies considered effective in enhancing critical thinking skills and a sense of responsibility is the Problem-Based Learning (PBL) model. PBL emphasizes problem-solving and context-based learning, which is believed to stimulate students to think critically and develop a sense of responsibility towards their learning. According to Yuniarsi's research (2022), by using PBL, students can be more active in learning, continuously sharpen their critical thinking skills, and better face real-world challenges. PBL contributes positively to improving the quality of learning and students' academic achievements (Yuniarsi & Sapri, 2024). Additionally, research conducted by (Nupus & Sofwan, 2024) found that the implementation of the Problem-Based Learning model can also enhance students' critical thinking skills and sense of responsibility. Therefore, this research intends to determine the effect and relationship of Problem Based Learning (PBL) model on students' critical thinking skills and responsibility attitudes in the topic of linear motion at MAN 1 Kota Jambi.

2. METHOD

This study was conducted at MAN 1 Kota Jambi from November 2024-January 2025 by implementing the Problem Based Learning (PBL) model in the teaching of straight motion. This research employs a quantitative method with a quasi-experimental design. The population of this study comprises 156 eleventh-grade students at MAN 1 Kota Jambi, divided into 6 classes. The sample consists of two eleventh-grade classes totaling 53 students, selected using the Simple Random Sampling technique. Data collection instruments include critical thinking skill tests and responsibility attitude questionnaires. The research instruments were designed based on the characteristics and indicators of critical thinking skills and students' sense of responsibility. Both instruments were validated by experts using content and construct validation. The validation results indicated that both the responsibility attitude questionnaire and the critical thinking skill test were deemed valid and suitable for use in the research. The data were then analyzed using hypothesis testing with the assistance of MS Excel and IBM SPSS 23 after conducting N-Gain tests and prerequisite tests (normality and homogeneity tests).

3. RESULTS AND DISCUSSION

Results of Critical Thinking Skills Data

Based on the pretest and posttest data of the critical thinking skills of the control and experimental classes, they can be described through Table 1.1 below.

Table 1.1 Descriptive Results of Critical Thinking Skills Data

Descriptive Statistics Results	Control class		experimental class	
	Pretest	Posttest	Pretest	Posttest
Mean	66,89	77,56	66,85	79,92
Standard Deviation	8,846	6,06	6,429	5,075
Variance	78,256	36,718	41,335	25,754
Minimum	50	68	54	72
Maximum	80	88	78	90
Median	68	78	68	79
N	27		26	

Table 1.1 shows that the average pretest scores of the control and experimental classes were 66.89 and 66.85, respectively, while the average posttest scores of the control and experimental classes were 77.56 and 79.92, respectively. The above average scores indicate that the critical thinking skills of students in both classes improved. This suggests that the teaching method used is effective in enhancing students' critical thinking skills. For a clearer representation of the improvement in scores, please refer to figure 1.1 below.

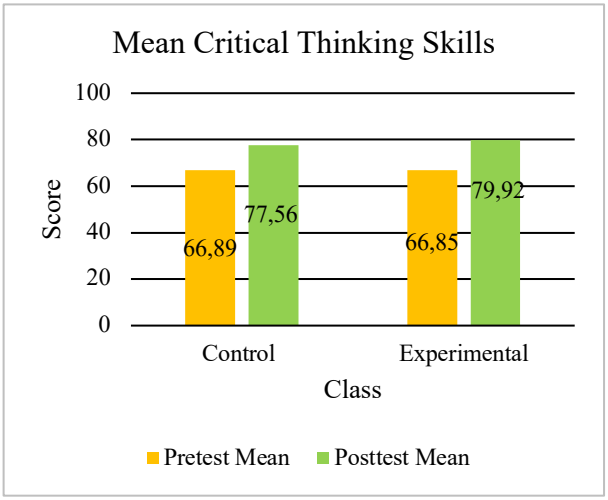

Figure 1.1 Mean Critical Thinking Skills

Result of Responsibility Attitude Data

Based on the pretest and posttest data of the critical thinking skills of the control and experimental classes, they can be described through Table 1.2 below.

Table 1.2 Descriptive Results of Responsibility Attitude Data

Descriptive Statistics Results	Control Class		Eksprimenl Class	
	Pretest	Posttest	Pretest	Posttest
Mean	69,5	80,11	69,7	83,08
Standard Deviation	3,673	3,945	3,403	3,599
Variance	13,49	36,718	11,582	12,954
Minimum	64	74	64	77
Maximum	78	88	80	89
Median	69	79	69,5	84
N	27		26	

Based on Table 4.6, the average pretest scores of the control and experimental classes were 69.52 and 69.7, respectively, while the average posttest scores of the experimental and control classes were 80.11 and 83.08, respectively. The above average scores indicate that the sense of responsibility in both classes has improved. With this improvement, it can be concluded that the teaching method used is effective in positively influencing students' sense of responsibility. For a clearer representation of the improvement, refer to figure 1.2 below.

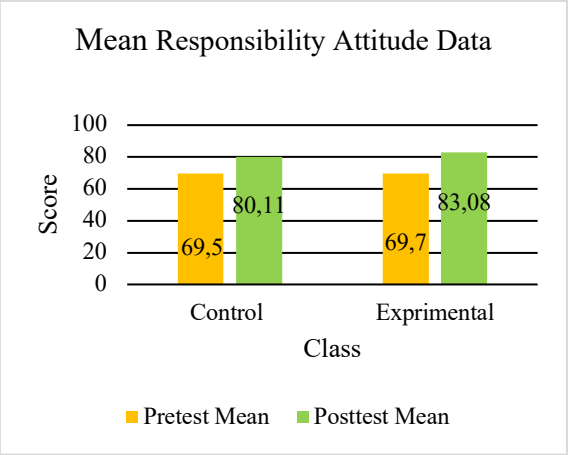

Figure 1.2 Mean Responsibility Attitude Data

N-Gain Test Results for Students' Critical Thinking Skills

The N-Gain test is used to provide a general overview of the percentage score improvement of learning outcomes before and after the implementation of the Problem-Based Learning model (Yampap & Hasyda, 2023). The N-Gain score data for critical thinking skills is presented in Table 1.3 below.

Tabel 1.3 N-Gain Score critical thinking skills

Class	N-Gain Score	Categories
Control	0,32	Medium
Exprimental	0,39	Medium

Table 4.9 shows that the average N-Gain score of the critical thinking skills of the experimental class is higher (N-Gain score: 0.39) compared to the control class (N-Gain score: 0.32). Although still in the medium category, this indicates that the Problem-Based Learning model applied in the experimental class is more effective in improving critical thinking skills compared to the teaching model applied in the control class. For a clearer representation of the improvement, refer to Figure 1.3 below.

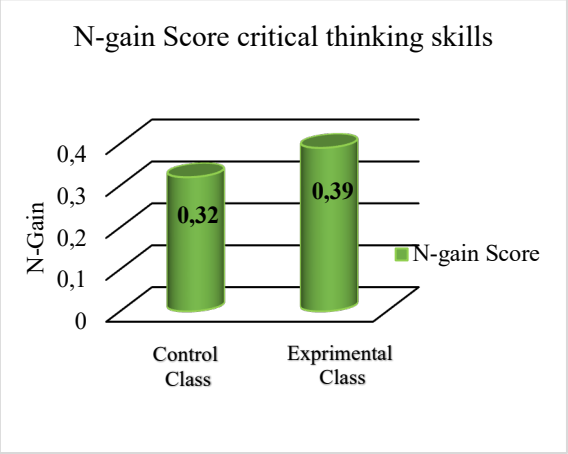

Figure 1.3 N-gain Score critical thinking skills

N-Gain Test Results for Students' Responsibility Attitude

The N-Gain score data for students' responsibility attitude is presented in Table 1.3 below.

Tabel 1.4 N-Gain Score students' responsibility attitude

Class	N-Gain Score	Categories
Control	0,35	Medium
Exprimental	0,44	Medium

Table 1.4 shows that the average N-Gain score for the responsibility attitude in the experimental class is higher (N-Gain score: 0.44) compared to the control class (N-Gain score: 0.35). Both classes experienced an increase in scores within the medium category. Nevertheless, this indicates that the Problem-Based Learning model applied in the experimental class is more effective in improving students' sense of responsibility compared to the teaching model applied in the control class. For a clearer representation of the improvement, refer to Figure 1.4 below.

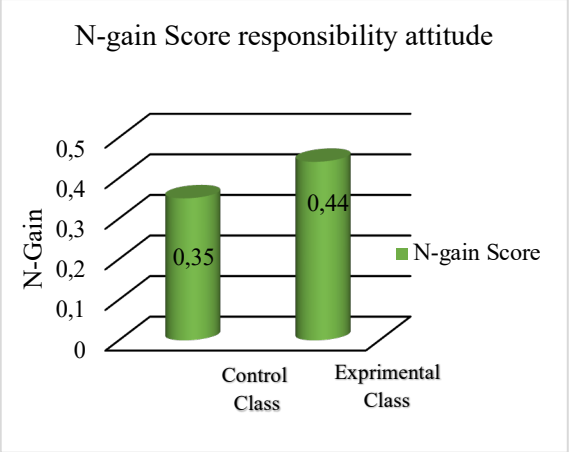

Figure 1.4 N-Gain score responsibility attitude

Normality Test Results for Students' Critical Thinking Skills

The normality test for critical thinking skills was conducted using the Kolmogorov-Smirnov test assisted by the IBM SPSS 23 application with a significance level (α = 5%). The normality test results for critical thinking skills data in both classes showed sig values > 0.05, indicating that the critical thinking skills data are normally distributed. more clarity, please refer to Table 1.5 below.

Table 1.5 Normality Test Results for Critical Thinking Skills

Tests of Normality

	Kelas	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Score Pre	Control Class	,201	27	,007	,928	27	,061

	Exprimental Class	,148	26	,147	,969	26	,586
Score Post	Kelas Kontrol	,191	27	,013	,931	27	,075
	Kelas Eksprimen	,186	26	,021	,942	26	,148

Normality Test Results for Students' Responsibility Attitude

The normality test for the responsibility attitude was conducted using the Kolmogorov-Smirnov test through the IBM SPSS 23 application with a significance level (α = 5%). The normality test results for students' responsibility attitude data in both classes showed sig values > 0.05, indicating that the critical thinking skills data are normally distributed. For more clarity, please refer to Table 1.6 below.

Table 1.6 Normality Test Results for Responsibility Attitude

Tests of Normality

	Kelas	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Score Pre	Kelas Kontrol	,149	27	,130	,952	27	,245
	Kelas Eksprimen	,158	26	,094	,926	26	,064
Score Post	Kelas Kontrol	,166	27	,053	,943	27	,145
	Kelas Eksprimen	,140	26	,200*	,944	26	,170

Homogeneity Test for Students' Critical Thinking Skills

The homogeneity test is used to determine whether the obtained data is homogeneous or not. The basis for decision-making in the homogeneity test is as follows: if the sig value > 0.05, the data is considered homogeneous; however, if the sig value < 0.05, the data is not homogeneous.

Table 1.7 Homogeneity Test Results for Critical Thinking Skills

Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
Score Pre	1,540	1	51	,220
Score Post	2,534	1	51	,118

From Table 1.7, the pretest and posttest significance values were 0.220 and 0.118, respectively. These significance values are greater than 0.05, indicating that the data is homogeneous.

Homogeneity Test Results for Students' Responsibility Attitude

To determine whether the data is homogeneous or not, refer to Table 4.20 below.

Table 1.8 Homogeneity Test Results for Responsibility Attitude

Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
Score Pre	,764	1	51	,386
Score Post	,435	1	51	,513

Based on Table 1.8, the pretest and posttest significance values were 0.386 and 0.513, respectively. These significance values are greater than 0.05, indicating that the data can be considered homogeneous.

Paired t-Test Results for Critical Thinking Skills

To assess the impact of each independent variable on the dependent variable, a t-test was conducted. If the t-test results show that the calculated t value is greater than the table t value and the sig value < 0.05, it can be concluded that there is a significant impact on the dependent variable (Purba et al., 2021). The t-test results for the PBL teaching model with critical thinking skills can be seen in Tables 1.9 and 1.10 below.

Table 1.9 T-Test Results for Critical Thinking Skills

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Score Pretest - Score Posttest	-13,07692	3,45164	,67692	-14,47107	-11,68277	-19,318	25	,000

Based on Table 1.9, the sig value obtained is 0.000 < 0.05. Thus, it can be concluded that the null hypothesis (H0) is rejected and the alternative hypothesis (H1) is accepted. This indicates that the Problem-Based Learning (PBL) model has a significant impact on critical thinking skills.

Table 1.10 Correlation Test Results for the PBL Teaching Model on Critical Thinking Skills

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Score Pretest & Score Posttest	26	,846	,000

Based on Table 1.10, the sig value obtained is 0.000 < 0.05. This indicates that the null hypothesis (H0) is rejected and the alternative hypothesis (H1) is accepted, which means there is a significant relationship between the PBL teaching model and critical thinking skills with a correlation percentage of 84%.

Paired t-Test Results for Responsibility Attitude

The t-test results for the PBL teaching model with students' responsibility attitude can be seen in Tables 1.11 and 1.12 below.

Table 1.11 T-Test Results for Responsibility Attitude

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Score Pretest - Score Posttest	-13,38462	2,57801	,50559	-14,42590	-12,34333	-26,473	25	,000

Based on Table 1.11, the sig value obtained is 0.000 < 0.05, thus the null hypothesis (H0) is rejected and the alternative hypothesis (H1) is accepted. This indicates that the Problem-Based Learning (PBL) model also influences the responsibility attitude.

Table 1.12 Correlation Test Results for the PBL Teaching Model on Responsibility Attitude

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Score Pretest &Score Posttest	26	,730	,000

Based on Table 1.12, the sig value obtained is 0.000 < 0.05. Thus, it can be concluded that the Problem-Based Learning (PBL) model correlates with the independent variable Y2 (responsibility attitude) with a correlation percentage of 73%.

4. CONCLUSION

Based on the research results, it can be concluded that: Firstly, N-gain score for responsibility attitudes in the experimental class was 0.44 and 0.35 in the control class. These findings suggest the PBL model is more effective in enhancing critical thinking and responsibility. Secondly,the Problem-Based Learning (PBL) model is effective in improving critical thinking skills. The Problem-Based Learning (PBL) model has a significant impact on critical thinking skills and students' responsibility attitude, with a significance value of 0.000, which is less than 0.05. Thirdly, the Problem-Based Learning (PBL) model is effective in improving students' responsibility attitude. The Problem-Based Learning (PBL) model has a significant impact on the responsibility attitude, with a significance value of 0.000, which is less than 0.05. Fourth, the correlation test also shows a relationship between the Problem-Based Learning (PBL) model and critical thinking skills and students' responsibility attitude, with a significance value of 0.000 which is less

than 0.05. Thus, the null hypothesis (H_0) is rejected and the alternative hypothesis (H_1) is accepted.

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