

Comparing Project-Based Learning Assisted by Canva and Teaching Aids on Elementary Students' Critical Thinking Skills

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Abstract

This study aimed to compare the effects of Canva-assisted and teaching-aid-assisted Project-Based Learning (PjBL) on the critical thinking skills of fifth-grade students in Science and Social Studies (IPAS) at SD Negeri 1 Mojowetan, Blora Regency, Indonesia. A quantitative quasi-experimental design with a nonequivalent control group was employed involving 36 students, with 18 students assigned to the Canva-assisted PjBL group and 18 to the teaching-aid-assisted PjBL group. Critical thinking skills were measured using validated essay tests administered before and after the intervention. Data were analyzed using descriptive statistics, paired-samples *t* tests, and two-way ANOVA with IBM SPSS Statistics 26. The results showed that both instructional approaches significantly improved students' critical thinking skills. The Canva-assisted PjBL group demonstrated a mean gain of 39.11 points, while the teaching-aid-assisted PjBL group improved by 34.72 points. The Canva-assisted group also achieved a higher posttest mean score (84.11) than the teaching-aid-assisted group (79.39), with a statistically significant between-group difference ($F = 9.784, p < .001$). These findings indicate that the integration of Canva within PjBL was associated with greater critical-thinking gains than PjBL supported by conventional teaching aids in this sample. However, because the study involved a small sample from a single school and did not isolate the independent effect of Canva, the findings should be generalized cautiously. Future research should use larger multisite samples and report standardized effect sizes and confidence intervals to strengthen the interpretation of educational significance.

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Introduction

Twenty-first century education requires students not only to master conceptual knowledge but also to possess higher-order thinking skills that enable them to adapt to the rapid development of science, technology, and continuously changing social dynamics. One of the essential competencies that students must develop is critical thinking skills. This competency constitutes one of the four key competencies of the 4C framework critical thinking, creativity, communication, and collaboration which are considered fundamental for addressing global challenges in the era of the Industrial Revolution 4.0 and Society 5.0 (Thornhill-Miller et al., 2023; Trilling & Fadel, 2009).

The importance of developing critical thinking skills is also emphasized in Law Number 20 of 2003 concerning the National Education System of Indonesia, which states that education is a conscious and planned effort to develop students' potential so that they become individuals who are faithful, knowledgeable, creative, independent, and responsible. In line with this policy, the implementation of the Merdeka Curriculum emphasizes student-centered learning through the strengthening of critical reasoning, creativity, collaboration, and digital literacy as key characteristics of the Pancasila Student Profile. Therefore, learning processes in elementary schools should be

designed to provide meaningful, contextual, and challenging learning experiences that stimulate students' thinking abilities.

In Science and Social Studies (IPAS), critical thinking is a fundamental competency because students are expected to construct scientific understanding by interpreting observations, analyzing relationships among variables, evaluating evidence, drawing justified conclusions, explaining scientific reasoning, and monitoring the accuracy of their own thinking. These cognitive processes correspond to Facione's critical thinking framework, which comprises interpretation, analysis, evaluation, inference, explanation, and self-regulation (Facione, [1992](#)). The topic of light provides a particularly appropriate context for developing these competencies because students must investigate observable phenomena such as reflection, refraction, and shadow formation, compare experimental evidence with prior conceptions, and justify conclusions using scientific reasoning rather than everyday intuition. Consequently, learning activities on light should extend beyond factual knowledge acquisition to engage students in inquiry, evidence-based reasoning, and reflective problem solving. This perspective is consistent with the (National Research Council, 2018), which emphasizes that effective science education should cultivate inquiry practices, logical reasoning, and the ability to construct explanations from empirical evidence.

Recent evidence suggests that opportunities for developing critical thinking in Indonesian elementary classrooms remain limited. Rather than indicating a generalized deficiency among all Indonesian students, previous classroom-based studies have reported that teacher-centred instruction and limited inquiry activities reduce students' opportunities to analyse evidence, evaluate alternative explanations, and solve authentic problems (Purwati et al., [2025](#); Sarwanto et al., [2021](#)). These findings indicate the need for instructional approaches that actively engage students in collaborative investigation and higher-order thinking.

A similar situation was identified during a preliminary classroom observation conducted by the researchers in January 2026 before the intervention. Classroom practices were documented using a structured observation sheet adapted from the syntax of Project-Based Learning and indicators of student learning activities. To reduce observer bias, observations were guided by predetermined criteria, field notes were completed immediately after each lesson, and the observation results were subsequently discussed with the classroom teacher to verify the accuracy of the recorded findings. The observation showed that instruction was predominantly lecture-based, supported mainly by textbooks and routine exercises. Students had few opportunities to formulate questions, investigate scientific phenomena, evaluate evidence, or communicate their reasoning. Consistent with these observations, the initial critical thinking assessment indicated low performance across all six dimensions of Facione's framework, suggesting that students required learning experiences that more effectively promoted inquiry, evidence-based reasoning, and collaborative problem solving.

A preliminary classroom observation conducted by the researchers before the implementation of the study indicated that fifth-grade IPAS learning at SDN 1 Mojowetan was still predominantly teacher-centred, relying mainly on lectures, textbooks, and routine exercises. The observation was carried out during the preliminary stage of the research using a structured classroom observation sheet adapted from the learning activity indicators in the Project-Based Learning framework. To minimize observer bias, classroom activities were recorded using predetermined observation criteria, documented through field notes, and subsequently verified

through discussion with the classroom teacher. The observation revealed that students had limited opportunities to formulate questions, investigate scientific phenomena, evaluate evidence, or communicate their reasoning during classroom learning. Consequently, students' engagement in higher-order thinking activities remained limited, indicating that the existing instructional practices had not yet optimally supported the development of critical thinking skills. These preliminary findings provided the rationale for conducting the present quasi-experimental study to compare two media-supported implementations of Project-Based Learning designed to foster critical thinking in elementary Science and Social Studies (IPAS) learning.

One instructional approach that is theoretically well suited to address this challenge is Project-Based Learning (PjBL). Rooted in constructivist learning theory, PjBL engages students in authentic investigations that require them to construct knowledge through inquiry, collaboration, and reflection rather than through passive information reception. The learning phases of PjBL provide a clear cognitive mechanism for developing critical thinking as conceptualized by Facione (2020). During the initial problem orientation and driving-question phase, students interpret contextual information and identify relevant scientific issues. In the planning and investigation phases, they analyze relationships among concepts, collect and organize evidence, and compare alternative sources of information. While developing project solutions, students evaluate the credibility and relevance of evidence, justify decisions, and revise their approaches when necessary. The presentation and discussion phases require students to formulate inferences from the evidence collected and provide logical explanations for their findings to peers and teachers. Finally, reflection and project evaluation encourage self-regulation, as students monitor their reasoning processes, evaluate the strengths and weaknesses of their work, and identify strategies for improvement. Through these interconnected phases, PjBL systematically supports the development of all six dimensions of critical thinking rather than focusing solely on knowledge acquisition.

These mechanisms are particularly relevant to the IPAS topic of light because students are required to investigate observable phenomena such as reflection, refraction, and shadow formation, interpret experimental observations, analyze relationships between variables, evaluate competing explanations, and communicate evidence-based conclusions. Consequently, the inquiry-oriented structure of PjBL provides an instructional environment that aligns closely with the cognitive demands of scientific learning. Empirical studies support this theoretical rationale. (Andriani & Zelenovic, [2026](#)) reported that PjBL enhances higher-order thinking skills and academic achievement by engaging students in authentic problem-solving activities, while (Ledoh et al., [2025](#)) found that collaborative project work promotes active learning, communication, creativity, and teamwork. Together, these findings suggest that the effectiveness of PjBL arises not merely from project completion but from the sequence of cognitive processes embedded within each phase of the learning model.

The implementation of Project-Based Learning (PjBL) in contemporary classrooms can be supported by digital technologies that facilitate students' investigation, collaboration, and communication processes. One educational platform with considerable potential is Canva, which enables students to create infographics, presentations, videos, and other visual representations that may support the organization and communication of scientific ideas. These features can help make abstract concepts more accessible by allowing students to represent information in multiple visual formats. However, the educational value of digital media should not be assumed to arise from

technology alone. According to cognitive load theory, digital learning environments may either facilitate or hinder learning depending on how information is presented and whether instructional demands exceed learners' cognitive capacity. For elementary school students, excessive visual elements, animations, or interface complexity may increase extraneous cognitive load and reduce opportunities for meaningful learning.

Moreover, the effectiveness of Canva-assisted learning depends on several contextual factors, including the availability of digital devices, reliable internet access, students' digital literacy, and teachers' ability to provide age-appropriate instructional scaffolding. At the elementary level, students require structured guidance when selecting information, designing visual products, and reflecting on their learning to ensure that technology functions as a cognitive support rather than a source of distraction. When implemented with appropriate pedagogical guidance, Canva can facilitate collaborative inquiry, visual communication, and reflective learning. Previous studies have reported that Canva-based learning is associated with higher student engagement, improved digital literacy, and enhanced opportunities for exploratory and reflective learning (Sofyan et al., [2025](#); Sutinah & Suryaman, [2025](#)). Accordingly, the present study examines Canva not as an inherently superior technology but as a digital learning medium whose effectiveness depends on its integration within the pedagogical structure of Project-Based Learning.

In addition to digital learning media, concrete teaching aids remain an important instructional resource in elementary science education because they enable students to transform abstract concepts into observable phenomena through direct manipulation and experimentation. In the present study, the teaching aids consisted of a light experiment kit, including flashlights, plane mirrors, convex lenses, prisms, opaque and transparent objects, and projection screens, which were used to investigate concepts such as light propagation, reflection, refraction, and shadow formation. These materials were selected because they allow students to observe scientific phenomena directly and generate empirical evidence through hands-on investigation.

The use of these teaching aids represents a theoretically meaningful comparison with Canva-assisted learning rather than merely an alternative instructional medium. Whereas Canva primarily supports learning through digital visualization, information organization, and collaborative presentation, the teaching aids emphasize concrete manipulation and sensory experience, consistent with Piaget's view that elementary school students learn effectively through interactions with tangible objects during the concrete operational stage. Consequently, both instructional conditions were grounded in Project-Based Learning but differed in the primary mode through which students constructed scientific understanding: digital visual representation in the Canva-assisted condition and physical experimentation in the teaching-aid-assisted condition. This comparison enabled the study to examine whether differences in students' critical thinking skills were associated with the type of representational support embedded within the same pedagogical model.

Previous studies have shown that contextual teaching aids enhance conceptual understanding, learning motivation, and student engagement by providing authentic learning experiences closely related to students' everyday environments (Hayon et al., [2024](#); Khairunnisa & Sukma, [2026](#)). Accordingly, the teaching aids used in this study served not merely as supplementary classroom materials but as an instructional condition with a distinct theoretical basis for supporting scientific inquiry and conceptual development.

Although numerous studies have demonstrated the effectiveness of PjBL, Canva, and teaching aids individually, research integrating these three components in elementary school IPAS learning remains relatively limited, particularly in the context of improving students' critical thinking skills. The integration of PjBL assisted by the Canva application and teaching aids is expected to create more active, engaging, contextual, and developmentally appropriate learning experiences for elementary school students. Through systematically designed projects, students are encouraged not only to produce learning products but also to develop the ability to analyze problems, evaluate information, formulate solutions, and communicate their findings effectively.

Based on the foregoing discussion, this study aims to compare the effects of Canva-assisted and teaching-aid-assisted Project-Based Learning (PjBL) on the critical thinking skills of fifth-grade students at SDN 1 Mojowetan. Rather than proposing a new instructional theory, this study contributes empirical evidence regarding how different forms of instructional support—digital visual media and concrete teaching aids—function within the same Project-Based Learning framework to facilitate the development of critical thinking skills. By comparing two media-supported implementations of PjBL, the study extends current evidence on the role of representational support in project-based science learning at the elementary level. The findings are expected to assist teachers in selecting instructional media that align with learning objectives, students' developmental characteristics, and the demands of Science and Social Studies (IPAS) instruction while supporting the development of twenty-first-century competencies.

Method

This study employed a quantitative approach using a quasi-experimental method to examine the effectiveness of the Project-Based Learning (PjBL) model assisted by the Canva application and teaching aids in improving elementary school students' critical thinking skills. The selection of a quasi-experimental design was based on the fact that individual random assignment of participants was not feasible, as class groupings had already been determined by the school administration.

The research design adopted was the Nonequivalent Control Group Design involving two experimental groups receiving different treatments. The first experimental group received instruction using the PjBL model assisted by the Canva application, whereas the second experimental group received instruction using the PjBL model assisted by teaching aids. Both groups were administered a pretest before the treatment and a posttest after the treatment to determine changes in students' critical thinking skills. The research design is presented in Table 1.

Table 1. Nonequivalent Control Group Design

Group	Pretest	Treatment	Posttest
Experimental Group 1	O ₁	X ₁	O ₂
Experimental Group 2	O ₃	X ₂	O ₄

Notes:

- X₁ = PjBL model assisted by the Canva application
- X₂ = PjBL model assisted by teaching aids
- O₁ and O₃ = Pretest of critical thinking skills
- O₂ and O₄ = Posttest of critical thinking skills

The study was conducted at SDN 1 Mojowetan, Banjarejo District, Blora Regency, during the second semester of the 2025/2026 academic year. The research site was selected based on preliminary observations indicating that students' critical thinking skills in Science and Social Studies (IPAS), particularly in the topic of light, were still relatively low.

The study population consisted of all fifth-grade students at SDN 1 Mojowetan, totaling 36 students distributed across two classes, namely Class VA and Class VB, with 18 students in each class. Considering the relatively small population size, saturated sampling was employed, whereby all members of the population were included as research participants. Class VA was designated as Experimental Group 1 and received the PjBL treatment assisted by Canva, while Class VB was designated as Experimental Group 2 and received the PjBL treatment assisted by teaching aids.

The independent variables in this study were the PjBL model assisted by the Canva application and the PjBL model assisted by teaching aids, whereas the dependent variable was students' critical thinking skills. Critical thinking skills were measured based on indicators derived from Facione's critical thinking framework, including interpretation, analysis, evaluation, inference, explanation, and self-regulation.

Data collection techniques included tests, observations, and documentation. The primary research instrument was an essay-based critical thinking skills test administered during both the pretest and posttest stages. Observations were conducted to assess the implementation of the PjBL learning syntax throughout the instructional process, while documentation was used to obtain supporting data such as student lists, learning materials, and records of research activities. Prior to implementation, the research instruments underwent content validity testing through expert judgment and empirical validity testing using Pearson Product-Moment correlation analysis. Reliability testing was conducted using Cronbach's Alpha coefficient, with instruments considered reliable if the alpha value exceeded 0.60. Furthermore, item difficulty and discrimination index analyses were performed to ensure the quality of the test items used in the study.

Data analysis was performed using IBM SPSS Statistics software. The initial stage involved descriptive statistical analysis to obtain information regarding the mean, standard deviation, minimum score, and maximum score for each group. Subsequently, prerequisite assumption tests were conducted, including the Shapiro–Wilk normality test and Levene's Test for homogeneity, using a significance level of 5%. The effectiveness of the treatment within each group was analyzed using a paired sample t-test when the data were normally distributed or the Wilcoxon signed-rank test when the normality assumption was violated. Meanwhile, differences in the improvement of critical thinking skills between the two groups were analyzed using an independent sample t-test based on N-Gain scores when parametric assumptions were met or the Mann–Whitney U test when those assumptions were not satisfied. The effectiveness level of learning was determined according to Hake's (1999) N-Gain classification, namely high ($g \geq 0.70$), moderate ($0.30 \leq g < 0.70$), and low ($g < 0.30$).

Result and Discussion

Descriptive Statistics of Pretest Scores on the Critical Thinking Skills of Fifth-Grade Students at SD Negeri 1 Mojowetan, Banjarejo District

Descriptive statistical analysis was conducted to provide an overview of students' initial critical thinking skills before the implementation of the Project-Based Learning (PjBL) model assisted by the Canva application and teaching aids. The pretest results were used to identify students' baseline conditions and to ensure that their initial critical thinking abilities were still at a level requiring innovative instructional intervention.

Table 2. Descriptive Statistics of Pretest Scores on Students' Critical Thinking Skills

Statistics	Value
Sample Size	36
Ideal Score	100
Maximum Score	65
Minimum Score	25
Mean Score	42
Standard Deviation	9.87

Based on Table 2, the mean pretest score for students' critical thinking skills was 42 out of the ideal score of 100. The highest score obtained by students was 65, while the lowest score was 25, with a standard deviation of 9.87. These results indicate that students' critical thinking skills prior to the intervention were still relatively low. To obtain a more detailed overview of the distribution of students' critical thinking abilities, the pretest scores were further classified into five categories, as presented in Table 3.

Table 3. Frequency Distribution and Percentage of Pretest Scores on Students' Critical Thinking Skills

No	Score Interval	Category	Frequency	Percentage (%)
1	81–100	Very High	0	0.00
2	61–80	High	2	5.56
3	41–60	Moderate	15	41.67
4	21–40	Low	19	52.78
5	1–20	Very Low	0	0.00
	Total		36	100

Table 3 shows that the majority of students were classified in the low category, comprising 19 students (52.78%). A total of 15 students (41.67%) were categorized as having moderate critical thinking skills, while only 2 students (5.56%) achieved the high category. No students were classified in either the very high or very low categories. These findings indicate that most students still experienced difficulties in interpreting information, analyzing problems, evaluating evidence, drawing inferences, and providing explanations for the problems presented in the critical thinking skills test.

When the mean pretest score of 42 is converted into the critical thinking assessment criteria, the initial critical thinking skills of fifth-grade students at SD Negeri 1 Mojowetan, Banjarejo District, prior to the implementation of the Project-Based Learning model assisted by Canva and teaching aids, fall into the low category. This condition highlights the need for more innovative and student-centered instructional approaches to improve students' critical thinking skills. Furthermore, students' learning mastery based on the Minimum Mastery Criterion (KKM) of 70 is presented in Table 4.

Table 4. Pretest Learning Mastery of Students' Critical Thinking Skills

Score Range	Category	Frequency	Percentage (%)
$0 \leq x < 70$	Not Mastered	36	100
$70 \leq x \leq 100$	Mastered	0	0
	Total	36	100

Based on Table 4, all students (100%) failed to achieve the school's Minimum Mastery Criterion (KKM) of 70. No students reached the mastery category during the pretest administration. These results indicate that students' critical thinking skills prior to the intervention required

substantial improvement through the implementation of instructional models capable of promoting higher-order thinking, problem-solving skills, and active student engagement in the learning process. Overall, it can be concluded that the critical thinking skills of fifth-grade students at SD Negeri 1 Mojowetan, Banjarejo District, prior to the implementation of the Project-Based Learning (PjBL) model assisted by the Canva application and teaching aids, were categorized as low, with a learning mastery rate of 0%. These findings provided an important basis for the implementation of subsequent instructional interventions aimed at improving students' critical thinking skills.

Descriptive Statistics of Posttest Scores on the Critical Thinking Skills of Fifth-Grade Students at SD Negeri 1 Mojowetan, Banjarejo District

Descriptive statistical analysis of the posttest scores was conducted to determine the level of students' critical thinking skills after the implementation of the Project-Based Learning (PjBL) model assisted by the Canva application and teaching aids. The posttest results provide an overview of the effectiveness of the treatments in improving students' critical thinking skills in Science and Social Studies (IPAS) learning.

Table 5. Descriptive Statistics of Posttest Scores on Students' Critical Thinking Skills

Statistics	Value
Sample Size	36
Ideal Score	100
Maximum Score	100
Minimum Score	50
Mean Score	82
Standard Deviation	14.969

Based on Table 5, the mean posttest score for students' critical thinking skills was 82 out of the ideal score of 100. The highest score achieved by students was 100, while the lowest score was 50, with a standard deviation of 14.969. The standard deviation value, which was substantially lower than the mean score, indicates that the data distribution was relatively homogeneous and that the mean score adequately represented students' critical thinking abilities after the intervention. These findings demonstrate a considerable improvement compared with the pretest mean score, which had previously been only 42.

To obtain a more detailed picture of students' critical thinking skills after the intervention, the posttest scores were categorized into five levels as presented in Table 6.

Table 6. Frequency Distribution and Percentage of Posttest Scores on Students' Critical Thinking Skills

No	Score Interval	Category	Frequency	Percentage (%)
1	81–100	Very High	17	47.22
2	61–80	High	17	47.22
3	41–60	Moderate	2	5.56
4	21–40	Low	0	0.00
5	1–20	Very Low	0	0.00
	Total		36	100

As shown in Table 6, the majority of students were classified in the high and very high categories. A total of 17 students (47.22%) achieved scores in the very high category, while another 17 students (47.22%) were categorized in the high category. Meanwhile, only 2 students (5.56%)

were classified in the moderate category, and no students fell into either the low or very low categories.

This distribution indicates that after the implementation of the Project-Based Learning model assisted by the Canva application and teaching aids, there was a substantial shift in students' critical thinking skills from the low category toward the high and very high categories. Compared with the initial conditions observed during the pretest, a considerable improvement occurred both in terms of the mean score and the distribution of students across the performance categories.

When the mean posttest score of 82 is converted into the critical thinking assessment categories, the average critical thinking ability of fifth-grade students at SD Negeri 1 Mojowetan, Banjarejo District, after the implementation of Project-Based Learning assisted by Canva and teaching aids falls into the very high category. Furthermore, students' learning mastery based on the Minimum Mastery Criterion (KKM) of 70 is presented in Table 7.

Table 7. Posttest Learning Mastery of Students' Critical Thinking Skills

Score Range	Category	Frequency	Percentage (%)
$0 \leq x < 70$	Not Mastered	6	16.67
$70 \leq x \leq 100$	Mastered	30	83.33
	Total	36	100

Based on Table 7, a total of 30 students (83.33%) achieved learning mastery, whereas 6 students (16.67%) did not reach the school's Minimum Mastery Criterion (KKM) of 70. These results indicate that the majority of students successfully attained the expected competency standards after participating in learning activities using the Project-Based Learning model assisted by the Canva application and teaching aids.

From a classical mastery perspective, the learning process was considered successful because the percentage of students achieving the minimum score of 70 exceeded the predetermined classical mastery threshold of 70% of the total number of students. Therefore, the implementation of the Project-Based Learning model assisted by the Canva application and teaching aids proved effective in improving the critical thinking skills of fifth-grade students at SD Negeri 1 Mojowetan, Banjarejo District.

Overall, the posttest results demonstrated a substantial improvement compared with the pretest results in terms of mean scores, the distribution of critical thinking skill categories, and students' learning mastery levels. These findings provide preliminary evidence that the implemented instructional model contributed positively to the development of students' critical thinking skills in Science and Social Studies (IPAS) learning.

Experimental Group 1 (Implementation of the PjBL Model Assisted by the Canva Application)

Normality Test

The normality test was conducted to determine whether the pretest and posttest scores of students' critical thinking skills in Experimental Group 1 were normally distributed. The analysis was performed using IBM SPSS Statistics version 26 with the Kolmogorov–Smirnov test at a significance level of 5% ($\alpha = 0.05$). The data were considered normally distributed when the significance value (Sig.) exceeded 0.05. The results of the normality test for the pretest and posttest scores of students' critical thinking skills in Experimental Group 1 are presented in Table 8.

Table 8. Results of the Normality Test for Critical Thinking Skills of Class VA Students (Experimental Group 1) at SD Negeri 1 Mojowetan

Variable	Kolmogorov-Smirnov Statistic	Sig.	Interpretation
Pretest	0.149	0.319	Normal
Posttest	0.087	0.910	Normal

Based on Table 8, the normality test results using the Kolmogorov-Smirnov test showed a significance value of 0.319 for the pretest data and 0.910 for the posttest data in Experimental Group 1. Both values were greater than the 0.05 significance level ($\text{Sig.} > 0.05$), indicating that there was insufficient evidence to reject the assumption of normality for either the pretest or posttest data. Accordingly, the pretest and posttest scores can be treated as approximately normally distributed based on the Kolmogorov-Smirnov results. However, because the sample size in Experimental Group 1 was relatively small ($n = 18$), the normality assessment should be interpreted cautiously. For samples of this size, the Shapiro-Wilk test is generally recommended as a more appropriate formal test of normality, and the assessment should ideally be complemented by graphical diagnostics, such as Q-Q plots or histograms. Therefore, if Table 8 reports only the Kolmogorov-Smirnov results, these values should be reported exactly as presented rather than interpreted as definitive evidence of normality. Subject to confirmation through the Shapiro-Wilk test and graphical diagnostics, the data may subsequently be considered for parametric analysis. The homogeneity of variance assumption should then be examined separately before conducting the appropriate hypothesis test.

Homogeneity Test

The homogeneity test was performed to determine whether the variance of students' critical thinking skills across the research groups was equal (homogeneous) or unequal (heterogeneous). The test was conducted using Levene's Test for Equality of Variances through IBM SPSS Statistics version 26 at a significance level of 5% ($\alpha = 0.05$). The data were considered homogeneous if the significance value exceeded 0.05, whereas significance values below 0.05 indicated non-homogeneous variances. The results of the homogeneity test are presented in Table 9.

Table 9. Results of the Homogeneity Test for Students' Critical Thinking Skills

Variable	Levene Statistic	df1	df2	Sig.	Interpretation
Critical Thinking Skills	5.123	1	35	0.027	Not Homogeneous

Based on Table 9, the homogeneity test produced a significance value of 0.027. Because the significance value was lower than the 0.05 significance level ($0.027 < 0.05$), the null hypothesis of equal variances was rejected. Thus, the variance of students' critical thinking scores differed significantly between the two research groups, indicating that the homogeneity of variance assumption was not satisfied. The subsequent hypothesis testing should therefore use a statistical procedure that does not assume equal variances, as appropriate to the research design and comparison being conducted. It is important to clarify that the homogeneity test should compare the same outcome scores across the two groups, for example, the posttest critical thinking scores of Experimental Group 1 and Experimental Group 2, if that is the intended analysis. The reported degrees of freedom should also be verified against the original statistical output. With two groups and a total of 36 participants, a conventional Levene's test would ordinarily have $\text{df1} = 1$ and $\text{df2} = 34$ because the denominator degrees of freedom are calculated as $N - k$ ($36 - 2 = 34$). Therefore, if Table 9 reports $\text{df2} = 35$, the underlying test, sample size, grouping structure, or statistical procedure

should be checked before the result is finalized. The reported significance value of 0.027 should likewise be retained exactly as generated by the statistical software once the correct output has been confirmed.

Hypothesis Testing

After the pretest and posttest data on students' critical thinking skills in Experimental Group 1 were assessed for normality, hypothesis testing was conducted using the Paired-Samples t-Test. This test was used to determine whether there was a significant difference between students' pretest and posttest critical thinking scores following the implementation of the Project-Based Learning (PjBL) model assisted by the Canva application among fifth-grade students at SD Negeri 1 Mojowetan, Banjarejo District. The paired-samples t-test results comparing the pretest and posttest scores are presented in Table 10. The correlation between pretest and posttest scores is reported as a descriptive component of the paired-samples output and is not used to determine the effectiveness of the intervention.

Table 10. Results of the Paired Samples Correlation Analysis for Experimental Group 1

Variable	N	Correlation	Sig.
Pretest and Posttest	18	0.781	0.000

Table 10 shows that the significance value was 0.000, which was lower than the significance level of 0.05 ($0.000 < 0.05$). These findings indicate a statistically significant relationship between students' pretest and posttest critical thinking scores in Experimental Group 1. The correlation coefficient of 0.781 indicates a strong relationship between students' initial abilities and their final abilities after receiving instruction through the PjBL model assisted by the Canva application. Furthermore, the results of the comparison between the pretest and posttest mean scores using the Paired Sample t-Test are presented in Table 11.

Table 11. Results of the Paired Sample t-Test for Experimental Group 1

Variable	Mean Difference	t-value	df	Sig. (2-tailed)
Pretest – Posttest	-39.11	-12.487	17	0.000

Based on Table 11, the paired-samples t-test yielded a significance value of $p < .001$, indicating a statistically significant difference between the pretest and posttest scores of students' critical thinking skills following the implementation of the Project-Based Learning (PjBL) model assisted by the Canva application. The mean critical thinking score increased by 39.11 points from pretest to posttest. Thus, the results provide statistical evidence that students' critical thinking scores improved significantly following the intervention. The mean change should additionally be reported together with its 95% confidence interval (CI) to indicate the precision of the estimated improvement. A paired-samples effect size, such as Cohen's d_z , should also be reported to describe the magnitude of the change independently of statistical significance. These values should be calculated directly from the paired pretest–posttest data or the corresponding standard deviation of the difference scores. Once the 95% CI and Cohen's $d_{z\text{score}}$ have been established, the effectiveness of the Canva-assisted PjBL intervention can be interpreted more comprehensively in terms of both statistical significance and practical magnitude.

Experimental Group 2 (Implementation of Project-Based Learning Assisted by Teaching Aids)

Normality Test

The normality test was conducted to determine whether the pretest and posttest scores of students' critical thinking skills in Experimental Group 2 were normally distributed. The analysis was performed using IBM SPSS Statistics version 26 with the Kolmogorov-Smirnov test at a significance level of 5% ($\alpha = 0.05$). The data were considered normally distributed when the significance value (Sig.) exceeded 0.05. The results of the normality test are presented in Table 12.

Table 12. Results of the Normality Test for Critical Thinking Skills of Class VB Students (Experimental Group 2) at SD Negeri 1 Mojowetan

Variable	Kolmogorov-Smirnov Statistic	Sig.	Interpretation
Pretest	0.156	0.290	Normal
Posttest	0.108	0.716	Normal

Based on Table 12, the significance values for the pretest and posttest data were 0.290 and 0.716, respectively. Since both values exceeded the significance level of 0.05 (Sig. > 0.05), it can be concluded that the pretest and posttest data for students' critical thinking skills in Experimental Group 2 were normally distributed. The fulfillment of the normality assumption indicated that the data met one of the requirements for parametric statistical analysis. Therefore, the analysis proceeded with the homogeneity test.

Homogeneity Test

The homogeneity test was conducted to determine whether the variance of students' critical thinking skills was homogeneous across observations. The analysis was performed using Levene's Test for Equality of Variances through IBM SPSS Statistics version 26 at a significance level of 5% ($\alpha = 0.05$). The data were considered homogeneous if the significance value exceeded 0.05. The results are presented in Table 13.

Table 13. Results of the Homogeneity Test for Critical Thinking Skills of Class VB Students (Experimental Group 2)

Variable	Levene Statistic	df1	df2	Sig.	Interpretation
Critical Thinking Skills	0.964	1	34	0.330	Homogeneous

Table 13 indicates that the significance value was 0.330, which exceeded the significance level of 0.05 ($0.330 > 0.05$). Therefore, the variance of the critical thinking skills data in Experimental Group 2 was considered homogeneous. Since both the normality and homogeneity assumptions were satisfied, the data met the requirements for hypothesis testing using parametric statistics, namely the Paired Sample t-Test.

Hypothesis Testing

Hypothesis testing was conducted using the Paired Sample t-Test to determine the effectiveness of the Project-Based Learning (PjBL) model assisted by teaching aids in improving the critical thinking skills of fifth-grade students at SD Negeri 1 Mojowetan, Banjarejo District. The correlation analysis between pretest and posttest scores is presented in Table 14.

Table 14. Results of the Paired Samples Correlation Analysis for Experimental Group 2

Variable	N	Correlation	Sig.
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Pretest and Posttest	18	0.748	0.000
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Based on Table 14, the significance value was 0.000, which was lower than 0.05 ($0.000 < 0.05$). Therefore, a statistically significant relationship existed between the pretest and posttest scores of students' critical thinking skills in Experimental Group 2. The results of the comparison between pretest and posttest mean scores using the Paired Sample t-Test are presented in Table 15.

Table 15. Results of the Paired Sample t-Test for Experimental Group 2

Variable	Mean Difference	t-value	df	Sig. (2-tailed)
Pretest – Posttest	-34.72	-10.934	17	0.000

Based on Table 15, the significance value (Sig. (2-tailed)) was 0.000, which was lower than 0.05 ($0.000 < 0.05$). These findings indicate a statistically significant difference between students' pretest and posttest critical thinking scores after the implementation of Project-Based Learning assisted by teaching aids.

The mean score increased by 34.72 points following the intervention, indicating that the implementation of PjBL assisted by teaching aids had a positive effect on improving students' critical thinking skills. Therefore, the research hypothesis stating that the Project-Based Learning model assisted by teaching aids is effective in improving students' critical thinking skills was accepted. These findings suggest that both Canva-assisted PjBL and teaching-aid-assisted PjBL significantly improved students' critical thinking skills, although the magnitude of improvement between groups required further investigation through comparative analysis.

Comparison of Critical Thinking Skills Between Experimental Group 1 and Experimental Group 2

The comparative analysis was conducted to determine whether there was a difference in the improvement of students' critical thinking skills between those who participated in Project-Based Learning (PjBL) assisted by the Canva application and those who participated in PjBL assisted by teaching aids. The study involved one independent categorical factor, namely the learning treatment, with two levels: (1) Canva-assisted PjBL and (2) teaching-aid-assisted PjBL, while students' critical thinking skills constituted the dependent variable.

Because the research design contains only one experimental factor, the use of a Two-Way Analysis of Variance (Two-Way ANOVA) is not appropriate unless a second independent factor is explicitly specified and its interaction with the treatment factor is analyzed. Therefore, the comparative analysis should use a statistical procedure consistent with the actual research design. If the purpose is to compare posttest critical thinking scores while controlling for initial differences in pretest scores, Analysis of Covariance (ANCOVA) with pretest scores as the covariate is appropriate. Alternatively, if the focus is specifically on improvement, a change-score analysis can be conducted by calculating the difference between posttest and pretest scores for each student and comparing the change scores between the two treatment groups using an independent-samples *t*-test, provided its assumptions are satisfied.

Prior to the selected hypothesis test, the relevant assumptions should be examined, including the normality of residuals or change scores and homogeneity of variance. For ANCOVA, the assumption of homogeneity of regression slopes should also be tested. The analysis was conducted using IBM SPSS Statistics version 26.

Residual Normality Test

The residual normality test was conducted to ensure that the residuals generated by the ANOVA model were normally distributed. The Kolmogorov–Smirnov test was employed at a significance level of 5% ($\alpha = 0.05$). Residuals were considered normally distributed when the significance value exceeded 0.05.

Table 16. Results of the Residual Normality Test for Critical Thinking Skills of Class VA and VB Students

Statistic	Value
Kolmogorov–Smirnov Z	0.927
Sig.	0.328
Interpretation	Normal

Based on Table 16, the significance value was 0.328, which exceeded 0.05 ($0.328 > 0.05$). Therefore, it can be concluded that the model residuals were normally distributed, indicating that one of the assumptions of Two-Way ANOVA had been satisfied.

In addition to statistical testing, residual normality was also examined through the Normal P–P Plot, which showed that the residual points were distributed closely around the diagonal line, further supporting the normality assumption.

Mean Scores of Each Treatment Group

Before conducting the comparative analysis, the mean critical thinking scores for each treatment group are presented in Table 17.

Table 17. Mean Critical Thinking Scores Across Treatment Groups

Treatment Group	Mean
PjBL Assisted by Canva	84.11
PjBL Assisted by Teaching Aids	79.39

Table 17 indicates that students who learned through PjBL assisted by the Canva application achieved an average critical thinking score of 84.11, whereas students who learned through PjBL assisted by teaching aids achieved an average score of 79.39. Descriptively, the Canva-assisted PjBL group demonstrated higher critical thinking performance than the teaching-aid-assisted PjBL group.

Homogeneity of Variance Test

The homogeneity test was conducted to determine whether variances across the treatment groups were equal. The analysis was performed using Levene's Test at a significance level of 5% ($\alpha = 0.05$).

Table 18. Results of the Homogeneity of Variance Test

Levene Statistic	df1	df2	Sig.	Interpretation
0.904	1	35	0.411	Homogeneous

Based on Table 18, the significance value was 0.411, which exceeded 0.05 ($0.411 > 0.05$). Therefore, the variances across the treatment groups were considered homogeneous, indicating that the homogeneity assumption for the ANOVA analysis was satisfied.

Results of the Two-Way ANOVA

After all assumptions had been met, hypothesis testing was performed using Two-Way ANOVA to determine differences in critical thinking skills between the two treatment groups.

Table 19. Results of the Two-Way ANOVA for Students' Critical Thinking Skills

Source of Variation	F	Sig.	Decision
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Learning Model	9.784	0.000	H ₀ Rejected
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Based on Table 19, the significance value was 0.000, which was lower than 0.05 ($0.000 < 0.05$). Therefore, the null hypothesis (H_0) was rejected and the alternative hypothesis (H_1) was accepted. It can be concluded that a statistically significant difference existed in critical thinking skills between students who learned through PjBL assisted by the Canva application and those who learned through PjBL assisted by teaching aids.

The results demonstrated that students in the Canva-assisted PjBL group achieved higher average critical thinking scores than students in the teaching-aid-assisted PjBL group. These findings suggest that the integration of digital technology through the Canva application provides a more interactive, visual, and engaging learning experience, thereby encouraging students to participate more actively in analysis, evaluation, and problem-solving activities during the learning process.

Therefore, it can be concluded that the Project-Based Learning model assisted by the Canva application was more effective than the PjBL model assisted by teaching aids in improving the critical thinking skills of fifth-grade students at SD Negeri 1 Mojowetan, Banjarejo District.

Discussion

The present study examined the effectiveness of Project-Based Learning (PjBL) supported by Canva and by conventional teaching aids in developing fifth-grade students' critical thinking skills. The results demonstrate three principal patterns. First, students participating in Canva-assisted PjBL showed a statistically significant improvement in critical-thinking scores from pretest to posttest ($p < .001$). Second, students experiencing PjBL supported by teaching aids also demonstrated a statistically significant improvement, indicating that the project-based instructional structure itself was conducive to the development of critical thinking. Third, the between-group analysis revealed a significant difference ($p < .001$), with the Canva-assisted PjBL group obtaining higher critical-thinking scores than the teaching-aid-assisted PjBL group. Nevertheless, this difference should not be interpreted as evidence that Canva independently caused the superior outcome because both groups received PjBL and several potentially influential instructional factors such as digital familiarity, teacher support, time-on-task, classroom interaction, and novelty effects were not independently controlled. Accordingly, the strongest empirical conclusion is that Canva-assisted PjBL was associated with higher critical-thinking performance under the conditions examined, rather than that Canva itself was the sole causal mechanism.

The observed improvement is broadly consistent with international evidence positioning PjBL as an active, constructivist learning environment that encourages learners to investigate authentic problems, generate products, evaluate alternatives, and reflect on their decisions. Guo et al. (2020), in a comprehensive review of PjBL research, concluded that project-based environments are associated with cognitive, behavioral, and affective learning outcomes, while emphasizing that the quality of project design and measurement remains important. Similarly, Almulla (2020) showed that PjBL supports student engagement through authentic, collaborative, iterative, and disciplinary learning processes. Markula and Aksela (2022) further identified problem-centeredness, collaboration, technological tools, artifact creation, scientific inquiry, presentation, and reflection as key characteristics of effective K-12 PjBL implementation. These characteristics provide a theoretically plausible explanation for the increase observed in the present study because critical thinking requires students to move beyond information reproduction toward analysis, judgment, decision-making, and evidence-based explanation.

More specifically, the critical-thinking findings correspond with studies demonstrating that project-oriented learning can support higher-order cognition across disciplinary and cultural settings. Oyewo et al. (2022) reported that authentic project-based STEM activities created meaningful opportunities for learners to reason about complex real-world problems. Witarsa and Muhammad (2023) likewise found that project-oriented citizenship learning improved critical-thinking performance by involving learners in problem identification, information gathering, documentation, presentation, and reflection. Rehman et al. (2024) showed that PjBL was associated not only with critical thinking but also with problem solving, collaboration, engagement, and more favorable learning attitudes. Most recently, Song et al. (2025) reported significant improvements in critical thinking among learners exposed to online PjBL compared with a teacher-centered comparison condition. Although these studies involve different educational levels and subjects, their convergence supports the proposition that the project structure rather than a single technological tool—is an important component of critical-thinking development.

The integration of Canva also places the present findings within the broader literature on technology-enhanced critical-thinking instruction. Meirbekov et al. (2022) demonstrated that digital tools supporting visualization, problem solving, real-time collaboration, and information organization can facilitate critical-thinking development. Falloon (2024), focusing specifically on K-6 education, showed that successful technology-supported critical-thinking curricula depend on the alignment among pedagogy, technology, curriculum, and school conditions, rather than merely on access to digital devices. This distinction is particularly important for interpreting Canva: its educational value is unlikely to originate from visual attractiveness alone, but from how teachers integrate its visual design capabilities into cognitively demanding tasks. Research on digital competence likewise emphasizes that technology generates educational value only when accompanied by appropriate pedagogical competence and intentional instructional design (Falloon, 2020; Fernández-Batanero et al., 2022).

This interpretation is also supported by Maor et al. (2023), who found meaningful interrelationships among metacognition, creativity, and critical thinking in PjBL settings. Their findings imply that project work is most cognitively productive when students are required to plan, monitor, question, evaluate, and reflect upon their learning. Bağ and Gürsoy (2021) similarly showed that critical thinking improved when it was explicitly embedded in instructional tasks rather than expected to emerge automatically. Yu and Zin's (2023) systematic review reinforces this point: problem- and project-oriented instructional environments require deliberate critical-thinking scaffolds if they are to consistently generate higher-order outcomes. Consequently, the present results should not be interpreted as suggesting that either PjBL or Canva automatically generates critical thinking. Instead, the observed gains are more plausibly attributed to the interaction among project structure, cognitively demanding tasks, visual information organization, teacher facilitation, and opportunities for reflection.

The present findings are also congruent with Indonesian evidence. Adekantari et al. (2020) found that technology-assisted PjBL using Instagram produced greater improvements in critical thinking than the comparison condition, suggesting that digital environments can complement constructivist project-based pedagogy when technology is integrated with meaningful tasks. Darussyamsu et al. (2024), using the PjBL-RAHMA model, similarly demonstrated that structured stages of recognizing problems, analyzing problems, conducting projects, monitoring progress, and

assessing outcomes enhanced critical-thinking performance. Sari et al. (2025) extended this evidence by integrating digital flipbooks with PjBL and reporting stronger critical-thinking and scientific-literacy outcomes than conventional learning materials. These studies reinforce the present finding that digital media may offer additional pedagogical affordances when embedded within structured inquiry and project work, rather than functioning simply as presentation media.

More directly related to elementary education and Canva, Yuliyanto et al. (2025) reported that fifth-grade students exposed to Canva-based interactive multimedia achieved stronger critical-thinking outcomes than those experiencing conventional instruction. Arianti et al. (2026) likewise reported gains in critical thinking through Canva-supported active learning among elementary learners. These studies provide contextual support for the direction of the present results, although the instructional models are not equivalent and therefore should not be treated as direct replications. The current investigation contributes an important distinction because it compares two PjBL conditions with different forms of instructional support, allowing the discussion to focus more specifically on how digital versus concrete supports may operate within an otherwise project-oriented environment.

The findings are additionally compatible with emerging Indonesian digital-learning scholarship. Pribowo et al. (2024), in research involving Muhammad Sufian, demonstrated that an interactive Flipbook-based e-module incorporating multimedia and Canva-supported visual design was feasible and effective for enhancing learning. Al Khansa et al. (2024) similarly emphasized that contextual and integrated instructional design can strengthen student engagement when learning connects academic content with meaningful experience. From *Digital Learning, Social Science, and Life-course Studies*, Sari et al. (2025) reported stronger critical-thinking outcomes with interactive digital media, while Sidik et al. (2025) synthesized evidence concerning PBL and PjBL in technology-oriented learning. Together, these studies strengthen the local argument that digital technology is pedagogically consequential when it is integrated into an active learning architecture, rather than treated as an instructional end in itself.

Theoretically, the findings reinforce constructivist conceptions of learning by demonstrating that critical thinking appears to develop most productively when learners actively construct knowledge through inquiry, artifact creation, problem solving, and reflection rather than passively receiving information. The higher scores under Canva-assisted PjBL further suggest that digital representation may enrich this constructivist environment by enabling students to organize textual and visual evidence, redesign information, externalize ideas, and communicate project conclusions, although the independent contribution of these mechanisms was not tested. Broader evidence on educational technology likewise suggests that digital tools can enhance engagement and information processing when integrated purposefully into pedagogical activity (Bond et al., 2020; Haleem et al., 2022; Tang, 2024). Pedagogically, elementary teachers should therefore combine PjBL with explicit critical-thinking prompts, questioning strategies, evidence evaluation, reflection, and structured opportunities for students to explain design choices rather than using Canva primarily to beautify project products. Such activities may simultaneously support visual and digital literacy, but those outcomes require separate assessment. Likewise, student engagement, emotional well-being, online identity, and media literacy were not directly measured in this study, so they should not be reported as demonstrated outcomes. At the policy level, the findings support investment in teacher digital competence, equitable device and internet access, project-oriented curriculum design, and

professional development that integrates technological, pedagogical, and critical-thinking competencies. They do not provide direct empirical evidence for social-media regulation or mental-health policy; those implications would require research explicitly examining online behavior and psychological outcomes.

The principal novelty of this study lies in comparing Canva-assisted PjBL with teaching-aid-assisted PjBL among fifth-grade elementary students rather than simply contrasting PjBL with conventional teacher-centered instruction. This design provides a more nuanced contribution because both groups operated within a common project-based pedagogical framework, while the supporting media differed. Accordingly, the findings extend existing research by suggesting that the form of instructional support within PjBL may matter for critical-thinking performance. At the same time, the study challenges technologically deterministic interpretations: the higher performance of the Canva group cannot be attributed exclusively to the application because the pedagogical affordances of Canva, teacher scaffolding, novelty, digital familiarity, interaction patterns, and time-on-task were not independently modelled. The contribution therefore lies not in demonstrating technological superiority, but in identifying Canva-assisted PjBL as a promising configuration of pedagogy and digital media that merits more controlled investigation.

Several limitations delimit the interpretation of the findings. The study was conducted within a specific elementary-school context, which restricts broad generalization across subjects, schools, regions, and student populations. Although significant pretest–posttest improvements and between-group differences were identified, critical-thinking scores were the principal measured outcome; collaboration, engagement, motivation, digital literacy, argumentation, evidence evaluation, and metacognition were not independently assessed and therefore cannot be treated as confirmed mediators.

Conclusion

The findings indicate that both Canva-assisted PjBL and teaching-aid-assisted PjBL were associated with significant improvements in the critical thinking scores of fifth-grade students in IPAS learning at SD Negeri 1 Mojowetan. The paired-samples *t*-tests showed significant pretest–posttest differences in both groups ($p < .001$). A significant between-group difference was also identified, with the Canva-assisted PjBL group achieving higher critical-thinking scores than the teaching-aid-assisted PjBL group. Thus, under the conditions of this study, both instructional approaches were associated with improved critical-thinking performance, while the Canva-assisted approach produced the higher observed outcome.

These findings should be interpreted within the limitations of the research design. The study demonstrates differences and pretest–posttest changes under the specific instructional conditions examined, but it does not establish that Canva alone caused the higher performance. Alternative explanations, including students' prior digital familiarity, novelty effects, teacher support, instructional time, and differences in classroom engagement, were not independently measured or controlled. Therefore, the results should not be generalized as evidence that Canva-assisted PjBL is universally more effective than teaching-aid-assisted PjBL. Further research using larger samples, stronger controls, and measures of potential mediating factors is needed to determine the unique contribution of digital media within PjBL.

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