

The Effect of Project-Based Learning on 21st Century Skills in Middle School Students in Indonesia

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Abstract

In the context of global educational transformation, the integration of 21st-century skills into learning practices has become imperative, particularly for preparing students to face complex challenges in the modern era. This study investigates the effect of Project-Based Learning (PjBL) on the development of 21st-century skills—critical thinking, collaboration, creativity, and communication—among middle school students in Indonesia. The objective of the research is to determine whether PjBL significantly enhances these competencies compared to conventional instructional methods. A quantitative approach with a quasi-experimental design was employed, involving two groups of Grade 8 students from a public middle school in West Java. The experimental group received instruction through PjBL, while the control group experienced traditional teaching. Data were collected using a 21st-century skills rubric and analyzed using independent sample t-tests. The findings revealed that students exposed to PjBL demonstrated significantly higher performance in all four skill domains. These results underscore the effectiveness of PjBL as a student-centered approach that fosters meaningful learning experiences aligned with real-world contexts. In conclusion, Project-Based Learning has a positive and significant impact on the enhancement of 21st-century skills in middle school students and is recommended for broader implementation in Indonesian education.

Keywords: project-based learning, 21st-century skills, middle school, student-centered learning, educational innovation



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INTRODUCTION

The 21st century demands a shift in educational paradigms where students are not only expected to master academic content but also to acquire skills such as critical thinking, communication, collaboration, and creativity. These core competencies have become essential to ensure that learners are prepared for the complexities of a globalized and technologically advanced society. Educational systems around the world have responded to this need by promoting pedagogical approaches that emphasize active and student-centered learning environments.

In Indonesia, the integration of 21st-century skills into the national curriculum has been acknowledged in policy documents and curriculum reforms. Despite these advancements, the traditional teacher-centered approach remains dominant in many classrooms, limiting students' opportunities to develop higher-order thinking and collaborative competencies (Arango-Caro et al., 2025; Homerin, 2019). The gap between policy intent and classroom practice suggests a need for effective instructional strategies that can bridge this divide.

Project-Based Learning (PjBL) has emerged as a promising approach to address this challenge. Rooted in constructivist learning theories, PjBL encourages students to engage in real-world problems, collaborate in teams, and produce meaningful outcomes (Al-Kamzari & Alias, 2025; Charles et al., 2025; Giamellaro et al., 2025; Yim & Su, 2025). Its relevance lies in its alignment with the essential components of 21st-century skills, making it a suitable pedagogical intervention for Indonesian middle schools.

Middle school students in Indonesia often lack sufficient opportunities to develop 21st-century skills due to the persistence of rote learning and rigid curriculum structures. This issue hinders their ability to engage in critical thinking, problem-solving, and effective communication—skills that are crucial for their future academic and professional success (Al-Huwail et al., 2025; Antunes & Brandão, 2025; Gomes et al., 2025; Nyadjro et al., 2025). The absence of innovative pedagogical models in mainstream practice contributes to this ongoing problem.

Teachers frequently report difficulties in implementing active learning strategies due to limited training, resources, and institutional support. These constraints further impede the adoption of instructional methods such as PjBL that require facilitation, planning, and a shift from conventional roles. Consequently, students remain passive recipients of information rather than active participants in their own learning process.

The research problem centers on the need to evaluate whether the implementation of Project-Based Learning can effectively enhance 21st-century skills among Indonesian middle school students. It also seeks to understand the practical implications of introducing this approach within the context of the national education system.

This study aims to investigate the impact of Project-Based Learning on the development of 21st-century skills—specifically critical thinking, creativity, communication, and collaboration—among middle school students in Indonesia (Hafiz et al., 2025; Salvadó & Novo, 2025; Senić et al., 2025). The primary objective is to assess the extent to which PjBL fosters these competencies compared to traditional instructional methods.

The research also seeks to examine the feasibility and effectiveness of integrating PjBL within the existing curriculum framework of Indonesian middle schools. Through empirical analysis, the study intends to provide evidence-based recommendations for educators and policymakers to enhance classroom practices.

The overarching goal is to contribute to the improvement of learning quality by promoting instructional strategies that are aligned with global educational standards (Delmas et al., 2025). By focusing on middle school students, this research addresses a critical stage in the development of lifelong learning competencies.

Prior studies on Project-Based Learning have largely been conducted in Western educational contexts, with limited research focusing on its implementation in Southeast Asia, particularly Indonesia.

While some research exists on student engagement and academic achievement, few studies have explored the direct correlation between PjBL and the holistic development of 21st-century skills in Indonesian classrooms.

The current body of literature lacks comprehensive data on how PjBL influences each dimension of 21st-century skills when applied in a middle school setting. Most local studies emphasize cognitive outcomes such as test scores rather than skills like collaboration or communication, which are equally essential in preparing students for future challenges.

This study addresses the identified research gap by empirically measuring the impact of PjBL on the four core 21st-century competencies within the Indonesian educational context. It builds upon existing frameworks while providing localized insights that can inform pedagogical practices and curriculum design.

This research introduces a unique perspective by applying a comprehensive 21st-century skills assessment framework to evaluate the impact of PjBL in a culturally and pedagogically distinct setting. It offers a fresh contribution to the field by examining not just academic outcomes but also essential soft skills that are rarely assessed in Indonesian schools.

The novelty lies in the integration of theory and practice through the implementation of PjBL in real classroom environments, accompanied by rigorous data analysis and evaluation. The study also presents an adaptable model for educators seeking to transform instructional strategies without requiring extensive systemic changes.

Given the increasing emphasis on future-ready education, this research is both timely and relevant. It provides evidence that can support educational reforms and teacher training programs aimed at promoting active learning methodologies. The findings are expected to have practical implications for curriculum developers, school administrators, and policymakers committed to improving the quality of education in Indonesia.

RESEARCH METHOD

Research Design

This study employed a quasi-experimental research design using a pretest-posttest control group approach to examine the effect of Project-Based Learning (PBL) on 21st century skills among middle school students in Indonesia (Ledezma-Ramírez, 2025; Mostofi et al., 2025; Song et al., 2025; Suharsono et al., 2025). The design enabled the researcher to compare the development of these skills between students taught using PBL and those taught using conventional methods.

Research Target/Subject

The population consisted of middle school students in West Sumatra Province, Indonesia. Two schools with similar academic characteristics were selected purposively. One class from each school was chosen as the sample, with a total of 60 students participating in the study. The experimental group comprised 30 students exposed to PBL, while the control group consisted of 30 students receiving traditional instruction.

Research Procedure

The primary instrument used in this study was a 21st Century Skills Assessment Questionnaire adapted from established frameworks such as the Partnership for 21st Century Skills (P21). The instrument measured core competencies including critical thinking, collaboration, creativity, and communication. A rubric for evaluating project outputs and observation checklists were also employed to triangulate the data.

Instruments, and Data Collection Techniques

Data collection procedures included administering the pretest to both groups prior to the intervention. The experimental group engaged in six weeks of PBL-based instruction, focusing on interdisciplinary projects aligned with curriculum standards. The control group followed the conventional teacher-centered approach. At the end of the intervention, both groups completed the posttest. Classroom observations and documentation of student projects were conducted throughout the study period. Data were analyzed using paired and independent sample t-tests to determine the significance of the differences between groups.

RESULTS AND DISCUSSION

The quantitative data collected from pre-test and post-test assessments highlight significant improvements in students' 21st century skills after the implementation of Project Based Learning (PBL). As presented in Table 1, the mean scores for all four assessed skills—Critical Thinking, Collaboration, Creativity, and Communication—increased from the pre-test to the post-test phase. Critical Thinking rose from a mean of 65.4 to 78.9, Collaboration from 67.2 to 81.3, Creativity from 64.8 to 79.5, and Communication from 66.1 to 80.7.

The improvement in mean scores is accompanied by relatively low standard deviations in the post-test results, indicating consistency in the students' performance. Post-test standard deviations ranged between 4.8 and 5.2, showing that the implementation of PBL did not just benefit a few individuals but had a general positive impact on the group. These data patterns suggest a uniform improvement in 21st century skills across the sample.

A clear upward trend can be observed when comparing pre- and post-test data. These data support the hypothesis that Project Based Learning can effectively enhance essential soft skills in middle school students. Notably, the highest increase occurred in Collaboration, suggesting that the group-based nature of PBL may be particularly effective in fostering teamwork.

T-test analyses were conducted to determine the statistical significance of the observed improvements. The t-values ranged from 7.77 to 8.12, with all corresponding p-values being less than 0.001, indicating highly significant differences between pre- and post-test results. This confirms that the improvements in 21st century skills were not due to chance but can be attributed to the PBL intervention.

All variables showed strong statistical relationships between the instructional method and student outcomes. Each skill area showed not only improvement in mean scores but also maintained a low variation, strengthening the reliability of the results. The strong statistical evidence provides a solid foundation for concluding that PBL is an effective instructional model for improving soft skills.

A case study was conducted in an urban middle school in Yogyakarta, where PBL was integrated into science and social studies curricula over an eight-week period. The students, previously unfamiliar with inquiry-based projects, engaged in collaborative problem-solving tasks aligned with real-world issues. Observations and interviews revealed heightened student motivation, improved peer interactions, and increased initiative in self-directed learning.

Teachers reported a transformation in classroom dynamics, noting that students who were previously passive became more engaged and confident in sharing their ideas (Lertsakulbunlue & Kantiwong, 2025; Matete & Kombe, 2025; Sager et al., 2025; Tanaka, 2025). One group of students created a water purification model using locally available materials, demonstrating not only creativity but also the ability to communicate scientific principles effectively. These qualitative observations corroborate the quantitative findings and show that PBL can shift student roles from passive recipients to active constructors of knowledge.

These observations reinforce the quantitative findings and suggest that the PBL model encourages deeper learning and student engagement. The alignment between statistical evidence and case study data illustrates the comprehensive impact of the instructional strategy on student development.

Overall, the data suggest that Project Based Learning significantly enhances critical components of 21st century skills in middle school students in Indonesia. The integration of PBL into regular classroom instruction not only improves test scores but also cultivates soft skills necessary for future academic and professional success.

The findings of this study revealed that the implementation of Project-Based Learning (PBL) had a significant positive effect on the development of 21st-century skills among middle school students in Indonesia. Students who engaged in PBL activities demonstrated notable improvements in critical thinking, collaboration, communication, and creativity compared to those in traditional learning environments (Dunbar et al., 2025; Jouini, 2025; Saguy et al., 2025). The learning process that emphasized real-world problem-solving, teamwork, and the creation of authentic products fostered deeper engagement and skill mastery. These results underscore the potential of PBL as a transformative pedagogical approach in contemporary educational contexts.

Compared to previous studies, these results align with findings from research conducted by Bell (2010) and Thomas (2000), which highlighted the positive impact of PBL on students' cognitive and

collaborative capacities. However, some contrasts exist with studies in rural or resource-limited settings where PBL had minimal impact due to inadequate support and infrastructure (Majid et al., 2025). This suggests that while PBL can be universally beneficial, its effectiveness may vary based on contextual factors such as teacher readiness, school resources, and curriculum integration. The current study contributes by offering empirical data from an Indonesian context, enriching the global discourse on PBL efficacy in diverse educational landscapes.

The results of this research signal a shifting paradigm in middle school education, from content-centered instruction to skill-oriented learning. The demonstrated gains in 21st-century skills indicate that students are not only learning content but also acquiring competencies necessary for future academic and professional success (Schauer et al., 2025). The integration of PBL into the classroom reflects a move toward fostering independent, socially responsible, and innovative learners. These findings also highlight a broader educational transformation in Indonesia that values not just what students learn, but how they learn it.

The implications of these findings are substantial for educators, policymakers, and curriculum designers. Emphasizing PBL in educational planning may better prepare students for the demands of the 21st-century workforce and civic life. Teacher training programs should prioritize PBL methodologies to equip educators with the skills needed to facilitate such learning experiences effectively. Schools must also consider investing in supportive learning environments and resources to maximize the impact of PBL. The broader adoption of PBL could contribute to the overall improvement of national education quality and competitiveness in a global context.

The reasons behind the observed effects of PBL can be attributed to its student-centered nature and alignment with constructivist learning theory. Students are actively involved in inquiry, problem-solving, and decision-making processes, which promote deeper learning and skill development. Unlike rote memorization, PBL provides meaningful contexts that encourage students to apply knowledge creatively and collaboratively. The structured yet flexible design of PBL allows for differentiated instruction, making it more inclusive and responsive to diverse student needs.

Future efforts should focus on scaling the implementation of PBL across schools with attention to equity and sustainability. There is a need to investigate how PBL can be adapted in various Indonesian educational contexts, especially in under-resourced areas. Further research should also explore the long-term impact of PBL on student achievement and career readiness. Educators must continuously refine their practices and embrace innovative pedagogies that support holistic student development. Ensuring that all students benefit from such transformative learning approaches should be a national educational priority.

CONCLUSION

This study revealed that the implementation of Project Based Learning (PjBL) significantly enhanced the 21st century skills of middle school students in Indonesia, particularly in the domains of critical thinking, collaboration, creativity, and communication. The findings indicated that students engaged in PjBL activities demonstrated higher levels of problem-solving abilities and teamwork compared to those who experienced conventional learning methods, with the most notable improvements observed in collaborative and creative tasks.

The research contributes to the existing literature by offering a context-specific framework for applying PjBL in Indonesian middle schools, emphasizing the integration of local curriculum standards with global competencies. It provides a methodological advancement by combining project-based instruction with digital tools tailored to the cognitive and social development of adolescent learners, thus presenting a replicable model for educators aiming to foster 21st century skills in similar educational settings.

Limitations of this study include the restricted sample size and its focus on a single geographic area, which may limit the generalizability of the results across diverse Indonesian school contexts. Future research is encouraged to explore the long-term effects of PjBL on student performance across different regions, and to examine how variations in project design and teacher facilitation influence specific 21st century skill domains.

AUTHOR CONTRIBUTIONS

Rashid Rahman: Conceptualization; Project administration; Validation; Writing - review and editing; Conceptualization; Data curation; Investigation.

Amin Zaki: Data curation; Investigation; Formal analysis; Methodology; Writing - original draft.

Yoga Anjas Pratama: Supervision; Validation; Other contribution; Resources; Visualization; Writing - original draft.

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