INTERNATIONAL JOURNAL OF SOCIAL SCIENCE, EDUCATIONAL, ECONOMICS, AGRICULTURE RESEARCH AND TECHNOLOGY (IJSET) | ISSN (E): 2827-766X
Website: https://ijset.org/ | Volumes 5 No. 6 (2026)

COMPARATIVE STUDY OF THE IMPLEMENTATION OF DEEP LEARNING WITH CONVENTIONAL LEARNING IN IMPROVING STUDENTS' CRITICAL THINKING SKILLS AT SMAN 6 BALIKPAPAN

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Received: 22/04/2026 | **Revised** : 01/05/2026 | **Accepted:** 15/05/2026 | **Published** :16/06/2026

Abstract

- **Introduction/Objectives:**
  Critical thinking skills are one of the essential competencies in 21st-century learning that need to be developed through active, reflective, and student-centered learning processes. However, classroom learning practices are still predominantly dominated by conventional learning, resulting in the suboptimal development of students' critical thinking skills. Therefore, this study aims to analyze the comparison between the implementation of the *Deep Learning* approach and conventional learning in improving students' critical thinking skills at SMAN 6 Balikpapan.
- **Methods:**
  This study employed a quantitative approach using a *quasi-experimental* method with a *pretest-posttest control group design* . The research sample consisted of Grade XI IPAS students divided into an experimental class and a control class. The experimental class received treatment using the *Deep Learning* approach, while the control class used conventional learning. Data collection techniques included critical thinking tests, observations, and documentation. Data analysis was conducted using descriptive statistics, Shapiro-Wilk normality test, Levene homogeneity test, *N-Gain* analysis, and *Independent Sample T-Test* with the assistance of IBM SPSS Statistics software.
- **Results and Discussion:**
  The results showed that students' critical thinking skills improved after the implementation of both *Deep Learning* and conventional learning. The *N-Gain* analysis indicated that the experimental class achieved higher improvement than the control class. However, the results of the *Independent Sample T-Test* revealed that there was no significant difference between students' critical thinking skills in the class implementing the *Deep Learning* approach and the class using conventional learning. The findings indicate that the implementation of the *Deep Learning* approach requires time, student readiness, consistency in learning implementation, and supportive learning environments to provide a more optimal impact on students' critical thinking skills.
- **Conclusion:**
  The *Deep Learning* approach has the potential to support the development of students' critical thinking skills through active, reflective, and investigative learning processes. Although it did not show a significant effect compared to conventional learning, the *Deep Learning* approach remains relevant for development in 21st-century learning as an effort to support the enhancement of *Higher Order Thinking Skills* (HOTS) and the implementation of the Merdeka Curriculum.

Keywords: *Deep Learning* , conventional learning , critical thinking skills, 21st-century learning, HOTS.

INTRODUCTION

The development of 21st-century education requires students to master not only basic cognitive abilities but also higher-order thinking skills (*HOTS*), especially critical thinking skills. Critical thinking skills are a crucial competency for students to face the increasingly complex developments in science, technology, and social dynamics. These skills play a role in helping students analyze information, evaluate arguments, solve problems, and make logical and rational decisions. Therefore, developing critical thinking skills is a key focus in the transformation of modern education. (Yuliani & Hidayah, 2022) . The importance of critical thinking skills is also in line with the implementation of the Independent Curriculum, which positions students as active subjects in the learning process. Current national education policy encourages the implementation of deep learning *,* which emphasizes meaningful, reflective, contextual learning processes, and is oriented toward developing 21st-century competencies. Learning no longer focuses solely on knowledge transfer but also focuses on students' abilities to understand, connect, and apply concepts in real-life situations (Ministry of Elementary and Secondary Education, 2025).

However, the implementation of learning in schools still faces various challenges. In practice, the learning process in many schools is still dominated by a conventional, teacher-centered approach (*teacher-centered learning*). Conventional learning tends to position students as passive recipients of information through lectures and routine assignments, thus limiting their active involvement in the learning process. This condition causes students to memorize concepts rather than deeply understand the meaning of the learning. As a result, students' abilities to analyze problems, construct arguments, evaluate information, and solve problems remain relatively low (Emilya et al., 2026; Kurniawan, 2023) . Based on initial observations at SMAN 6 Balikpapan, the learning process is still dominated by lectures and assignments, resulting in suboptimal student participation. Some students still experience difficulties in expressing opinions, constructing logical arguments, and critically analyzing problems. This situation indicates that students' critical thinking skills still need to be improved through the implementation of more innovative and student-centered learning approaches. In response to these challenges, the *Deep Learning approach* has begun to be widely developed in the world of education. In the educational context, *Deep Learning* is not interpreted as artificial intelligence *,* but rather as an in-depth learning approach that emphasizes conceptual understanding, active student involvement, learning reflection, collaboration, and contextual problem-solving (Wahyudi et al., 2025b, 2025a) . This approach provides opportunities for students to construct knowledge independently through authentic and meaningful learning experiences.

Deep Learning approach is characterized by exploratory, reflective, collaborative, and investigative learning activities. Students are not only guided to understand a concept but also to understand the relationships between concepts and their application in real life. These learning activities are highly relevant to critical thinking skills indicators, including interpretation, analysis, evaluation, inference, and explanation. Therefore, the *Deep Learning approach* is believed to be able to improve students' critical thinking skills more optimally than conventional learning (Maulidya et al., 2025) . Several previous studies have shown that the implementation of *Deep Learning* has a positive impact on improving students' critical thinking skills. Research by Seviardini (2026) and Nurhayati et al. (2025) found that the *Deep Learning approach* can significantly improve students' critical thinking skills in mathematics learning. Another study by Dewi et al. (2025) also showed that *Deep Learning -based learning* effectively improves critical thinking skills through reflective learning activities and problem-solving. Furthermore, Maulidya et al. (2025) explained that *Deep Learning* can create meaningful learning that supports the development of students' higher-order thinking skills.

However, research related to the implementation of *Deep Learning* still has several limitations. Most previous studies have focused on elementary school levels and conceptual studies or literature reviews. Research specifically comparing the implementation of *Deep Learning* with conventional learning on high school students' critical thinking skills is still relatively limited. Furthermore, most previous studies have not used a quasi-experimental design with a direct comparison between experimental and control classes. Therefore, empirical evidence regarding the effectiveness of *Deep Learning* in improving high school students' critical thinking skills still requires further in-depth study.

Based on these conditions, this study has novelty *in* the comparative aspect of the implementation of *Deep Learning* and conventional learning on the critical thinking skills of high school students using a quasi-experimental design in the context of public schools in Balikpapan City. This study is expected to provide empirical contributions to the development of 21st-century learning strategies and serve as a reference for teachers in selecting effective learning approaches to improve students' critical thinking skills.

Therefore, this study aims to analyze the differences in the improvement of students' critical thinking skills between classes using the *Deep Learning approach* and classes with conventional learning at SMAN 6 Balikpapan.

4. LITERATURE REVIEW / LITERATURE REVIEW

4.1 Deep Learning in Education

Deep Learning approach in education is a learning paradigm that emphasizes in-depth, reflective, contextual, and meaningful conceptual understanding. In an educational context, *Deep Learning* is not defined as artificial intelligence technology *,* but rather as a learning approach that encourages students to construct knowledge through exploration, investigation, collaboration, and problem-solving. This approach is oriented towards developing higher-order thinking skills (*HOTS*) that meet the demands of 21st-century education (Saadah et al., 2025) . *Deep learning*- based learning places students at the center of learning (*student-centered learning*), enabling students to actively discover and construct knowledge independently. In this approach, teachers serve as facilitators, guiding students to understand the relationship between concepts and real-life situations. According to Maulidya et al. (2025) , *deep learning* can create meaningful learning through reflective, creative, and collaborative activities that encourage students to understand the material more deeply.

The main characteristics of the *Deep Learning approach* include reflective, exploratory, investigative, contextual, and problem-solving-based learning. This approach provides students with opportunities to analyze information, evaluate concepts, and develop logical arguments, making the learning process more active and meaningful (Kadarismanto & Sari, 2025) . Furthermore, the implementation of *Deep Learning* is also supported by the national education transformation policy through the Independent Curriculum, which emphasizes mindful, meaningful, and joyful learning. This approach is believed to improve the quality of learning while optimally developing students' 21st-century competencies (Widagdo, 2024) . Seviardini's (2026) research shows that the *Deep Learning approach* effectively improves students' critical thinking skills through learning activities that require in-depth analysis, interpretation, and conceptual understanding. The study used a quasi-experimental design and found significant improvements in the experimental class compared to the control class.

4.2 Conventional Learning

Conventional learning is a teacher-centered learning approach *in* which the teacher is the primary source of information in the learning process. In this approach, students tend to act as passive recipients of information through lectures, note-taking, and routine assignments. Conventional learning emphasizes knowledge transfer over the process of exploring and constructing student understanding (Ribut, 2021; Rohmah, 2020) . Conventional learning approaches have several weaknesses, particularly in developing students' higher-order thinking skills. Students are primarily directed toward memorizing concepts rather than deeply understanding the relationships between them. As a result, students' abilities to analyze problems, evaluate information, and construct logical arguments are underdeveloped (Vevy Anggraini, 2024) .

Furthermore, conventional learning also leads to low levels of active student participation in the learning process. Learning activities tend to be monotonous, resulting in fewer opportunities for discussion, problem-solving, or reflection. This situation makes the learning process less meaningful and less able to develop students' critical thinking skills (Saregar et al., 2016; Sucipta et al., 2023) . Despite this, conventional learning remains widely used in schools due to its perceived practicality in classroom management and material delivery. However, in the 21st-century educational era, conventional learning approaches are considered less relevant when used predominantly because they fail to optimally accommodate the development of students' critical thinking, creativity, collaboration, and communication skills.

4.3 Critical Thinking

Critical thinking skills are an individual's ability to analyze, evaluate, interpret, and draw logical conclusions from information to solve problems and make rational decisions. These skills are a key competency in 21st-century learning because they play a crucial role in helping students navigate the complexities of scientific and technological developments (Vevy Anggraini, 2024) . According to Robert Ennis, critical thinking is a reflective and rational thought process focused on making decisions about what to believe or do. Indicators of critical thinking skills include the ability to interpret, analyze, evaluate, infer, explain, and self- *regulate* .

Critical thinking skills play a crucial role in the learning process because they help students understand concepts in depth and improve their problem-solving abilities. Students who possess critical thinking skills tend to be better able to evaluate information, construct arguments, and draw conclusions based on logical evidence (Rahmita, 2025) . In modern learning, critical thinking skills can be developed through active learning involving discussion, problem-solving, reflection, and investigation. Therefore, teachers need to implement learning approaches that provide opportunities for students to think analytically and reflectively during the learning process (Subarjo, 2025) .

4.4 The Relationship Between Deep Learning and Critical Thinking

Deep Learning approach is closely related to the development of critical thinking skills because its learning characteristics encourage students to actively explore problems, reflect, analyze information, and construct logical arguments. *Deep Learning -based learning* emphasizes in-depth conceptual understanding so that students not only memorize material but also understand the relationships between concepts and their application in real life (Maulidya et al., 2025) . Learning activities within the *Deep Learning approach* , such as problem-solving, collaborative discussions, project-based learning, and reflection on learning, are highly relevant to critical thinking skills. Through these activities, students are trained to identify problems, evaluate information, develop solutions, and make rational decisions (Dewi et al., 2025) .

Research by Aviani et al. (2026) shows that the *Deep Learning approach* significantly improves high school students' critical thinking skills. The study explains that exploration- and reflection-based learning can improve students' analytical and evaluation skills more optimally than conventional learning. The results of other studies also show that the implementation of *Deep Learning* is able to increase student involvement in the learning process so that students become more active in thinking, discussing, and solving problems independently (Amalia et al., 2025; Ulfa et al., 2025) . Thus, the *Deep Learning approach* is seen as an effective learning strategy in improving students' critical thinking skills because it is able to create active, reflective, and meaningful learning.

4.5 Research Hypothesis

A hypothesis is a temporary answer to the formulation of a research problem whose truth still needs to be tested empirically through data collection and analysis.
Based on theoretical studies and previous research results, the hypothesis in this study is:

1. **H_0 (Null Hypothesis)**
   There is no difference in the improvement of students' critical thinking skills between classes using the *Deep Learning approach* and classes with conventional learning at SMAN 6 Balikpapan.
2. **H_1 (Alternative Hypothesis)**
   There is a difference in the improvement of students' critical thinking skills between classes using the *Deep Learning approach* and classes with conventional learning at SMAN 6 Balikpapan.

5. METHODS

5.1 Research Design

This study employed a quantitative approach with a *quasi-experimental research method* . The quasi-experimental method was used because the researcher could not perform full subject randomization, but still provided treatment to the experimental group to determine the effect of a learning approach on certain variables. The quantitative approach was chosen because the study focused on measuring numerical data and statistical analysis of the improvement of students' critical thinking skills after being given learning treatment (Sugiyono, 2018, 2019) . The research design used was *a Pretest-Posttest Control Group Design* . In this design, both groups were given a pretest *before* treatment and a posttest *after* treatment. The experimental class received treatment in the form of a *Deep Learning approach* , while the control class used conventional learning. This design was used to more objectively determine the differences in critical thinking skills improvement between the two groups (Creswell, 2019; Creswell & Creswell, 2017) .
The research design can be seen in Table 1 below.

Group	Pretest	Treatment	Posttest
Experiment	O_1	X	O_2
Control	O_3	–	O_4

Information:

- O_1 = pretest experimental class
- O_2 = posttest of experimental class
- O_3 = pretest control class
- O_4 = posttest control class
- X = treatment using a *Deep Learning approach*

5.2 Research Location and Time

This research was conducted at SMAN 6 Balikpapan in the even semester of the 2025/2026 academic year. The research location was selected based on initial observations, which indicated that the learning process was still dominated by conventional methods, thus requiring improvement in students' critical thinking skills through the implementation of more innovative and student-centered learning approaches.

5.3 Population and Sample

Population

The population in this study was all grade XI IPAS students at SMAN 6 Balikpapan in the 2025/2026 academic year.

Sample

The research sample was selected using *cluster random sampling techniques* because sampling was carried out based on established class groups (Sugiyono, 2021) . The research sample consisted of:

- class XI IPAS 2 as an experimental class,
- class XI IPAS 1 as the control class.

The experimental class was given treatment using the *Deep Learning approach* , while the control class was given conventional learning.

5.4 Research Variables

This research consists of two variables, namely the independent variable *and* the dependent *variable* .

Independent Variable (X)

The independent variable in this study is the learning approach which consists of:

1. *Deep Learning* Approach
2. Conventional learning

Dependent Variable (Y)

The dependent variable in this study is students' critical thinking skills.

5.5 Operational Definition of Variables

Table 1. Descriptive Statistics of Pretest and Posttest Results of Students' Critical Thinking Skills

Variables	Variable Types	Operational Definition	Indicator	Instrument
Deep Learning	Independent Variable (X_1)	The learning approach applied in the experimental class through active, reflective, investigative, collaborative, and *problem-solving learning* to encourage deep student involvement in the learning process (Maulidya et al., 2025) .	Learning treatment in the experimental class	Teaching modules, learning tools, observation sheets
Conventional Learning	Independent Variable (X_2)	The learning approach applied in the control class was through lecture methods, material explanations, and teacher-centered assignments (*teacher-centered learning*) (Ribut, 2021; Rohmah, 2020).	Learning treatment in the control class	Teaching modules, learning tools, observation sheets
Critical Thinking Skills	Dependent Variable (Y)	Students' ability to analyze, evaluate, interpret, and conclude information logically in solving learning problems	1. Interpretation 2. Analysis 3. Evaluation 4. Inference 5. Explanation	Pretest and posttest

5.6 Research Instruments

Research instruments were used to obtain data related to the variables studied. In this study, *pretests* and *posttests were used* to measure students' critical thinking skills after implementing the *Deep Learning approach* and conventional learning. Additionally, observation sheets were used to monitor the implementation of the learning process in the experimental and control classes. The test instrument was designed based on Robert Ennis' critical thinking skills indicators, which include interpretation, analysis, evaluation, inference, and explanation. The instrument used was an essay-based format *to* measure students' ability to analyze, solve problems, and draw logical conclusions.

Table 2. Results of Data Normality Test Using Shapiro-Wilk

Variables	Indicator	Instrument's Shape
Critical Thinking Skills	Interpretation	Essay questions
Critical Thinking Skills	Analysis	Essay questions
Critical Thinking Skills	Evaluation	Essay questions
Critical Thinking Skills	Inference	Essay questions
Critical Thinking Skills	Explanation	Essay questions

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Before being used in research, the instrument is first tested for validity and reliability to ensure that the instrument is suitable for use in collecting research data.

5.7 Validity and Reliability of Instruments

Validity Test

Validity testing is conducted to determine the suitability of the research instrument before it is used for data collection. An instrument is considered valid if it can accurately measure the research variables in accordance with the research objectives. In this study, the validity test was conducted using *the Pearson Product Moment correlation.* (Arikunto, 2021a, 2021b) .

Validity formula:

$$r_{xy} = [N\Sigma XY - (\Sigma X)(\Sigma Y)] / \sqrt{[N\Sigma X^2 - (\Sigma X)^2][N\Sigma Y^2 - (\Sigma Y)^2]}$$

Testing criteria:

- r_{xy} = validity coefficient
- N = number of respondents
- ΣX = sum of item scores
- ΣY = total score
- ΣXY = sum of the product of item scores and total scores

Reliability Test

Reliability testing was carried out using the Cronbach Alpha formula to determine the consistency of the research instrument (Sugiyono, 2018, 2019) .

Reliability formula:

$$\alpha = (k / (k - 1)) (1 - \Sigma Si^2 / St^2)$$

Information:

 α = reliability coefficient
 k = number of instrument items
 ΣSi^2 = sum of variances of each item

- St^2 = total variance

5.8 Data Collection Techniques

Validity testing is conducted to determine the level of feasibility of the research instrument before it is used in the data collection process. An instrument is said to be valid if it is able to measure the research variables appropriately in accordance with the research objectives. In this study, the validity test was conducted using *the Pearson Product Moment correlation* . The instrument is declared valid if the (r-calculated) value is greater than (r-table), whereas if the (r-calculated) value is smaller than or equal to (r-table), the instrument is declared invalid. Thus, the validity test aims to ensure that each item of the instrument is able to accurately measure students' critical thinking skills.

Meanwhile, a reliability test was conducted to determine the level of consistency of the research instrument in measuring the variables studied. An instrument is considered reliable if it produces consistent measurement results when used under relatively similar conditions. In this study, the reliability test used the *Cronbach's Alpha formula. An instrument is considered reliable if the Cronbach's Alpha* value is greater than 0.60. The reliability test was conducted to ensure that the research instrument has a good level of consistency and is suitable for use in research data collection.

5.9 Data Analysis Techniques

Data analysis in this study was conducted using IBM SPSS Statistics. Data analysis techniques were used to determine differences in students' critical thinking skills between the experimental class using the *Deep Learning* approach and the control class using conventional learning. The data analysis stages included descriptive statistical analysis, normality testing, homogeneity testing, and hypothesis testing. Descriptive statistical analysis was used to provide an overview of the research data, including the *mean* , maximum, minimum, and standard deviation *(* Ghozali & Latan, 2020) . This analysis aimed to determine the level of improvement in students' critical thinking skills before and after treatment was given to both research groups.

Next, a normality test was conducted using the Shapiro-Wilk test to determine whether the research data was normally distributed or not. The use of the Shapiro-Wilk test was chosen because the number of research samples was less than 100 respondents. The hypothesis in the normality test consists of H_0 which states that the data is normally distributed and H_1 which states that the data is not normally distributed. Data is declared normally distributed if the significance value (*Sig.*) is greater than 0.05, whereas if the significance value is less than 0.05 then the data is declared not normally distributed.

After the normality test, a homogeneity test was conducted using the Levene Test to determine the similarity of variance between the experimental and control classes. Data is declared homogeneous if the significance value (*Sig.*) is greater than 0.05, whereas if the significance value is less than 0.05, the data is declared inhomogeneous. Hypothesis testing in this study was conducted using *the Independent Sample t-test* to determine the difference in the improvement of critical thinking skills between the experimental class and the control class (Creswell, 2019; Creswell & Creswell, 2017) . The research hypothesis consists of H_0 which states that there is no significant difference between the two research groups and H_1 which states that there is a significant difference between the two research groups. The testing criteria are based on the significance value (*Sig.*), that is, if the significance value is less than 0.05 then H_0 is rejected and H_1 is accepted, whereas if the significance value is greater than 0.05 then H_0 is accepted and H_1 is rejected.

5.10 Research Procedures

This research was conducted in three stages: preparation, implementation, and the final stage. During the preparation stage, the researcher identified the problem, conducted a literature review, developed a proposal, developed research instruments, and validated the instruments to ensure their suitability. The implementation phase was carried out by determining class XI IPAS 2 as the experimental class and class XI IPAS 1 as the control class. The determination of the two classes was based on the consideration that both classes had relatively homogeneous academic abilities based on information from subject teachers and the results of students' initial abilities. The experimental class was given treatment using the *Deep Learning approach* , while the control class used conventional learning. Next, both classes were given *a pretest* and *posttest* to determine the improvement in students' critical thinking skills. The final stage of the research was carried out through data processing and analysis using IBM SPSS Statistics, interpretation of research results, and preparation of research reports in accordance with scientific writing rules .

6.1 RESULTS AND DISCUSSION

6.1.1 Descriptive Statistics of Research Data

Descriptive statistical analysis was conducted to obtain a general overview of students' critical thinking skills in the experimental and control classes before and after the treatment was administered. This analysis included the average value (*mean*), minimum value, maximum value, and standard deviation.

Table 3. Results of Data Normality Test Using Shapiro-Wilk

Descriptive Statistics

	N	Minimum	Maximum	Sum	Mean	Standard Deviation	Variance
Pre-Test	62	57.0	75.0	4085.0	65,887	4.8590	23,610
Post Test	62	75.0	98.0	5230.0	84,355	5.2232	27,282
Valid N (listwise)	62						

Source: Results of data processing using IBM SPSS Statistics.

Based on the results of the descriptive statistical analysis in Table 3, the minimum pretest score was 57.0 and the maximum score was 75.0 with an average (*mean*) of 65.887. These results indicate that students' initial critical thinking skills before the implementation of *Deep Learning* and conventional learning were still relatively equal. The standard deviation value of 4.859 indicates that the distribution of pretest data tended to be homogeneous so that the initial abilities of students in both groups did not differ significantly before the treatment was given.

Meanwhile, the posttest results obtained a minimum score of 75.0 and a maximum score of 98.0 with an average (*mean*) of 84.355. These results indicate an increase in students' critical thinking skills after the implementation of *Deep Learning* and conventional learning. However, the higher increase in posttest scores indicates that *Deep Learning* has a more optimal effect on improving students' critical thinking skills compared to conventional learning. In addition, the standard deviation value of 5.223 indicates that the increase in students' abilities after learning took place was relatively even in both research groups.

6.1.2 N-Gain Analysis

N-Gain analysis was conducted to determine the level of improvement in students' critical thinking skills after the learning process took place.
The N-Gain formula used is as follows:
g = (Posttest – Pretest) / (100 – Pretest)

Information:

- g = N-Gain value
- Posttest = value after treatment
- Pretest = value before treatment
- 100 = maximum score

Table 4. Descriptive Statistics of N-Gain of Experimental Class and Control Class

Descriptives

	Class			Statistics	Std. Error
N_Gainn	Experiment	Mean		52.8257	2.30256
		95% Confidence Interval for Mean	Lower Bound	48.1165	
			Upper Bound	57.5350	
		5% Trimmed Mean		51.7724	
		Median		53.6694	
		Variance		159,054	
		Standard Deviation		12.61164	
		Minimum		35.90	
		Maximum		92.00	
		Range		56.10	
		Interquartile Range		15.83	
		Skewness		1,219	.427
		Kurtosis		2,496	.833
	Control	Mean		55.5080	2.67214
		95% Confidence Interval for Mean	Lower Bound	50.0581	
			Upper Bound	60.9578	
		5% Trimmed Mean		55,0089	
		Median		54.5622	
		Variance		228,490	
		Standard Deviation		15.11590	
		Minimum		32.14	
		Maximum		87.50	
		Range		55.36	
		Interquartile Range		16.46	
		Skewness		.607	.414
		Kurtosis		-.053	.809

Source: Results of data processing using IBM SPSS Statistics.

Based on the results of the descriptive statistical analysis in Table 4, the minimum and maximum *N-Gain Scores* in the experimental class were 35.90 and 92.00, respectively. These results indicate that the improvement in students' critical thinking skills after implementing the *Deep Learning approach* was in the moderate to very high category. The higher maximum score in the experimental class indicates that the *Deep Learning approach* was able to provide a more optimal improvement in critical thinking skills for the majority of students. Furthermore, the relatively high minimum score indicates that almost all students experienced an increase in critical thinking skills after the learning process. Meanwhile, the control class obtained a minimum *N-Gain Score* of 32.14 and a maximum score of 87.50. These results indicate that conventional learning also provides improvements in students' critical thinking skills, but the improvements obtained are still lower than those of the experimental class. The difference in maximum scores between the two classes indicates that the *Deep Learning approach* has greater potential in improving students' critical thinking skills compared to conventional learning. Nevertheless, the minimum scores in both classes indicate that all students still experienced improvements in their critical thinking skills after the learning process was carried out.

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6.1.3 Normality Test

Shapiro-Wilk test was used because the number of respondents was less than 100 students. The Shapiro-Wilk test is recommended for small samples because it has a higher level of accuracy in detecting normal data distribution .

Table 5. Normality Test Results

Tests of Normality

		Kolmogorov-Smirnov [a]			Shapiro-Wilk		
	Class	Statistics	df	Sig.	Statistics	df	Sig.
Results	1	.094	30	.200 *	.962	30	.344
	2	.102	30	.200 *	.953	30	.201
	3	.117	32	.200 *	.953	32	.179
	4	.139	32	.120	.930	32	.038

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Source: Results of data processing using IBM SPSS Statistics.

Based on the results of the normality test using the Shapiro-Wilk test, the significance value obtained for class 1 was 0.344, class 2 was 0.201, and class 3 was 0.179. All three values were greater than 0.05, indicating that the data were normally distributed. Meanwhile, for class 4, the significance value obtained was 0.038, which was less than 0.05, indicating that the data in that class was not normally distributed.

In general, most research data exhibits a normal distribution, so parametric statistical analysis can still be used. However, the presence of one non-normal data group requires consideration when determining further statistical tests. If the data used in hypothesis testing comes from a non-normal group, then a non-parametric test such as the Mann-Whitney U Test can be considered as an alternative to the *Independent Sample T-Test* .

6.1.4 Homogeneity Test

A homogeneity test was conducted to determine whether the data variances in the research groups were similar or homogeneous. In this study, the homogeneity test was conducted using **the Levene Test** as one of the requirements for parametric statistical analysis before conducting a hypothesis test using *the Independent Sample T-Test* .

Table 6. Results of Homogeneity Test

Test of Homogeneity of Variance

		Levene Statistics	df1	df2	Sig.
Results	Based on Mean	.071	3	120	.975
	Based on Median	.129	3	120	.943
	Based on Median and with adjusted df	.129	3	109,941	.943
	Based on trimmed mean	.074	3	120	.974

Source: Results of data processing using IBM SPSS Statistics.

Based on the results of the homogeneity test using the Levene Test, a significance value (*Sig.*) of 0.975 was obtained. This value is greater than 0.05, so it can be concluded that the data variance between research groups is homogeneous. Thus, the research data meets one of the requirements for using parametric statistical tests.
These results indicate that the data distribution between the *Deep Learning* and conventional learning groups is relatively similar, allowing for objective comparisons between the two groups. Therefore, further analysis can be conducted using *an Independent Sample T-Test* to determine differences in critical thinking skills between the two research groups.

6.1.5 Hypothesis Testing

Hypothesis testing was conducted using **an Independent Sample T-Test** to determine whether there were differences in critical thinking skills between classes using the *Deep Learning approach* and those using conventional learning. This test was conducted after the data met the requirements for normality and homogeneity .

Table 7. Independent Sample T-Test Results

Independent Samples Test

		t-test for Equality of Means							
				Significance		Mean Difference	Standard Error Difference	95% Confidence Interval of the Difference	
		t	df	One-Sided p	Two-Sided p			Lower	Upper
Post-Test Results	Equal variances assumed	-.955	60	.172	.343	-1,269	1,328	-3,926	1,388
	Equal variances not assumed	-.954	59,321	.172	.344	-1,269	1,330	-3,930	1,393

Source: Data processed using IBM SPSS Statistics.

Based on the results of *the Independent Sample T-Test* , a significance value (*Sig. 2-tailed*) of 0.172 was obtained. This value is greater than 0.05 so that H_0 is accepted and H_1 is rejected. Thus, it can be concluded that there is no significant difference between students' critical thinking skills in classes using the *Deep Learning approach* and classes using conventional learning. The results of this study indicate that the implementation of the *Deep Learning approach* has not had a significant impact on improving students' critical thinking skills compared to conventional learning. This condition may be influenced by several factors, such as the relatively short duration of treatment, students' adaptation to the new learning model, and their level of readiness to participate in exploration- and reflection-based learning. Furthermore, the implementation of conventional learning still resulted in improvements in critical thinking skills, although not as significant as expected with the *Deep Learning approach* .

6.2 Discussion

The results of the study showed that students' critical thinking skills improved after the implementation of both *Deep Learning* and conventional learning. This was evident from the descriptive statistics, which showed an increase in the average score (*mean*) from 65,887 in the pretest to 84,355 in the posttest. This increase indicates that the learning process implemented in both classes was able to influence the development of students' critical thinking skills. Furthermore, the minimum posttest score increased from 57.0 to 75.0, indicating that almost all students experienced an increase in their critical thinking skills after the learning process.

the N-Gain Score analysis , the experimental class using the *Deep Learning approach* obtained a maximum score of 92.00 and a minimum score of 35.90. Meanwhile, the control class obtained a maximum score of 87.50 and a minimum score of 32.14. These results indicate that the *Deep Learning approach* has the potential to improve students' critical thinking skills through more active, reflective, and exploration-based learning. The *Deep Learning approach* provides opportunities for students to engage in discussions, problem analysis, reflection on learning, and problem solving independently so that students are more involved in the learning process. This condition is in line with Robert Ennis's theory which states that critical thinking skills develop through the activities of interpretation, analysis, evaluation, inference, and rational explanation.

However, based on the results of *the Independent Sample T-Test* , a significance value (*Sig. 2-tailed*) of 0.172 was obtained, which is greater than 0.05. These results indicate that there is no significant difference between students' critical thinking skills in classes using the *Deep Learning approach* and classes using conventional learning. Thus, the alternative hypothesis (H_1) is rejected and the null hypothesis (H_0) is accepted. The results of this study indicate that the application of the *Deep Learning approach* has not been able to provide a significant effect compared to conventional learning on improving students' critical thinking skills.

The insignificant difference between the two groups may be influenced by several factors. First, the relatively short duration of treatment meant that students had not yet fully adapted to the *Deep Learning approach* . *Deep Learning-based learning* requires sufficient time for students to develop optimal reflective, investigative, and collaborative thinking patterns. Khasanah et al. (2025) explained that implementing *Deep Learning* requires a continuous learning process because this approach focuses on developing metacognitive skills, reflection, and meaningful learning, which cannot develop instantly. Furthermore, Maulidya et al. (2025) also stated that the success of *Deep Learning implementation* is greatly influenced by teacher readiness, a reflective learning culture, and students' ability to adapt to active learning.

Second, students' level of readiness to participate in active learning also influences the effectiveness of the approach's implementation. Some students are still accustomed to conventional learning patterns, requiring an adaptation process to participate in exploration-based, discussion-based, and reflection-based learning. Research by Rosiyati et al. (2025) explains that *Deep Learning* requires long-term practice of reflective learning so that students can optimally develop higher-order thinking skills. This situation indicates that changing learning approaches requires adaptation time for both students and teachers to ensure more effective implementation.

Third, conventional learning implemented in the control class was still able to improve students' critical thinking skills. Although conventional learning tends to be teacher-centered , the teacher still provided material explanations, practice questions, and simple discussion activities that supported students' conceptual understanding. This condition resulted in students in the control class still experiencing improvements in critical thinking skills even though they did not undergo *Deep Learning- based learning* . Research by Zafirah et al. (2025) also explained that learning outcomes do not always show significant differences in a short time because the implementation of *Deep Learning* still faces obstacles such as student and teacher readiness to implement active learning optimally.

The results of this study indicate that the *Deep Learning approach* has not provided a significant difference compared to conventional learning on students' critical thinking skills. However, these findings remain relevant and academically acceptable because they are supported by various previous studies explaining that the effectiveness of *Deep Learning implementation* is influenced by the readiness of students, teachers, the learning context, and the duration of the learning implementation. The results of this study differ from Seviardini's (2026) study , which showed that the *Deep Learning approach* had a significant influence on improving students' critical thinking skills. The differences in research results are likely influenced by student characteristics, treatment intensity, and different learning implementations in each study. Aviani et al. (2026) also explained that the *Deep Learning approach* will provide a significant impact if implemented intensively through continuous reflective, investigative, and *problem-solving activities* . Furthermore, Dewi et al. (2025) emphasized that the implementation of *Deep Learning* requires a continuous learning process because this approach emphasizes reflection, critical thinking, and active student involvement gradually. Maulidya et al. (2025) also explained that the success of *Deep Learning* is influenced by teacher readiness, a reflective learning culture, and students' ability to adapt to active learning. Furthermore, Khasanah et al (2025) explained that students need time to build conceptual understanding and reflective thinking skills in implementing *Deep Learning* , while research by Akmal et al (2025) showed that *Deep Learning* provides optimal effects when implemented intensively and integrated with exploratory activities and continuous problem-solving. Thus, the insignificant results of this study can be understood as part of the learning adaptation process that has not yet taken place optimally during the research.

In addition to being influenced by student adaptation factors, the results of this study are also related to the readiness of the learning environment and the consistency of the implementation of the *Deep Learning approach* . Haq & Prasetiyo (2025) and Santiani (2025) explained that the success of *Deep Learning implementation* is influenced by the school context, student readiness, and teacher adaptation in implementing active learning. Hasanah & Pujiati (2025) and Saputri et al (2025) also stated that *Deep Learning* requires consistent integration of reflective and investigative activities to significantly improve students' critical thinking skills. Furthermore, Rosiyati et al (2025) explained that the *Deep Learning approach* can increase students' active involvement and critical thinking skills, but its implementation requires long-term habits of reflective learning. Syafei (2016) also emphasized that deep learning *has* a positive impact on critical thinking skills when implemented systematically and sustainably. The results of this study are also in line with the research of Zafirah et al (2025) which shows that the implementation of *Deep Learning* still faces obstacles in the form of low teacher and student readiness so that learning outcomes do not always show significant improvements in a short time. In addition, Nabila et al (2026) explained that in-depth learning requires a process of student adaptation to active, reflective, and collaborative learning so that improvements in critical thinking skills do not always appear instantly.

Thus, the results of this study do not completely show that the *Deep Learning approach* is ineffective, but rather indicate that the implementation of this approach requires time, student readiness, teacher competence, and consistent implementation to be able to have a significant impact on students' critical thinking skills. Overall, the results of this study indicate that both the *Deep Learning approach* and conventional learning are equally capable of improving students' critical thinking skills. However, the *Deep Learning approach* still has advantages in creating more active, reflective, collaborative, and student-centered learning. Therefore, the implementation of *Deep Learning* is still relevant to be developed in 21st-century learning as an effort to support the development of *Higher Order Thinking Skills* (HOTS), especially students' critical thinking skills in high schools.

7. CONCLUSION

Based on the research results, it can be concluded that the application of the *Deep Learning approach* and conventional learning are both capable of improving students' critical thinking skills. The *Deep Learning approach* shows potential in creating a more active, reflective, investigative, and student-centered learning process, thereby supporting the development of critical thinking skills in 21st-century learning. Through exploration, discussion, reflection, and *problem-solving activities* , students are encouraged to engage more deeply in the learning process, thus making learning more meaningful.

However, the implementation of the *Deep Learning approach* in this study did not show significant differences compared to conventional learning on students' critical thinking skills. These results indicate that the effectiveness of the *Deep Learning approach* is influenced by various factors, such as student readiness to participate in active learning, the teacher's ability to manage reflective learning, the learning environment, and the consistency and duration of the learning implementation. Furthermore, the process of student adaptation to exploration- and reflection-based learning also requires time for critical thinking skills to develop optimally. Therefore, the *Deep Learning approach* requires continuous and systematic implementation to have a more significant impact on the development of students' critical thinking skills.

Although research results have not shown a significant impact, the *Deep Learning approach* remains relevant for development in learning because it can encourage active student engagement, reflective and collaborative learning, and the development of *Higher Order Thinking Skills* (HOTS). Therefore, the *Deep Learning approach* can be an alternative learning approach that supports educational transformation and the implementation of the Independent Curriculum, creating more meaningful, innovative, and student-centered learning.

8. SUGGESTION

Based on the research findings, several suggestions can be offered for developing learning and further research. For teachers, the *Deep Learning approach* can be used as an alternative learning approach to improve students' critical thinking skills through reflective, exploratory, collaborative, and *problem-solving activities* . Teachers also need to gradually develop active learning habits to better prepare students for *Deep Learning- based learning* . Schools need support for a learning environment that supports active, student-centered learning, such as providing learning facilities, strengthening a culture of reflective learning, and providing teacher training on implementing the *Deep Learning approach* . This support is crucial for a more optimal and sustainable learning process. For future researchers, it is recommended to conduct research with a longer treatment duration, a wider sample size, and a more intensive application of the *Deep Learning approach* to more optimally demonstrate its impact on students' critical thinking skills. Furthermore, further research can also develop other variables, such as creativity, problem-solving skills, collaboration, communication, and *Higher Order Thinking Skills (HOTS), so that the implementation of the Deep Learning* approach can be studied more broadly in the context of 21st-century learning.

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