

## IMPLEMENTATION OF ASSESSMENT FOR LEARNING INSTRUMENTS IN PROJECT BASED LEARNING TO IMPROVE STUDENTS' CRITICAL THINKING SKILL

Fadhilah Oktaviyanti<sup>1</sup>, Viyanti Viyanti<sup>2</sup>

<sup>1,2</sup> Department of Mathematics and Science Education, Faculty of Teacher Training and Education, Lampung University, Lampung, Indonesia

Corresponding author email: [viyanti.1980@fkip.unila.ac.id](mailto:viyanti.1980@fkip.unila.ac.id)

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### Abstract :

The purpose of this research is to determine whether the Assessment for Learning instrument in project-based learning can enhance students' critical thinking skills and to describe each level of critical thinking skills achieved by students influenced by Assessment for Learning in project-based learning. The quantitative sample in this study is the X.1 grade students at State Islamic High School 1 Central Lampung for the 2024/2025 academic year, even semester. Meanwhile, the qualitative sample used consists of one student from each measurable of critical thinking skill. This study uses a mixed-method research approach with an Explanatory Sequential Design. The research results show that after the use of the AfL instrument in project-based physics learning, students' critical thinking skills improved. This is evident from the results of the average pretest and posttest score difference test using the Paired Sample T-Test, which showed a significance value of  $< 0.05$ . The improvement in critical thinking skills is supported by the calculation of N-Gain, which falls within the moderate criteria.

Keywords: Assessment for Learning, Critical Thinking Skill, PjBL

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## INTRODUCTION

Education is one of the important factors in the development of quality human resources. The Preamble of the 1945 Constitution mandates the government to educate the public about the nation's history and culture. Article 31 Paragraph 3 of the 1945 Constitution directs the Government to organize and implement the national education system to help all of Indonesia become fully human by enhancing moral and spiritual standards. To fulfill the moral obligation imposed on the Indonesian government as stated in the Preamble of the 1945 Constitution and to advance Indonesian education, the government is making improvements by changing policies in the field of education (Casillano & Casillano, 2024; Ramalisa & Oktavia, 2024). One of the efforts made is the launch of the independent learning curriculum by the Ministry of Education, Culture, Research, and Technology (Anggita et al., 2024; Haryanto et al., 2024).

The existence of the independent learning curriculum is highly relevant to the needs of students and the demands of education in the 21st century (Ernaini et al., 2023; Oktavia et al., 2023; Setiyani et al., 2024; Wardani et al., 2023). The independent curriculum is the answer to the intense competition in 21st-century education in the era of society 5.0 (Yulia & Desyandri, 2023; Oktavia et al., 2024). In

facing the era of society 5.0, the world of education plays an important role in the effort to improve the quality of human resources. In this era, students are expected to possess and be able to apply 21st-century skills known as the 6Cs, which include character, citizenship, critical thinking, creativity, collaboration, and communication (Harahap et al., 2023; (Fakhroni & Puotier, 2023; Habibi et al., 2024; Perdana et al., 2024).

The Merdeka Curriculum in physics education offers teachers the opportunity to create a more interactive learning environment focused on problem-solving and even project creation, thereby requiring critical thinking skills to understand concepts in their application, aligning with 21st-century competencies. Critical thinking is the skill of students to evaluate the accuracy of information obtained to determine its trustworthiness (Suriati et al., 2021). Students need to actively develop critical thinking skills during the learning process to achieve optimal results.

The level of critical thinking skills among students in Indonesia is still categorized as low. This is supported by the research results of Amelia & Chusni (2024), which show that students' critical thinking skills on renewable energy material are at achievement percentages of 24.2% in the low category, 20% in the medium category, and 20.3% in the high category. Analysis of the five indicators of critical thinking skills shows that the highest percentage of students falls under the indicator "elementary clarification" at 65.52%, while the lowest percentage is under the indicator "advanced explanation" at 37.21%. Other indicators, namely "basic support" "inference," and "strategies and tactics," are at an intermediate level.

The critical thinking skills of students in Indonesia still have the potential to be improved, one of which is by changing the learning process to foster students' interest and motivation in physics by using student-centered learning. Efforts that can be made include implementing a learning model that can enhance students' critical thinking skills. The learning model considered capable of facilitating students' critical thinking skills is the Project Based Learning model (Fahmi, 2022). According to (Nurdayanti et al., 2023), Project Based Learning (PjBL) is a project-based learning model that contains very engaging learning activities and is able to guide students to actively participate in learning activities.

PjBL is one of the good choices of learning models to facilitate the understanding of lesson material because it includes direct practical activities, so when encountering problems, students are able to respond critically to the issues, provide solutions, and make it easier for teachers to give students learning experiences (Dywan & Airlanda, 2020). In the implementation of the PjBL model, assessment instruments that can enhance critical thinking skills are needed. Assessment instruments in this context include various tools and strategies used to enhance the understanding of physics concepts, science process skills, and critical thinking abilities.

Ideally, assessment is conducted through three approaches: Assessment of Learning (final learning assessment), Assessment for Learning (assessment for learning), and Assessment as Learning (assessment as learning) (Subehi & Sriyanto, 2021). The instrument considered capable of enhancing students' critical thinking skills is Assessment for Learning (AfL). According to Rosana et al. (2020), AfL is an assessment for learning based on the process of collecting and interpreting evidence that contains a summary of the assessment on the provision of specific learning points at a certain time, which serves as a consideration of the quality of students' learning based on assessment criteria and assigns grades to represent the quality of the students. AfL has the principle that teachers and students play an important role in enhancing and perfecting learning in the classroom (Romadon et al., 2023). AfL focuses on monitoring the quality of the learning process and providing continuous feedback to guide learning and teaching, which can positively influence the learning process (Westbroek et al., 2020; Fernande et al., 2024; Hardyanti et al., 2023; Jusmaniar et al., 2024).

The assessment instruments used by teachers are also not specifically designed to measure students' critical thinking skills but only measure students' cognitive and psychomotor abilities in general. In fact, learning activities, especially in physics, which are project-based to enhance students' critical thinking skills, should be accompanied by assessment instruments that can measure and even improve students' critical thinking abilities. Assessment instruments are not only used to determine learning outcomes but also to enhance the quality of student learning.

Based on several studies, Assessment for Learning can be used in effective teaching and learning and can enhance student engagement and understanding of physics concepts, as well as serve merely as

a tool to measure students' critical thinking abilities. However, there has been no research that develops and implements the AfL instrument in project-based learning (PjBL) to enhance students' critical thinking skills. Based on the aforementioned problem description, a study titled "Implementation of Assessment for Learning Instruments in Project-Based Learning to Enhance Students' Critical Thinking Skills" will be conducted.

## RESEARCH METHOD

Contains the type of research, time and place of research, targets/objectives, research subjects, procedures, instruments and data analysis techniques as well as other matters related to the method of research. targets/objectives, research subjects, procedures, data and instruments, and data collection techniques, as well as data analysis techniques and other matters related to the method of research can be written in sub-chapters, with sub-headings. Sub-subheadings do not need to be notated, but are written in lowercase with a capital letter, TNR-11 bold, left aligned. As an example can be seen below.

### *Research Design*

This research is a development and experimental research. The product developed in this study is an instrument to measure critical thinking skills in project-based physics learning. The type of instrument developed is assessment for learning, which is an assessment that is carried out while learning is ongoing. This development research uses the procedure of research and development of instruments according to Thiagarajan (1974), namely the 4D model (Define, Develop, Disseminate). After the product is developed, an experimental research is carried out by implementing the product to see the improvement of the level of critical thinking skills of students. Experimental research. This study uses a mixed research approach with an Explanatory Sequential Design research design. The Mixed Method focuses on data collection and analysis and combines quantitative data and qualitative data. In Explanatory Sequential Design, the project begins with quantitative research, which is then followed by qualitative research that helps explain the quantitative results. The design form of the Explanatory Sequential Design research is shown in Figure 1.

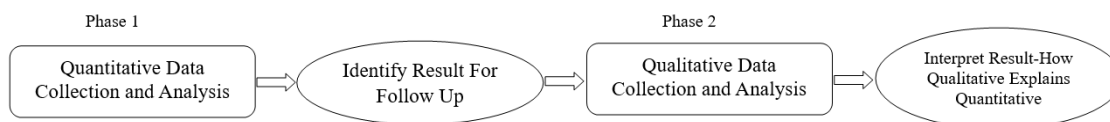


Figure 1. Explanatory Sequential Design

(Source: Creswell, 2022)

In quantitative research, the Pre-experimental Design method was used using the One Group Pretest - Posttest design. One Group Pretest - Posttest design used is to conduct research on one group of experiments. For qualitative research, the experimental group took a certain sample based on the results of quantitative research from the posttest score. Qualitative research is carried out with structured interviews with selected samples, then the qualitative data will be interpreted contextually which can describe the level of students' critical thinking skills that have been achieved from the posttest assessment.

### *Research Target/Subject*

Research targets/subjects (for qualitative research) or sample-population (for quantitative research) need to be explained clearly in this section. It is also necessary to write down the technique of obtaining subjects (qualitative research) and/or the sampling technique (quantitative research).

### **Research Procedure**

Procedures need to be described according to the type of research. How the research is carried out and the data will be obtained, needs to be described in this section. For experimental research, the type of design (experimental design) used should be written in this section.

### **Data Collection Techniques**

#### 1. Non-Test Techniques

Non-test data consists of semi-structured interview results for preliminary studies and structured interview results data for qualitative research as a reinforcement of the quantitative data that has been obtained. The collection technique used is a semi-structured interview technique conducted to classroom physics teachers related to real circumstances according to the needs of the researcher and structured interviews conducted to class X students according to a predetermined qualitative research sample.

#### 2. Test Techniques

The technique of collecting data on students' critical thinking skills is carried out using a written test in the form of a pretest - posttest in the form of a description. Pretest questions are given to students before being given treatment and posttest questions are given to students after being given treatment. Based on the pretest and posttest scores, the average N-gain score will be obtained. The written test given to students used for data collection consists of descriptive questions containing indicators of critical thinking skills.

### **Data analysis technique**

This study uses two types of data, namely quantitative data and qualitative data. Quantitative data consists of product development research data and product implementation research data. The data from the development research was analyzed using product validity tests and product reliability tests. Meanwhile, quantitative data from product implementation research in the form of pretest and posttest which will be analyzed using descriptive statistics and inferential data in the form of normality tests, hypothesis tests (Paired Sample T-Test), and N-Gain calculations. For qualitative data, it will be analyzed using the NVivo 15 program by visualizing the non-numerical data obtained.

## **RESULTS AND DISCUSSION**

### **AfL Instrument Validation Test**

At this stage, the assessment instrument for learning is to measure students' critical thinking skills which are validated by two expert lecturers and one physics teacher on the aspects of construction, substance, and language. The results of the validation assessment by each expert validation are presented in Table 1.

The field trial stage was carried out by testing the AfL instrument to measure students' critical thinking skills in learning physics on renewable energy topics that have been declared suitable for use by experts with revised notes and have been revised by researchers. This instrument was tested on 35 students in class X who were studying the topic of renewable energy. The test conducted on students aims to determine the empirical validity and reliability of the AfL instrument to measure students' critical thinking skills.

The data obtained was then analyzed using the Rasch model with the help of Ministep 4.8.2 software. The data obtained was tabulated in Ms. Excel software which was then converted and analyzed with the help of Ministep 4.8.2 software. Based on the results of the analysis using the Rasch model, the following information was obtained.

The results of the analysis of the AfL instrument for critical thinking skills from Ministep 4.8.2 software can be seen in Table 1.

Table 1. Item fit Analysis Assessment for Learning Critical Thinking Skills Instrument

Measure	Mnsq	Outfit Zstd	Pt-Measure Corr	Item
1.22	1.16	.68	.43	P4
-.43	1.13	.65	.71	P12
.93	1.12	.56	.66	P11
.26	1.09	.47	.47	P7
1.03	1.04	.26	.62	P6
-.64	1.05	.31	.49	P3
-.75	1.03	.21	.43	P1
-.43	1.03	.20	.41	P13
.46	1.00	.07	.58	P5
-.47	1.02	.16	.51	P8
.23	.98	.01	.55	P10
-.58	.82	-.79	.60	P2
.14	.79	-.98	.67	P14
-1.25	.63	-1.78	.62	P9

Based on Table, 5 of 14 items of assessment instruments for learning critical thinking skills have met the criteria of valid parameters of Boone, Stever & Yale (2014), namely: (1) accepted outmean square (MNSQ) value:  $0.5 < \text{MNSQ} < 1.5$ , (2) accepted Z-standard outfit value (ZSTD):  $-2.0 < \text{ZSTD} < +2.0$ ; (3) Point Measure Correlation (Pt Mean Corr) value accepted:  $0.4 < \text{Pt Measure Corr} < 0.85$ . Based on these criteria, it can be stated that all items of the statement are valid. Because it has met the MNSQ criteria, which means that the data is in accordance with the Rasch model, it meets the ZSTD criteria, which can be interpreted as the data has a rational possible value and meets the Point Measure Correlation (Pt Mean Correlation) criteria.

The reliability value is obtained by analyzing the Rasch Model assisted by ministep software with the provisions of the alpha Cronbach formula The alpha Cronbach value in reliability is the value of the interaction between person reliability and the overall reliability item. The value of person reliability and item reliability used is REAL RMSE because this value is the worst condition of lower limit reliability based on the instrument used (Sumintono & Widhiarso, 2015). The value of the person Reliability Assessment Instruments for Learning Capabilities critical thinking can be seen in Table 2.

Table 2. Item Reliability Analysis Assessment for Learning Critical Thinking Skills Instrument

	Total Score	Cnt	Measure	Model S.E.	Infit		Outfit	
					MNSQ	ZSTD	MNSQ	ZSTD
Mean	43.0	14.0	1.78	.50	1.00	-.03	.99	-.05
Sem	.9	.0	.21	.00	.06	.15	.06	.15
P.Sd	5.0	.0	1.24	.02	.34	.89	.33	.88
S.Sd	5.0	.0	1.26	.02	.35	.91	.34	.89
Max.	50.0	14.0	3.61	.55	1.89	1.86	1.75	1.63
Min.	33.0	14.0	-.60	.46	.52	-1.57	.48	-1.57
Realrmse	.54	True Sd	1.12	Separation	2.07	Person Reliability		.81
Modelrmse	.50	True Sd	1.14	Separation	2.25	Person Reliability		.84
S.E. Of Person Mean = .22								

Person Raw Score-To-Measure Correlation = 1.00

Cronbach Alpha (KR-20) Person Raw Score "Test" Reliability = .83

In Table 2, it is known that the average INFIT MNSQ and OUTFIT MNSQ are 0.99 and 0.99 respectively, meaning that the value is getting better because the value is close to the ideal, which is 1.00. The values of INFIT ZSTD and OUTFIT ZSTD are 0.01 and 0.00 respectively, meaning that the quality of the item is getting better because it is close to the ideal value of 0.0. The item reliability value is 0.79 which shows that the quality of question items with categories is sufficient based on criteria according to Sumintono & Widhiarso (2015).

**Implementation of the AfL instrument**

Quantitative data from the average pretest and posttest results of the critical thinking skill sample class were calculated using descriptive statistics with the IBM SPSS statistics 26.0 program. The following quantitative data of the average calculation results can be seen in Table 3.

Table 3. Quantitative Data from Experimental Class Research Results

Parameters Statistics	Pretest	Posttest
Number of Samples (N)	35	35
Lowest Rate	5	15
Highest Scores	50	90
Maximum Value	100	100
Average Value	26,14	56,71
Std. Deviation	9,858	15,948

Based on Table 7, it is known that the average of students' posttest scores appears to be greater than the average of pretest scores. This shows that the final skill of students to think critically increases from the initial skill of students to think critically after being given treatment. The data normality test was conducted to determine whether the quantitative data of the study were normally distributed or not. The normality test of the quantitative data of this study used the Kolmogorov-Smirnov Test with the help of the IBM SPSS statistical programs 26.0 with a significance level of 0.05.

The normality test of quantitative data in this study uses the Kolmogorov-Smirnov Test with the help of the IBM SPSS statistics 26.0 program program with a significance level of 0.05. The following are the results of the quantitative data normality test can be seen in Table 4.

Table 4. Normality Test Result

Valuation	Kolmogorov-Smirnov				Interpret
	Std. Devi	Statistic	N	Asymp. Sig.	
Pretest	9,858	0,146	35	0,56	Normal
Posttest	15,948	0,131	35	0,139	Normal

Table 4 shows that the significance value (Asymp. Sig.) in the pretest and posttest values is greater than 0.05 so it can be concluded that the two data are distributed normally. Both data are eligible to test the hypothesis using the Paired Sample T-Test parametric statistical test.

The hypothesis was tested using the Paired Sample T-Test parametric statistical test. The conditions for using the Paired Sample T-Test parametric statistical test are normal distributed data. The Paired Sample T-Test test was carried out by testing the average difference from the pretest and posttest score data. The results of hypothesis testing using the Paired Sample T-Test parametric statistical test can be seen in Table 5.

Table 5. Paired Sample T-Test Result

Pair	Paired Samples Test	
	Mean	Sig. (2-tailed)
Pretest-Posttest	-28,571	0,000

Based on Table 9, it can be seen that the value of sig. (2-tailed) from the results of the parametric statistical test of the Paired Sample T-Test is less than 0.05, then H0 is rejected and H1 is accepted. This means that there is a significant difference between the average pretest and posttest scores so that it can be concluded that there is an improvement in students' critical thinking skills after the use of AfL instruments in project-based physics learning.

The normalized gain calculation (N-Gain) was carried out to see the magnitude of the improvement in students' critical thinking skills after the use of the AfL instrument in project-based physics learning through pretest and posttest scores. The N-Gain calculation in this study is also used to support the results of hypothesis testing. The results of the N-Gain calculation can be seen in Table 6.

Table 6. N-Gain Calculation Results

Class	Highest N-Gain	Lowest N-Gain	Average N-Gain	Category
Experiment	0,85	0,08	0,39	Sedang

Table 6 shows the average value of N-Gain with the medium category. The N-Gain calculation can support the hypothesis testing that has been carried out, namely there is an increase in critical thinking skills from students' pretest and posttest scores after the use of AfL instruments in project-based physics learning. After the calculation of the average N-Gain, the N-Gain calculation for each indicator of critical thinking skill is carried out based on the score obtained on each question. Each question on the critical thinking skill instrument consists of 1 indicator of critical thinking skill. The results of the N-Gain calculation for each critical thinking indicator can be seen in Figure 2.

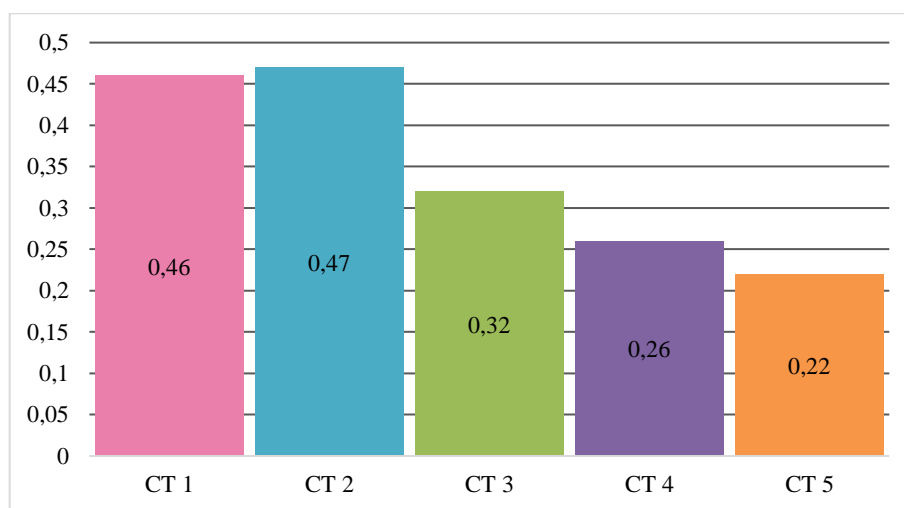


Figure 2. Results of N-Gain Calculation for Each Critical Thinking Skill Indicator

The graph in Figure 2 shows that the results of the average calculation of the N-Gain of each critical thinking skill indicator are different from the critical thinking indicators in the medium N-Gain category, namely elementary clarification, basic support, and advanced clarification. Meanwhile, the indicator of critical thinking skills with the N-Gain category, namely inference and strategies and tactics. This means that the improvement of critical thinking skills for each indicator can increase after the use of AfL instruments in project-based physics learning. The use of AfL instruments in project-based physics learning can improve critical thinking skills because of the AfL strategies in it. The strategy requires a change in classroom assessment practices by incorporating the seven elements of AfL in project-based learning (Astalini et al., 2024; Kumalasari et al., 2024; Zulkhi, 2024). The results of his research stated that AfL is very promising for effective learning with good learning outcomes. Students have a good performance after using the AfL instrument along with the strategy consisting of several elements in it. This element is the AfL's strategy in learning.

The advantage of this research is that the use of AfL instruments in project-based physics learning is able to encourage students to think critically and be actively involved in various activities in learning both individually and in groups (Habibi et al., 2024; Hardiyanti et al., 2023; Octavia et al., 2023). The use of the AfL instrument will also help provide *feedback* in improving the quality of project-based physics learning based on the next project based on the learning that has been carried out. This statement is supported by, that through AfL, teachers follow the progress of students during learning activities and use information about ongoing student learning to take corrective actions, thereby improving the

teaching process of students. In addition, the use of the AfL instrument can improve the ability to think critically on renewable energy materials based on the increase in *the posttest* value of the *pretest*. Similar research has never been done before. However, it can be supported by research from with the results of the research, namely that there was an increase in *the posttest* value from *the pretest* after the use of the AfL instrument in project-based physics learning on renewable energy materials.

## CONCLUSION

Based on the results of research that has been carried out in class X. even semester of the 2024/2025 school year, the conclusions obtained are as follows. The use of Assessment for Learning (AfL) instruments in project-based physics learning of renewable energy materials can improve students' critical thinking skills. This is based on the results of hypothesis testing showing that there is a difference in critical thinking skills based on the average pretest and posttest scores which can be seen through the sig score. (2-tailed) with a < value of 0.05. The results of hypothesis testing are supported by the results of the N-Gain calculation to see the magnitude of the increase in critical thinking skills, which is in the medium category. Based on the research findings, the author recommend to the researcher or the next user of the AfL instrument, if there are difficulties in assessing the learning process of individual students. The advice that the author can give is to use the highest and lowest range of scores/scores for the assessment carried out. The highest range of grades/scores can be taken from one student with good learning activity, then the lowest range can be taken from one student with poor learning activity. Then, the assessment of other students can be given a score/score between the highest and lowest ranges that have been obtained.

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