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A Comparison of Students' Critical Thinking Skills Based on Assessment Techniques in Natural and Social Sciences (IPAS)

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Abstract

Critical thinking is a fundamental competency in Natural and Social Sciences (IPAS) learning; however, school-based assessment practices remain dominated by conventional techniques that primarily measure learning outcomes and provide limited insight into students' thinking processes. This study aimed to compare the critical thinking skills of students assessed through authentic and conventional assessment techniques and to determine whether the two approaches produced significantly different outcomes. A quantitative quasi-experimental approach with a nonequivalent control group design was employed. The sample comprised 68 students, including 35 students in the experimental group and 33 students in the control group. Data were collected using an essay-based critical thinking test developed according to the FRISCO indicators: Focus, Reason, Inference, Situation, Clarity, and Overview. The data were analyzed using descriptive statistics, normality and homogeneity tests, N-Gain analysis, and an independent-samples t test. The findings showed that the experimental group achieved a higher mean posttest score than the control group (73.94 vs. 63.00). The data met the assumptions of normality ($p > .05$) and homogeneity ($p = .236$), while the independent-samples t test revealed a

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statistically significant difference between the two groups, $t = 4.430$, $p < .001$. The N-Gain analysis also indicated greater improvement among students assessed through authentic assessment than among those assessed through conventional assessment. These findings demonstrate that authentic assessment is more effective in supporting the development of students' critical thinking skills in IPAS learning. This study contributes practical evidence that assessment practices incorporating process-oriented and performance-based tasks can provide a more comprehensive measure of students' reasoning and strengthen the integration of critical thinking into elementary science and social science instruction.

Keywords: Authentic Assessment; Critical Thinking Skills; Elementary Education; FRISCO Indicators; IPAS Learning

INTRODUCTION

Assessment is an essential component of the learning process because it provides information about students' attainment of competencies and serves as a basis for decisions intended to improve learning quality. Assessment is concerned not only with learning outcomes but also with the learning process, the development of abilities, and the skills demonstrated by students during learning activities. Therefore, the assessment system used by teachers should provide a comprehensive representation of students' abilities so that learning objectives can be achieved optimally.

Twenty-first-century education requires students not only to master knowledge but also to possess higher-order thinking skills (*Higher Order Thinking Skills*/HOTS), one of which is critical thinking. Critical thinking is a highly important competency because it enables students to analyze information, evaluate alternative solutions to problems, and make decisions based on logical reasoning. In elementary-school IPAS learning, critical thinking is particularly necessary because the subject requires not only conceptual mastery but also the ability to connect concepts with phenomena encountered in everyday life.

Nevertheless, assessment practices in elementary schools are still dominated by conventional assessment that emphasizes final learning outcomes through written tests. Such assessment tends to measure students' ability to remember and understand concepts and therefore does not fully represent their thinking processes. Consequently, teachers obtain

limited information about students' abilities to analyze, evaluate, and solve problems during learning. This condition has prevented the optimal development of critical thinking skills.

As an alternative, authentic assessment is considered more compatible with the characteristics of twenty-first-century learning because it evaluates students through real activities conducted during the learning process. Authentic assessment evaluates not only knowledge but also skills and attitudes through techniques such as performance, project, product, observation, and *peer assessment*. Students are therefore given opportunities to demonstrate their thinking skills in real situations, enabling teachers to obtain a more complete picture of their competency development.

In IPAS learning, authentic assessment provides students with opportunities to observe, investigate, discuss, communicate findings, and produce learning products. These activities encourage the development of critical thinking through identifying problems, seeking information, analyzing data, constructing arguments, and drawing conclusions from evidence. Authentic assessment therefore functions not only as an evaluation instrument but also as an integral part of learning that can improve the quality of students' learning experiences.

Recent research has consistently indicated that authentic assessment can strengthen critical thinking by requiring students to demonstrate knowledge through contextualized tasks, reflection, evidence-based reasoning, and performance. Afrizal (2022) documented its role in supporting critical thinking during online learning, while Sulistyo et al. (2023) showed that authentic assessment grounded in a scientific approach can measure and develop critical reasoning among elementary-school students. Similar conclusions have been reported in elementary and science-learning contexts by Aini et al. (2023), Cholifah et al. (2024), Martatiyana and Madani (2023, 2024), and Umam et al. (2024).

At the implementation level, studies emphasize that authentic assessment must align tasks, performance criteria, feedback, and learning outcomes. Achmad et al. (2022) and Angkat et al. (2024) highlighted its relevance to competency-oriented curricula, whereas Arsita and Fathoni (2022) and Faizah et al. (2024) identified teacher workload, instrument design, and limited assessment literacy as recurring constraints. These findings indicate that an integrated design is necessary if authentic assessment is expected to capture knowledge, skills, and dispositions comprehensively.

Research on critical thinking in elementary education also demonstrates that the construct should be measured through subject-specific and higher-order tasks. Anggraeni et al. (2022), Dewi et al. (2023), Gumala et al. (2024), and Susanti et al. (2025) reported continuing variation in elementary students' critical thinking achievement, while Haryanti et al. (2022), Himmah et al. (2024), Lestari et al. (2024), Kumala et al. (2025), and Lailiyah et al. (2025) showed that inquiry-oriented, project-based, technology-supported, and scientific learning can strengthen these skills. Instrument-development and research-mapping studies likewise stress the need for valid indicators and authentic tasks (Khasanah & Prasetyo, 2023; Triansyah et al., 2023; Pratiwi et al., 2026). The importance of science-process skills and HOTS-oriented assessment is further reinforced by Rahmaniati and Aulia (2025) and Jupri et al. (2025).

Although authentic assessment has been widely studied, most previous research has focused on developing authentic assessment instruments or examining their general effectiveness. Studies that specifically compare students' critical thinking skills under authentic and conventional assessment techniques in elementary-school IPAS remain relatively limited. Moreover, authentic assessment in several previous studies primarily evaluated knowledge, while the integrated assessment of skills through projects, products, and performance had not yet been implemented. These conditions indicate a research gap that requires further investigation.

To address this gap, the novelty of the present study lies in implementing an authentic assessment technique that integrates *performance assessment*, *project assessment*, *product assessment*, and *peer assessment* in Grade V elementary-school IPAS learning. These assessment techniques were directly compared with conventional assessment to identify differences in students' critical thinking skills. Critical thinking was measured using the FRISCO indicators—*Focus*, *Reason*, *Inference*, *Situation*, *Clarity*, and *Overview*—thereby providing a more comprehensive representation of students' critical thinking development.

This study aimed to examine the critical thinking skills of students participating in learning assessed through authentic and conventional assessment techniques and to analyze differences in critical thinking skills between the two techniques in Grade V elementary-school IPAS. The findings are expected to contribute to the development of learning-evaluation theory and to provide a reference for teachers in selecting more effective assessment techniques for developing students' critical thinking skills.

METHODS

This study employed a quantitative *quasi-experimental* approach because the researchers could not control all external variables influencing the implementation of the study. A *Nonequivalent Control Group Design* was used, involving an experimental class and a control class. The experimental class received authentic assessment, whereas the control class used conventional assessment. Both classes completed a *pretest* before the treatment and a *posttest* after instruction to identify changes in students' critical thinking skills.

The study was conducted at UPTD SD Negeri 37 Parepare during the second semester of the 2025/2026 academic year. The population consisted of all 68 Grade V students in two classes. The sample was selected through non-probability purposive sampling, resulting in Class VA as the experimental class with 35 students and Class VB as the control class with 33 students.

The independent variable was the assessment technique, consisting of authentic assessment in the experimental class and conventional assessment in the control class. Authentic assessment was implemented through *performance assessment*, *project assessment*, *product assessment*, and *peer assessment* during IPAS learning. Conventional assessment, by contrast, consisted of written tests and individual assignments that focused more strongly on learning outcomes. The dependent variable was students' critical thinking skills, measured using the FRISCO indicators: *Focus*, *Reason*, *Inference*, *Situation*, *Clarity*, and *Overview*.

Data were collected using tests, observation, and documentation. The primary research instrument was an essay test developed from the FRISCO critical thinking indicators and the Grade V IPAS topic of Energy Transfer Among Living Organisms. Before use, the instrument was validated by experts to ensure the appropriateness of its content, construction, and language. Observation was used to obtain data on the implementation of authentic assessment during learning, while documentation supplemented the research data with student lists, scores, photographs of learning activities, and other supporting documents.

Data were analyzed using descriptive and inferential statistics with SPSS Statistics version 27. Descriptive statistics were used to describe minimum and maximum scores, mean, median, mode, standard deviation, and the distribution of students' critical thinking scores in the experimental and control classes. The prerequisite tests included the Shapiro-Wilk normality test and Levene's Test for homogeneity. After the assumptions of normality

and homogeneity were satisfied, an *Independent Sample t-test* at a significance level of 0.05 was used to determine differences in critical thinking skills between the groups. Improvement in critical thinking was also analyzed using *N-Gain* and classified into low, moderate, and high categories to evaluate the effectiveness of authentic assessment relative to conventional assessment.

RESULTS

This study compared the critical thinking skills of Grade V students whose IPAS learning used authentic assessment with those whose learning used conventional assessment. Data were obtained from critical thinking tests administered before (*pretest*) and after (*posttest*) the treatment in both groups.

Descriptive Statistics

Descriptive statistical analysis was conducted to describe students' critical thinking skills in the experimental and control classes before and after the treatment.

Table 1. Descriptive Statistics of Pretest and Posttest Scores

Class	Number of Students	Pretest Mean	Posttest Mean	Standard Deviation
Experimental	35	45.54	73.94	14.80
Control	33	45.45	63.00	17.21

Table 1 shows that the two classes had relatively similar initial abilities. The experimental class had a mean *pretest* score of 45.54, while the control class had a mean score of 45.45. After the treatment, the experimental class's mean *posttest* score increased to 73.94, whereas the control class's mean *posttest* score increased to 63.00. These results indicate that the improvement in critical thinking skills was greater in the experimental class than in the control class.

In addition to the increase in mean scores, the score distribution showed that most students in the experimental class achieved higher scores than they had before the treatment.

N-Gain Analysis

N-Gain analysis was conducted to determine the degree of improvement in students' critical thinking skills after the learning process.

Table 2. N-Gain Analysis Results

Class	Low	Moderate	High
Experimental	3	25	7
Control	14	19	0

The *N-Gain* analysis showed that the experimental class included 7 students in the high category, 25 in the moderate category, and 3 in the low category. In contrast, no students in the control class reached the high category; 19 were in the moderate category and 14 were in the low category.

These results indicate that the improvement in critical thinking skills was greater in the class using authentic assessment than in the class using conventional assessment.

Normality Test

Before hypothesis testing, the data were examined using the Shapiro-Wilk normality test.

Table 3. Normality Test Results

		Kolmogorov-Smirnov		
	Class	Statistic	Df	Sig
N-Gain Score	Experimental	0.133	35	0.124
	Control	0.107	33	0.200

The significance values for both groups exceeded 0.05, indicating that the students' critical thinking data were normally distributed.

Homogeneity Test

The homogeneity of the two groups' variances was examined using Levene's Test.

Table 4. Homogeneity Test Results

Test of Homogeneity of Variances			
	Levene Statistic	F	Sig
N-Gain Score	Equal variances assumed	1.432	0.236

The significance value of 0.236 (> 0.05) indicates that the variances of the two groups were homogeneous, satisfying the requirement for a parametric *Independent Sample t-test*.

Independent Sample t-test

An *Independent Sample t-test* was conducted to determine whether the experimental and control classes differed in critical thinking skills.

Table 5. Independent Sample t-test Results

Levene's Test for Equality of Variances						
		F	Sig	t	Df	Sig. (2-tailed)
N-Gain Score	Equal variances assumed	1.432	0.236	4.430	66	<0.001
				4.447	65.697	

The *Independent Sample t-test* results showed a Levene's Test significance value of 0.236 > 0.05; therefore, the two groups had homogeneous variances and the results in the Equal variances assumed row were used. The Sig. (2-tailed) value was < 0.001, which was below 0.05. Accordingly, H_0 was rejected and H_1 was accepted, indicating a significant difference in critical thinking skills between the class using authentic assessment and the class using conventional assessment.

DISCUSSION

The findings showed a difference in critical thinking skills between students in the class using authentic assessment and those in the class using conventional assessment in IPAS learning. This difference was evident in the experimental class's higher mean *posttest* score. In addition, the *Independent Sample t-test* produced a significance value of < 0.001, indicating that authentic assessment had a more favorable effect on students' critical thinking skills than conventional assessment.

The improvement in the experimental class occurred because authentic assessment functioned not only as a tool for measuring learning outcomes but also as part of an active learning process. During learning, students had opportunities to observe phenomena, participate in discussions, complete projects, produce products, and conduct *peer assessment*. These activities provided more meaningful learning experiences because students were directly involved in constructing knowledge and solving problems related to the learning material.

Through authentic assessment, students were required not only to recall concepts but also to analyze information, connect concepts with real situations, justify their selected

answers, and formulate conclusions based on evidence obtained during learning. This process indirectly trained the critical thinking indicators of *Focus*, *Reason*, *Inference*, *Situation*, *Clarity*, and *Overview* (FRISCO). Consequently, the improvement in the experimental class was greater than that in the control class using conventional assessment.

By contrast, learning in the control class relied more heavily on conventional assessment in the form of written tests and individual assignments. This technique emphasized the attainment of learning outcomes rather than students' thinking processes. Consequently, students had fewer opportunities to develop their abilities to analyze, evaluate, and solve problems. Although scores improved after learning, the improvement was smaller than that in the class receiving authentic assessment.

These findings are consistent with Cholifah et al. (2024) and Martatiyana and Madani (2024), who emphasized that authentic assessment evaluates students' ability to apply knowledge in context and allows teachers to observe the learning process more comprehensively than outcome-only tests. Authentic tasks provide students with opportunities to demonstrate reasoning through activities connected to real situations, thereby producing richer evidence of competence.

The findings also support Khasanah and Prasetyo (2023), who explained that authentic assessment reveals students' thinking processes more comprehensively because it is conducted through various real activities. Teachers can therefore identify not only students' level of content mastery but also how they acquire knowledge, formulate problem-solving strategies, and make decisions based on available information.

The findings are also consistent with Afrizal (2022) and Umam et al. (2024), who showed that authentic assessment promotes reflection, analysis, contextual problem solving, and evidence-based judgment. Such activities correspond to the cognitive processes represented in the FRISCO indicators and help explain why the experimental class achieved a stronger increase in critical thinking.

The results also support Sulistyo et al. (2023), who stated that authentic assessment based on a scientific approach can be used both to assess and to develop elementary-school students' critical thinking skills. Authentic assessment functions not only as a tool for evaluating learning outcomes but also as a learning strategy that encourages students to think systematically, logically, and reflectively throughout the learning process.

The present study differs from previous research through its integrated implementation of several authentic assessment techniques in IPAS learning. Previous studies generally examined only one form of authentic assessment or focused on instrument development. This study integrated performance, project, product, and *peer assessment* within a single instructional sequence and then directly compared the approach with conventional assessment. Critical thinking was also measured using the FRISCO indicators, providing a more comprehensive representation of students' critical thinking development.

The *N-Gain* analysis further strengthened the findings. More students in the experimental class achieved moderate and high improvement categories than in the control class. This result indicates that authentic assessment not only produced a statistically significant difference but also resulted in greater improvement in critical thinking during IPAS learning.

Overall, the effectiveness of authentic assessment in improving critical thinking can be attributed to its student-activity-centered characteristics. Assessment was conducted continuously throughout learning, giving students opportunities to improve their understanding, develop thinking skills, and receive direct feedback from teachers and peers. Authentic assessment therefore functions not only as an evaluation tool but also as an effective learning strategy for developing elementary-school students' critical thinking skills in IPAS.

CONCLUSION

The study showed that Grade V students taught using authentic assessment techniques demonstrated better critical thinking skills than those taught using conventional assessment techniques in IPAS. Statistical analysis indicated that the experimental class had a higher mean critical thinking score than the control class after the treatment. The *N-Gain* analysis also showed that the experimental class achieved a better category of improvement than the control class.

The *Independent Sample t-test* produced a significance value of < 0.001, indicating a significant difference between students taught using authentic assessment and those taught using conventional assessment. Thus, authentic assessment was more effective in improving students' critical thinking skills in IPAS learning.

These findings imply that authentic assessment can serve as an alternative assessment strategy that not only measures learning outcomes but also develops critical thinking through students' active involvement in a range of learning activities. Teachers are therefore encouraged to integrate performance, project, product, and *peer assessment* into instruction to support the attainment of twenty-first-century competencies.

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