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The Impact of Project-Based Learning on Students' Collaboration Skills in Secondary Schools

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Abstract
The objective of this investigation is to examine the impact of project-based learning on secondary school students' collaborative abilities. This investigation utilizes qualitative research methods and a case study approach. To this end, data were collected via direct observations of students' interactions during the project, in-person interviews with students and teachers to gain insight into their experiences, and an analysis of documents such as project assignments, reports, and students' reflections. Findings from the study demonstrated that the integration of PBL led to substantial advancements in students' collaboration abilities. These enhancements can be categorized into three main aspects: communication skills, teamwork, and problem-solving abilities. The analysis of communication skills revealed that students exhibited an improvement in conveying ideas and attending to others' opinions, indicating enhanced interactive processes. Furthermore, students displayed an enhancement in teamwork, which included effective task allocation and reciprocal assistance in accomplishing shared objectives. Additionally, problem-solving skills exhibited by students demonstrated a marked progression, with students attaining creative and innovative solutions through collaborative efforts. The findings of this study offer significant insights into the merits of incorporating project-based learning methodologies within the secondary school curriculum, with the aim of cultivating critical collaboration skills in students to equip them to confront challenges in their future educational and professional pursuits.The effective integration of this pedagogical approach necessitates comprehensive support from educators in their role as facilitators, along with students' readiness to engage in a more interactive and participatory learning process. Further exploration through research is warranted, focusing on the implementation of this pedagogical approach across diverse contexts and academic levels. Such inquiry would serve to enhance the comprehension and practical implementation of project-based learning strategies in cultivating students' collaborative skills.

Keywords: *project-based learning, students, skils*

I. INTRODUCTION

Collaboration skills are one of the essential competencies that students must have to face the challenges of the 21st century (Rahmatiani et al., 2024). In the era of globalization marked by the rapid development of technology and information, the world of work and social life requires individuals to be able to work together effectively in various contexts. These skills include the ability to communicate well, share responsibilities, adapt to different views, and solve problems collectively. Global reports, such as those from the World Economic Forum (WEF), place collaboration skills as one of the key competencies in "21st Century Skills," necessary for success in an increasingly complex and interconnected society (Herlinawati et al., 2024).

In the context of education, project-based learning (PjBL) has been identified as an effective learning method to develop collaboration skills (Saputri & Maura, 2024). PjBL allows students to learn through hands-on experience by completing relevant and meaningful projects. This method provides space for students to actively interact, discuss, solve problems and work together to achieve a common goal. Through PjBL, students not only develop academic knowledge, but also build interpersonal skills that are essential for their future success. Several studies have shown that PjBL has a positive impact on collaboration skills, as students learn to share ideas, receive feedback, and work in teams to complete projects with tangible results (Dag & Durdu, 2017).

However, the implementation of PjBL in Indonesia still faces various challenges, such as limited infrastructure, lack of training for teachers, and varying levels of student engagement (Philip Putra Perdana & Wahyudi, 2024). On the other hand, Indonesia's education policy, particularly within the framework of the Merdeka Curriculum, strongly supports the project-based learning approach as one of the main strategies to create Pancasila learners. This policy

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emphasizes the importance of developing students' character and competencies involving creativity, collaboration and independence. Thus, this research becomes relevant to examine in depth how the implementation of PjBL can impact the development of students' collaboration skills in secondary schools in Indonesia. The focus of this research is directed at how students interact in groups, the challenges they face, and the real impact felt in the project-based learning process (Jamal et al., 2024).

This research aims to make a scientific as well as practical contribution to the field of education by exploring the effectiveness of PjBL in developing students' collaboration skills in secondary schools. The findings from this study are expected to provide new insights for teachers, policy makers, and educational practitioners on how project-based learning approaches can be optimized to produce a collaborative generation ready to face future challenges. Thus, this research not only contributes to the development of educational theories, but also to classroom teaching practices that are more inclusive and oriented to the needs of the 21st century.

II. METHODS

This research uses a qualitative approach with a case study design to explore the impact of project-based learning (PjBL) on students' collaboration skills in secondary schools. The qualitative approach was chosen because it is suitable for exploring phenomena in depth and understanding the experiences of research subjects in a particular context. A case study design was used to focus on one group of grade XI students in a secondary school in Jakarta who were intensively engaged in project-based learning for one semester. This approach allowed the researcher to thoroughly explore how the process and outcomes of project-based learning influenced the development of students' collaboration skills in a real-world setting (Alaslan, 2024).

Research Subjects

The research subjects were purposively selected 50 grade X students in SMA N 70 Jakarta as they were directly involved in the implementation of PjBL for a whole semester. This subject selection aims to ensure that the data obtained is relevant to the focus of the research, namely the impact of PjBL on collaboration skills. In addition to students, teachers involved in the implementation of PjBL were also included as informants to provide perspectives from the learning facilitator's point of view.

Data Collection Techniques

The research data were collected through three main techniques: observation, in-depth interviews, and document analysis.

Observation

Observation was conducted directly during the project-based learning process. The researcher observed the interaction between students, the way they worked together in groups, as well as the dynamics that emerged during the implementation of the project. This observation was done systematically to record the pattern of communication, participation, and problem-solving strategies applied by the students. Field notes were made in detail to document relevant findings, including the challenges students faced and their efforts in overcoming them. These observations provide rich empirical data on how students' collaboration skills develop in real situations.

In-depth Interviews

In-depth interviews were conducted with students and teachers to gain richer insights into their experiences during the implementation of PjBL. Students were asked to share their experiences in working together with their group mates, the challenges they faced, as well as the benefits they felt from this learning method. Meanwhile, interviews with teachers focused on their perceptions of the effectiveness of PjBL in developing students' collaboration skills, as well as the strategies they used to facilitate the learning process. These interviews were recorded and transcribed for further analysis, ensuring the accuracy and richness of the data obtained.

Document Analysis

The researcher also collected and analyzed various documents produced during the implementation of PjBL, such as project reports, group presentations, and students' reflective notes. These documents were used to examine in depth the tangible outcomes of student collaboration, including how they divided tasks, solved problems, and brought ideas

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together to achieve project goals. Students' reflective notes provided additional insight into their learning process, including the feelings, challenges and achievements they experienced during the project.

The combination of these three data collection techniques provided a comprehensive view of how PjBL influenced students' collaboration skills. Triangulation techniques were used to ensure data validity, where results from observations, interviews and document analysis were compared to find congruence and consistent patterns. With this approach, the research was able to present in-depth, valid, and relevant findings to answer the research objectives (Suyitno, 2021).

Figure 1. Research Design

III. RESULTS AND DISCUSSION

A. *Effective Teamwork*

Effective Teamwork is one of the key outcomes of implementing project-based learning in secondary schools. The following is a more detailed explanation of these findings, accompanied by tables and graphs to clarify the research results. In team-based projects, students learn to work together by dividing tasks effectively. Each team member is assigned specific roles and responsibilities according to their abilities and interests. This not only improves the efficiency of teamwork, but also allows each student to contribute maximally (Saysin & Dhammapissamai, 2023).

During the project, students are required to communicate constantly to ensure that all aspects of the project go according to plan. Effective communication allows them to solve problems quickly and avoid misunderstandings. In addition, providing each other with emotional and professional support was key to the team's success. Students also develop the skills of active listening, providing constructive feedback, and negotiation in resolving conflicts. Project tasks encourage students to develop trust and mutual respect within the team. The process of working together over a long period of time allows them to get to know each other better and build strong relationships. Trust is an important foundation in effective teamwork, as without trust, communication and collaboration are hindered (CSISZARIK-KOCSIR & BERENYI, 2023).

The following are the results of the survey on the level of trust and respect between students before and after the implementation of the project:

Table 1. Effective Teamwork

Aspect	Before PjBL	After PjBL
Trust between Students	36%	80%
Team Rewards	42%	84%

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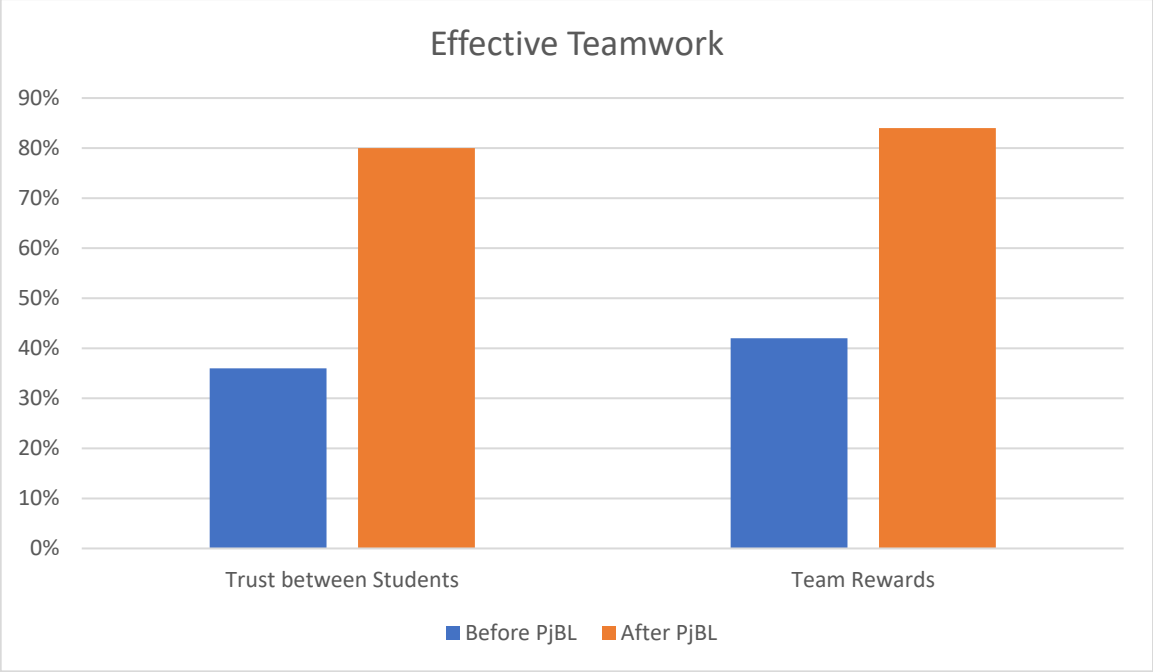

Graphic 1. Effective Teamwork

Students engage in complex problem solving during the execution of the project. They must work together to find creative solutions to the various challenges that arise. This process teaches them to think critically, combine different ideas, and make joint decisions that are best for achieving the project goals.

The results show that effective teamwork is one of the positive impacts of project-based learning. Students learn to divide tasks, communicate effectively and support each other to achieve a common goal. They also develop trust and mutual respect within the team, which are essential for successful collaboration. The process of joint problem solving also helps to improve students' critical and creative thinking skills (Lauren Fogg & Mary Fendley, 2024).

From these results, it can be concluded that the integration of project-based learning in the secondary school curriculum can make a significant contribution in developing students' collaboration skills. Proper implementation and continuous support from teachers will help create a learning environment conducive to the development of these skills.

B. *Communication Enhancement*

In the project planning process, students learn to communicate effectively with their team members. Good communication is essential to ensure that all team members understand the purpose of the project, their respective tasks, and the schedule to follow. Here is a table showing the aspects of communication observed during project planning:

Table 2. Communication Enhancement

Aspect	Before PjBL	After PjBL
Clarity of Instruction	32%	86%
Listening Skills	38%	84%
Use of Appropriate Language	40%	90%

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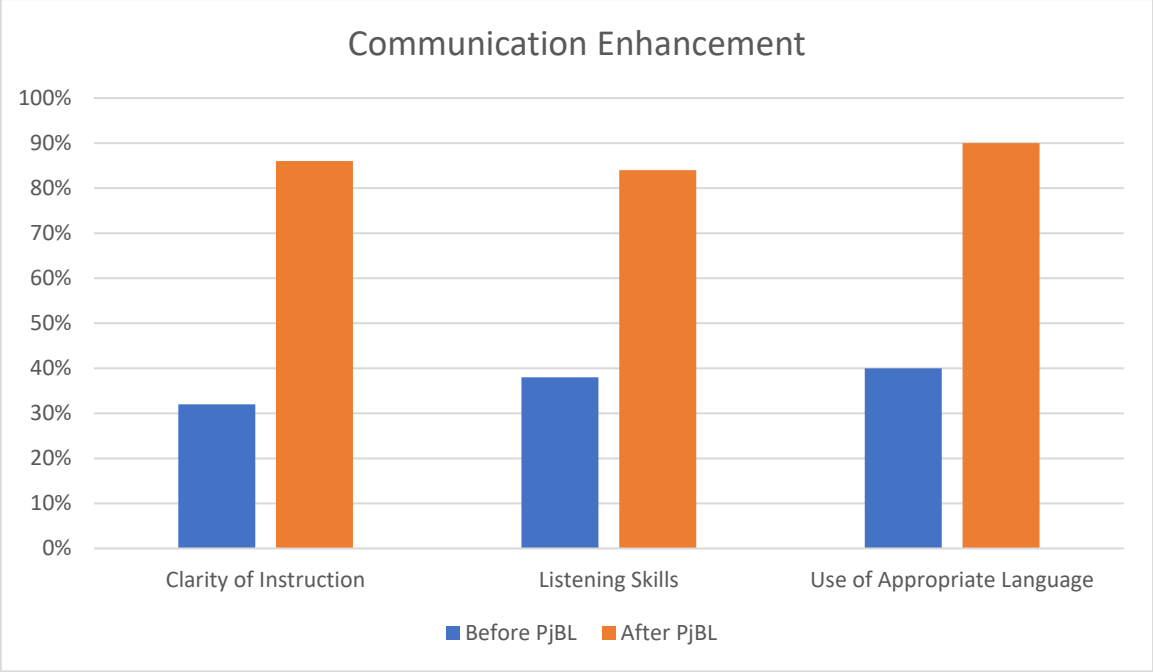

Graphic 2. Communicative Enhancement

From the table above, we can see a significant improvement in clarity of instruction, listening skills, and proper language usage after the implementation of project-based learning.

Group discussions are the heartbeat of project-based learning. Through lively debates, students sharpen their ability to articulate thoughts and embrace diverse perspectives. These interactions nurture public speaking prowess, as they practice in front of peers, diving into debates and creative brainstorming.

Project presentations transform students into confident communicators, showcasing their hard work to an eager audience of teachers and classmates. These moments not only enhance public speaking skills but also teach the art of organizing ideas logically and delivering messages with flair.

Here are the survey results on students' public speaking skills, before and after the project launch:

Table 3. Public Speaking Skills

Aspect	Before PjBL	After PjBL
Confident	30%	90%
Clarity of Delivery	34%	86%
Presentation Structure	34%	90%

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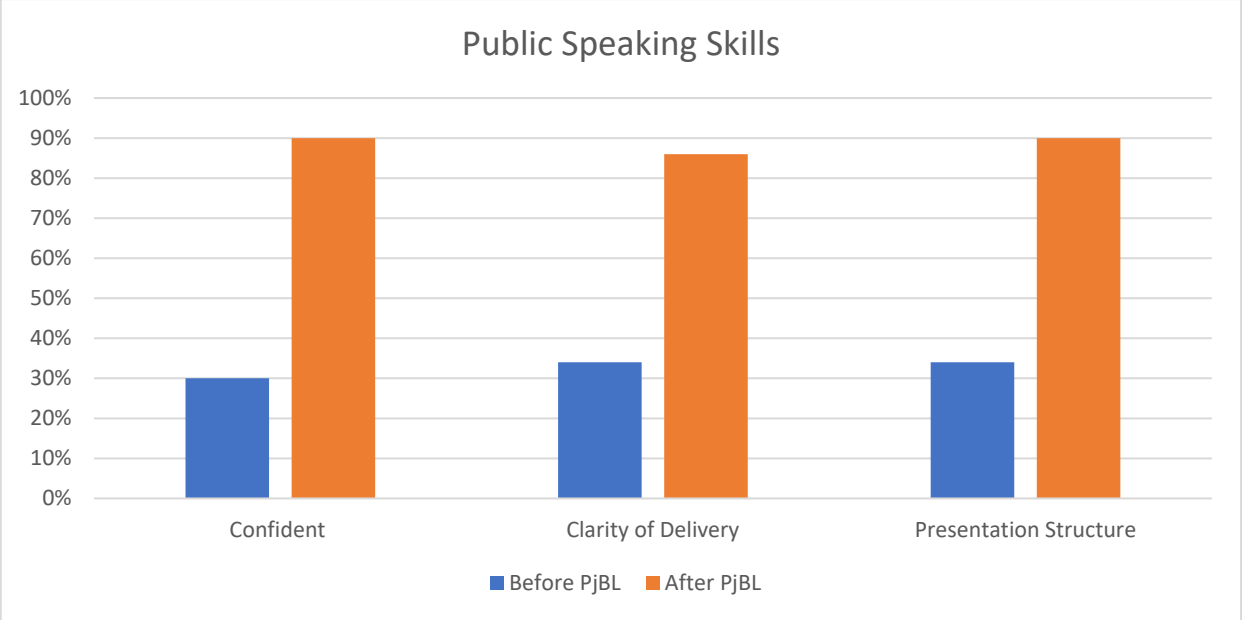

Graphic 3. Public Speaking Skills

The survey results indicated a marked enhancement in the students' confidence levels, the clarity of their delivery, and the structural organization of their presentations subsequent to their engagement in project-based learning.
In the digital age, digital communication tools have become an integral component of project-based learning. Students are instructed in the use of various online platforms for communication with team members; these include email, instant messaging apps, as well as collaboration platforms such as Google Docs or Microsoft Teams. These digital instruments facilitate the sharing of information, the management of tasks, and the facilitation of efficient work.
The findings reveal that project-based learning is a powerful communication catalyst. Students master the art of effective communication while planning and executing projects. Through lively group discussions and presentations, they hone their public speaking prowess. Plus, they adeptly wield digital tools for seamless collaboration.
These enhancements don't just shine in academia; they also pave the way for success in the workplace and everyday interactions.
Thus, it's clear: integrating project-based learning into secondary school curricula is key. With the right implementation and ongoing teacher support, we can cultivate a thriving environment rich in communication skill development.

C. *Teacher Support*

Teacher support constitutes a pivotal element in determining the success of project-based learning (PjBL) initiatives. Teachers, acting as facilitators, assume a pivotal role in providing guidance and support during project implementation, thereby facilitating students' development of collaboration skills and ensuring optimal outcomes. The ensuing exposition provides a detailed exposition of these observations, accompanied by tables and graphs that serve to elucidate the research results.
The instructor provides students with clear initial guidance on the purpose of the project, the steps to be followed, and the expected results. This guidance encompasses instructions on the division of tasks, the utilization of resources, and the project timeline.Effective initial guidance assists students in comprehending their obligations and the methods through which they can accomplish them.
The subsequent table illustrates the students' comprehension of the initial instructions before and after the project.

Table 4. Students' comprehension of the initial instructions

Aspect	Before PjBL	After PjBL
Instruction Comprehension	32%	92%
Task Clarification	38%	84%
Project Readiness	34%	88%

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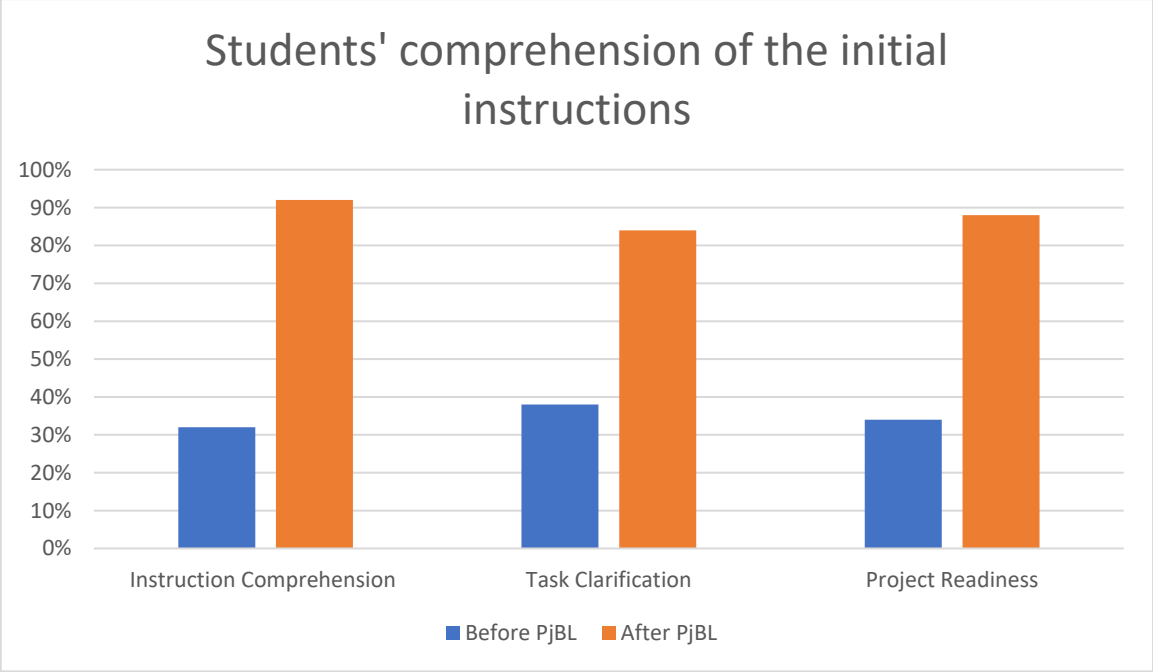

Graphic 4. Students' comprehension of the initial instructions

As illustrated in the above table, a substantial enhancement in terms of instruction comprehension and task clarification has been observed following the integration of project-based learning methodologies.

During the course of project execution, educators assume an active role in the supervision of students' advancements, providing them with constructive feedback to promote further growth. This monitoring is conducted through direct observation and interaction with each group. The feedback provided by the teachers has been instrumental in facilitating continuous improvement and refinement of the students' work.

Teachers also provide emotional support to students, especially in facing challenges and difficulties during the project. This support encompasses moral encouragement, positive reinforcement, and assistance in managing stress or conflict among team members. The provision of emotional support by teachers fosters a conducive learning environment and contributes to the cultivation of collaboration skills.

The subsequent survey results illustrate the extent of emotional support students experienced before and after the project.

Table 5. Emotional support students experienced

Aspect	Before PjBL	After PjBL
Moral Impulse	40%	90%
Positive Reinforcement	42%	90%
Help in Conflict	36%	86%

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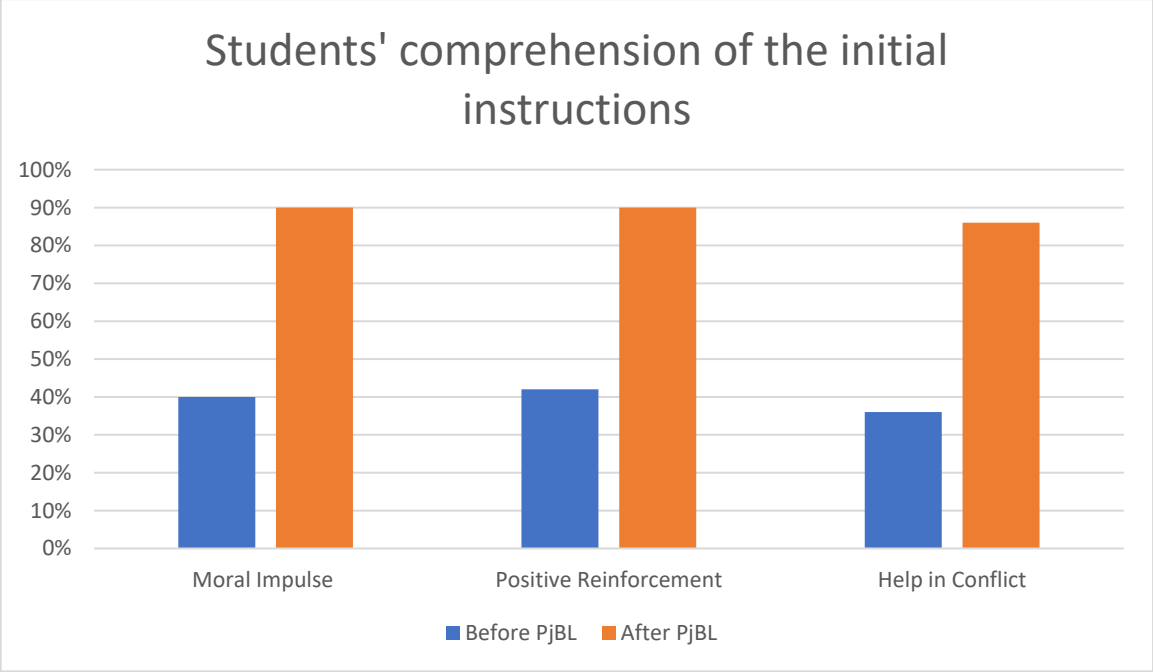

Graphic 5. Emotional support students experienced

Teachers provide assistance to students in accessing the resources necessary to complete the project. This assistance encompasses the provision of reading materials, tools, and technology, in addition to directing students to pertinent sources of information. The facilitation of resources is instrumental in ensuring that students are well-equipped to successfully complete their projects.

Subsequent to project completion, the teacher facilitates an evaluation and reflection session with the students. This evaluation encompasses the assessment of project outcomes, the teamwork process, and individual achievements. Reflection aids students in recognizing their learning gains and identifying areas for future enhancement. The subsequent section will present the results of the evaluation of the impact of teacher support during the project.

Table 6. The impact of teacher support

Aspect	Before PjBL	After PjBL
Effectiveness of Support	34%	90%
Satisfaction	36%	90%
Skill Enhancement	36%	86%

The findings indicate that the role of the teacher as a facilitator, providing guidance and support during project implementation, is of significant importance. Key elements contributing to the success of project-based learning include clear initial guidance, constructive monitoring and feedback, emotional support, resource facilitation, and evaluation and reflection with students. Teacher support has been shown to foster the development of strong collaboration skills in students and to facilitate the achievement of optimal results in their projects.

The findings of this study indicate that the integration of project-based learning into the secondary school curriculum necessitates substantial support from educators to foster a conducive learning environment and facilitate students' skill development. Proper implementation and continuous support from teachers are identified as crucial factors in ensuring students' success in project-based learning.

D. *Problem Solving*

Problem-solving dances at the heart of project-based learning. When students tackle complex challenges, they engage in a world of critical thinking and creativity. This realm of knowledge is enriched through collaboration, where

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teamwork sparks innovative solutions to obstacles that stand in their way. As we delve into these research insights, let's illuminate the findings with detailed tables and graphs to visualize the journey.

Project-based learning immerses students in real-world scenarios demanding intricate problem-solving. These multifaceted projects require a keen analysis, decisive actions, and practical resolutions. Journeying through this process, students develop the skill to pinpoint issues, weigh options, and pinpoint the best solutions from diverse sources of information.

Collaboration is the compass guiding teams toward successful problem resolution. Here, students discover that pooling their strengths and perspectives cultivates superior, inventive solutions—far beyond what they could hatch alone. Project teams foster a spirit of support, encouraging the sharing of ideas and collective navigation through hurdles.

Through teamwork, students unleash their creative prowess and innovative flair. The vibrant exchange of brainstorming leads them to fresh ideas, experimental hypotheses, and unconventional methods. This dynamic not only sharpens their problem-solving prowess but also instills an appreciation for inventive and original thinking.

Table 7. Creativity & Innovation

Aspect	Before PjBL	After PjBL
Brainstorming Ability	32%	90%
Innovative Solutions	30%	92%
Exploration of New Ideas	30%	90%

Projects rich in collaboration forge invaluable skills, such as analytical reasoning, decision-making, and evaluative abilities. Students learn to trace problems back to their roots, assess alternatives, and select the most effective paths forward. This hands-on experience equips them to tackle similar challenges, both academically and in their future careers.

Research clearly shows that diving into complex problem-solving and collaborating significantly enhances students' abilities. They become adept at identifying dilemmas, exploring a palette of solutions, and working cohesively to devise creative resolutions. The enriched collaborative skills and problem-solving talents cultivated during projects prepare students for the trials that lie ahead.

Thus, we conclude that project-based learning is a potent catalyst for cultivating students' problem-solving talents. With skilled implementation and unwavering teacher support, a nurturing learning environment emerges, setting the stage for student success in both academic and professional arenas.

E. *Discussion*

Research findings highlight the substantial benefits of project-based learning in secondary education. This approach greatly improves students' collaboration skills in several key areas: effective teamwork, strong communication, essential teacher support, and strategic problem-solving. In this discussion, we will explore these findings and their implications for the educational landscape.

Effective teamwork emerges as a key outcome of this research. Students learn to allocate tasks effectively, maintain ongoing communication, and support each other in achieving shared goals. The clarity of instructions, listening skills, and language use all improve through project-based learning. Additionally, trust and mutual respect within teams grow, as evidenced by surveys indicating increased levels of both among students. These findings suggest that a collaborative learning environment fosters positive group dynamics and essential interpersonal skills (Aggrawal et al., n.d.).

Improved communication is another significant insight. Through project planning and execution, students enhance their communication skills and develop public speaking abilities during group discussions and presentations (Febti Ismiatun et al., 2024). The boost in their confidence, clarity of delivery, and presentation structure after engaging in project-based learning is clear. Moreover, the increasing use of digital communication tools during projects shows that students are evolving not only in direct communication but also in leveraging technology for collaboration. These insights indicate that project-based learning equips students with communication skills that meet the demands of today's world (Gebre, 2024).

Teacher support plays a vital role in the success of project-based learning (Fitri et al., 2024). Teachers act as facilitators, providing essential initial guidance, constructive monitoring, emotional support, and resource facilitation.

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Clear instructions help students navigate project objectives and associated steps, while ongoing feedback promotes refinement and improvement (Johnson, 2025). Emotional support from teachers reduces stress and conflict—key elements that contribute to a supportive learning environment. The increase in teacher effectiveness, along with student satisfaction and skill development, underscores the importance of the teacher's role in the success of project-based learning initiatives (Elsayed et al., 2024).

Problem-solving also stands out as a critical aspect demonstrating the positive impact of project-based learning. Students engage in complex problem-solving during projects, requiring them to think critically, analyze challenges, and find effective solutions (Sinaga et al., 2024). Team collaboration fosters creativity and innovation, as reflected in the improvement of brainstorming abilities and exploration of new ideas following the implementation of project-based learning (Alonemarera & Tendrita, 2024). The notable enhancement in problem-solving skills indicates that authentic educational experiences nurture the vital skills necessary to address future challenges (Kurniawan et al., 2024).

In summary, the results of this study emphasize the significant and positive impact of project-based learning on students' collaboration skills in secondary schools. Integrating this approach into educational curricula can equip students with essential skills in teamwork, communication, and problem-solving that are crucial for their future success. Ongoing teacher support and effective use of technology remain critical factors in successfully implementing project-based learning. Future research can further investigate its application across diverse educational contexts and identify best practices that enhance quality education.

IV. CONCLUSIONS

Project-based learning has been demonstrated to have a particularly salient impact on the development of students' collaborative skills within the context of high school. The implementation of project-based learning in the existing high school curriculum has been observed to facilitate effective communication and collaborative work among students, in addition to nurturing their capacity for effective problem-solving, a skill that has been demonstrated to be critical to future success. The nature of project activities, which often entail complex tasks and real-life scenarios, fosters intensive interaction, idea exchange, and collaborative problem-solving, thereby enhancing students' confidence, creativity, and critical thinking abilities.The role of the teacher as a facilitator, providing guidance and constructive feedback throughout the project, is also noteworthy in guiding students toward optimal outcomes. Consequently, it is imperative to persist in the exploration and investigation of the efficacy of project-based learning across diverse educational settings and levels, with the objective of maximizing the potential of this pedagogical approach in cultivating competent youth who are adequately prepared to confront global challenges.Subsequent research is anticipated to identify optimal practices and efficacious implementation strategies, thereby facilitating the widespread adoption of project-based learning to enhance the quality of education and the comprehensive development of students' competencies.

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