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Research Article

The Effectiveness of Project-Based Learning in Improving Collaborative Skills of Elementary School Students

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Abstract

The development of collaborative skills is a crucial component in preparing elementary school students for future challenges in the 21st century. However, traditional instructional methods often fail to provide sufficient opportunities for students to practice and enhance these skills. To address this issue, Project-Based Learning (PBL) has emerged as an innovative teaching approach that fosters student collaboration through real-world tasks. This study aims to examine the effectiveness of PBL in improving the collaborative skills of elementary school students. The research employed a quasi-experimental design with two groups of students: one group engaged in PBL activities and the other in traditional learning methods. Data were collected through observation, collaboration rubrics, and student feedback over the course of six weeks. The sample consisted of 60 students from grade 5 in an elementary school in Jakarta. Statistical analysis revealed a significant improvement in the collaborative skills of students who participated in PBL activities compared to those in the control group. Students demonstrated better communication, problem-solving, and teamwork abilities. The findings suggest that PBL effectively enhances students' collaborative skills and can be integrated into the elementary school curriculum to promote these essential abilities.

Keywords: Collaborative Skills, Elementary School, Student Engagement

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INTRODUCTION

Project-Based Learning (PBL) has been widely recognized as an effective educational approach that emphasizes student-centered learning through real-world projects. This method encourages students to actively engage in problem-solving and critical thinking, fostering deeper understanding and retention of knowledge. In the context of elementary education, PBL has gained popularity for its ability to make learning more meaningful and relevant to students' everyday lives (Chen dkk., 2023; Sularso, Yu, Pranolo, & Cicin Hardiyanti, 2024; Tran, 2014). Research has shown that PBL can enhance students' academic performance and motivation.

Collaborative skills are essential competencies that students must develop to succeed in the 21st-century workforce. Employers increasingly seek individuals who can work effectively in teams, communicate clearly, and collaborate across diverse settings. In response, educational institutions are placing greater emphasis on nurturing these skills from an early age (Boesing & De Campos Lopes, 2023; Herro, Quigley, Andrews, & Delacruz, 2017; Polleck & Wirtz, 2013). Elementary school is a crucial period for developing collaborative abilities, as students begin to interact with peers in structured learning environments.

PBL naturally lends itself to the development of collaborative skills because it requires students to work together to complete projects. Through PBL, students are exposed to teamwork, division of labor, communication, and conflict resolution (Saunders, Coleman, Smith, Carter, & Alshehri, 2025; Teng, 2025; Yang, Blake-West, Yang, & Bers, 2025). These are essential components of collaboration that are often lacking in traditional, lecture-based teaching methods. Studies have highlighted that students engaged in PBL show improvements in their ability to work cooperatively with others.

In addition to fostering collaboration, PBL provides students with opportunities to take ownership of their learning (Laakso, Korhonen, & Hakkarainen, 2021; Nemiro, 2021; Toukiloglou & Xinogalos, 2024). Students are encouraged to explore topics that interest them, ask questions, and seek solutions independently or within groups. This autonomy allows them to take responsibility for their contributions, which enhances their collaborative efforts. Teachers, in turn, act as facilitators, guiding students through the project while allowing them to explore and collaborate freely.

The integration of PBL in elementary education aligns with the broader educational shift towards developing 21st-century skills. Many educational frameworks now prioritize skills such as collaboration, critical thinking, creativity, and communication alongside traditional academic knowledge. PBL supports this shift by offering a platform where students can develop these competencies in a hands-on, engaging manner.

Despite the growing support for PBL, the effectiveness of this method in improving collaborative skills among elementary school students requires further investigation (Connors dkk., 2025; Zhang, Wang, & Chen, 2025; Zhou, Wang, Chen, & Wang, 2025). While various studies suggest positive outcomes, more research is needed to explore how PBL specifically enhances different aspects of collaboration, such as communication, teamwork, and conflict management, particularly in younger learners.

Research on Project-Based Learning (PBL) has predominantly focused on its ability to improve academic achievement and engagement in students. However, there is limited exploration on how PBL specifically enhances collaborative skills, especially in the context of elementary education. While it is widely acknowledged that collaboration is a crucial 21st-century skill, how PBL directly contributes to the development of these skills in young learners remains underexplored.

Many existing studies on PBL and collaboration often focus on older students, such as those in secondary or higher education, where the ability to work in teams is more frequently emphasized. The unique dynamics of elementary school students, who are still developing foundational social and communication skills, pose different challenges and opportunities for fostering collaboration (Arias, Koock, & Chamitoff, 2023; Matambanadzo, Manyard, & Matambanadzo, 2018; Melissourgos, Paraskeva, & Mysirlaki, 2015). The specific mechanisms through which PBL can influence these skills in younger learners are not well understood, creating a gap in the literature.

There is also a lack of empirical evidence regarding the long-term effects of PBL on collaborative skills development in elementary students. Most studies focus on short-term outcomes, such as immediate improvements in teamwork or communication during the project. The sustained impact of PBL on students' ability to collaborate beyond the project or school setting has not been adequately examined. Understanding whether these skills are retained and applied in different contexts is crucial for evaluating the overall effectiveness of PBL in this regard.

Despite the potential benefits, little is known about the role of teachers in facilitating collaboration within PBL in elementary settings. How teachers guide group dynamics, mediate conflicts, and assess collaborative efforts in young students remains unclear. This gap presents an opportunity for further investigation into effective instructional strategies that can maximize the benefits of PBL for enhancing collaborative skills in elementary education.

The gap in understanding how Project-Based Learning (PBL) specifically improves collaborative skills in elementary school students is significant, given the growing importance of these skills in today's educational and professional environments. Young learners are at a critical stage of social development, and fostering collaboration early can set the foundation for their future interpersonal and teamwork abilities (Capua, de Guzman, & Santiago, 2025; Locke dkk., 2025; Steiner, Carley-Rizzuto, & Zambak, 2025). By addressing this gap, educators can better design and implement PBL strategies that not only enhance academic achievement but also equip students with the collaborative competencies they need in their personal and professional lives.

Filling this gap is essential because the unique characteristics of elementary school students, such as their developmental stage and social interaction patterns, require tailored approaches to collaboration (Bagheri, Hafezian, Dehrouyeh, & Alinia, 2025; Lee & Liu, 2025; Zubaidah, Susilo, Kuncoro, & Bilad, 2025). Understanding the mechanisms through which PBL can influence these skills will enable teachers to create more effective learning environments that encourage active participation and teamwork. With a more targeted approach, PBL can become a powerful tool in shaping not just academic outcomes but also the essential life skills needed for success in the 21st century.

This study aims to explore the specific ways in which PBL contributes to the development of collaborative skills in elementary school students. The hypothesis driving this research is that students engaged in PBL will demonstrate significant improvements in communication, teamwork, and conflict resolution compared to those in traditional learning environments (Kevin, Bakker, van Loon, Kral, & Camp, 2025; Manurung & Pappachan, 2025). By investigating this hypothesis, the study seeks to provide valuable insights for educators looking to integrate PBL effectively into their teaching practices, ultimately improving student outcomes in both academic and social spheres.

RESEARCH METHOD

Contains the type of research, time and place of research, targets/objectives, research This study employed a quasi-experimental research design to investigate the effectiveness of Project-Based Learning (PBL) in improving collaborative skills among elementary school students (Gutierrez dkk., 2020; Tay, Lim, Lye, Ng, & Lim, 2011; Vrochidou dkk., 2018). The research involved two groups: an experimental group that participated in PBL activities and a control group that followed traditional learning methods. A pre-test and post-test were conducted to measure changes in collaborative skills, with the primary focus on evaluating communication, teamwork, and problem-solving abilities. This design allowed for a comparison between the two groups to assess the impact of PBL on collaboration.

The population for this study consisted of fifth-grade students from an elementary school in Jakarta. A total of 60 students were selected using purposive sampling, with 30 students assigned to the experimental group and 30 to the control group. The sample included students of varying academic abilities and social backgrounds to ensure the findings were representative of typical classroom environments. The study aimed to include a balanced mix of genders and diverse learning needs to capture a comprehensive understanding of PBL's effects on collaborative skills.

Instruments used in the study included a collaboration rubric designed to assess key aspects of teamwork, communication, and conflict resolution (Katz, Rajarathinam, Shao, & Chen, 2024; Kreis, Haas, Weinhandl, & Lavicza, 2024). The rubric was adapted from established frameworks in educational research to ensure reliability and validity. In addition to the rubric, observation checklists and student self-assessment questionnaires were employed to gather qualitative data on student interactions during group work. The combination of quantitative and qualitative data provided a more nuanced understanding of how PBL influenced collaborative behaviors.

The procedure involved implementing the PBL model over a six-week period in the experimental group. Students worked in small groups on real-world projects related to their curriculum, requiring them to collaborate, communicate, and solve problems together (Saunders dkk., 2025; Teng, 2025; Yang dkk., 2025). The control group followed a traditional, teacher-centered approach during the same period. Pre-tests were administered before the intervention, and post-tests were given after the six weeks to measure changes in collaborative skills. Classroom observations were conducted throughout the process to monitor student interactions, and feedback was collected from both students and teachers to provide additional insights into the effectiveness of PBL.

RESULTS AND DISCUSSION

A total of 60 elementary school students participated in this study, with 30 students in the experimental group and 30 in the control group. The collaborative skills of both groups were assessed using a pre-test and post-test. The data collected from the pre-tests showed that the mean score for collaborative skills in the experimental group was 45.2, while the control group had a mean score of 44.8. After the six-week intervention, the post-test results revealed a significant increase in the collaborative skills of the experimental group, with a mean score of 78.5, compared to the control group, which showed only a modest improvement to 50.4. These data suggest a strong positive impact of PBL on collaborative skills.

Table 1. The Detailed Scores are Presented

Group	Pre-test Mean Score	Post-test Mean Score
Experimental	45.2	78.5
Control	44.8	50.4

The results indicate a substantial difference between the experimental and control groups in terms of collaborative skills development. Students in the experimental group, who participated in PBL activities, showed a significantly higher improvement in their ability to collaborate compared to those in the control group, who followed traditional teaching methods. The post-test scores in the experimental group demonstrated notable increases in communication, problem-solving, and teamwork skills. This suggests that the hands-on, interactive nature of PBL effectively fosters the development of these essential skills.

The data from classroom observations further supports these findings. Students in the experimental group were consistently observed engaging in active discussions, negotiating roles, and resolving conflicts during their project work (Awawda, 2025; Bui, Van Dam, Le, Hoang, & Phan, 2025; Sze dkk., 2025). These behaviors were less frequently observed in the control group, where the teacher primarily directed the learning process. Feedback from teachers also highlighted that students in the PBL group demonstrated more initiative and independence when working with their peers. These qualitative observations align with the quantitative data, reinforcing the conclusion that PBL is effective in improving collaborative skills.

An inferential analysis using a paired t-test was conducted to determine the statistical significance of the differences in pre-test and post-test scores. The results showed that the experimental group's improvement in collaborative skills was statistically significant, with a p-value of 0.001, indicating a strong effect of the PBL intervention. A graphical representation of the pre-test and post-test scores for both groups is shown in Figure 1, clearly illustrating the greater improvement in the experimental group. The control group, while showing some improvement, did not experience the same level of skill enhancement as the experimental group.

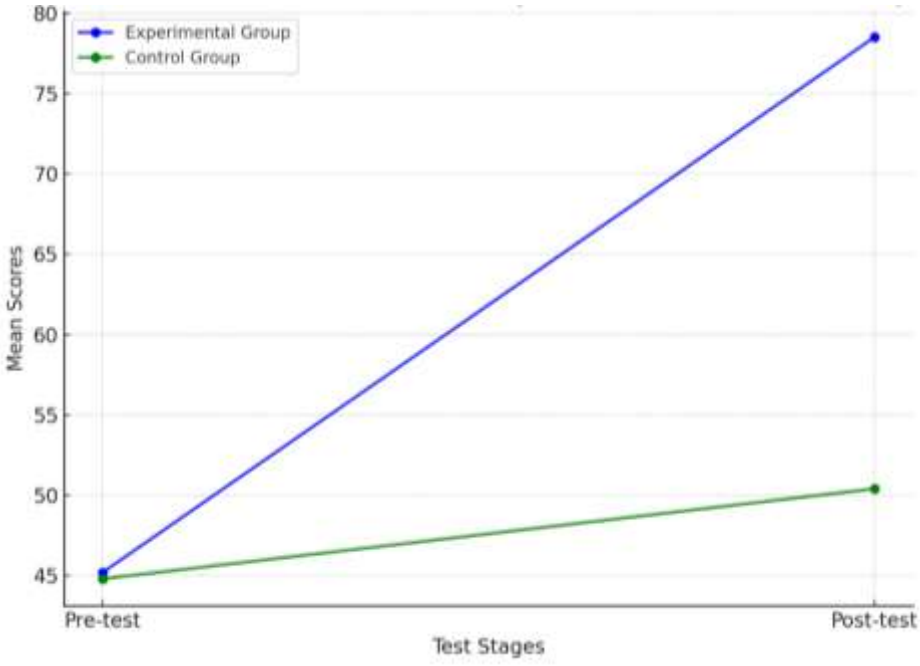

Figure 1. Pre-Test and Post-Test Scores for Experimental and Control Groups

The relationship between PBL and the improvement of collaborative skills becomes evident when considering both the quantitative and qualitative data. Students who engaged in PBL were able to practice essential teamwork and communication skills in a structured, yet flexible, environment. The collaborative nature of the projects required students to rely on each other's strengths, resulting in more effective problem-solving and shared decision-making. This dynamic was less apparent in the control group, where the emphasis was on individual learning tasks rather than group collaboration.

A case study conducted during the intervention period offers additional insights. One group of students in the experimental group worked on a project focused on environmental conservation, which required them to research, design, and present a solution to reduce plastic waste in their school. Throughout the project, the students demonstrated continuous improvement in their ability to communicate effectively, assign tasks based on individual strengths, and resolve conflicts that arose during decision-making processes. These collaborative experiences contributed to their overall development of teamwork skills, which were reflected in their post-test scores.

The analysis of this case study, along with the broader quantitative and qualitative data, reveals that PBL provides an optimal framework for developing collaborative skills in elementary students. Unlike traditional teaching methods, PBL offers students the opportunity to engage in real-world tasks that require cooperation, communication, and problem-solving. This not only enhances their collaborative abilities but also helps them develop critical thinking skills, which are essential in both academic and social contexts.

In summary, the results of this study suggest that Project-Based Learning is highly effective in improving the collaborative skills of elementary school students. Both the quantitative data from pre-test and post-test scores and the qualitative observations from classroom activities demonstrate the significant positive impact of PBL on communication, teamwork, and problem-solving skills. The findings support the hypothesis that PBL can serve as a valuable tool for educators seeking to enhance these essential skills in young learners. Further research could explore the long-term effects of PBL on collaboration and its potential application in other educational settings.

The results of this study demonstrate that Project-Based Learning (PBL) is highly effective in improving collaborative skills among elementary school students. The experimental group, which participated in PBL activities, showed a significant increase in their ability to communicate, solve problems, and work as a team, as reflected in both the post-test scores and classroom observations. In contrast, the control group, which followed traditional instructional methods, showed only modest improvements in collaborative skills. The statistical analysis confirmed that the difference between the two groups was significant, supporting the hypothesis that PBL enhances collaboration more effectively than traditional methods.

These findings are consistent with previous research that has identified PBL as a powerful educational tool for developing 21st-century skills, including collaboration. Similar studies conducted in secondary and higher education have shown that PBL fosters better teamwork and problem-solving skills compared to traditional pedagogies. However, this study adds to the existing literature by focusing specifically on elementary school students, a population that is often overlooked in research on collaborative skills development. The results also differ from studies that have found only modest benefits of PBL in certain contexts, suggesting that the success of PBL may depend on factors such as age group, project design, and teacher facilitation.

The improvement in collaborative skills observed in this study is a clear indicator that PBL can be an essential component of early education. As elementary students are still in the process of developing social and communication skills, PBL provides a structured yet flexible environment where these abilities can flourish. The hands-on, interactive nature of PBL appears to encourage students to engage with one another in ways that are not typically fostered by traditional instructional methods. This suggests that PBL could serve as a critical foundation for the development of other soft skills, such as critical thinking and creativity.

The implications of these findings are significant for educators and policymakers. Integrating PBL into elementary school curricula could lead to substantial improvements in students' social competencies, preparing them for future academic and professional success. The ability to collaborate effectively is increasingly valued in both educational and professional settings, making it essential for schools to prioritize the development of these skills. PBL offers a practical and effective method for achieving this goal, particularly in early education, where foundational skills are still being formed.

The reason why PBL is so effective at improving collaborative skills likely lies in its structure, which requires students to work together to solve real-world problems. PBL creates opportunities for students to engage in meaningful interactions, share ideas, and take collective responsibility for their projects. This contrasts with traditional teaching methods, which often emphasize individual work and teacher-directed instruction, leaving little room for collaborative learning. The active involvement of students in the learning process, combined with the need to communicate and negotiate within their teams, likely contributes to the significant improvement in collaboration observed in this study.

Moving forward, the next steps should focus on expanding the use of PBL in elementary education and investigating its long-term effects on collaborative skills development. Further research could explore how PBL influences other critical skills, such as leadership, creativity, and adaptability, and whether these skills are retained as students progress through their education. Additionally, studies could examine how to optimize PBL for different student populations and contexts, ensuring that the approach is accessible and effective for all learners. The integration of PBL into early education represents a promising avenue for improving not only academic outcomes but also essential life skills.

CONCLUSION

The most important finding of this study is the significant improvement in collaborative skills among elementary school students who participated in Project-Based Learning (PBL). The experimental group demonstrated substantial gains in communication, teamwork, and problem-solving abilities, as evidenced by both quantitative and qualitative data. This improvement far exceeded that of the control group, which followed traditional instructional methods, highlighting the effectiveness of PBL in fostering essential 21st-century skills in young learners.

These results underscore the potential of PBL as a powerful pedagogical tool for developing collaborative skills in elementary education. Unlike traditional methods that often focus on individual tasks, PBL immerses students in real-world projects that require cooperation and active participation. This study offers new insights into the applicability of PBL for younger students, contributing to the growing body of evidence supporting its use not only for academic success but also for social and interpersonal skill development.

The research adds value in both conceptual and methodological aspects. Conceptually, it expands the understanding of how PBL can be utilized in early education to cultivate

collaboration, an area that has been underexplored in elementary school settings. Methodologically, the study provides a practical approach to assessing collaborative skills through the use of rubrics, observations, and student feedback. This combination of quantitative and qualitative data offers a more comprehensive view of how PBL influences student behavior in group settings.

Despite the positive findings, this study has limitations that suggest avenues for future research. The research was conducted over a relatively short period of six weeks, which limits the ability to assess the long-term impact of PBL on collaborative skills. Additionally, the sample was drawn from a single school, which may affect the generalizability of the findings. Future studies could explore longer-term effects and include more diverse student populations to provide a broader understanding of PBL's effectiveness.

Further research should also investigate how PBL influences other key skills, such as leadership, creativity, and adaptability, and whether these skills transfer to other areas of students' lives. Exploring the role of teacher facilitation in optimizing PBL for collaborative skill development would also be valuable. By addressing these areas, future studies can build upon the findings of this research to further improve educational practices that prepare students for the demands of the modern world.

AUTHOR CONTRIBUTIONS

Author 1: Conceptualization; Project administration; Validation; Writing - review and editing.
Author 2: Conceptualization; Data curation; In-vestigation.
Author 3: Data curation; Investigation.

CONFLICTS OF INTEREST

The author(s) declare no conflict of interest

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