Research Article

Application of Moodle-based Blended Learning to Improve Students' Critical Thinking Skills in Straight Motion Materials

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Abstract.
The learning applied to the revised 2013 edition of the curriculum requires students to master critical thinking skills. One of the efforts to improve critical thinking skills is by applying blended learning. This study aimed to determine the improvement of critical thinking skills using Moodle-based blended learning. This type of research is a quasi-experiment with a nonequivalent research design. Sampling was done using purposive sampling technique, in order to obtain class X MIPA 4 as the experimental class and X MIPA 5 as the control class at Cisolok, which consists of 60 people, 37 are female and 23 are male. This research instrument uses essay questions to test critical thinking skills in straight-motion material with as many as 10 questions. The results showed an increase in critical thinking skills of experimental class students who obtained an N-gain of 0.60, while an increase in critical thinking skills of control class students obtained an N-gain of 0.56. The results of the hypothetical analysis of t-test using blended learning obtained t count pretest of 1.07 and posttest of 1.53, while t table of -2.048 so that t count > t table and H0 is rejected while Ha is accepted. Thus, it can be concluded that there is an increase in students' critical thinking skills by applying Moodle-based blended learning on straight motion.

Keywords: moodle-based blended learning, critical thinking skills, straight motion materials

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1. INTRODUCTION

The learning applied to the revised 2013 edition of the curriculum requires students to master high order thinking skills. This learning is in accordance with the demands of the 21st century which emphasizes that students have 4C competencies [1]. which includes critical thinking skills, creative thinking skills, communication thinking skills and collaboration thinking skills. 21st century competence is one of the tangible manifestations in terms of supporting learning that is applied today.

One of the 21st century competencies is to cultivate critical thinking skills [2]. Critical thinking skills are one of the skills that must be possessed by students and is one of

the higher-order thinking skills that can be built through science learning [3]. A student is required to have good critical thinking skills [4].

These critical thinking skills can be used in learning and contribute to the process of students' mental activity in proving a statement and collect facts that are used to draw conclusions. Because of the importance of critical thinking skills, more attention needs to be given to developing them into learning. This critical thinking skill needs to be measured using an appropriate test measuring tool [5].

Based on these demands, students must have good critical thinking skills. However, based on research conducted by Martawijaya regarding critical thinking skills [6]. This study resulted in data on students' critical thinking skills to get a score range of 0-7 with an average value of 2.9 and a standard deviation of 1.91. So it can be said that the critical thinking ability of students in Indonesia is included in the low category.

Based on these data, a teacher must be able to design a learning system that is able to improve students' critical thinking skills, especially in learning physics at school. Sometimes the material presented during the learning process in class cannot be received optimally by students due to limited learning time in class. To overcome these shortcomings in learning, researchers utilize online learning systems in terms of interacting with students during learning other than face-to-face in class. One of the learning media that can be a learning solution is to use a Learning Management System (LMS) in the form of Moodle. E-Learning can be a breakthrough to bridge the impasse of direct communication between teachers and students and vice versa in teaching and learning activities. Teachers can collaborate with students while learning using E-Learning.

The use of E-Learning can be done synchronously or asynchronously which is also used as a complement or learning aid only or fully to support online learning [7]. These tools can be used in online learning models. There are various ways in online learning, one of which is learning through Moodle [8]. Moodle is an E-Learning learning platform designed to provide educators, administrators and students with a secure, robust and integrated system for creating personalized learning environments [9]. Moodle is an Open-Source course management system that can be used with learning models.

This alternative E-Learning platform can be used in learning, but it creates confusion in choosing the right learning model to improve students' critical thinking skills which shows a positive increase for use in learning physics. To bridge and develop students' critical thinking skills, an appropriate learning model is needed [10].

One of the learning models that can be used in applying Blended Learning to improve critical thinking skills is to use the Discovery Learning Model [11]. The advantages of this

model can help students to improve critical thinking skills. If the learning model can be integrated with Moodle-based Blended Learning and can be carried out as effectively as possible, then Moodle-based Blended Learning can be used as a learning model that can improve students' critical thinking skills.

Based on the background of the problem that has been described, the authors are encouraged to conduct research with the title "Application of Moodle-Based Blended Learning to Improve Students' Critical Thinking Skills in Straight Motion Materials.

2. RESEARCH METHOD

This type of research is a quasi-experimental and was conducted at Cisolok. The research sample was selected using purposive sampling. The sample of this study consisted of two classes, namely the experimental class (X MIPA 4) and the control class (X MIPA 5) consists of 60 people, 37 are female and 23 are male for the academic year 2021/2022. The type of data obtained from this research is quantitative data in the form of implementation of learning and improvement of critical thinking skills obtained from the pre-test-post-test scores of students on the material of straight motion. The initial stage in this research is to conduct a pre-test to students to determine students' initial critical thinking skills. The Thinking Instrument used is according to Ennis critical thinking skills, which consists of Basic Clarification, Building Basic Skills, Inference, Advanced Clarification, Strategy and Tactics. The pre-test questions that were tested were in the form of 10 essay questions on straight motion material which had been tested for validity, reliability, different test and level of difficulty when testing the question instrument. instrument test results can be seen in the Table 1.

Based on Table 1, the test instruments used in the research are Numbers 1A, 2A, 3A, 4B, 5A, 6A, 7B, 8A, 9A, 10B. Learning activities in the experimental class were given treatment in the form of applying Blended Learning using the Discovery Learning model. While the control class was given treatment in the form of the application of E-Learning using the Discovery Learning model. After the learning process is complete, students in the experimental class and control class are given a post test to determine the final ability of students' critical thinking skills after being given treatment by applying the learning carried out. After getting the data, the data is first analyzed by calculating n-gain because the researcher wants to see the results of improving students' critical thinking skills. Then the normality test and homogeneity test were carried out and the results obtained that the two classes were normally distributed and homogeneous. Last do hypothesis testing in research.

TABLE 1: Results of critical thinking skills pre-test experiment and control class.

Number	Validity Test Results		Reliability Test Results		Difficulty Level Test Results		Different test results	
	Value	Interpretation	Value	Interpretation	Value	Interpretation	Value	Interpretation
1A	0.747	High	0.88	Very High	0.828	Easy	0.22	Moderate
2A	0.605	High			0.703	Easy	0.22	Moderate
3A	0.612	High			0.500	Quite Difficult	0.19	Bad
4A	0.485	Medium			0.672	Quite Difficult	0.15	Bad
5A	0.668	High			0.609	Quite Difficult	0.21	Moderate
6A	0.705	High			0.531	Quite Difficult	0.40	Good
7A	0.743	High			0.406	Quite Difficult	0.25	Moderate
8A	0.735	High			0.625	Quite Difficult	0.25	Moderate
9A	0.732	High			0.672	Quite Difficult	0.22	Moderate
10A	0.752	High			0.406	Quite Difficult	0.31	Moderate
1B	0.723	High	0.80	High	0.781	Easy	0.25	Moderate
2B	0.444	Medium			0.734	Easy	0.15	Bad
3B	0.767	High			0.656	Quite Difficult	0.25	Moderate
4B	0.726	High			0.609	Quite Difficult	0.22	Moderate
5B	0.298	Low			0.703	Easy	0.09	Bad
6B	0.547	Medium			0.859	Easy	0.15	Bad
7B	0.613	High			0.625	Quite Difficult	0.19	Bad
8B	0.575	Medium			0.703	Easy	0.22	Moderate
9B	0.361	Low			0.703	Easy	0.10	Bad
10B	0.608	High			0.515	Quite Difficult	0.15	Bad

This study aims to determine the improvement of students' critical thinking skills using Blended Learning and E-Learning using the Discovery Learning model on straight motion material. The critical thinking skill test instrument that was compiled was used as a test instrument to identify students' critical thinking skills in straight motion material.

3. RESULTS AND DISCUSSION

This study aims to determine the improvement of students' critical thinking skills using Blended Learning and E-Learning using the Discovery Learning learning model on straight motion material. The data obtained in this study is the result of increasing critical thinking skills in the experimental class and control class

Before being given treatment the experimental class and control class were given a pre test and after being given treatment a post test was given to determine students' critical thinking skills. The results of critical thinking skills before being given treatment are shown in Table 2.

TABLE 2: Results of critical thinking skills pre-test experiment and control class.

Description	Preliminary Test	
	Experiment	Control
Number of students	30	30
Average	30	29
Lowest Value	18	16
Highest Value	42	38

Based on Table 2, it can be seen that the average values of the experimental class and control class are 30 and 29 with the difference in the average value of the initial test of the two classes being 1. The results of the pre-test of the two classes were calculated using the normality test with the chi square test and the chi square test. Homogeneity with the table F test. After analyzing the research data using the chi square test, the experimental class obtained a value of x^2 Count of $4.06 < x^2$ table of 11.07 while the control class obtained a value of x^2 Count of $0.72 < x^2$ table of 11.07 then it can be said that both data are normally distributed.

After the two data were normally distributed, homogeneity test was carried out using the F test. The F value for the experimental class and the control class was 1.45 with a significance level of 0.05, while the F_{table} value was 2.62. Based on the data obtained by $F_{count} < F_{table}$, it can be concluded that the two classes are homogeneous. While the results of critical thinking skills in the experimental class and control class after being given treatment are shown in Table 3 as follows:

TABLE 3: Results of critical thinking skills post- test experiment and control class.

| Description	Preliminary test	
	Experiment	Control
Number of students	30	30
Average	72	68
Lowest Value	60	56
Highest Value	86	80

Based on the Table 3, it can be seen that the average values of the experimental class and control class are 72 and 68 with the difference in the average value of the final test of the two classes being 4. The post-test results of the two classes were calculated using the normality test with the chi squared test and the homogeneity test with test table F. After analyzing the data using the chi square test, the experimental class obtained a value of X^2 count of $8.4 < X^2$ table of 11.07 while in the control class obtained a value of x^2 Count of $8.67 < x^2$ table of 11.07, it can be said that both data are normally distributed.

After the two data were normally distributed, homogeneity test was carried out using the F test so that the F_{count} was 1.25 with a significance level of 0.05, while the F_{table} value was 2.62. Based on the data obtained by $F_{count} < F_{table}$, it can be concluded that the two classes are homogeneously distributed. Based on Table 1 and Table 2 it can be concluded that there is an increase in thinking ability critically students use Blended Learning with the "medium" category. This is reinforced by the results of critical thinking skills shown in Fig. 1.
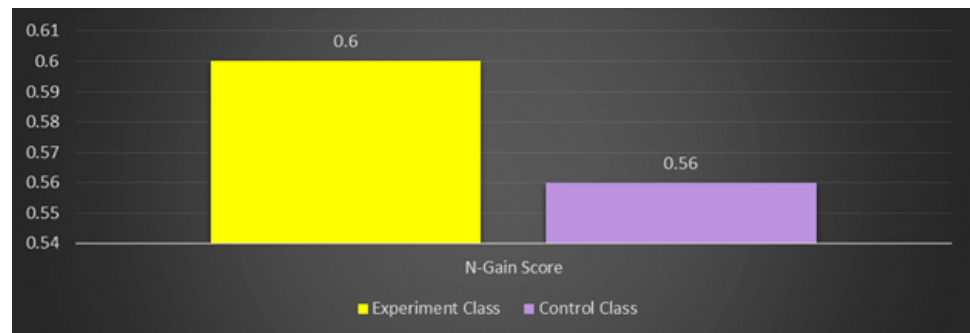
Figure 1: N-gain test score critical thinking skills experiment class and control class.

The average results of the N-gain test for critical thinking skills shown in Fig. 1 show that the N-gain for the experimental class is 0.60 and the N-gain for the Control class is 0.56. The calculation of the average N-gain score was also carried out to determine the increase in students' critical thinking skills per sub-material. The material of straight motion in this study is divided into three sub-materials, namely: (1) Uniformly Straight Motion, (2) Uniformly Changing Straight Motion, (3) Free Falling Motion. The results of calculating the average N-gain score per sub-material in both classes towards improving critical thinking skills are shown in Fig. 2.
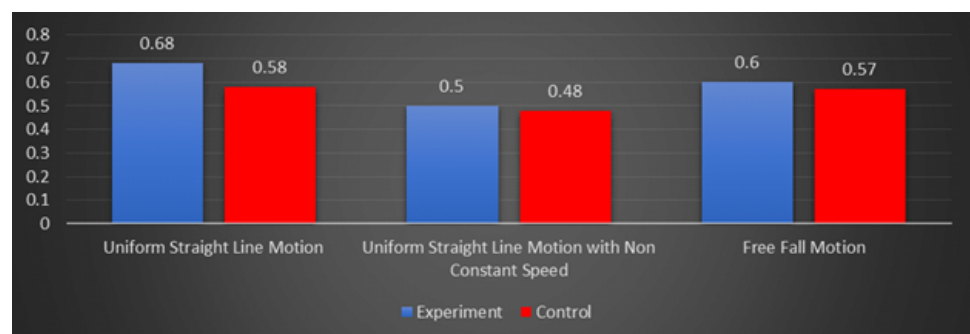
Figure 2: N-gain test score critical thinking skills experiment class and control class.

The average results of the N-gain test per sub-material of critical thinking skills are shown in Fig. 2. The calculation of the average score of the N-gain value is also used to determine the increase in the results of students' critical thinking skills per critical thinking skill indicator. The indicators of students' critical thinking skills in this study

were divided into four sub-indicators, namely: (1) basic clarification, (2) building basic skills, (3) inference, (4) further clarification, and (5) strategies and tactics.

The results of calculating the average score of N-gain values per sub-indicator in the experimental class and control class on improving critical thinking skills are shown in Fig. 3.
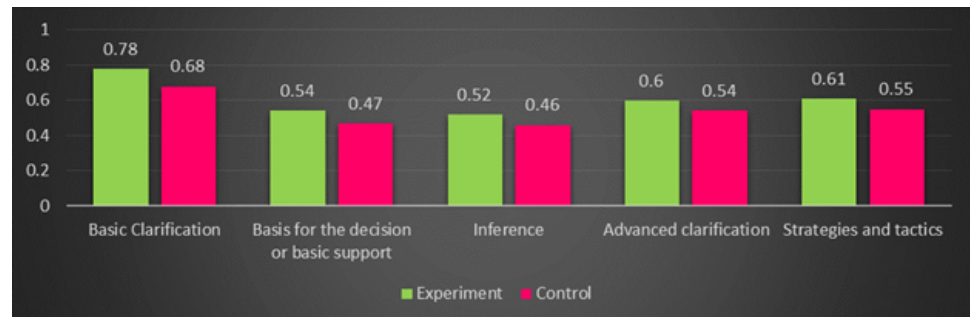

Figure 3: N-gain test score each critical thinking skills indicator.

The result of calculating the average score of N-gain value per sub-indicator in the experimental class is 0.60. The results of improving critical thinking skills are detailed based on the experimental class for each indicator shown in Fig. 4.
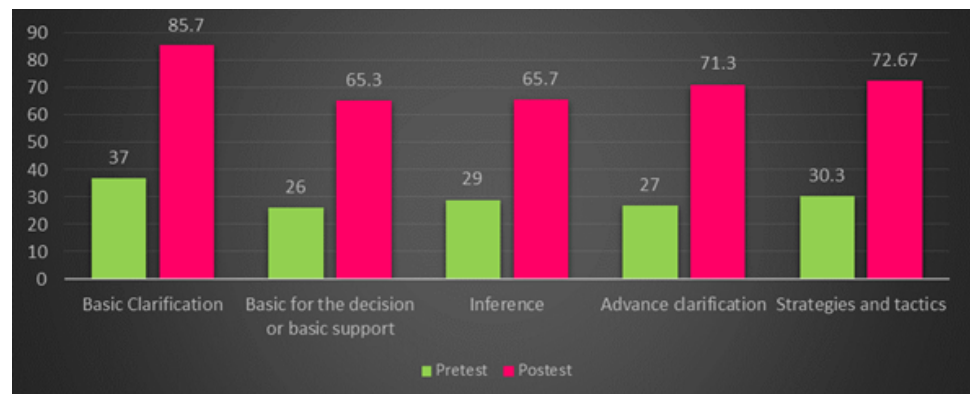

Figure 4: Experiment class critical thinking skill improvement.

The results of the calculation of the average score of the N-gain value per sub-indicator in the control class is 0.56. The results of improving critical thinking skills are detailed based on the control class for each indicator shown in Table 4.

TABLE 4:

TABLE 4. Percentage of N-gain value of experiment class

No	Category	Percentage
1	High	23%
2	Medium	77 %
3	Low	0 %

The improvement of students' critical thinking skills in the control class is classified into three categories, namely high, medium and low categories. The results of calculating the average score for the N-gain category for all students in the control class are shown in Table 5.

TABLE 5: Percentage of N-gain value of control class.

No	Category	Percentage
1	High	0.3%
2	Medium	97 %
3	Low	0 %

Based on the research data that has been described, the data is then analyzed using hypothesis testing to determine whether or not there is an increase in students' critical thinking skills in straight motion material. After the data is processed, it is obtained an increase in critical thinking skills.

Based on the results of research that has been done with data analysis, overall students experience an increase in critical thinking skills after being given treatment by applying Moodle-based Blended Learning on straight motion material which is better than just using E-Learning. The results of the research conducted stated that the application of Blended Learning could improve students' critical thinking skills. In addition, the Blended Learning strategy can improve critical thinking skills. This is in line with research conducted by Supri in his journal who stated that Blended Learning can improve critical thinking skills and can also be used as one of the learning innovations that follow the development of learning technology in the era of the industrial revolution 4.0. Learning is no longer just using face-to-face learning in class. however, it can be combined with online learning in the form of Blended Learning.

Based on the results of the analysis and discussion that have been presented, it can be concluded that there is an increase in students' critical thinking skills by applying Moodle-based Blended Learning to the material of straight motion. This learning can be used as an alternative in improving students' critical thinking skills. This can be shown by increasing students' critical thinking skills with an average N-gain value of 0.60 in the medium category.

Differences in the improvement of students' critical thinking skills in the experimental class and control class can be identified by testing the hypothesis using the independent sample t-test. Prior to the t-test, the data were tested with prerequisites, namely normality test and homogeneity test. The results of the normality and homogeneity test data processing stated that the two data were normally distributed and homogeneous. Furthermore, hypothesis testing is carried out to determine whether the initial

hypothesis is accepted or rejected. Based on the calculation, the pretest t_{count} is 1.07 and the posttest t_{count} is 1.53 while the t table is -2.048 so that $t_{count} > t_{table}$ and H_0 is rejected, while H_a is accepted. So from the results of this study it can be seen that the students of class X MIPA 4 and X MIPA 5 at SMAN 1 Cisolok overall experienced an increase in critical thinking skills after being given treatment. The experimental class treatment used Moodle-based Blended Learning by applying the Discovery Learning learning model, while the control class treatment used Moodle-based E-Learning by applying the Discovery Learning learning model.

4. CONCLUSION

Based on the results and discussion, it is concluded that the application of Moodle-based Blended Learning can improve students' critical thinking skills. Furthermore, there is no significant difference between the application of E-Learning and Blended Learning, the only difference being the application of the learning model used. Thus, it can be concluded that the application of Blended Learning can improve students' critical thinking skills in learning physics.

Acknowledgments

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