The impact of Project-based Learning on senior high school students' academic performance

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ABSTRACT

This study aims to examine the effect of the Project-Based Learning (PjBL) method on the academic performance of senior high school students. With the increasing demand for innovative teaching methods to enhance student engagement and achievement, this research focuses on a public senior high school in Jakarta, Indonesia. The research utilized a qualitative case study approach involving 11 students and 5 teachers as participants. Data were collected through in-depth interviews, classroom observations, and document analysis. Thematic analysis was applied to identify key patterns and insights. The findings revealed that the PjBL method significantly fostered students' critical thinking skills, collaboration, and intrinsic motivation, all of which contributed to improved academic performance. Teachers' involvement in project design, as well as the availability of adequate learning resources, were identified as crucial factors in the successful implementation of PjBL. This study suggests that when implemented with thoughtful planning and sufficient support, PjBL can be a highly effective approach for enhancing student outcomes. The research contributes to the growing body of evidence supporting the integration of PjBL in the classroom and underscores its potential as a strategy to address academic challenges in senior high schools.

Introduction

The educational landscape of the 21st century has been shaped by the evolving demands of a globalized world, where the acquisition of subject-specific knowledge is no

longer sufficient. Contemporary educational paradigms call for the development of a broader set of competencies, including critical thinking, creativity, collaboration, and problem-solving (Rahimi & Oh, 2024). These 21st-century skills are essential for students to navigate complex and interconnected global challenges (Avdiu et al., 2025). In particular, the increasing emphasis on digital literacy and technological advancements has necessitated a shift in pedagogical practices to ensure that students are not only consumers of knowledge but also active contributors to solving real-world problems (Al-Haimi et al., 2024). This shift underscores the importance of integrating innovative teaching methods that can engage students in meaningful learning experiences (Ong & Annamalai, 2024). One such method, Project-Based Learning (PjBL), has gained considerable attention in recent years for its potential to foster deep learning through authentic, hands-on projects (Dos Santos et al., 2023).

Project-Based Learning (PjBL) is an instructional approach that centers on student-driven projects, where learners engage in complex, real-world tasks that promote the acquisition of both academic knowledge and essential life skills (Gary, 2015). In PjBL, students take ownership of their learning process, actively participating in all stages of the project—from conceptualization and planning to execution and evaluation (Wang et al., 2024). This approach facilitates the development of critical thinking, collaboration, and communication skills, as students work together to tackle problems and present solutions in a collaborative, interdisciplinary setting (Sasson et al., 2018). Given its potential to provide a more holistic learning experience, PjBL has emerged as a promising strategy for enhancing academic achievement while simultaneously equipping students with the competencies necessary for success in the 21st century (Ndiung & Menggo, 2024). Furthermore, it fosters a deeper understanding of content by allowing students to connect theoretical concepts to practical applications, thus bridging the gap between classroom learning and the real world (Gamboa et al., 2024).

A growing body of research has explored the application of Project-Based Learning (PjBL) across different educational contexts, showing its effectiveness in promoting student engagement and improving academic outcomes. For instance, studies have demonstrated that PjBL enhances students' problem-solving abilities by encouraging them to engage with real-world challenges that require critical thinking and creativity (Cortázar et al., 2021; Goshu & Ridwan, 2024). In a study by Gamboa et al. (2024), PjBL was found to foster a deeper understanding of content by facilitating the application of theoretical knowledge in practical contexts. This aligns with the goals of the present research, which also seeks to understand how PjBL impacts students' academic achievement and skill development. Furthermore, research by Dos Santos et al. (2023) found that PjBL significantly contributed to the improvement of collaborative skills and teamwork, which are crucial for academic and professional success. These studies highlight the promise of PjBL in addressing the multifaceted needs of students, particularly in developing competencies beyond traditional subject-specific knowledge.

The importance of investigating the impact of PjBL on academic achievement is particularly critical within the context of senior high school education in Indonesia. In recent years, there has been a growing recognition of the need for educational reforms that can better align with the demands of the modern workforce and society (Tran et al., 2024). Indonesian students, like their global counterparts, face significant challenges in preparing for an increasingly complex world. Many students at the senior high school level, particularly in public institutions, still engage with traditional, teacher-centered learning approaches that emphasize rote memorization rather than critical engagement with content (Mukminin et al., 2019). This research addresses the urgency of exploring innovative pedagogical methods that can address these gaps, improve student learning outcomes, and better prepare them for future academic and professional success.

Despite the increasing popularity of PjBL in various educational contexts worldwide, there is limited empirical research focusing on its implementation at the senior high school level in Indonesia. Most studies have concentrated on higher education

or have been conducted in developed countries where educational systems are structurally different. In the Indonesian context, research on the efficacy of PjBL at the senior high school level remains sparse, and the available studies tend to focus on the challenges of implementing PjBL without providing in-depth insights into its effects on student academic performance and skill development. As a result, there is a clear gap in the literature that this study seeks to address. Specifically, this research aims to fill this gap by examining the impact of PjBL on both academic achievement and the development of essential 21st-century competencies such as critical thinking, teamwork, and communication skills among senior high school students in Jakarta.

This study is unique in that it not only evaluates the direct effects of PjBL on academic performance but also explores its broader impact on student development. While many studies focus primarily on the academic outcomes of PjBL, this research takes a more holistic approach by considering how the method influences a range of skills that are critical for personal and professional growth. In addition, the study is novel in its focus on the Indonesian educational context, providing valuable insights into the potential benefits and challenges of implementing PjBL in a non-Western, developing country setting. The research contributes to the growing body of literature on PjBL by offering empirical evidence from an underexplored region and setting, which will be invaluable for educators and policymakers looking to implement or refine PjBL strategies in similar contexts.

The primary purpose of this study is to investigate the effects of Project-Based Learning (PjBL) on the academic performance and skill development of senior high school students in Jakarta, Indonesia. Specifically, the study seeks to answer the following research questions: (1) How does the implementation of Project-Based Learning (PjBL) affect students' academic achievement in a senior high school setting? and (2) What impact does PjBL have on the development of critical thinking, collaboration, and communication skills among students? To address these questions, the study employs a qualitative case study approach, gathering data through in-depth interviews with students and teachers, classroom observations, and document analysis. This methodology allows for a comprehensive exploration of the experiences and perceptions of both students and teachers, providing a nuanced understanding of the impact of PjBL on student learning and development.

The findings from this research are expected to have significant implications for the future of education in Indonesia and similar educational contexts. By highlighting the strengths and challenges of PjBL, this study aims to provide practical recommendations for educators, school administrators, and policymakers. The research will offer insights into how PjBL can be effectively implemented at the senior high school level to improve academic performance and develop the competencies necessary for success in the 21st century. Moreover, it will contribute to the growing body of knowledge on innovative teaching methods and their potential to transform education systems in developing countries. Ultimately, the study seeks to inform educational practices and policies that can support the holistic development of students, preparing them for the challenges and opportunities of the future.

Theoretical Framework

The theoretical framework for this research draws upon several established theories that align with the objectives of investigating the impact of Project-Based Learning (PjBL) on senior high school students' academic performance and skill development. First, the Constructivist Learning Theory, particularly the work of Piaget (Waite-Stupiansky, 2022) and Vygotsky (1978), provides a foundational understanding of how students actively construct knowledge through experiences. According to constructivism, learning is most effective when students engage in activities that require them to solve real-world problems, which is central to the PjBL approach (Chuang, 2021).

In this context, PjBL offers an ideal pedagogical method, as it allows students to participate in authentic projects that require critical thinking, collaboration, and problem-solving, thereby facilitating deeper learning. This aligns with the constructivist view that knowledge is best acquired through active involvement and reflection, making PjBL an effective strategy for fostering both academic achievement and the development of 21st-century competencies.

In addition to constructivism, Social Learning Theory (Bandura, 1977) also plays a crucial role in understanding how PjBL enhances student outcomes. Bandura's theory emphasizes the importance of observational learning, imitation, and modeling in the learning process, which directly connects to the collaborative and interactive nature of PjBL. As students engage in group projects, they are exposed to the knowledge and behaviors of their peers, teachers, and even external stakeholders, thus learning through social interactions (Masjudin et al., 2024). Furthermore, Social Learning Theory highlights the role of self-efficacy, or the belief in one's ability to succeed, which is crucial in project-based environments (Akers & Jennings, 2015). PjBL's emphasis on student autonomy and the iterative process of project completion builds students' confidence in their abilities, thereby increasing their motivation and academic performance. These theories together offer a robust framework for examining how PjBL influences students' academic achievement and the development of essential skills, such as critical thinking, teamwork, and communication.

Method

This study employed a qualitative case study design to investigate the implementation of Project-based Learning (PjBL) and its effects on senior high school students' academic performance and skill development. Qualitative research was chosen because it allows for an in-depth exploration of complex, real-world educational practices and provides rich, contextual insights. The case study approach was particularly appropriate as it enables the examination of PjBL within a specific educational context, offering detailed understanding of its impact on students and teachers. The research focused on a single high school, facilitating an intensive exploration of PjBL implementation and its outcomes over a one-year period.

This study was conducted at a public senior high school in Jakarta, Indonesia, known for its consistent use of PjBL over the past year. This school was selected due to its experience with PjBL, adequate facilities, and a conducive environment for project-based learning. The study involved 15 students of eleven grade (coded as S1 – S11) and 5 subject teachers (coded as T1 – T5) from various disciplines, including mathematics, English, natural sciences, and social sciences. Students were purposefully selected based on their active participation in PjBL activities, while teachers were chosen for their experience with the method and involvement in the design and facilitation of PjBL projects. The selection ensured a diverse representation of perspectives from both students and educators.

Data was collected using three main methods: in-depth interviews, direct observation, and document analysis. In-depth interviews were conducted with both students and teachers to explore their experiences and perceptions of PjBL. First of all, students were asked about their involvement in projects, the challenges they encountered, and the impact of PjBL on their motivation and learning outcomes. Teachers were interviewed about their role in facilitating projects, the challenges they faced, and their assessment of PjBL's impact on student achievement and classroom dynamics. Second, direct observation was used to gain insights into the classroom dynamics during PjBL activities. The researcher observed student interactions, group collaboration, and teacher facilitation, noting the levels of engagement and the application of critical thinking and problem-solving skills. Third, document analysis focused on student project reports and academic assessments. The project reports provided qualitative data on student

work, including creativity, organization, and problem-solving abilities. Pre- and post-PjBL academic assessments were analyzed to evaluate changes in student performance.

Thematic analysis was employed to analyze the qualitative data. The process began with coding, where relevant data from interviews, observations, and documents were labeled and organized into categories. Next, broader themes were identified from these codes, which helped to understand the patterns related to PjBL's impact on student achievement and skill development. The researchers also used data triangulation to enhance the credibility of the findings by comparing insights from different data sources—student interviews, teacher interviews, classroom observations, and project documents. This comparison helped to confirm the validity of emerging themes and ensured that the findings were not biased by any single data source. Finally, the findings were interpreted in light of relevant theories and prior research to provide a deeper understanding of how PjBL influences academic performance and the development of key skills such as critical thinking, teamwork, and motivation.

Results

The results of this study are presented based on two key themes as stated in the research questions: (1) the implementation of PjBL in senior high school and (2) the impact of PjBL on students' academic performance. The presentation of the findings is accompanied by direct quotations from the participants to support the description of key findings. The quotations are coded based on their role as students or teachers, followed by their sequential numbers (S1 – S11; T1 – T5), the source of data, and the number of data. For example, the code "S1-Interview-103" means that the quotation is obtained from Student 1 through interview with number of response No. 103.

The Implementation of PjBL in Senior High School to Enhance Academic Performance

The teachers in this study provided valuable insights into how the implementation of PjBL impacted students' academic performance. Overall, teachers observed improvements in both academic achievement and non-academic skills, such as teamwork and problem-solving. However, they also highlighted several challenges in adapting the traditional teaching approach to PjBL. Teacher 1 noted that, through PjBL, students developed a deeper understanding of the subject matter:

> "I have seen noticeable improvements in students' problem-solving skills and their ability to connect theory to practice. They engage more deeply with the material because the projects are directly related to real-world issues, which makes them see the value of what they're learning." [T1-Interview-102]

Teacher 1 emphasized that students were able to apply concepts from mathematics and science in tangible ways, which enhanced their academic performance. This was particularly true for students who had struggled with traditional methods of teaching. Similarly, Teacher 2 observed improvements in students' performance in subjects like social science and language:

> "The students were more motivated to work harder because they could see how their efforts contributed to a final product. Their grades in assessments before and after the project improved, especially for those who had not done well before." [T2-Interview-211]

Teacher 2's observation underscores the motivational aspect of PjBL. Students who had previously underperformed started showing improvements after being engaged in real-world tasks where they could directly apply what they had learned.

Teacher 3 also spoke about the academic impact, particularly in terms of critical thinking and collaboration:

"I noticed that students were thinking critically during their projects, making connections that were not just academic but also practical. This was reflected in their test results as well. The group work also helped them learn from each other, which improved their individual performances." [T3-Intervie-328]

Teacher 3's perspective highlights the cognitive and collaborative benefits of PjBL, which contributed to a noticeable shift in students' academic achievement, especially in areas that require analytical thinking. However, Teacher 4 acknowledged that there were challenges related to the time required to implement PjBL effectively:

"Although PjBL has been effective in improving students' academic outcomes, the biggest challenge has been time. It requires a lot of time for planning and for students to complete the projects, which sometimes affects their ability to complete other assignments on time." [T4-Interview-508]

Despite these challenges, Teacher 4 acknowledged that the benefits of increased engagement and improved academic outcomes outweighed the difficulties. Finally, Teacher 5 mentioned the positive impact of PjBL on students' grades and long-term retention. Teacher 5's comments suggest that the hands-on nature of PjBL not only improves immediate academic performance but also enhances long-term retention of knowledge.

"I have noticed a lasting effect on students' academic performance. They remember what they learned from the projects much better than traditional lecture-based lessons, which reflects in their grades and how they approach learning in general." [T5-Interview-478]

From the students' perspective, PjBL had a significant impact on their academic achievement. The students expressed increased motivation and a greater sense of ownership over their learning. They described how the projects helped them understand concepts more clearly and allowed them to apply their knowledge in real-world scenarios. Student 1 highlighted how PjBL increased engagement in subjects they previously found challenging:

"Before the project, I wasn't really interested in the material. But when we had to create something real, like a model or a report, I could see how what I learned mattered. It made me study harder and my grades improved." [S1-Interview-008]

Student 1's statement illustrates how the hands-on nature of PjBL encouraged deeper engagement and a sense of relevance to their learning, leading to improved academic performance. Similarly, Student 2 discussed how PjBL fostered collaboration and enhanced learning outcomes:

"Working with my friends on a project made studying less boring. We could help each other understand the lessons better. As a result, I understood the material more deeply and did better on tests and assignments." [S2-Interview-102]

Student 2 emphasizes the social learning aspect of PjBL, where collaboration and peer support contributed to better academic results. Moreover, student 3 reflected on how PjBL allowed them to develop critical thinking skills, which positively impacted their academic achievement:

"The project required me to think critically and find solutions to problems. It was different from just memorizing facts for a test. After doing the project, I felt more confident in my ability to tackle other subjects too, and my grades showed it." [S3-Interview-205]

This statement suggests that the critical thinking skills developed through PjBL had a broader impact on students' overall academic performance. Student 4 also noted an improvement in their understanding of academic content as a result of PjBL:

> "I was able to learn more because I could see how everything fit together. The project helped me understand things I didn't get before. My grades went up in the subjects we worked on." [S4-Interview-398]

Student 4's experience demonstrates how PjBL can enhance comprehension and retention, leading to improved academic results. Student 5 expressed a similar view, explaining how PjBL made learning more relevant:

> "The projects felt real, not like something we would forget after the test. This made me care more about my studies. I could see how what I learned could be used outside of school, and that made me more motivated." [S5-Interview-567]

Student 5 highlights the motivational aspect of PjBL, which ties academic learning to real-world applications, thereby improving both engagement and academic performance. However, Student 6 mentioned that, while PjBL improved their academic achievement, the process was sometimes overwhelming:

> "It was a bit stressful at times, especially when there were many deadlines. But when I saw the final product and how much I had learned, it was worth it. My grades improved, and I felt proud of the work we did." [S6-Interview-518]

Student 6 acknowledges the challenges that come with the intensive nature of PjBL but also recognizes the positive impact on academic performance. Finally, Student 7 expressed that PjBL allowed them to take more ownership of their learning, which led to better academic outcomes. Student 7's statement emphasizes the autonomy and self-directed learning fostered by PjBL, which contributed to their academic success.

> "I felt like I had more control over what I was learning. It made me focus more on the subjects, and I think that's why my grades went up." [S7-Interview-642]

In conclusion, the findings from both teachers and students suggest that the implementation of PjBL has a positive impact on students' academic achievement in senior high school. Teachers observed improvements in student engagement, critical thinking, and overall academic performance. From the students' perspective, PjBL not only increased motivation but also helped them understand the material better and apply their knowledge more effectively. While there were challenges, particularly related to time management, the overall impact on academic outcomes was highly positive. These results underscore the potential of PjBL to enhance student achievement in a real-world, collaborative learning environment.

The Impact of PjBL on Students' Academic Performance

Critical Thinking Skills

Teachers noted that PjBL had a significant impact on students' critical thinking abilities. They observed that students were increasingly engaged in problem-solving, decision-making, and analytical tasks, all of which are central to developing critical thinking. Teacher 1 highlighted that PjBL promoted deeper cognitive engagement. Teacher 1's observation underscores how PjBL encourages students to move beyond rote learning and engage in higher-order thinking.

"Students are no longer just memorizing facts; they are actively applying their knowledge to solve real-world problems. During the project, they constantly had to think critically about how to approach issues and come up with solutions. It was evident that their critical thinking had improved by the end." [T1-Interview-118]

Teacher 2 observed a similar growth in students' ability to analyze and evaluate information. According to Teacher 2, the structured problem-solving within the projects enabled students to refine their critical thinking skills by engaging in tasks that demanded analysis and evaluation.

"Throughout the project, students faced challenges that required them to assess data, compare alternatives, and make decisions. These tasks definitely enhanced their critical thinking, and I saw it reflected in their project outcomes and assessments." [T2-Interview-287]

From the students' perspectives, PjBL had a clear impact on their ability to think critically. They reported feeling more confident in analyzing problems, thinking through potential solutions, and justifying their decisions based on evidence. Student 1 explained how the project helped develop their critical thinking. Student 1 emphasizes that PjBL provided them with a more meaningful way to engage with their learning, fostering deeper cognitive engagement.

"Before this, I never really thought about why I was learning certain things, but when we worked on the project, I had to think about how to apply everything I'd learned to solve real problems. It really made me think more deeply about the subject." [S1-Interview-003]

Student 2 echoed this sentiment, mentioning that PjBL taught them how to assess and approach challenges. For Student 2, PjBL was an opportunity to practice critical thinking in a real-world context, which they found more engaging and challenging than traditional learning methods.

"In the project, I had to evaluate different options and think critically about which one would work best. This was different from just reading a textbook, and it helped me improve my problem-solving skills." [S2-Interview-298]

Table 1. Students' Critical Thinking Scores before and after PjBL

Aspects of Critical Thinking Skills	Average Score Before PjBL	Average Score After PjBL	Improved
Problem Identification	65	85	20
Information Analysis	60	82	22
Solution Drafting	58	80	22
Creativity in Problem Solving	62	88	26

The interview data were supported by the findings of observation and document analysis. The data obtained from document analysis in forms of students' scores show that students' critical thinking skills were improved after the implementation of PjBL (see Table 1). The implementation of Project-Based Learning (PjBL) significantly enhanced students' critical thinking skills across several key areas. Before PjBL, many students struggled with problem identification, often failing to pinpoint the core issue in a case study or project. However, after engaging in PjBL, students demonstrated a marked improvement in this area, becoming more adept at filtering relevant information and focusing on the main problem. This shift can be attributed to the collaborative nature of

PjBL, which encourages students to discuss and delve deeper into the project topic, thus improving their problem-identification abilities. Similarly, prior to PjBL, students tended to passively receive information without critically analyzing its relevance or accuracy. Post-PjBL, students became more proactive in verifying information from various sources, enhancing their analytical skills and making more informed decisions as part of their projects.

Moreover, the ability to formulate solutions and think creatively showed significant improvement with the PjBL approach. Before PjBL, students often proposed solutions that were generic and lacked innovation. In contrast, after participating in PjBL, students demonstrated the ability to design more complex, creative, and applicable solutions tailored to the specific project problems. Their creativity in problem-solving also improved: whereas their thinking was initially more linear and conventional, PjBL encouraged them to explore unconventional ideas and approaches. Several factors contributed to these improvements in critical thinking. Collaborative group discussions played a key role, as students exchanged ideas and gained new perspectives, thus broadening their thinking. Additionally, the design of relevant projects, often connected to real-life issues, motivated students to engage deeply and contribute meaningfully. Teacher feedback during the project further supported students' development, helping them recognize areas for improvement and refining their problem-solving skills. The improvement of students' critical thinking skills is depicted in Figure 1.
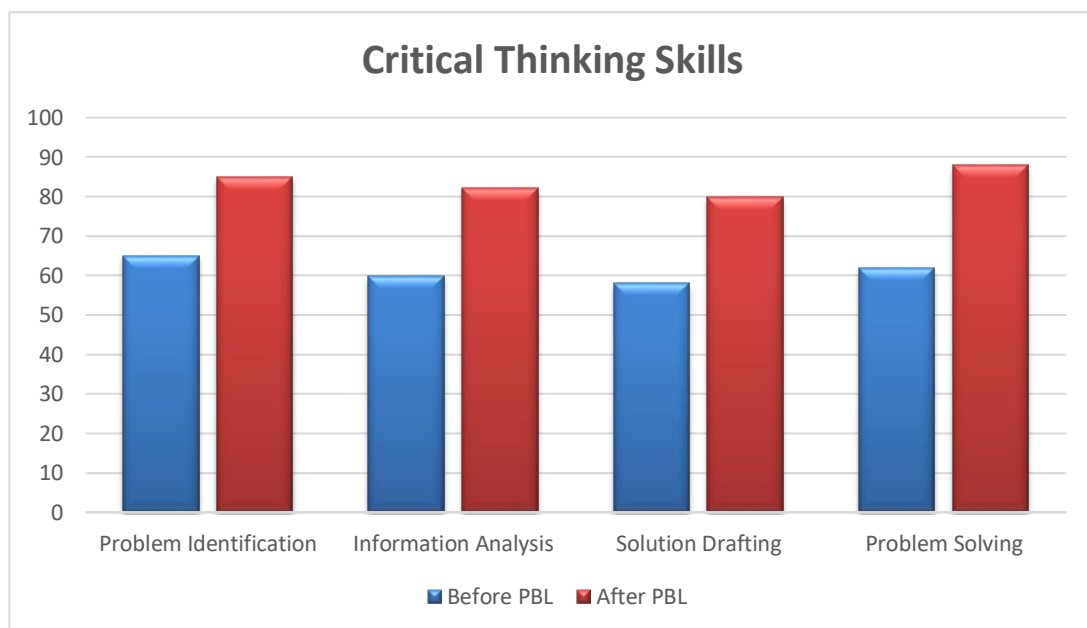

Figure 1. Improvement of Students' Critical Thinking Skills

Collaborative Skills

In terms of collaborative skills, teachers reported that PjBL fostered a high level of teamwork among students, encouraging them to work together to achieve common goals. Teacher 3 observed that students learned how to manage group dynamics and collaborate effectively. Teacher 3 emphasized that the collaborative nature of PjBL played a pivotal role in students' development of interpersonal skills, which are essential for both academic and professional success.

> "One of the most noticeable improvements was in how students worked as a team. They had to divide tasks, negotiate roles, and collaborate on solutions. By the end of the project, their

ability to work together had clearly improved, and their collaboration skills were much stronger." [T3-Interview-383]

Teacher 4 also commented on the role of collaboration in enhancing students' communication skills. Teacher 4 highlights the interpersonal benefits of PjBL, particularly the improvement in students' communication and teamwork abilities, which are fundamental to successful collaboration.

"The project required constant communication between students, which helped them develop better interpersonal skills. They learned how to discuss their ideas and listen to others, which was a major improvement compared to when they worked individually." [T4-Interview-511]

Students also recognized the positive effect of PjBL on their collaborative abilities. They described how working in teams helped them develop better communication, teamwork, and leadership skills. Student 3 shared their experience of learning how to collaborate more effectively. Student 3's account highlights how PjBL provided a structured environment in which they could enhance their ability to collaborate, especially through the challenge of working with diverse peers.

"At first, we had a hard time working together, but as we progressed, we learned to divide the tasks and help each other. I feel like I've become a better team player, and I know how to manage group work more effectively now." [S3-Interview-357]

Student 4 elaborated on the communication aspects of collaboration. Student 4's comment points out the importance of communication in collaboration, where PjBL helped them overcome challenges and improve their teamwork skills.

"During the project, we had to talk to each other constantly. It taught me how to express my ideas clearly and listen to others. That's something I've struggled with in the past, but now I feel more comfortable sharing my thoughts and working together with others." [S4-Interview-451]

Table 2. Students' Collaboration before and after PjBL

Collaboration	Average Score Before PjBL	Average Score After PjBL	Improved
Communication Skills	64	88	24
Division of Responsibility	70	92	22
Conflict Resolution	56	80	24
Teamwork Effectiveness	62	86	24

The implementation of Project-Based Learning (PjBL) led to significant improvements in students' collaborative skills, especially in key areas such as communication, responsibility sharing, conflict resolution, and teamwork effectiveness (see Table 2). After PjBL was introduced, students demonstrated a marked improvement in communication. This was evident through more purposeful discussions during project completion, where students were able to articulate their ideas clearly and express their opinions effectively. Additionally, there was an increased willingness among students to give and receive constructive feedback from their peers. This enhancement in communication helped foster a more open and collaborative environment. Regarding responsibility sharing, students became more proactive in taking on tasks based on their

individual strengths, which enhanced the efficiency of group work. In contrast to the earlier phases of the project, where task division was less structured, students now organized themselves better, allowing for a smoother workflow and more balanced contributions from all team members.

Conflict resolution and teamwork effectiveness also showed notable improvements following the introduction of PjBL (see Figure 2). Before PjBL, conflicts often hindered group progress, but after its implementation, students became better equipped to resolve disagreements through open dialogue, negotiation, and compromise. The guidance provided by teachers during the projects played a critical role in helping students navigate these conflicts effectively. Additionally, teamwork effectiveness saw a boost, with students working more cohesively towards achieving project goals. They displayed better organization and focus, ensuring that tasks were completed on time and with satisfactory results. Several factors contributed to these improvements: the selection of relevant projects that aligned with students' interests motivated active involvement, while the teachers' role as facilitators helped students overcome barriers to collaboration. Furthermore, the use of formative assessments to evaluate project progress periodically encouraged consistent teamwork, allowing groups to reflect on their achievements and address challenges as they arose.
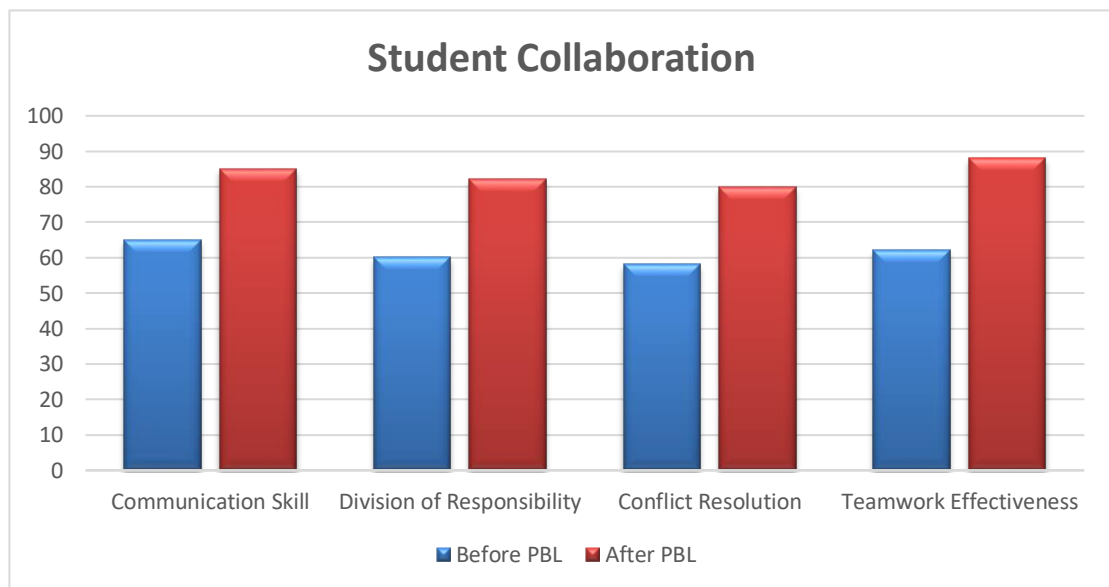

Figure 2. Improvement in Students' Collaboration

Learning Motivation

Teachers found that the hands-on, real-world nature of PjBL significantly boosted students' motivation. When students saw the relevance of their work, their engagement and enthusiasm increased. Teacher 5 noticed that students were more invested in the learning process. Teacher 5's comment indicates that PjBL has a motivational component that actively engages students in their learning, pushing them to put in greater effort.

> "The level of motivation I saw in students during the project was remarkable. They were far more engaged and excited about the work, compared to when we followed traditional methods. This higher motivation was reflected in the quality of their work and their overall performance." [T5-Interview-678]

From the students' perspective, PjBL also had a profound impact on their learning motivation. They reported feeling more engaged in the material and excited about their

projects, which led to improved academic performance. Student 5 reflected on how the project-based approach made learning more interesting and relevant:

> "I used to find studying boring, but with the project, I saw how the things we were learning could be used in real life. It made me more motivated to study and do well." [S6-Interview-781]

In addition, student 6 also acknowledged the role of PjBL in keeping them motivated and engaged:

> "The project was a lot of work, but I was excited to see the final product. It kept me motivated because I could see how my efforts were making a difference. I was more willing to put in the work compared to traditional lessons." [S6-Interview-862]

Student 6's statement suggests that the tangible outcomes of PjBL, such as completing a project, played a key role in sustaining motivation throughout the learning process. Moreover, student 7 shared how PjBL made them more invested in their education, by highlighting that PjBL helped them take ownership of their learning, which is a key factor in sustaining motivation and improving academic performance:

> "When we worked on the project, I felt like I was part of something important. That made me want to work harder. I knew the more effort I put in, the better the result would be, and it motivated me to do my best." [S7-Interview-801]

According to data from document analysis, the implementation of Project-Based Learning (PjBL) significantly enhanced students' learning motivation, as evidenced by a marked increase in their enthusiasm for learning, active participation, and involvement in project completion (see Table 3). Observations and interviews revealed that students became more enthusiastic about learning, with increased interactions during class discussions and group activities. In the past, many students tended to remain passive during traditional learning methods, awaiting instructions from the teacher. However, after PjBL was introduced, students were more proactive, asking questions, offering input, and sharing ideas. This shift in behavior was particularly evident in their involvement in project planning and completion. Students expressed a greater sense of responsibility and ownership over their work, which further fueled their engagement and motivation. As a result, students displayed a stronger commitment to the learning process, making PjBL an effective method for fostering deeper involvement in academic activities.

Table 3. Student Learning Motivation

Motivation Indicator	Average Score Before PjBL	Average Score After PjBL	Improved
Students' enthusiasm for learning	60	90	30
Active participation in class discussions	50	80	30
Involvement in project completion	55	85	30

In addition to the increased enthusiasm and participation, there was a noticeable decrease in boredom and loss of focus, which had previously been common in more

conventional learning settings. The real-world relevance of the projects assigned under PjBL made the learning experience more engaging and applicable, sparking students' interest and motivating them to stay focused. The relevance of these projects to students' lives was a key factor in increasing their intrinsic motivation. As students could see the practical applications of what they were learning, they developed a stronger connection to the material. This approach also provided them with opportunities to understand the direct impact of their learning on real-world issues, which reinforced their sense of purpose and engagement. Overall, PjBL's emphasis on authentic, real-life projects played a crucial role in motivating students, encouraging greater involvement, and enhancing their overall academic performance. The illustration of students' improvement before and after PjBL is depicted in Figure 3.
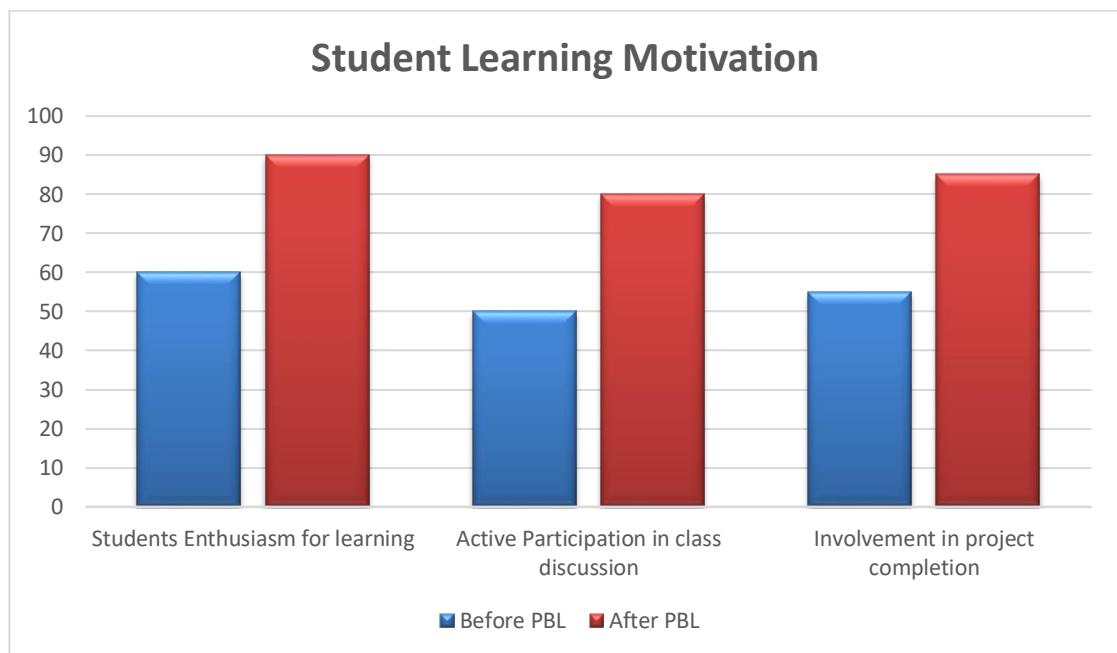

Figure 3. Improvement of Learning Motivation before and after PjBL

In a nutshell, the findings indicate that Project-Based Learning (PjBL) had a significant positive impact on students' critical thinking skills, collaboration abilities, and learning motivation. Teachers observed substantial growth in these areas, particularly in terms of students' ability to apply knowledge, engage in team-based tasks, and stay motivated throughout the learning process. From the students' perspective, PjBL provided them with a more engaging and meaningful learning experience, which fostered greater academic achievement. Both teachers and students agreed that PjBL promoted deeper cognitive engagement, stronger teamwork, and higher motivation, all of which contributed to enhanced academic performance.

Discussion

The findings of this study underscore the significant impact of Project-Based Learning (PjBL) on students' academic achievement, particularly in enhancing critical thinking, collaboration, and motivation. This aligns with the growing body of research supporting the efficacy of PjBL as a powerful pedagogical approach that engages students in solving real-world problems and fosters deeper learning (Chen & Yang, 2019; Harahap et al., 2025). The improvement in critical thinking, collaboration, and motivation observed in this study not only reflects the positive outcomes of PjBL but also corresponds with prior studies that emphasize the benefits of an active, participatory learning environment

(Awamleh, 2024; Ndiung & Menggo, 2024). Research by Jia et al. (2023) suggests that PjBL encourages students to actively engage with content, ask questions, and collaborate, which enhances their cognitive and social skills.

One of the key aspects of PjBL highlighted in this study is its ability to develop students' critical thinking skills. Before the implementation of PjBL, students were often passive recipients of information, receiving knowledge from the teacher without actively engaging in the analysis or evaluation of the material (Suteja & Setiawan, 2022). After engaging in PjBL, however, students demonstrated notable improvements in problem identification, information analysis, and solution formulation. They became more adept at filtering relevant information, critically assessing sources, and proposing innovative solutions, all of which are essential components of critical thinking. This finding is consistent with the work of previous scholars who assert that project-based learning encourages students to engage in higher-order thinking processes, thus enhancing their problem-solving abilities (Gandi et al., 2019; Tafakur et al., 2023). The shift from passive learning to active, inquiry-based learning promotes an environment where students can engage in deeper analysis, develop hypotheses, and test solutions in practical settings, all of which are hallmarks of critical thinking.

Moreover, the study found significant improvements in students' collaborative skills, including communication, division of responsibilities, conflict resolution, and teamwork effectiveness. These results echo the importance of collaboration as a critical 21st-century skill, one that is integral to preparing students for the complexities of the modern workforce (Andriyani & Anam, 2022; Zhang & Ma, 2023). As students worked in teams, they honed their communication abilities, shared responsibilities based on individual strengths, and resolved conflicts through dialogue and compromise (Baser et al., 2017). The collaborative nature of PjBL not only improves students' interpersonal skills but also mirrors the collaborative practices often found in professional environments, thus equipping students with the skills necessary for future success (Li et al., 2020). This finding is supported by previous research, which suggests that PjBL provides students with opportunities to engage in meaningful collaboration, leading to better outcomes in teamwork and social interaction (Crespí et al., 2022).

In addition to these cognitive and social benefits, PjBL also had a substantial impact on students' learning motivation. The findings of this study demonstrate that students' enthusiasm for learning increased significantly after the implementation of PjBL. Students became more actively involved in the learning process, participated in discussions, and took ownership of their learning (Firdausih & Aslan, 2024). The real-world applicability of the projects played a pivotal role in sparking students' interest and engagement. As the projects were connected to students' everyday lives, they felt a stronger sense of purpose and relevance in their learning, leading to increased motivation and reduced boredom. This aligns with findings from other studies, such as those by Awamleh (2024) and Fitriany (2024), who highlight the importance of authentic learning experiences in motivating students to engage deeply with content. PjBL, by providing opportunities for students to see the tangible results of their efforts, fosters a sense of accomplishment and intrinsic motivation, which in turn drives their continued engagement with the learning process.

However, the successful implementation of PjBL, as indicated by the findings, requires substantial support in several key areas, particularly in terms of teacher preparedness, school resources, and time allocation. Teachers play a crucial role as facilitators, guiding students through the various stages of the project, from planning to execution (Ratih et al., 2024). The study revealed that teachers who were well-trained in PjBL strategies were more effective in designing meaningful projects, offering timely feedback, and supporting students in overcoming challenges. This suggests the importance of professional development and ongoing training for educators to ensure that they can successfully integrate PjBL into their teaching practices (Coffey et al., 2024). Additionally, the need for adequate school resources, including materials, technology, and

access to external expertise, was also evident in the study. Schools must be equipped to provide the necessary tools and environments for PjBL to thrive, which may require investment in both physical infrastructure and educational technology.

The time constraints associated with PjBL were identified as another significant challenge in this study. As PjBL projects require considerable time for students to plan, collaborate, and execute their work, this often conflicts with the limited time available in a traditional classroom schedule. Previous studies, such as those by Samsudin et al. (2023), have also noted that PjBL can be time-consuming, requiring teachers and students to adapt their schedules and work outside regular class hours to complete projects effectively. To mitigate this challenge, schools may need to adopt flexible scheduling practices or explore collaborative partnerships with external organizations to provide additional resources and time for project completion (Gandi et al., 2019). Collaboration between schools, parents, and community organizations can also play a vital role in ensuring that students have the time and resources necessary to complete their projects successfully (Ezeh et al., 2024).

The findings of this study are closely aligned with the theoretical frameworks outlined in the introduction, particularly Constructivist Learning Theory and Social Learning Theory. Constructivist learning, as proposed by Vygotsky (1978), emphasizes the importance of active, student-centered learning, where students construct knowledge through their experiences and interactions with others. PjBL is inherently consistent with these principles, as it involves students engaging in real-world problem-solving tasks that require them to apply their knowledge in practical contexts (Rahman et al., 2024). By participating in projects, students are able to integrate new information with their existing knowledge, thus constructing deeper understanding and critical thinking skills. The findings of this study, which highlight improvements in students' ability to analyze information, formulate solutions, and work collaboratively, reflect the core tenets of constructivist theory, which posits that learning is most effective when students are actively engaged in authentic, meaningful tasks.

Furthermore, the study's findings also support Social Learning Theory, as articulated by Bandura (1977), which emphasizes the role of social interaction and observation in learning. PjBL provides an environment where students learn not only through direct experience but also through collaboration with peers and guidance from teachers. As students work together on projects, they observe each other's problem-solving strategies, communicate ideas, and negotiate solutions, all of which contribute to their learning (Masjudin et al., 2024). The improvements in collaboration, communication, and teamwork observed in this study are consistent with Bandura's assertion that social interactions are fundamental to learning (Wang et al., 2024). By working in teams and engaging in shared problem-solving, students develop social and cognitive skills that are critical for success in both academic and professional settings.

From a practical perspective, the findings of this study suggest several implications for educators and policymakers. First, to maximize the effectiveness of PjBL, it is essential to provide teachers with proper training in PjBL methodologies. Educators should be equipped with the skills to design meaningful projects, facilitate student learning, and assess project outcomes effectively. This may involve professional development programs, workshops, or collaborative learning communities where teachers can share best practices. Second, schools should invest in the necessary resources to support PjBL, including classroom materials, technology, and access to external experts. These resources will ensure that students have the tools they need to complete projects successfully and engage in deeper learning. Furthermore, schools may need to reconsider traditional scheduling practices to allow for more flexible project timelines, ensuring that students have sufficient time to engage with complex, real-world problems. Lastly, policymakers should recognize the importance of PjBL in fostering critical thinking, collaboration, and motivation, and consider integrating PjBL more broadly into educational curricula. By doing so, they can better prepare students for the challenges of

the 21st century and equip them with the skills necessary for success in an increasingly complex and interconnected world.

Conclusion

This study demonstrated that the implementation of Project-Based Learning (PjBL) in senior high school settings positively influenced students' academic achievement, particularly in critical thinking, collaboration, and learning motivation. The key findings highlight significant improvements in students' ability to analyze and solve problems, engage in effective teamwork, and take responsibility for their learning. The findings also underscore the importance of authentic, real-world projects in increasing students' motivation and active participation in the learning process. Teachers' guidance and project design were essential to the success of PjBL, while time constraints and the availability of resources were identified as challenges. Overall, the results suggest that PjBL is a promising pedagogical approach that can foster essential skills for students' academic and professional success, thus contributing to the development of 21st-century competencies such as critical thinking, collaboration, and creativity.

However, this study has some limitations that should be considered when interpreting the results. First, the research was conducted in a single educational context, which may limit the generalizability of the findings to other settings or disciplines. Second, the sample size was relatively small, which may not fully capture the diversity of students' experiences with PjBL. Additionally, the study primarily relied on qualitative data, such as interviews and observations, which could be complemented with quantitative data for a more comprehensive understanding of the impact of PjBL. Future research could expand the sample size and include multiple schools to explore how PjBL influences a broader range of students. Moreover, longitudinal studies could examine the long-term effects of PjBL on students' academic performance and career readiness. Further studies could also investigate how different types of projects or subject areas influence the outcomes of PjBL, as well as the specific challenges teachers face in implementing this approach effectively across various educational contexts.

Authors' Declaration

The authors made substantial contributions to the conception and design of the study. The authors took responsibility for data analysis, interpretation and discussion of results. The authors read and approved the final manuscript.

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