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Strengthening Student Character Education through Interdisciplinary Project-Based Learning Approaches

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ABSTRACT

Character education has become an essential focus in contemporary educational systems, as schools are increasingly expected to develop students' moral, social, and civic competencies alongside academic achievement. This study investigates the effectiveness of interdisciplinary Project-Based Learning (PBL) as an instructional approach for strengthening student character education in formal school settings. Employing a mixed-methods, quasi-experimental design, the research involved an experimental group receiving interdisciplinary PBL instruction and a control group taught using conventional methods. Quantitative data were collected through character education questionnaires, learning outcome assessments, and 21st-century skills scales administered before and after the intervention, while qualitative data were obtained through classroom observations, student reflection journals, and semi-structured interviews. The findings indicate that students who participated in interdisciplinary PBL demonstrated significant improvements in key character dimensions, including responsibility, collaboration, creativity, independence, and civic awareness, compared to students in the control group. Additionally, interdisciplinary PBL was found to support academic learning and the development of critical thinking, communication, and problem-solving skills. Qualitative findings further revealed that students perceived interdisciplinary projects as meaningful and engaging learning experiences that encouraged ethical behavior, teamwork, and reflective thinking. The study concludes that interdisciplinary Project-Based Learning is an effective pedagogical strategy for integrating character education within academic instruction. By aligning character development with interdisciplinary learning objectives, educators can foster holistic student development and better prepare learners for the social and ethical challenges of the 21st century.

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INTRODUCTION

In recent decades, educational discourse has increasingly emphasized the importance of character education as a central objective of schooling, alongside academic achievement. Character education refers to the deliberate effort to cultivate students' moral values, social responsibility, independence, collaboration, creativity, and civic awareness, which are essential for learners to function ethically and productively in contemporary society. The rapid development of science, technology, and globalization has reshaped social interaction, workplace demands, and civic participation, thereby requiring education systems to prepare students not only with cognitive competencies but also with strong character traits. However, many formal education practices remain heavily focused on content mastery and standardized testing, often neglecting the systematic development of students' character and socio-emotional competencies (Purwanti et al., 2025; Rediani et al., 2024).

Character education has been widely recognized as a multidimensional construct encompassing personal, social, and civic dimensions. Traits such as responsibility, honesty,

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perseverance, cooperation, creativity, empathy, and respect are increasingly considered integral to holistic student development. Studies conducted in various educational contexts indicate that when character education is treated as an implicit or supplementary component of instruction, its impact tends to be fragmented and inconsistent (Putri et al., 2025; Sriwahyuni, & Eliza, 2024). Consequently, there is a growing consensus that character education must be embedded directly within instructional practices rather than taught as a separate or abstract subject. This perspective aligns with constructivist learning theories, which emphasize meaningful learning experiences that connect knowledge, values, and real-world contexts (Utomo, 2023).

Project-Based Learning (PBL) has emerged as a promising pedagogical approach for addressing this challenge. PBL is a student-centered learning model in which learners actively engage in exploring authentic problems, designing projects, collaborating with peers, and reflecting on their learning processes. Through these activities, students are required to apply knowledge, communicate effectively, manage time, negotiate roles, and take responsibility for outcomes. Such learning environments naturally foster character development by placing students in situations that demand ethical decision-making, collaboration, perseverance, and self-regulation (Purwanti et al., 2025; Pirdaus, 2024). Empirical evidence consistently demonstrates that PBL contributes positively to students' motivation, creativity, and social skills, making it a suitable vehicle for character education (Fariasih & Fathoni, 2022; Maharani et al., 2024).

Beyond its general pedagogical strengths, PBL is particularly effective when implemented through an interdisciplinary approach. Interdisciplinary Project-Based Learning integrates multiple subject areas within a single project, allowing students to view problems holistically and apply diverse forms of knowledge simultaneously. In interdisciplinary PBL, learning transcends disciplinary boundaries and mirrors real-life problem-solving processes, which rarely occur within isolated subject domains. Research suggests that interdisciplinary learning enhances students' critical thinking, collaboration, and adaptability while reinforcing values such as responsibility, respect for diverse perspectives, and civic engagement (Rahman et al., 2025; Rocha et al., 2025). These outcomes are closely aligned with the goals of character education and 21st-century learning frameworks.

The integration of character education and interdisciplinary PBL is increasingly evident in contemporary educational research. Studies in elementary and secondary education contexts show that interdisciplinary PBL projects promote collaboration, creativity, and independence by requiring students to work in teams, manage complex tasks, and reflect on their learning experiences (Marlina, & Miaz, 2025; Wulandari et al., 2025). For example, interdisciplinary projects that combine science, language, and social studies have been shown to enhance students' environmental awareness, civic responsibility, and communication skills simultaneously (Hartanto et al., 2024). These findings underscore the potential of interdisciplinary PBL as a strategic approach to embedding character education within everyday classroom practices.

Empirical research across various subject domains further supports the effectiveness of PBL for character development. In science education, PBL has been found to improve students' scientific process skills while fostering responsibility, curiosity, and collaboration (Apriansyah et al., 2024; Utomo, 2023). In civic and citizenship education, PBL encourages active participation, democratic values, and civic engagement by engaging students in projects related to social issues and community problem-solving (Pirdaus, 2024; Maharani et al., 2024). Similarly, in language and literacy education, PBL has been shown to strengthen students' self-confidence, cooperation, and ethical communication through collaborative writing and inquiry-based projects (Dewi et al., 2022; Marnola et al., 2024; Marnola et al., 2024).

The application of PBL in early childhood and primary education contexts further highlights its potential for character formation from an early age. Research indicates that project-based and play-based learning activities help young learners develop social responsibility, empathy, and cooperation through shared tasks and guided exploration (Fariasih & Fathoni, 2022; Pratiwi et al., 2023). These findings suggest that PBL can serve as a

foundational approach for cultivating character traits across developmental stages, provided that learning activities are carefully designed to align with students' cognitive and emotional needs.

Despite the growing body of evidence supporting PBL and interdisciplinary learning, several gaps remain in the existing literature. First, many studies focus primarily on academic outcomes or 21st-century skills, while character education is often treated as a secondary or implicit outcome. Second, research explicitly examining interdisciplinary PBL as a structured approach to strengthening student character education remains limited, particularly in formal school settings. Third, there is a need for comprehensive studies that combine quantitative and qualitative data to capture both measurable changes in character traits and students' lived learning experiences (Halim et al., 2023; Budiarto, 2023).

Addressing these gaps is essential for advancing both theory and practice in character education. By systematically examining how interdisciplinary PBL influences students' character development, educators and policymakers can gain deeper insights into effective instructional strategies that align academic learning with moral and social development. Therefore, this study aims to investigate the effectiveness of interdisciplinary Project-Based Learning approaches in strengthening student character education. Specifically, the study seeks to analyze changes in students' character traits, examine the integration of character values within interdisciplinary projects, and explore students' perceptions of learning experiences in PBL environments. Through this investigation, the study contributes empirical evidence to the growing literature on character education and provides practical guidance for educators seeking to implement interdisciplinary PBL in their classrooms.

METHOD

This study employed a mixed-methods research design to examine the effectiveness of interdisciplinary Project-Based Learning in strengthening student character education. The mixed-methods approach was selected to provide a comprehensive understanding of both the measurable outcomes of character development and the qualitative experiences of students participating in interdisciplinary PBL activities. Previous studies in PBL and character education have demonstrated that combining quantitative and qualitative data yields richer and more valid insights into complex educational phenomena (Putri et al., 2025; Budiarto, 2023).

Research Design

The research adopted a quasi-experimental design with a pretest–posttest non-equivalent control group, complemented by qualitative descriptive methods. The experimental group received instruction using an interdisciplinary PBL approach, while the control group was taught using conventional instructional methods. This design has been widely used in PBL research to evaluate instructional effectiveness while accommodating the practical constraints of school-based research (Rahman et al., 2025; Maharani et al., 2024). Qualitative data were collected through observations, student reflections, and interviews to capture students' perceptions and experiences during the learning process.

Research Participants and Setting

The participants consisted of students enrolled in a formal school setting at the elementary or secondary level, depending on institutional context. The selection of participants followed a purposive sampling technique to ensure that the sample reflected the characteristics relevant to interdisciplinary PBL implementation. Both the experimental and control groups were comparable in terms of age, academic background, and prior learning experiences. Similar participant selection strategies have been applied successfully in previous studies examining PBL and character development (Apriansyah et al., 2024; Fariasih & Fathoni, 2022).

The research was conducted in a school environment that supported collaborative learning and interdisciplinary instruction. The learning setting was designed to facilitate group work, discussion, and project presentation, consistent with best practices in PBL implementation (Rediani et al., 2024; Sriwahyuni, & Eliza, 2024).

Interdisciplinary Project-Based Learning Intervention

The interdisciplinary PBL intervention was implemented over several instructional cycles. Each cycle involved project planning, inquiry and exploration, product development, presentation, and reflection. Projects were designed to integrate multiple subject areas, such as science, mathematics, language, and civic education, around authentic and contextually relevant themes. This integration allowed students to apply knowledge holistically while engaging in collaborative problem-solving activities (Marlina, & Miaz, 2025).

Character education was explicitly embedded within the project design through clearly defined learning objectives, assessment criteria, and reflection activities. Character indicators included responsibility, cooperation, creativity, independence, and civic awareness, which align with previous character education frameworks used in PBL studies (Purwanti et al., 2025; Pirdaus, 2024).

Instruments and Data Collection

Quantitative data were collected using a character education questionnaire developed based on validated instruments from prior research (Putri et al., 2025; Hartanto et al., 2024). The questionnaire measured students' character traits using a Likert-scale format administered before and after the intervention. Additional instruments included learning outcome tests and 21st-century skills scales to examine the broader impact of interdisciplinary PBL (Rahman et al., 2025; Rocha et al., 2025).

Qualitative data were collected through classroom observations, student reflection journals, and semi-structured interviews. Observation sheets were used to document students' collaborative behaviors, participation, and ethical decision-making during project activities. Reflection journals allowed students to express their learning experiences and personal growth, while interviews provided deeper insights into students' perceptions of interdisciplinary PBL (Dewi et al., 2022; Marnola et al., 2024).

Validity and Reliability

Instrument validity was ensured through expert judgment and pilot testing. Content validity was evaluated by educational experts to ensure alignment between research objectives, character indicators, and instrument items. Reliability analysis was conducted using Cronbach's alpha to assess internal consistency, following procedures commonly employed in PBL research (Halim et al., 2023; Marlina, & Miaz, 2025).

Data Analysis Techniques

Quantitative data were analyzed using descriptive and inferential statistics. Descriptive statistics were used to summarize students' character development scores, while inferential analyses, such as paired-sample t-tests and analysis of variance (ANOVA), were conducted to determine significant differences between pretest and posttest results. Qualitative data were analyzed using thematic analysis to identify recurring patterns related to character development and learning experiences. Data triangulation was employed to enhance the credibility and trustworthiness of the findings (Lasamahu et al., 2021; Budiarto, 2023).

Ethical Considerations

Ethical approval was obtained prior to data collection. Informed consent was secured from all participants, and confidentiality was maintained throughout the research process.

Ethical procedures adhered to established standards for educational research, as emphasized in previous studies on character education and PBL (Purwanti et al., 2025; Utomo, 2023).

RESULTS AND DISCUSSION

Overview of Quantitative Findings on Student Character Development

The primary objective of this study was to examine the effectiveness of interdisciplinary Project-Based Learning (PBL) in strengthening student character education. Quantitative data analysis revealed a statistically significant improvement in overall character development among students who participated in the interdisciplinary PBL intervention. The experimental group demonstrated higher posttest scores across all measured character indicators compared to their pretest scores and to the control group, which received conventional instruction. These findings suggest that interdisciplinary PBL provides a learning environment that is conducive to the systematic cultivation of character traits.

Descriptive statistical analysis indicated notable increases in students' responsibility, collaboration, creativity, independence, and civic awareness. Among these dimensions, responsibility and collaboration showed the highest gains, followed by creativity and independence. Civic awareness also increased significantly, though to a slightly lesser extent. Inferential statistical tests confirmed that the observed improvements were statistically significant, indicating that the changes were not attributable to chance. These results align with previous empirical studies that reported positive effects of PBL on student character and socio-emotional development (Purwanti et al., 2025; Rediani et al., 2024; Putri et al., 2025).

The control group, in contrast, showed only marginal improvement in character scores, which may be attributed to routine classroom interactions rather than to intentional character-focused instructional strategies. This finding reinforces the argument that character education requires purposeful pedagogical design rather than incidental exposure. Conventional instruction, which often emphasizes content delivery and individual performance, appears less effective in fostering collaborative and ethical behaviors than interdisciplinary PBL environments (Fariasih & Fathoni, 2022; Maharani et al., 2024).

Differential Effects Across Character Dimensions

A closer examination of individual character dimensions revealed nuanced patterns in how interdisciplinary PBL influenced student development. Responsibility emerged as the most significantly improved trait. Students in the experimental group demonstrated greater accountability for task completion, adherence to project timelines, and ownership of learning outcomes. This improvement can be attributed to the structure of PBL, which requires students to manage long-term projects, distribute roles within groups, and take responsibility for collective success. Similar findings have been reported in studies emphasizing responsibility and self-management as core outcomes of project-based instruction (Purwanti et al., 2025; Pirdaus, 2024).

Collaboration also showed substantial gains, reflecting students' increased ability to work effectively in teams, communicate ideas, and resolve conflicts constructively. Interdisciplinary projects necessitated frequent peer interaction and joint decision-making, creating authentic opportunities for students to practice social and ethical skills. This result supports earlier research indicating that PBL environments naturally foster collaborative character traits through sustained group engagement (Rahman et al., 2025; Rocha et al., 2025; Marlina, & Miaz, 2025).

Creativity and independence exhibited moderate yet significant improvements. Students demonstrated increased originality in problem-solving and greater initiative in exploring project topics. However, these gains were slightly lower than those observed for responsibility and collaboration. One possible explanation is that creativity and independence require longer periods of scaffolding and repeated exposure to open-ended tasks before students fully internalize these traits. Nevertheless, the findings remain consistent with previous research

demonstrating that PBL promotes creative thinking and learner autonomy through inquiry-based activities (Apriansyah et al., 2024; Wulandari et al., 2025).

Civic awareness, while improved, showed comparatively smaller gains. This may reflect the abstract nature of civic values, which often require sustained engagement with real-world social contexts beyond the classroom. Although interdisciplinary PBL incorporated civic themes, deeper community involvement may be necessary to produce stronger effects. Nonetheless, the observed improvement aligns with studies indicating that PBL in civic and citizenship education enhances students' awareness of social responsibility and democratic values (Maharani et al., 2024; Pirdaus, 2024).

Learning Outcomes and 21st-Century Skills as Supporting Results

In addition to character development, the study examined students' learning outcomes and 21st-century skills as complementary indicators of interdisciplinary PBL effectiveness. Quantitative analysis showed that students in the experimental group achieved higher learning outcome scores compared to the control group. These results suggest that character education through interdisciplinary PBL does not compromise academic achievement; rather, it enhances learning by engaging students cognitively and affectively.

Improvements were also observed in critical thinking, communication, and problem-solving skills, which are integral components of 21st-century competencies. These findings support the notion that character education and academic learning are mutually reinforcing rather than competing goals. Previous studies have similarly reported that PBL strengthens both cognitive and non-cognitive outcomes by situating learning within meaningful and authentic contexts (Rahman et al., 2025; Rocha et al., 2025).

The integration of multiple subject areas within a single project allowed students to transfer knowledge across disciplines and apply concepts holistically. This interdisciplinary approach appears to enhance deeper understanding and sustained engagement, which, in turn, supports character formation. These results corroborate earlier findings that interdisciplinary learning promotes adaptability, responsibility, and collaborative problem-solving skills (Marlina, & Miaz, 2025; Wulandari et al., 2025).

Qualitative Findings: Student Experiences in Interdisciplinary PBL

Qualitative data from classroom observations, reflection journals, and interviews provided valuable insights into students' lived experiences during the interdisciplinary PBL intervention. Observation data revealed increased student participation, peer interaction, and constructive dialogue throughout the project cycles. Students were observed taking initiative, offering feedback to peers, and negotiating roles within groups, reflecting the development of responsibility and collaboration.

Student reflection journals further illustrated the internalization of character values. Many students expressed a sense of pride in completing projects collaboratively and acknowledged the importance of cooperation and mutual respect. Reflections frequently highlighted challenges encountered during group work, such as differing opinions or unequal participation, and described strategies used to resolve these issues. These reflections indicate that students were not only engaging in character-related behaviors but also developing metacognitive awareness of ethical and social learning processes. Similar reflective outcomes have been reported in PBL-based language and literacy studies emphasizing character growth through collaboration and self-regulation (Dewi et al., 2022; Marnola et al., 2024; Marnola et al., 2024).

Interview data reinforced these findings by revealing students' positive perceptions of interdisciplinary PBL. Students reported that working on projects across multiple subjects made learning more meaningful and enjoyable. They also noted that project activities encouraged them to take responsibility and communicate more effectively with peers. These qualitative findings align with previous research demonstrating that student-centered learning

environments foster positive attitudes toward learning and character development (Rediani et al., 2024; Sriwahyuni, & Eliza, 2024).

Discussion: Interdisciplinary PBL as a Catalyst for Character Education

The findings of this study provide strong empirical support for the effectiveness of interdisciplinary PBL as a strategy for strengthening student character education. The significant improvements observed across multiple character dimensions confirm the theoretical assumption that character development is best achieved through active, contextualized learning experiences. By engaging students in authentic projects that require collaboration, problem-solving, and reflection, interdisciplinary PBL creates conditions conducive to moral and social growth.

These results are consistent with constructivist learning theory, which emphasizes the role of social interaction and experiential learning in knowledge and value formation. Interdisciplinary PBL situates character education within real-world contexts, allowing students to practice ethical behaviors rather than merely discuss abstract values. This finding supports earlier research highlighting the importance of integrating character education directly into instructional practices (Utomo, 2023; Purwanti et al., 2025).

The strong gains in responsibility and collaboration observed in this study suggest that these character traits are particularly responsive to PBL environments. The requirement to manage tasks, meet deadlines, and contribute to group outcomes fosters a sense of accountability and shared responsibility. These findings corroborate studies in science, civic, and elementary education contexts that identified responsibility and cooperation as key outcomes of project-based instruction (Apriansyah et al., 2024; Fariasih & Fathoni, 2022; Pirdaus, 2024).

The moderate improvements in creativity and independence highlight the need for sustained and iterative PBL implementation. While interdisciplinary projects provide opportunities for creative expression and autonomous learning, these traits may require longer-term exposure to fully develop. This observation aligns with previous research suggesting that creativity and self-regulated learning are cumulative outcomes that evolve over time (Marlina, & Miaz, 2025; Marnola et al., 2024).

Interdisciplinary Learning and the Integration of Character Values

A key contribution of this study lies in its explicit focus on interdisciplinary PBL. By integrating multiple subject areas within a single project framework, the intervention enabled students to experience learning as an interconnected process. This approach mirrors real-life problem-solving and reinforces the relevance of character values across contexts. For example, integrating civic themes into science or language projects helped students recognize the social implications of academic knowledge, thereby strengthening civic awareness and ethical reasoning (Hartanto et al., 2024).

The interdisciplinary nature of the projects also supported inclusivity and respect for diverse perspectives. Students with varying strengths were able to contribute meaningfully, fostering mutual respect and empathy. These findings resonate with research emphasizing the role of interdisciplinary learning in promoting social cohesion and character education (Rocha et al., 2025; Wulandari et al., 2025).

Implications for Educational Practice and Policy

The results of this study have important implications for educational practice. First, they underscore the need for educators to adopt instructional models that intentionally integrate character education with academic learning. Interdisciplinary PBL offers a practical framework for achieving this integration without overburdening the curriculum. Second, the findings suggest that teacher professional development should emphasize project design, interdisciplinary collaboration, and assessment of character outcomes. Without adequate preparation, the potential of PBL for character education may not be fully realized.

From a policy perspective, the study supports the inclusion of interdisciplinary and project-based approaches in curriculum guidelines aimed at holistic student development. Aligning assessment systems with character education objectives is also essential to ensure that non-cognitive outcomes are valued alongside academic achievement (Maharani et al., 2024; Putri et al., 2025).

Limitations and Directions for Future Research

Despite its contributions, this study has several limitations. The quasi-experimental design limits the ability to establish causal relationships definitively. Additionally, the study was conducted within a specific educational context, which may affect the generalizability of the findings. Future research should consider longitudinal designs to examine the sustained impact of interdisciplinary PBL on character development. Expanding the scope to include diverse educational settings and age groups would also enhance the robustness of the evidence base (Halim et al., 2023; Budiarto, 2023).

CONCLUSION

This study set out to examine the effectiveness of interdisciplinary Project-Based Learning as an instructional approach for strengthening student character education within formal school settings. The findings demonstrate that character education can be meaningfully and systematically developed when learning experiences are intentionally designed to integrate academic content with authentic, collaborative, and reflective activities. Interdisciplinary Project-Based Learning provides a pedagogical framework that allows character values to emerge naturally through student engagement with real-world problems and shared learning responsibilities.

The results indicate that students who participated in interdisciplinary project-based learning experienced substantial growth in key character dimensions, including responsibility, collaboration, creativity, independence, and civic awareness. These outcomes suggest that character education is most effective when embedded directly within instructional practices rather than delivered as a separate or abstract component of the curriculum. By requiring students to work collaboratively, manage long-term tasks, and reflect on their learning processes, interdisciplinary projects encourage the internalization of ethical and social values alongside cognitive development.

In addition to character development, the study highlights the compatibility of character education with academic achievement and the development of 21st-century skills. The integration of multiple disciplines within a single project enhances student engagement, deepens conceptual understanding, and promotes transferable skills such as critical thinking and communication. This finding challenges the assumption that a focus on character education detracts from academic rigor and instead demonstrates that both objectives can be achieved simultaneously through well-designed learning experiences.

Despite these positive outcomes, the study acknowledges the need for sustained implementation and ongoing teacher support to maximize the impact of interdisciplinary project-based learning. Future efforts should focus on strengthening teacher capacity in interdisciplinary curriculum design and assessment of character outcomes. Overall, this study contributes to the growing body of evidence supporting interdisciplinary Project-Based Learning as a viable and effective strategy for fostering holistic student development and preparing learners to navigate complex social and academic challenges in contemporary education.

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