

The Effectiveness of Project-Based Learning on Students' Critical Thinking Post-Pandemic

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ABSTRACT

Changes in educational systems caused by the COVID-19 pandemic created various challenges that affected learning quality and the development of students' critical thinking skills. In the post-pandemic learning context, educational approaches are required to encourage active student engagement while fostering twenty-first-century competencies. This study aims to analyze the effectiveness of Project-Based Learning (PjBL) in enhancing secondary school students' critical thinking skills in the post-pandemic era. The study employed a library research method with a qualitative descriptive approach by reviewing scientific literature published over the last five years. Data sources consisted of national and international journal articles discussing the implementation of PjBL and the development of critical thinking skills. The findings indicate that PjBL effectively improves critical thinking skills through student involvement in investigation, problem-solving, collaboration, and reflective learning activities. Project-based learning also encourages students to develop analytical, evaluative, argumentative, and decision-making abilities more effectively than conventional learning approaches. Furthermore, the student-centered nature of PjBL makes it highly relevant as a learning strategy for supporting educational recovery in the post-pandemic period. Therefore, PjBL can serve as an effective instructional approach to enhance critical thinking skills among secondary school students.

Keywords: *Critical Thinking, Post-Pandemic Era, Project-Based Learning, Secondary School, Student-Centered Learning.*

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1. | INTRODUCTION

The COVID-19 pandemic has brought significant changes to the education system in various countries. Learning that was previously carried out face-to-face had to switch to online learning in a relatively short time. Although educational technology has developed rapidly during the pandemic, various studies have shown that the distance learning process also poses a number of challenges, such as declining student involvement, limited learning interactions, and the emergence of the learning loss phenomenon that has an impact on the quality of student learning outcomes. This condition requires a learning strategy that is able to support the recovery of education quality in the post-pandemic era while developing competencies that are relevant to the needs of the 21st century (Rahmayanti et al., 2021; Cortázar et al., 2021).

One of the competencies that is of major concern in 21st-century education is critical thinking skills. Critical thinking skills allow students to analyze information objectively, evaluate alternative solutions, identify cause-and-effect relationships, and make decisions based on logical reasons. In the context of increasingly complex scientific and technological developments, critical thinking skills are important capital for students to face various academic and social life challenges. Therefore, the development of critical thinking skills needs to be one of the main goals in the learning process in secondary school (Issa & Khataibeh, 2021).

However, various studies show that students' critical thinking skills are still at a level that is not optimal. One of the factors that affect this condition is the dominance of learning practices that are still oriented towards delivering material and memorizing concepts. Teacher-centered learning models tend to limit students' opportunities to explore knowledge, solve real problems, and develop high-level thinking skills. Therefore, a more active, collaborative, and contextual learning approach is needed so that students can be directly involved in the knowledge construction process (Almulla, 2020).

Project-Based Learning (PjBL) is one of the learning models that is considered to be able to answer these needs. PjBL places students as the center of learning through the implementation of projects related to real problems. In this model, students are encouraged to plan activities, conduct investigations, collect data, develop solutions, and present the results of completed projects. The process allows students to develop a variety of essential skills, including collaboration, communication, creativity, and critical thinking (Kokotsaki et al., 2016).

Various studies show that PjBL has a positive contribution to improving the quality of learning. Through active involvement in project completion, students gain a more meaningful learning experience than conventional learning. In addition, PjBL encourages students to connect theoretical concepts with real situations so that the learning process becomes more relevant and contextual. Chen and Yang (2019) through a meta-analysis study found that the application of PjBL has a positive impact on students' academic achievement at various levels of education. The findings show that

PjBL not only improves material mastery, but also supports the development of high-level thinking skills.

In line with these findings, Guo et al. (2020) explained that the success of PjBL lies in its ability to create a learning environment that encourages students' active participation in the problem-solving process. When students are faced with complex project tasks, they are required to conduct analysis, evaluation, and reflection on an ongoing basis. These activities are directly related to the indicators of critical thinking skills. In addition, the research of Han et al. (2016) shows that the implementation of PjBL is able to improve students' problem-solving abilities and high-level thinking skills through authentic and collaborative learning experiences.

In the post-pandemic context, the implementation of PjBL has become increasingly relevant because it is able to overcome various learning limitations that arise during the education crisis. PjBL allows students to learn more independently, collaborate with peers, and develop adaptability to various changes in the learning environment. Research by Rahmayanti et al. (2021) shows that the implementation of PjBL during the pandemic contributes to improving students' critical thinking skills through learning activities oriented towards real problem solving. Similar findings are also strengthened by Seftiani et al. (2021) who conclude that PjBL has a significant positive influence on students' critical thinking skills at the secondary school level.

Although various studies have proven the effectiveness of PjBL in improving learning outcomes and critical thinking skills, most studies still focus on the implementation of such learning models in the context of specific subjects or specific educational environments. In addition, studies that specifically place PjBL as a strategy for restoring learning quality and strengthening critical thinking skills in the post-pandemic era are still relatively limited. This condition shows the need to conduct a more comprehensive study on the effectiveness of PjBL as a relevant learning approach in facing post-pandemic educational challenges.

Based on this description, this study aims to analyze the effectiveness of Project-Based Learning in improving the critical thinking skills of high school students in the post-pandemic learning era. This study is expected to make a theoretical contribution to the development of project-based learning models and become a reference for educators in designing learning strategies that are able to support sustainable improvement of the quality of education.

2. | RESEARCH METHOD

This study uses a library research method with a qualitative descriptive approach to analyze the effectiveness of Project-Based Learning (PjBL) in improving the critical thinking skills of high school students in the post-pandemic learning era. The literature study was chosen because it allows researchers to gain a comprehensive understanding of the development of the concept, implementation, and effectiveness of PjBL based on the results of previously published research. Through this method, researchers can

identify patterns of findings, similarities in results, and various factors that affect the success of the implementation of PjBL in the context of secondary education.

The data sources in this study come from various scientific literature relevant to the research topic, including national and international journal articles, empirical research results, review articles, and meta-analysis studies published in the last five years. The time limit is carried out to ensure that the data used reflects the latest developments regarding the implementation of Project-Based Learning and critical thinking skills, especially in the context of educational transformation before, during, and ahead of the post-pandemic era. The literature used was obtained through an academic database indexed in Google Scholar using keywords such as "Project-Based Learning", "critical thinking skills", "secondary education", "student-centered learning", "post-pandemic learning", and a combination of other terms relevant to the research focus.

The data collection process is carried out through several stages. The first stage is the identification of literature based on the suitability of the research theme. The second stage is the selection of sources based on the relevance of the substance, the year of publication, and the quality of the scientific publication. The third stage is data organization by grouping the literature into several main themes, namely the concept and characteristics of Project-Based Learning, the concept of critical thinking skills, the relationship between PjBL and critical thinking development, and the implementation of PjBL in the context of post-pandemic learning. The final stage is the recording and synthesis of important information related to the research objectives.

Data analysis was carried out using content analysis techniques. This technique is used to study, compare, and interpret various research findings contained in the selected literature. The data obtained were then analyzed systematically to identify the trends of the research results, the effectiveness of the application of PjBL on improving critical thinking skills, and the factors that support the success of its implementation. The results of the analysis are then presented descriptively and interpretively to produce an in-depth understanding of the contribution of Project-Based Learning in supporting the development of critical thinking skills of high school students in the post-pandemic learning era.

3. | RESULTS AND DISCUSSION

The results of the literature review show that Project-Based Learning (PjBL) is one of the learning models that has great potential in improving the critical thinking skills of high school students in the post-pandemic learning era. These findings are based on various studies that consistently show that students' involvement in project activities is able to encourage them to develop the ability to analyze problems, evaluate information, formulate solutions, and reflect on the learning process undertaken. In the perspective of 21st century learning, these abilities are important competencies that need to be developed because they relate to students' readiness to face increasingly complex social, academic, and professional challenges.

Conceptually, the effectiveness of PjBL is inseparable from the characteristics of the student-centered learning model. Kokotsaki et al. (2016) explained that PjBL provides opportunities for students to be actively involved in the investigation process of an authentic problem. Through these activities, students not only passively receive information, but also build understanding through hands-on experience. This process encourages the emergence of high-level thinking activities because students are required to identify problems, seek relevant information, and develop solutions based on the evidence obtained. These characteristics are different from conventional learning which generally still focuses on the delivery of material by teachers.

A study conducted by Quint & Condliffe (2018) shows that the success of PjBL in improving the quality of learning is influenced by the relationship between the project being carried out and the real problems faced by students. When learners are given the opportunity to solve contextual problems, they tend to be more motivated to explore and search for information independently. This situation encourages the development of critical thinking skills because students must consider various alternative solutions before making the decision that is considered most appropriate. Thus, project-based learning is not only oriented to the end result, but also to the thought process that occurs during the implementation of the project.

The findings of Chen and Yang's (2019) research through meta-analysis of various studies on PjBL show that the learning model has a positive influence on students' academic achievement. In addition to improving learning outcomes, PjBL also contributes to the development of high-level thinking skills which include analysis, evaluation, and problem-solving. These results indicate that learning success is not only measured through mastery of the material, but also through students' ability to apply knowledge to solve various problems faced. In the context of modern education, this ability is an important indicator of the success of the learning process.

Strengthening critical thinking skills through PjBL can also be seen from the results of Han et al.'s (2016) research. The study found that students who participated in project-based learning showed improved ability to identify problems, connect concepts, and develop solutions systematically compared to students who participated in traditional learning. The increase occurred because the project provided required students to conduct in-depth investigations, work together with groups, and account for the results of their work through presentations and discussions. These activities directly train students' critical thinking skills and argumentation skills.

In addition to improving analytical skills, PjBL is also able to increase student involvement in the learning process. Almulla (2020) explained that project-based learning creates a more interesting and meaningful learning environment because students have an active role in determining their own learning direction. This high involvement has an impact on increasing learning motivation, sense of responsibility, and the ability to manage the learning process independently. In post-pandemic conditions, this aspect is very important considering that many students experience a

decrease in learning motivation due to changes in learning patterns during the global health crisis.

Furthermore, Guo et al. (2020) explained that the success of PjBL in developing critical thinking skills is influenced by the collaborative process that occurs during the implementation of the project. When students work in groups, they are exposed to a variety of different perspectives and must engage in discussions, arguments, and negotiations to reach a mutual agreement. The interaction encourages students to evaluate information more critically and consider various points of view before making a decision. Therefore, collaboration in PjBL not only functions as a means of completing tasks, but also as a mechanism for developing critical thinking skills.

In the context of post-pandemic education, the need for a learning model that is able to reactivate student participation is becoming increasingly urgent. Cortázar et al. (2021) found that the application of project-based learning, including in online and hybrid learning environments, is able to improve students' critical thinking skills. The results of the study show that critical thinking skills can still develop when students are given the opportunity to engage in project activities that demand analysis, reflection, and problem-solving. These findings suggest that the effectiveness of PjBL is not limited to face-to-face learning, but can also be applied in a variety of learning formats that evolved after the pandemic.

The results of Rahmayanti et al.'s (2021) research further strengthen these findings. This research shows that the application of PjBL during the pandemic is able to help students develop critical thinking skills through the completion of projects related to real issues in the surrounding environment. Students not only learn concepts theoretically, but also apply them in concrete situations that require analysis and decision-making. This kind of learning experience provides an opportunity for students to build a deeper understanding compared to learning that is only oriented towards the delivery of material.

In line with this research, Kendal (2021) found that the integration of PjBL with STEM approaches has a positive impact on students' critical and creative thinking skills. Through projects that demand the application of cross-disciplinary concepts, students are encouraged to develop more complex analytical skills. They are not only asked to understand certain concepts, but also to connect various concepts to produce effective solutions to a problem. These findings show that the flexibility of PjBL allows the model to be integrated with various other learning approaches to improve the quality of the learning process.

The effectiveness of PjBL on critical thinking skills is also strengthened by the results of a meta-analysis conducted by Seftiani et al. (2021). The study showed that most of the studies analyzed found a significant improvement in students' critical thinking skills after participating in project-based learning. These results show that the positive influence of PjBL is not incidental, but consistent in various learning contexts and student characteristics. Similar findings were also reported by Anggito et al. (2021)

who concluded that PjBL has a high level of effectiveness in improving critical thinking skills compared to learning models that are more oriented towards direct knowledge transfer.

In addition to certain levels of education, the effectiveness of PjBL is also found in various fields of study. Susanto et al. (2021) showed that the application of PjBL was able to improve students' mathematical critical thinking skills through structured problem-solving activities. In this process, students are trained to analyze information, develop a solution strategy, and evaluate the results obtained. These findings indicate that the development of critical thinking through PjBL can be carried out in various subjects as long as teachers are able to design projects that are relevant to learning objectives.

The results of the research of Issa and Khataibeh (2021) also show that teachers view PjBL as an effective approach in improving students' critical thinking skills. According to them, student involvement in various stages of the project allows students to develop their thinking skills more deeply than conventional learning methods. In addition, students become more accustomed to expressing opinions, defending arguments, and evaluating information obtained from various sources.

Another relevant finding was conveyed by Nawangsari et al. (2022) who found that the application of PjBL significantly improves students' critical thinking skills through a learning process that requires exploration and reflection. The research showed that students who were involved in projects tended to have better ability to identify problems and devise solutions than students who learned using traditional approaches. These results strengthen the argument that PjBL is one of the effective learning models for developing high-level thinking skills.

In addition, research by Kabatiah et al. (2021) shows that project-based learning is able to improve critical thinking skills through assigning tasks that require independent and collaborative problem-solving. In the implementation of the project, students must gather information, interpret data, and make decisions based on available evidence. These activities directly involve various indicators of critical thinking that are needed in the modern learning process.

Based on the results of the study, it is shown that the effectiveness of PjBL in improving the critical thinking skills of high school students is influenced by several main factors, namely active student involvement, the use of authentic problems, group collaboration, an in-depth investigation process, and the opportunity to reflect on learning outcomes. These factors make PjBL a learning model that is in accordance with the needs of post-pandemic education that emphasizes strengthening 21st century competencies. Various studies that have been consistently reviewed show that students who learn through projects have better critical thinking skills than students who follow conventional learning. Therefore, PjBL can be seen as one of the effective learning strategies to support the recovery of education quality while preparing students to face increasingly complex future challenges.

4. | CONCLUSION

Project-Based Learning (PjBL) is one of the effective learning models in improving the critical thinking skills of high school students in the post-pandemic learning era. Based on the results of the literature review that has been conducted, the implementation of PjBL provides opportunities for students to be actively involved in the learning process through investigation, problem-solving, collaboration, and project completion activities related to real situations. This involvement encourages students to develop the ability to analyze information, evaluate various alternative solutions, formulate logical arguments, and make decisions based on rational considerations.

The effectiveness of PjBL in developing critical thinking skills is not only shown through the improvement of students' academic abilities, but also through the formation of more meaningful and contextual learning experiences. Project-based learning allows students to connect the concepts learned with the problems faced in daily life so that the learning process becomes more relevant to the needs of the 21st century. In addition, collaborative activities that are an important part of PjBL also support the development of communication, cooperation, and reflection skills that contribute to strengthening critical thinking skills.

In the context of post-pandemic education, PjBL is a relevant learning alternative to support the recovery of education quality while answering the needs of 21st century competency development. Its student-centered, problem-solving orientation, and active learning characteristics make this model able to improve the quality of the process and learning outcomes. Therefore, the implementation of Project-Based Learning needs to continue to be encouraged as a learning strategy that can help students develop critical thinking skills optimally and prepare them to face various challenges in the future.

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The authors declare that there is no conflict of interest.

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Data Disclosure Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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