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ANALYSIS OF PROJECT-BASED LEARNING MODELS IN IMPROVING CRITICAL THINKING SKILLS OF ELEMENTARY SCHOOL STUDENTS

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ABSTRACT
This study aims to explore in depth the implementation of Project-Based Learning (PjBL) in improving elementary school students' critical thinking skills. The research employed a qualitative approach with an intrinsic case study design conducted in a public elementary school in Indonesia. Participants consisted of one classroom teacher and ten fifth-grade students selected through purposive sampling. Data were collected through semi-structured interviews, participatory observation, and documentation, and were analyzed using the interactive model of Miles, Huberman, and Saldaña, combined with thematic analysis procedures. The findings reveal four main themes: (1) construction of understanding through authentic problem exploration, (2) collaborative dynamics and reflective dialogue, (3) transformation of the teacher's role as a cognitive facilitator, and (4) internalization of reflective attitudes in project completion. The study demonstrates that PjBL fosters analytical reasoning, evaluation of alternatives, inferential thinking, and metacognitive reflection through contextual and collaborative learning experiences. The results highlight that the effectiveness of PjBL is not solely reflected in measurable outcomes but also in the meaningful learning processes that shape students' critical dispositions. This study contributes theoretically to strengthening the integration of social constructivist theory and critical thinking frameworks, and practically provides insights for teachers in designing reflective and dialogic learning environments at the elementary level.

INTRODUCTIONS

Critical thinking skills are one of the key competencies in 21st century education that is seen as essential to prepare students to face the complexities of global life, where they are required not only to master factual knowledge but also to be able to analyze, evaluate, and solve problems systematically and reflectively. At the

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elementary education level, especially in elementary school (SD), critical thinking skills are an important foundation for the formation of higher-order thinking skills as well as providing students in the next learning process. However, empirical findings show that the critical thinking skills of Indonesian students are still relatively low according to the results of international assessments such as the Programme for International Student Assessment (PISA) 2022, which places Indonesia at the bottom in critical thinking and problem-solving skills compared to other countries (Bella & Setiawan, 2025)

This condition is also characterized by learning practices in many elementary schools that are still oriented to conventional methods with the dominance of teachers as the main role holders, thus giving little space for students to think independently and reflectively (Maysarah et al, 2024). A review of the educational literature confirms that learning that is more student-centered and provides authentic experiences in solving complex problems can improve higher-level thinking skills, including critical thinking (OECD, 2025). In this context, the Project-Based Learning (PjBL) model emerges as one of the pedagogical approaches that has the potential to provide a meaningful and contextual learning experience by involving students in authentic project activities that require analysis, reflection, communication, and collaboration.

A number of quantitative and qualitative studies have examined the application of PjBL at the elementary school level and reported its impact on students' critical thinking skills. For example, a qualitative descriptive study at SD Bogor found that the application of PjBL can describe the improvement of students' critical thinking skills through observation, interviews, and documentation (Noor et al, 2025). In addition, a qualitative case study at SD Muhammadiyah 1 Taman shows that the implementation of PjBL encourages increased student involvement in asking questions, thinking logically, and presenting project results effectively, which is an indicator of individual critical thinking (Rizmayannudin & Nuroh, 2025). However, most of the existing research is quantitative with experimental design or pre-post tests, while in-depth qualitative studies of the meaning, learning process, and perception of educational actors (teachers and students) during the implementation of PjBL are relatively limited.

This gap can be seen from the lack of studies that explore the meaning of the critical thinking experience of elementary school students in the context of PjBL and how teacher-student interaction facilitates the cognitive process qualitatively. These limitations show that there is a literature gap in understanding the processes, dynamics, and subjective experiences of students and teachers during project-based learning, as well as contextual factors that affect the success or obstacles to the implementation of the model.

Based on these reasons, this study was conducted with the aim of exploring qualitatively how the project-based learning model affects the improvement of critical thinking skills of elementary school students, with a focus on students' learning experiences, teachers' strategies in project facilitation, and the meaning of critical thinking that emerges in learning interactions. This research is expected to make a theoretical contribution in enriching the discourse of constructivist education and active pedagogy as well as a practical contribution for teachers, principals, and policymakers in designing effective learning models to facilitate the development of students' critical thinking skills in elementary school.

1. Literature Review

A. Project-Based Learning Concept

Project-Based Learning (PjBL) is a pedagogical approach that places real projects at the core of the learning process, where students actively investigate, collaborate, and reflect to complete tasks that are meaningful and relevant to the real-world context. PjBL is rooted in the theory of constructivism which emphasizes the active involvement of learners in the formation of meaning through direct experience (Thomas, 2000; in systematic literature on PjBL). In the context of basic education, PjBL is designed to facilitate high-level thinking skills, including critical thinking, through the stages of problem framing, project planning, implementation, and presentation of project results (systematic literature on PjBL) (Laili et al, 2025).

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The main characteristics of PjBL include (1) complex and authentic problem solving, (2) collaboration between students, (3) the use of contextual learning resources, and (4) reflection on learning outcomes formalized in products or presentations (systematic literature on PjBL). This approach is different from conventional learning which tends to focus on delivering material in a linear manner, because PjBL spurs students to map problems, find creative solutions, and take responsibility for their own learning process (Laili et al, 2025).

B. Theories and Indicators of Critical Thinking

Critical thinking is an active cognitive process that involves rational analysis, evaluation, inferences, and reflection on certain information or situations to produce the right decision or solution (Ennis, 2011). In the context of education, critical thinking plays a key role as a key competency in the 21st century that supports students in facing complex and dynamic challenges (*critical thinking theory*). Indicators of critical thinking according to Ennis include abilities (Aswan et al, 2024):

a) providing *a simple explanation*,
b) determining basic skills,
c) drawing *conclusions*,
d) providing *further explanation*, and
e) Developing strategies (*organising strategies*) that are the benchmark for measuring critical thinking in many educational research.

In the realm of basic learning, critical thinking skills are not only related to academic test results, but also to students' ability to formulate questions, reason relationships between concepts, evaluate evidence, and make decisions based on analytical processes (*critical thinking theory*) (Aswan et al, 2024).

C. The Relationship Between PjBL and Critical Thinking

Several empirical studies have shown that the application of the PjBL model is positively correlated with the development of students' critical thinking skills. For example, a study by *Wulandari et al. (2025)* in the context of elementary school shows that the implementation of the PjBL model can lead students to improve critical thinking skills by integrating project stages that require students to systematically analyze, evaluate, and solve real problems (Wulandari et al, 2025).

The results of the study *by Pemi Purnama Sari et al. (2025)* also confirm that the integration of interactive learning media with PjBL is effective in improving students' critical skills, especially when the project is designed contextually and relevant to students' lives (Sari et al, 2025).

In addition, research by *Faradya Rizmayannudin & Ermawati Zulikhathin Nuroh (2025),* who examined PjBL in elementary school settings, identified that project-based learning is structurally able to facilitate opportunities for students to think deeper, analyze information, and reflect critically on their learning process (Rizmayannudin & Nuroh, 2025).

D. Relevant Previous Research

Recent empirical evidence shows the consistency of findings that PjBL can contribute to improving students' critical thinking:

a) **Wulandari et al. (2025)** found that the application of the PjBL model in elementary school improves students' critical thinking skills and requires teachers to reorganize learning practices to be more contextual.
b) **Pemi Purnama Sari et al. (2025)** through *a literature review* showed that PjBL combined with the development of interactive learning media is effective in improving critical thinking skills in elementary school students.
c) **Rizmayannudin & Nuroh (2025)** emphasized that PjBL is able to encourage critical thinking skills in every phase of project learning that requires analysis and synthesis of information.

However, most previous research has been descriptive or quantitative experimental, focusing on measuring scores or increasing the average critical thinking ability. Relatively few studies have explored the *meaning of experiences*, teachers' *strategies in facilitating PjBL,* and students*' social and cognitive interactions* in the context of

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qualitative basic learning. This gap demonstrates the need for a study that delves deeply into students' critical thinking processes in the reality of project-based learning, including perceptions, experiences, and challenges experienced by students and teachers during implementation (Sari et al, 2025).

E. Research Conceptual Framework

Based on the above theoretical description, this study uses a conceptual framework that places PjBL as a learning approach that has the potential to facilitate students' active involvement in the critical thinking process. Key variables analyzed include:

a) **Project-Based Learning Model (PjBL)** as a pedagogical intervention oriented towards authentic learning experiences,
b) **Students' Critical Thinking Skills** are characterized by Ennis' indicators such as analysis, evaluation, inferences, and the preparation of thinking strategies.

This framework is expected to bridge the empirical relationship between the collaborative and productive managed learning process and the development of students' high-level thinking skills, as well as uncover the dynamics of learning experiences that have not been widely studied in the qualitative realm.

RESEARCH METHODS

The development and evaluation of educational products is part of R&D, according to Borg & Gall (1983: 775). The project aims to provide products of scientific value for feasibility testing (Borg & Gall, 1983). The resulting product is an educational medium for snake and ladder games. The snake and ladder game was created to evaluate the feasibility, practicality, and efficacy of a product in enhancing the career exploration of junior high school students.

The researchers used a five-step research and development framework: analysis, design, development, implementation, and assessment. Its methodical operational process and focus on developmental learning objectives, including guidance and counseling service media, make this model suitable for development (Suryani et al., 2018). As stated by Alannawa & Hidayati, (2021), the ADDIE development model has advantages because of its systematic framework, with a straightforward and easy-to-implement process (Alannawa & Hidayati, 2021).

This study uses a qualitative approach with an intrinsic case study design. The qualitative approach was chosen because this study aims to deeply understand the process, experience, and dynamics of the application of the Project-Based Learning (PjBL) model in improving the critical thinking skills of elementary school students. Qualitative research allows for the exploration of meaning, perception, and social interaction in the natural context of learning (Creswell & Poth, 2018).

The case study design was used because this study focuses on one specific case, namely the implementation of PjBL in a specific classroom context in elementary schools, to be analyzed comprehensively and contextually. Case studies are relevant when researchers want to explore contemporary phenomena in a real-life setting with clear boundaries between the phenomenon and its context (Yin, 2018). In this context, the case studied is the practice of project-based learning in an effort to improve students' critical thinking skills.

The design selection is in line with recent educational research that emphasizes the importance of in-depth exploration of learning processes to understand students' cognitive transformation, not just quantitatively measurable learning outcomes (e.g. a qualitative study of project-based learning in primary education in the 2020–2024 education journal).

RESEARCH AND DISCUSSION RESULTS

Based on data analysis through semi-structured interviews, participatory observations, and documentation, four main themes were obtained that represent the pattern of improving students' critical thinking skills in the implementation of the Project-Based Learning (PjBL) model, namely: (1) the construction of understanding through

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the exploration of authentic problems, (2) the dynamics of collaboration and reflective dialogue, (3) the transformation of the role of teachers as cognitive facilitators, and (4) the internalization of reflective attitudes in the process of solving projects.

1. Constructing Understanding through Exploration of Authentic Problems

The results of the observations showed that students were more active in asking questions and identifying problems when the project was associated with the context of daily life. In one of the projects themed "School Waste Management", students were asked to design solutions to reduce plastic waste in the school environment.

A student (S3) stated:

"Usually we only listen to the teacher's explanation, but during this project we have to find out for ourselves why there is a lot of plastic waste and how to reduce it."

The statement shows a shift from passive learning to active exploration that demands the ability to analyze and identify problems. Observations show that students begin to compare the data from field observations and discuss possible solutions argumentatively. This process reflects the indicators of critical thinking in the form of information analysis and evaluation.

2. Dynamics of Collaboration and Reflective Dialogue

The second theme is related to the role of group discussions in facilitating the critical thinking process. During observation, interaction between students showed the negotiation of ideas, giving reasons, and clarifying opinions.

The class teacher said in an interview:

"When they discussed, I saw them criticizing each other's ideas. Some ask 'what is the proof?' or 'why is that better?'."

This kind of dialogue shows the development of evaluative skills and the ability to provide logical justification. Students not only receive information, but also test their groupmates' arguments. This process shows the existence of a social construction of knowledge.

3. Transforming the Role of Teachers as Cognitive Facilitators

The findings show that teachers are no longer the center of information, but rather facilitators who provide *cognitive scaffolding*. In the learning process, teachers ask more open-ended questions such as "What is the reason you chose the solution?" or "Are there other alternatives?".

This approach encourages students to reflect back on their thought process. The teacher stated:

"I didn't give an answer right away. I try to direct them with questions so that they think for themselves."

This shows that teacher intervention plays a role in developing students' metacognition.

4. Internalization of Reflective Attitudes

In the final stage of the project, students are asked to present the results and reflect on the process that has been undertaken. The documentation shows an improvement in students' ability to explain the reasons for choosing a solution and evaluate the shortcomings of their project.

One of the students (S7) said:

"It turns out that our solution is not effective because not all students want to follow the rules. So maybe there should be a campaign as well."

This reflection shows the ability to self-evaluate and develop alternative strategies, which are part of the critical thinking indicators.

Overall, the results of the study show that PjBL creates a learning environment that encourages more in-depth analysis, evaluation, inferences, and reflection than conventional learning.

Discussion

The findings of this study reinforce the constructivist view that meaningful learning occurs when students actively build knowledge through direct experience and social interaction. The application of PjBL in this study has been proven to facilitate the emergence of critical thinking indicators such as problem analysis, evaluation of

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alternative solutions, and metacognitive reflection, as stated by Ennis (2011) regarding the main components of critical thinking.

These results are in line with research by Wulandari et al. (2025) which showed that PjBL improves the critical thinking skills of elementary school students through involvement in contextual problem solving. Similarly, the findings of Rizmayannudin and Nuroh (2025) confirm that systematic project stages are able to encourage in-depth analysis and synthesis of information.

Nevertheless, this study offers a new perspective by highlighting dimensions of students' subjective experiences and social interaction dynamics that have not been widely revealed in previous quantitative studies. While previous research has emphasized improving critical thinking test scores, this study shows how the process of dialogue, negotiation of meaning, and self-reflection is the main mechanism for developing these skills.

Theoretically, these results reinforce the integration between the theory of social constructivism and the concept of critical thinking, in which social interaction serves as a medium of cognitive development. The collaborative process that occurs in PjBL not only improves academic ability, but also forms a culture of reflective thinking in the classroom environment.

In terms of practical implications, this study shows that the success of PjBL is greatly influenced by teachers' ability to ask reflective questions and create open dialogue spaces. Without proper facilitation, projects can potentially become just technical activities without deep cognitive exploration.

However, this study has limitations in the scope of one school with a limited number of participants. Therefore, follow-up research can be conducted with a multi-case approach or a combination of quantitative and qualitative methods (*mixed methods*) to strengthen the generalization of findings.

CONCLUSION

Based on the findings of this study, it can be concluded that the implementation of the Project-Based Learning (PjBL) model is effective in enhancing elementary school students' critical thinking skills through meaningful, contextual, and collaborative learning processes. PjBL not only emphasizes learning outcomes but also focuses on the process of knowledge construction, where students actively engage in solving real-world problems.

The improvement in students' critical thinking skills is reflected through four main mechanisms: exploration of authentic problems, collaborative dynamics and reflective dialogue, transformation of the teacher's role as a cognitive facilitator, and the internalization of reflective attitudes. Through authentic problem exploration, students develop the ability to analyze situations, evaluate information, and propose solutions independently. Collaborative learning further supports the development of reasoning skills, argumentation, and logical decision-making through peer interaction.

In addition, the shift in the teacher's role from knowledge transmitter to facilitator plays a crucial role in guiding students' thinking processes. Teachers provide cognitive scaffolding by posing open-ended questions that encourage deeper analysis and reflection. The reflection phase at the end of the project also strengthens students' metacognitive awareness, enabling them to evaluate both their learning process and outcomes critically.

Overall, PjBL creates a learning environment that supports higher-order thinking skills, including analysis, evaluation, inference, and reflection. Therefore, this model is highly relevant for 21st-century education. However, its successful implementation depends on teachers' ability to design meaningful learning experiences and effectively facilitate student interaction and reflection.

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