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The Effect of Project-Based Joint Learning (PBJL) on Enhancing Students' Critical Thinking Skills at Class V Elementary

Halimatus Sa'dyah[1], Sibawaihul Fadil[2]

[1,2]*Darul Hikmah Islamic Boarding School, Tulungagung, Indonesia*
[1]halimah@staidhtulungagung.ac.id
[2]Sibawaihulfadil29@gmail.com

ABSTRACT This study aimed to investigate the effect of Project-Based Joint Learning (PBJL) on enhancing students' critical thinking skills among fifth-grade students. The research employed a quantitative approach using a one-group pretest-posttest design. The sample consisted of 23 students selected through total sampling techniques. Data were collected using critical thinking tests administered before and after the implementation of PBJL. The collected data were analyzed using descriptive statistics and paired sample t-test through SPSS software. The results showed that the mean score increased from 66.30 in the pretest to 84.17 in the posttest. The paired sample t-test revealed a significance value of 0.000, which was lower than 0.05, indicating a significant effect of PBJL on students' critical thinking skills. The findings demonstrate that PBJL effectively improves students' analytical, evaluative, collaborative, and problem-solving abilities in elementary school learning activities.

Keywords: *Project-Based Joint Learning, PBJL, critical thinking skills, elementary education, collaborative learning.*
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Introduction

Education plays an essential role in developing students' intellectual abilities, creativity, and problem-solving skills in the twenty-first century learning environment. Modern education emphasizes not only mastery of knowledge but also the development of higher-order thinking skills, especially critical thinking. Critical thinking enables students to analyze information logically, evaluate evidence objectively, and make appropriate decisions in solving problems encountered in daily life. In elementary schools, the cultivation of critical thinking skills is important because students are in the stage of cognitive development where reasoning and analytical abilities begin to grow significantly. According to Ghanizadeh (2017), critical thinking is an important educational outcome that supports students in becoming active and reflective learners.

In the Indonesian educational context, the implementation of the Merdeka Curriculum encourages teachers to apply student-centered learning approaches that promote collaboration, creativity, communication, and critical thinking. However, many elementary school learning activities are still dominated by conventional teaching methods in which teachers become the primary source of information while students remain passive recipients. This condition often limits students' opportunities to explore ideas, express opinions, and solve problems independently. As a result, students' critical thinking skills are not optimally developed during

classroom instruction. Educational innovation is therefore necessary to create meaningful learning experiences that actively involve students in the learning process (Serdyukov, 2017).

One of the learning approaches considered effective in improving students' critical thinking skills is *Project-Based Joint Learning* (PBJL). PBJL is a collaborative learning model that combines project-based learning activities with group cooperation in solving authentic problems and completing meaningful tasks. Through PBJL, students are encouraged to work together, discuss ideas, analyze information, and present project results collectively. The learning model provides opportunities for students to become active participants who construct knowledge through direct experiences and social interaction. Research conducted by Condliffe (2017) explained that project-based learning supports students' higher-order thinking skills because learners are involved in inquiry, investigation, and problem-solving activities.

Project-Based Joint Learning also provides a learning atmosphere that enhances students' motivation and participation during classroom activities. Students who work collaboratively in groups tend to develop communication skills, responsibility, and self-confidence while completing projects together. According to Avsheniuk dkk. (2023), project-based learning can improve students' engagement and foster independent learning habits through authentic and collaborative learning experiences.

Critical thinking skills are closely related to students' ability to identify problems, analyze arguments, evaluate evidence, and formulate logical conclusions. These abilities are necessary for elementary school students because they prepare learners to face academic challenges and social issues in modern society. Nevertheless, many students still experience difficulties in expressing arguments, analyzing information critically, and solving problems systematically during classroom instruction. This issue may occur because learning activities are often focused on memorization rather than analytical thinking processes. Therefore, teachers need to implement innovative learning strategies that stimulate students' reasoning and encourage active participation in knowledge construction (Ennis, 2015).

The learning process in fifth grade still faces several challenges related to students' critical thinking abilities. Based on classroom observations, some students tend to rely heavily on teachers' explanations and show limited initiative in asking questions or expressing opinions during learning activities. Students also experience difficulties when solving analytical questions that require reasoning and evaluation skills. Learning activities that are dominated by lectures and textbook exercises may contribute to the limited development of students' critical thinking skills. Consequently, there is a need for learning innovations that can actively engage students in collaborative and problem-solving activities.

The implementation of PBJL in elementary school classrooms is expected to provide opportunities for students to participate actively in the learning process through project-based collaboration. In PBJL, students work in groups to complete projects that require planning, investigation, discussion, and presentation of findings. Such learning activities encourage students to think critically when identifying problems, evaluating information, and making decisions during project completion. The collaborative nature of PBJL also helps students learn from peers and develop interpersonal communication skills. According to Wulandari dkk., (2023), project-based learning encourages meaningful inquiry and promotes deeper understanding through collaborative investigation and authentic problem-solving tasks.

Several previous studies have demonstrated the positive impact of project-based learning on students' critical thinking abilities at various educational levels. Research by Akhmad dkk., (2020) found that project-based learning significantly improved elementary school students' analytical and evaluative thinking skills. Similarly, Zitha dkk., (2023) reported that collaborative project activities enhanced students' participation and encouraged active engagement during classroom instruction. These findings indicate that learning models integrating projects and collaboration can support the development of higher-order thinking skills effectively. Therefore,

PBJL may serve as an appropriate instructional strategy for improving critical thinking among elementary school students.

In addition to improving cognitive abilities, PBJL also contributes to the development of students' social and emotional skills. Collaborative project activities require students to communicate effectively, respect others' opinions, manage responsibilities, and solve conflicts constructively within groups. These experiences are important in shaping students' teamwork abilities and positive learning attitudes in classroom settings. Furthermore, PBJL allows students to become more independent learners because they actively seek information and construct understanding through direct experience. Seprie dkk., (2025) emphasized that collaborative inquiry-based learning environments can enhance both cognitive and social competencies among students.

The importance of critical thinking in elementary education cannot be separated from the demands of global education and technological advancement in the digital era. Students today are exposed to large amounts of information from various media sources, making critical evaluation skills increasingly necessary. Learners who possess critical thinking abilities are more capable of distinguishing accurate information from misinformation and making rational decisions based on evidence. Therefore, schools must prepare students with the necessary thinking skills to adapt to rapidly changing social and technological environments(Moustaghfir & Brigui, 2024). Educational institutions are expected to implement innovative and interactive learning models that support students' intellectual growth comprehensively.

The initial picture of the condition of grade 5 students is as follows:

Table 1. Pre-Research Description of Students' Critical Thinking Skills

o	Indicator	Initial Condition	Category
	Problem Identification	Students had difficulty identifying problems independently.	Low
	Questioning Skills	Most students were passive during discussions.	Low
	Information Analysis	Students struggled to analyze information logically.	Low
	Argumentation	Students lacked confidence in expressing opinions.	Moderate
	Problem Solving	Students relied more on memorization than analysis.	Low
	Conclusion Making	Conclusions were often incomplete or inaccurate.	Moderate

Based on the preliminary observation results, most fifth-grade students still demonstrated low to moderate critical thinking skills before the implementation of Project-Based Joint Learning (PBJL). Students tended to experience difficulties in analyzing problems, expressing arguments, and evaluating information critically during classroom learning activities. These findings indicate the need for innovative learning approaches that actively involve students in collaborative and problem-solving activities to improve their critical thinking abilities.

Based on the explanation above, this study aims to investigate the effect of Project-Based Joint Learning (PBJL) on enhancing students' critical thinking skills among fifth-grade students. The study is important because it provides insights into the effectiveness of collaborative project-based learning in elementary school contexts. The findings of this research are expected to contribute to the development of innovative teaching strategies that improve students' higher-order thinking skills and classroom participation. In addition, the study may serve as a reference for teachers and researchers interested in implementing PBJL in primary education settings.

Ultimately, the research seeks to support the improvement of educational quality through meaningful and student-centered learning practices.

Method

This study employed a quantitative approach using a pre-experimental design with a one-group pretest-posttest model to examine the effect of Project-Based Joint Learning (PBJL) on students' critical thinking. Quantitative research is widely used to measure the effectiveness of educational interventions through statistical analysis and objective data collection. The pretest-posttest design enables researchers to compare students' abilities before and after the implementation of a learning model, thereby identifying the impact of the treatment on learning outcomes. PBJL was selected because it encourages collaborative learning, problem-solving, communication, and active student participation during classroom activities. According to Creswell and Creswell, quantitative methods are effective in evaluating educational phenomena and determining causal relationships between variables (Creswell & Creswell, 2017).

The population of this study consisted of all fifth-grade students, while the sample included 23 students selected through total sampling techniques. Total sampling was used because the number of participants in the class was relatively small and all students met the research criteria. The participants were involved in PBJL activities designed to improve critical thinking through group discussions, collaborative projects, problem analysis, and presentations. Project-based learning has been recognized as an effective instructional model for enhancing higher-order thinking skills and student engagement in elementary education contexts. Previous studies also indicate that collaborative and project-oriented learning environments significantly contribute to the development of critical thinking abilities among students (Chaaban dkk., 2025; Liu dkk., 2025).

The instrument used in this research was a critical thinking test administered before and after the PBJL implementation. The test consisted of essay and analytical questions adapted from critical thinking indicators such as interpretation, analysis, evaluation, inference, and explanation. In addition to the test, observation sheets were used to monitor students' participation and collaboration during learning activities. Instrument validity was examined through expert judgment, while reliability testing was conducted to ensure consistency in measurement results. Educational assessment instruments must demonstrate validity and reliability to produce accurate and trustworthy findings in classroom-based research (Hansen dkk., 2025).

The data obtained from the pretest and posttest were analyzed using descriptive and inferential statistical techniques. Descriptive statistics were used to identify the mean, maximum score, minimum score, and standard deviation of students' critical thinking results. Furthermore, a paired sample t-test was conducted to determine whether there was a significant difference between students' scores before and after the implementation of PBJL. Statistical analysis is important in educational research because it provides evidence regarding the effectiveness of instructional strategies and supports objective interpretation of research findings. The significance level used in this study was 0.05, meaning that PBJL was considered effective if the probability value was lower than 0.05 (Sugiyono, 2015).

The framework of this research flow can be seen:

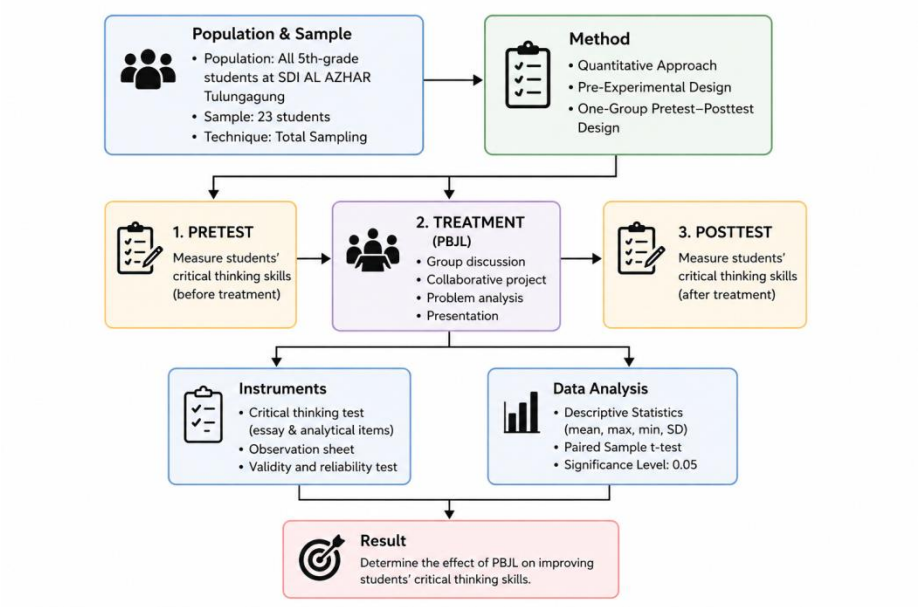


Figure 1. Research flow framework

RESULTS

A. DESCRIPTION OF RESEARCH DATA

This study was involving 23 fifth-grade students as the research sample. The research aimed to determine the effect of Project-Based Joint Learning (PBJL) on students' critical thinking skills. The study used a one-group pretest-posttest design in which students were given a pretest before the implementation of PBJL and a posttest after the learning treatment was completed. The data obtained from the tests were analyzed using descriptive statistics and inferential statistics through SPSS software. The results of the analysis are presented below.

Before the implementation of PBJL, students tended to show limited critical thinking abilities during classroom learning activities. Several students experienced difficulties in analyzing problems, evaluating information, and expressing logical arguments during discussions. Learning activities were generally teacher-centered, causing students to become passive participants in the learning process. After the implementation of PBJL, students became more active in discussing ideas, solving problems collaboratively, and presenting project results. The improvement in students' participation was also followed by increased critical thinking test scores.

The descriptive statistical analysis was conducted to identify the mean, minimum score, maximum score, and standard deviation of students' pretest and posttest scores. The results of descriptive statistics obtained through SPSS are shown in Table 1.

Table 1. Descriptive Statistics of Pretest and Posttest Scores

Test		Minimum	Maximum	Mean	Std. Deviation
Pretest	23	55	78	66.30	6.124
Posttest	23	72	95	84.17	5.876

Based on Table 1, the mean score of students' critical thinking skills before the implementation of PBJL was 66.30, while the mean score after treatment increased to 84.17. The minimum pretest score was 55 and increased to 72 in the posttest. Likewise, the maximum score

improved from 78 in the pretest to 95 in the posttest. The increase in mean scores indicates that students experienced improvement in critical thinking skills after participating in PBJL activities. The lower standard deviation in the posttest also indicates that students' learning outcomes became more consistent after treatment.

B. NORMALITY TEST

Before conducting hypothesis testing, a normality test was performed to determine whether the data distribution was normal. The normality test used in this study was the Shapiro-Wilk test because the sample size was less than 50 students. Data are considered normally distributed if the significance value is greater than 0.05. The results of the normality test using SPSS are presented in Table 2.

Table 2. Shapiro-Wilk Normality Test

Variable	Statistic	f	ig.
Pretest	0.962	3	.512
Posttest	0.971	3	.693

Based on Table 2, the significance value of the pretest was 0.512 and the posttest was 0.693. Both significance values were higher than 0.05, indicating that the data were normally distributed. Therefore, the paired sample t-test could be used to test the research hypothesis. The normal distribution of data indicates that the statistical assumptions required for parametric testing were fulfilled. As a result, the analysis proceeded using inferential statistical methods through SPSS.

C. PAIRED SAMPLE CORRELATION

The paired sample correlation test was conducted to identify the relationship between students' pretest and posttest scores. The results obtained from SPSS analysis are shown in Table 3.

Table 3. Paired Samples Correlations

Variables		Correlation	ig.
Pretest & Posttest	3	0.721	.000

Table 3 shows that the correlation coefficient between pretest and posttest scores was 0.721 with a significance value of 0.000. This result indicates that there was a strong positive relationship between students' scores before and after the implementation of PBJL. The significance value lower than 0.05 indicates that the correlation was statistically significant. The finding demonstrates that students who achieved higher scores in the pretest also tended to achieve higher scores in the posttest. However, the overall increase in scores indicates that PBJL contributed positively to improving students' critical thinking abilities.

D. HYPOTHESIS TESTING

The hypothesis testing in this study used a paired sample t-test to determine whether there was a significant difference between pretest and posttest scores after the implementation of

PBJL. The hypothesis tested in this research was 1) H0: There is no significant effect of Project-Based Joint Learning (PBJL) on students' critical thinking skills. 2) Ha: There is a significant effect of Project-Based Joint Learning (PBJL) on students' critical thinking skills.

The results of the paired sample t-test obtained from SPSS are presented in Table 4.

Table 4. Paired Samples Test

Variables	Mean Difference	Std. Deviation	t	f	Sig. (2-tailed)
Pretest – Posttest	-17.870	4.231	-20.281	2	0.000

Based on Table 4, the significance value (Sig. 2-tailed) was 0.000, which was lower than 0.05. Therefore, H0 was rejected and Ha was accepted. This result indicates that there was a significant effect of Project-Based Joint Learning (PBJL) on improving students' critical thinking skills. The mean difference value of -17.870 also indicates that students' posttest scores were significantly higher than their pretest scores. Thus, the implementation of PBJL successfully improved students' critical thinking abilities.

The improvement in students' critical thinking skills can be seen from their ability to analyze problems, provide arguments, evaluate information, and communicate ideas during project activities. During the PBJL implementation, students actively participated in group discussions and collaborated to solve problems related to learning materials. Students also showed increased confidence when presenting project results in front of the class. These activities trained students to think critically and communicate their ideas systematically. Therefore, PBJL provided meaningful learning experiences that encouraged active student participation.

The findings of this study are consistent with previous studies indicating that project-based learning can improve higher-order thinking skills among students. PBJL encourages students to become active learners who construct knowledge collaboratively through project activities and problem-solving tasks. Through group interaction, students learn to exchange ideas, analyze information critically, and make decisions collectively. Such learning experiences help students develop reasoning and analytical skills needed in twenty-first century education. Consequently, PBJL can be considered an effective learning strategy for elementary school students.

In addition to improving critical thinking skills, PBJL also increased students' motivation and engagement during classroom learning activities. Students became more enthusiastic because they were directly involved in completing meaningful projects with their peers. Collaborative learning activities created a more interactive and enjoyable classroom atmosphere compared to traditional teacher-centered instruction. Students also developed communication and teamwork skills through group discussions and project presentations. Therefore, PBJL not only improved cognitive abilities but also contributed positively to students' social skills development.

The results of this study indicate that innovative and student-centered learning models are important in improving the quality of elementary education. Teachers are encouraged to implement PBJL and other collaborative learning models to support the development of students' higher-order thinking skills. Through project-based activities, students can actively engage in inquiry, exploration, and problem-solving processes that enhance meaningful learning experiences. Furthermore, PBJL aligns with the goals of the Merdeka Curriculum, which emphasizes creativity, collaboration, communication, and critical thinking in classroom learning. Thus, PBJL can become an effective alternative learning strategy for elementary school education.

DISCUSSION

The findings of this study revealed that Project-Based Joint Learning (PBJL) had a significant positive effect on improving students' critical thinking skills among fifth-grade students. The improvement could be observed from the increase in students' posttest scores compared to the pretest scores after the implementation of PBJL. Students became more capable of analyzing problems, evaluating information, expressing arguments, and providing logical solutions during learning activities(Chen dkk., 2025). These results indicate that PBJL successfully created a student-centered learning environment that encouraged active participation and collaborative inquiry. The findings are consistent with previous studies stating that project-based learning positively influences students' higher-order thinking skills and classroom engagement (Wulandari dkk., 2023).

The significant increase in students' critical thinking skills occurred because PBJL integrates collaborative activities and project-based tasks that stimulate students' reasoning abilities. During the learning process, students were actively involved in group discussions, project planning, investigation, and presentation activities that required analytical and evaluative thinking. Such activities encouraged students to identify problems, interpret information, and formulate conclusions independently. Students were not only passive recipients of information but also active constructors of knowledge through meaningful learning experiences. According to Abramczyk & Jurkowski (2020), project-based learning enhances critical thinking because students engage in authentic problem-solving and inquiry processes throughout learning activities.

The collaborative nature of PBJL also contributed significantly to the improvement of students' critical thinking skills. In collaborative learning environments, students exchange ideas, discuss alternative solutions, and evaluate peers' opinions critically before making group decisions. These interactions train students to communicate effectively and think analytically during discussions. Collaboration also provides opportunities for students to learn from one another and develop broader perspectives toward problem-solving. Hmelo-Silver and Eberbach (2019) emphasized that collaborative inquiry learning supports cognitive development because students actively construct understanding through social interaction and cooperative problem-solving activities.

Another factor contributing to the effectiveness of PBJL was the use of real-life and contextual learning projects. Students were required to complete projects connected to their daily experiences, making learning more meaningful and engaging. Contextual learning situations encouraged students to apply theoretical concepts to authentic problems, thereby improving their reasoning and decision-making abilities. Students became more motivated because they understood the relevance of learning activities to real-world situations. According to Shin (2018), project-based learning becomes more effective when students work on authentic tasks that relate directly to real-life experiences and practical problem-solving contexts.

The findings of this study are in line with the constructivist learning theory, which states that students build knowledge actively through experience and interaction with their environment. PBJL allows students to explore information independently, investigate problems collaboratively, and construct understanding through project completion activities. Through this process, students develop deeper conceptual understanding and stronger analytical thinking skills. Learning activities become more interactive because students are encouraged to ask questions, discuss ideas, and evaluate information critically. Constructivist approaches are considered effective in improving higher-order thinking because students become active participants in knowledge construction rather than passive learners (Kosasih dkk., 2022).

The implementation of PBJL also improved students' communication and social interaction skills during classroom learning. Students learned to share opinions, negotiate ideas, and respect different perspectives while completing projects collaboratively. These communication activities indirectly supported the development of critical thinking because

students had to explain arguments logically and defend their ideas during discussions. Collaborative learning environments also increased students' confidence in expressing opinions in front of classmates. According to Keramati & Gillie(2023), cooperative learning environments positively influence students' communication, reasoning, and interpersonal skills through collaborative interaction and shared responsibility.

The improvement in students' critical thinking skills after the implementation of PBJL demonstrates the importance of active learning strategies in elementary school education. Traditional teacher-centered instruction often limits students' opportunities to participate actively in analytical and reflective thinking activities. In contrast, PBJL encourages students to engage directly in problem-solving processes and collaborative exploration of knowledge. Students become more responsible for their own learning because they actively seek information and contribute to group tasks. Brookhart explained that active learning activities are essential for developing critical thinking because they encourage students to analyze, evaluate, and apply knowledge meaningfully(Brookhart & Oakley, 2021).

The findings also support previous studies that reported the effectiveness of project-based learning in improving critical thinking skills at different educational levels. Research conducted by Zhang & Ma(2023) found that project-based learning significantly enhanced elementary school students' analytical thinking and problem-solving abilities. Similarly, Anjani dkk., (2024)reported that collaborative project activities increased students' participation and critical engagement during classroom instruction. The consistency of these findings indicates that PBJL is an effective instructional strategy for promoting higher-order thinking skills among students. Therefore, PBJL can be considered a relevant learning model for elementary education in the twenty-first century.In addition, research by Lestari dkk., (2024)demonstrated that project-based learning encouraged students to develop independent inquiry skills and reflective thinking through active collaboration and real-world problem solving. Another study conducted by Kokotsaki dkk., (2016) revealed that project-based instructional approaches improved students' communication, creativity, and critical reasoning abilities in primary education settings. The consistency of these findings indicates that PBJL is an effective instructional strategy for promoting higher-order thinking skills among students. Therefore, PBJL can be considered a relevant learning model for elementary education in the twenty-first century.

In addition to cognitive improvement, PBJL positively influenced students' learning motivation and classroom engagement. During project activities, students showed enthusiasm in discussing ideas, conducting investigations, and presenting project results. The collaborative learning atmosphere created enjoyable and meaningful learning experiences that increased students' interest in classroom participation. Students became more motivated because they were directly involved in hands-on learning activities rather than merely listening to lectures. According to Fernández-Espínola dkk., (2020) meaningful and collaborative learning activities can enhance intrinsic motivation because students experience autonomy, competence, and social interaction during learning processes.

The implementation of PBJL also aligns with the objectives of the Merdeka Curriculum in Indonesia, which emphasizes student-centered learning and the development of twenty-first century competencies. The Merdeka Curriculum encourages teachers to create learning environments that foster creativity, communication, collaboration, and critical thinking among students. PBJL supports these educational goals because students actively participate in collaborative project activities requiring analytical and creative problem-solving skills. Through PBJL, learning becomes more flexible, interactive, and contextual according to students' learning needs and experiences(Yani, 2024). Therefore, the findings of this study support the integration of innovative project-based learning strategies in Indonesian elementary schools.

The success of PBJL in improving critical thinking skills may also be influenced by the role of teachers as facilitators during learning activities. In PBJL, teachers guide students during project planning, discussion, investigation, and evaluation processes rather than merely delivering

information. This facilitative role helps students become independent learners who actively seek solutions to problems encountered during learning. Teachers also encourage students to reflect on learning experiences and evaluate their understanding critically. According to Mat & Jamaludin(2024), effective student-centered learning requires teachers to function as facilitators who support inquiry, collaboration, and reflective thinking among learners.

The results of this study indicate that PBJL can provide meaningful learning experiences that support students' holistic development. Besides improving cognitive skills, PBJL also develops teamwork, responsibility, communication, and self-confidence among students. These competencies are essential for elementary school students because they prepare learners to face future academic and social challenges effectively. Collaborative project activities train students to work responsibly within groups while respecting others' opinions and contributions(Korkmaz & Kalayci, 2021). Consequently, PBJL contributes not only to academic achievement but also to the development of social and emotional competencies necessary for lifelong learning.

The positive effect of PBJL on critical thinking skills can also be explained through inquiry-based learning principles integrated into project activities. During the learning process, students investigated problems, collected information, analyzed findings, and formulated conclusions collaboratively. Such inquiry activities encouraged students to think critically and evaluate information systematically before making decisions. Inquiry-oriented learning activities also improved students' curiosity and independent learning attitudes during classroom instruction. According to Seprie dkk., (2025), inquiry and problem-based learning environments are highly effective in developing analytical reasoning and critical reflection among students.

Although PBJL demonstrated significant positive effects, several challenges were identified during the implementation process. Some students initially experienced difficulties in adapting to collaborative learning because they were more accustomed to teacher-centered instruction. Certain students also needed additional guidance in managing time, organizing tasks, and communicating effectively within groups. However, these challenges gradually decreased as students became more familiar with collaborative project activities and classroom discussions. Teachers therefore need to provide continuous guidance and scaffolding during the early stages of PBJL implementation to ensure successful learning outcomes(Ashoumi & Yusuf, 2024).

Another important finding from this study is that PBJL encourages students to become more reflective learners. During project activities, students evaluated their own work, discussed mistakes, and revised project results collaboratively with peers. Reflective learning processes helped students recognize weaknesses in their understanding and improve problem-solving strategies systematically. Reflection activities also encouraged students to think more deeply about learning materials and classroom experiences. According to Indrašienė dkk., (2023), reflective learning plays an important role in developing critical thinking because students analyze experiences and evaluate their reasoning processes continuously.

The implementation of PBJL in elementary schools is highly relevant to current educational demands in the digital and global era. Modern education requires students to possess not only academic knowledge but also problem-solving, collaboration, communication, and critical thinking skills. PBJL provides opportunities for students to develop these competencies through active participation in meaningful project activities. Students become more prepared to face future educational and social challenges because they practice analytical thinking and teamwork regularly during learning. Therefore, project-based collaborative learning models are increasingly important in supporting twenty-first century education goals (Rehman dkk., 2023).

The findings of this study also suggest that PBJL can be implemented across different subjects in elementary education. Project activities may be integrated into science, social studies, language learning, mathematics, and interdisciplinary classroom instruction depending on educational objectives. Such flexibility allows teachers to adapt PBJL according to students' learning characteristics and classroom contexts. Through interdisciplinary projects, students can connect concepts from different subjects while developing broader analytical perspectives.

According to Sahin(2019), interdisciplinary project-based learning enhances students' understanding because learners integrate knowledge and skills across multiple disciplines simultaneously.

Furthermore, PBJL encourages the development of independent learning attitudes among students. During project completion, students were responsible for seeking information, organizing ideas, and solving problems collaboratively with peers. These activities trained students to become more autonomous and responsible in managing their learning processes. Independent learning attitudes are important because they help students adapt to future academic challenges and lifelong learning demands. Astuti & Rozikin(2024) explained that student autonomy and self-regulated learning positively contribute to academic achievement and critical thinking development.

The results of this study have important implications for teachers, schools, and educational policymakers. Teachers are encouraged to implement innovative and collaborative learning models such as PBJL to support students' higher-order thinking skills development. Schools should also provide facilities and learning environments that support project-based learning implementation effectively. In addition, educational policymakers may consider integrating collaborative project learning into curriculum development and teacher training programs(Chaaban dkk., 2025). Such efforts are necessary to improve educational quality and prepare students with competencies required in modern society.

Despite the positive findings, this study has several limitations that should be considered in future research. The study involved only 23 students from one elementary school, limiting the generalizability of the findings to broader educational contexts. The research also used a pre-experimental design without a control group, making it difficult to compare PBJL with other instructional models directly. Future studies are recommended to involve larger samples, different educational levels, and experimental research designs to obtain more comprehensive findings regarding PBJL effectiveness. Additional research may also explore the long-term effects of PBJL on students' academic performance and social competencies.

Overall, the findings of this study demonstrate that Project-Based Joint Learning (PBJL) is an effective instructional strategy for enhancing students' critical thinking skills. PBJL creates meaningful, collaborative, and student-centered learning experiences that encourage analytical thinking, communication, and active participation among learners. Through project activities and collaborative inquiry, students become more capable of solving problems, evaluating information, and expressing ideas logically. The implementation of PBJL therefore contributes positively to improving the quality of elementary education and supporting the development of twenty-first century learning competencies. Consequently, PBJL can be recommended as an innovative learning model for elementary school classrooms in Indonesia.

CONCLUSION

The results of this study indicate that Project-Based Joint Learning (PBJL) has a significant positive effect on enhancing students' critical thinking skills among fifth-grade students. The implementation of PBJL encouraged students to participate actively in collaborative learning activities, problem-solving processes, and project completion tasks that stimulated analytical and evaluative thinking. Based on the statistical analysis using the paired sample t-test, students' posttest scores showed significant improvement compared to their pretest scores after the implementation of PBJL. The learning model also increased students' motivation, classroom participation, communication skills, and teamwork abilities during instructional activities. Therefore, PBJL proved to be an effective student-centered learning strategy for improving critical thinking skills in elementary school education.

In addition, the findings demonstrate that collaborative and project-based learning environments provide meaningful learning experiences that support both cognitive and social

development among students. Through project activities, students learned to analyze problems critically, express logical arguments, evaluate information, and work cooperatively with peers in completing tasks. The implementation of PBJL is also relevant to the objectives of twenty-first century education and the Merdeka Curriculum, which emphasize creativity, communication, collaboration, and critical thinking skills. Consequently, teachers are encouraged to apply PBJL and other innovative learning models to improve the quality of classroom instruction and support students' higher-order thinking development. Future research is recommended to involve larger samples and broader educational contexts to obtain more comprehensive findings regarding the effectiveness of PBJL in elementary education.

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