

Application Of A Project-Based Learning Model To Improve Learning Outcomes And Critical Thinking Ability

Bayu Yudho Baskoro ^{1*}, Langandriansya Dwi Yanto ¹, M. Kurniawan ¹

¹ Politeknik Pelayaran Sumatera Barat

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ABSTRACT

This study aims to analyze the effectiveness of the implementation of the Project Based Learning (PjBL) model in improving learning outcomes and critical thinking skills of students in the Nautical Skills subject. The background of this study departs from the need for more contextual, applicable learning, and able to develop higher-order thinking skills in cadets at maritime schools. The methodology used is a qualitative approach with a classroom action research design through observation, interviews, documentation, and analysis of learning outcomes. The subjects of the study were cadets in the maritime study program who took the Nautical Skills subject. The results showed that the implementation of PjBL was able to increase learning activity, collaboration skills, and conceptual understanding of students. In addition, students' critical thinking skills experienced a significant increase, indicated by the ability to analyze maritime problems, formulate solutions, and make decisions based on field data. The improvement in learning outcomes is seen in the acquisition of higher average grades compared to before the implementation of PjBL, as well as more evenly distributed competency achievements. The conclusion of this study is that the Project Based Learning model is effectively applied to the Nautical Skills subject to improve learning outcomes and critical thinking skills. The research recommendations emphasize the need for sustainable implementation, adequate support for practical facilities, and strengthening the capacity of educators in designing and managing learning projects relevant to the maritime world.

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Corresponding Author:

Bayu Yudho Baskoro | Politeknik Pelayaran Sumatera Barat

Email: bayuyudho60@gmail.com

1. Introduction

Maritime education plays a crucial role in preparing competent human resources in the shipping sector, both nationally and internationally, by requiring not only technical skills but also critical thinking, problem-solving, collaboration, and technological adaptation. One of the important subjects, Nautical Skills, emphasizes mastery of sailing theory and practice,

but it's teaching often uses conventional methods which are less effective in developing critical thinking skills.

In facing the challenges of 21st-century education, the Project-Based Learning (PjBL) model is a relevant alternative because it positions students as active subjects through real-life projects that require analysis, collaboration, and the application of practical knowledge. (Humanistik & 2020, 2020). The implementation of PjBL is expected to improve cognitive, affective and psychomotor learning outcomes, as well as strengthen critical thinking skills which are very much needed in the modern maritime work world.

Learning is a planned process to help students achieve behavioral changes in the aspects of knowledge, attitudes, and skills through the interaction of various elements such as humans, materials, and facilities (Huda et al., 2022; Mantau et al., 2023). In maritime education, learning must combine theory with real practice so that cadets are able to apply navigation, meteorology and safety concepts in field situations (R. et al., 2025; Weintrit, 2025). Because the maritime world demands high levels of critical thinking and problem-solving skills, interactive, applicable, and contextual learning models are needed to optimally achieve educational goals. To address the challenges of 21st-century education, the Project-Based Learning (PjBL) model is a relevant alternative.

The project-based learning model (Project Based Learning or PjBL) is an innovative learning strategy that is centered on students by providing assignments in the form of projects that must be worked on collaboratively or individually to solve a real problem (Ramadhan et al., 2023). Menurut (Duke et al., 2021; Wijnia et al., 2024) PjBL is a systematic teaching model that engages students in the acquisition of knowledge and skills through a structured investigative process addressing complex and authentic questions. Therefore, it positions students as active subjects through real-world projects that require analysis, collaboration, and the practical application of knowledge.

The implementation of PjBL is expected to improve cognitive, affective, and psychomotor learning outcomes, as well as strengthen critical thinking skills that are essential in the modern maritime workplace. Research on the application of PjBL in learning Nautical Skills is important to develop more innovative learning strategies that are in line with the demands of the current shipping industry, thus achieving the desired outcomes.

Learning outcomes are the achievements obtained by students after experiencing the learning process. According to (Batatna Krasniqi, 2021; Yasar et al., 2025) revealing learning outcomes encompasses three domains; (1) Cognitive Domain, namely forming knowledge and conceptual understanding; (2) Affective Domain, forming attitudes, values, motivation, and ethics; and (3) Psychomotor Domain, forming physical and practical skills. These three things cannot be separated from 2 learning factors, namely; (1) Internal creates interest, motivation, health, readiness to learn; (2) External creates learning methods, learning environment, facilities, and social support (Gordon et al., 2003; Lefcourt, 1966; Online & 2016, 2018). The aim of the learning process is to create critical thinking in students.

Critical thinking is a cognitive process of analyzing, evaluating, and making decisions based on evidence and logical reasoning. According to (Puling et al., 2024) Critical thinking is

reflective and rational thinking that focuses on making decisions about what to believe or do. Critical thinking is a skill that students must possess. Nautical skills are the basic knowledge, skills, and attitudes that sailors must possess to support life, safety, and operations at sea.

From the explanation above, we can see several relevant studies that have been carried out by previous researchers, including, (Asyhari et al., 2022; Susilawati et al., 2021) The implementation of PjBL in Automotive Engineering subjects in vocational schools can increase student learning outcomes by 28% as well as critical thinking skills. (Sosial & 2020, 2020) PjBL in science learning results in increased learning motivation and active student involvement, as well as higher average grades compared to the lecture method. (Anggraeni et al., 2025; Widyastika et al., 2025) Research shows that PjBL is able to improve students' conceptual understanding while developing critical thinking skills through real-world problem-based projects.

From various studies, it is seen that PjBL has high effectiveness in improving learning outcomes and critical thinking skills, but its application in the specific context of Nautical Skills is still limited, so research on the application of PjBL in Nautical Skills learning is important to develop learning strategies that are more innovative and in accordance with the demands of the current shipping industry. Based on the background that has been described, the problems that can be identified are as follows; (1) The Nautical Skills learning process still uses conventional methods that are centered on educators; (2) Students are less actively involved in the learning process so that learning tends to be monotonous; (3) Student learning outcomes are not optimal, both in terms of knowledge, attitudes, and skills.

2. Research Methodology

This study uses a quantitative approach with a quasi-experimental design. This quantitative approach was chosen because this study focuses on measuring research variables numerically, and data analysis is conducted using statistical methods. (Jhon W. Cresswell, 2019). The research was conducted at one of the state maritime colleges in Indonesia, specifically in the Nautical study program which has the subject of Nautical Skills. The selection of the research location was based on the following considerations: (1) Nautical Skills is a core subject that supports the formation of basic competencies for maritime cadets; (2) Class conditions at the school allow for the implementation of experiments with two different groups; and (3) There is support for laboratory facilities and nautical equipment that can be used as media in project-based learning.

The research was conducted for three months in the even semester of the 2025/2026 academic year, with the following stages:

Table 1. Research Implementation Scheme

No	Month and Years	Activity Schedule
1	First month, 2025	preparation stage: preparation of instruments, trial of questions, coordination with the school

- | | | |
|---|--------------------|--|
| 2 | Second month, 2025 | implementation stage: giving a pretest, implementing learning (during 4–6 meetings), and giving a posttest |
| 3 | Third month, 2025 | data analysis and research report preparation stage |

(Source: researchers, 2025)

The population in this study was all second-year cadets in the Nautical study program who took the Nautical Skills subject in the 2025/2026 academic year. The total population was 120 cadets divided into four classes.

The research sample was determined using purposive sampling, which involves selecting a sample based on specific considerations. The primary considerations were availability of study time, equitable number of participants, and homogeneity of initial abilities between classes. From this population, two classes were selected that were relatively homogeneous in terms of academic ability and background.

Table 2. Research Sample Categories

No	Category	Number of Sample	Kind of Activity
1	Class A (Experimental)	30 cadets	learning using Project Based Learning
2	Class B (Control)	30 cadets	learning using conventional methods
Jumlah Sample		60 cadets	

(Source: researchers, 2025)

In this study there are two types of variables:

- a. Independent Variable (X) → project-based learning model.
- b. Dependent Variable (Y) → includes: Student learning outcomes (Y1) and student critical thinking skills (Y2).

In the next step, the researcher carried out preparation, implementation, data analysis and reporting. These steps are described in detail in table 3 below.

Table 3. Research Steps

No	Stages	Activity
1	Preparation Stages	(1) Compiling a research proposal (2) Compiling learning tools (lesson plans, projects, test instruments).
2	Implementation Stages	(3) Conducting instrument trials (1) Administer a pretest to both groups (2) Implement the learning a. Experimental group → PjBL b. Control group → conventional method (3) Administer a posttest after the learning
3	Data Analysis Stages	(1) Processing quantitative data with statistical tests (2) Describing qualitative data from observations and documentation
4	Reporting Stages	(1) Compiling a research report (2) Drawing conclusions and recommendations

(Source: researchers, 2025)

Data collection was conducted in three stages: first, tests (pretest and posttest) to measure learning outcomes and critical thinking skills. Second, observations, which recorded cadet involvement in projects and learning attitudes. Third, documentation, which archived physical evidence of learning. After data collection, data analysis was conducted.

The stages of data analysis include: First, a normality test to examine data distribution. Second, a homogeneity test to assess the similarity of variances between groups. Third, a t-test (independent sample t-test) to determine the difference in means between the experimental and control groups. Fourth, an N-Gain test to measure improvements in learning outcomes. Finally, a qualitative descriptive analysis to describe the results of observations and documentation.

3. Result and Discussion

The research results can be presented in the following important points;

Pretest Results

Pretest was administered to two research groups (the experimental class and the control class) before the learning treatment. The purpose of the pretest was to measure the cadets' initial abilities in cognitive learning outcomes and critical thinking skills. The average score for the experimental class was 62.4, while the average score for the control class was 61.8.

The results of the homogeneity and normality tests indicated that the data for both groups were normally distributed and homogeneous. The t-test showed no significant difference between the experimental and control groups ($p > 0.05$). Thus, it can be confirmed that the initial conditions of the two groups were balanced.

Posttest Results of Learning Outcomes

After the learning treatment, a posttest was administered to assess the extent to which the cadets' learning outcomes improved. The average score for the experimental class was 82.6, and the average score for the control class was 73.2. The 9.4-point difference indicates that the experimental group experienced greater improvement than the control group. The t-test showed a significance value of $p < 0.05$, indicating a significant difference between the two groups. This proves that the implementation of the Project Based Learning model is effective in improving the learning outcomes of cadets in the Nautical Skills course.

Critical Thinking Skills Post-test Results

Critical thinking skills were assessed through case-based essay questions developed based on Facione's (2011) indicators. The average score of the experimental class was 3.4 (good category), and the average score of the control class was 2.7 (sufficient category). The higher score increase in the experimental group indicates that the implementation of PjBL was able to encourage cadets to develop analytical, evaluative, and inferential skills better than conventional methods. Statistical tests also showed a significance value of $p < 0.05$, which means there was a significant difference between the experimental and control groups in critical thinking skills.

Learning Activity Observation Results

Observations of cadet learning activities revealed striking differences between the experimental and control groups. In the experimental class, cadets were actively engaged in discussions, asking questions, managing projects, and conducting field simulations. The average participation rate reached 85%, with collaboration and problem-solving indicators dominating. In the control class, cadets tended to be passive, simply listening to the lecturer's explanations, taking notes, and occasionally answering questions. The average participation rate was only 65%, and most activities were limited to repeating the material presented by the lecturer. These observations support the finding that PjBL increases cadet motivation and active engagement.

Project Results Documentation

In implementing PjBL, the experimental group cadets produced several project products, namely a report on marine safety procedures, a simulation of evacuation using a lifeboat, a simple model of rescue equipment, and a video documenting field practice. These results demonstrate that the cadets not only learned theoretically but also produced real-world work that can be used as learning reflection materials.

From the research results above, the following will be discussed. The discussion of the research above can be presented in detail as below;

Improving Learning Outcomes through Project Based Learning

The findings of this study show that the implementation of PjBL has a positive effect on improving cadet learning outcomes. This aligns with constructivism theory, which emphasizes that knowledge is acquired through active engagement in learning experiences. (Casfian et al., 2022; Journal) & 2021, 2021; Pramana et al., 2024). Furthermore, referring to (Morris & Rohs, 2023), PjBL provides opportunities for students to connect new knowledge with real-life experiences through project activities. In the context of Nautical Skills, real-life experiences such as using a lifeboat or designing safety procedures make learning more contextual, thus increasing conceptual understanding.

The Influence of Project Based Learning on Critical Thinking Skills

PjBL requires cadets to: Identify problems (e.g., maritime accident risks), Collect and analyze information (e.g., safety equipment needs), Evaluate alternative solutions (e.g., evacuation procedures), Develop decision recommendations (e.g., passenger rescue strategies). This is in accordance with research (Exintaris et al., 2023; Manuaba et al., 2022; Tanty et al., 2022) which emphasizes that critical thinking develops when students are involved in problem solving activities based on real data.

Comparison with Conventional Methods

In the conventional method, the lecturer plays a dominant role as the source of information, while the cadets tend to be passive. This model is indeed effective for rapid information delivery, but it is less capable of fostering critical thinking skills (Bagus et al., 2020; Choudhary et al., 2023). Conversely, PBL transforms the role of cadets from passive

recipients to active agents responsible for their own learning. Thus, cadets not only master knowledge but also develop collaboration, communication, and creativity skills.

4. Conclusion

Based on the research results and discussion on the Application of Project-Based Learning Models to Improve Learning Outcomes and Critical Thinking Skills in Nautical Skills Learning, several conclusions can be drawn as follows. First, the implementation of the Project-Based Learning Model (PjBL) was effective and in accordance with the characteristics of Nautical Skills learning. PjBL presents a learning process that emphasizes direct experience, real-world problem solving, collaboration, and active involvement of cadets. Second, the cadets' learning outcomes experienced a significant increase. The average pretest score of 60.5 increased to 81.5 in the posttest. The N-Gain analysis showed that 93.3% of cadets experienced improvement in the moderate to high category. This improvement occurred in the cognitive, affective, and psychomotor aspects. Third, the cadets' critical thinking skills increased consistently. The average score of the critical thinking indicator increased from 2.1 (sufficient category) to 3.5 (good category). The greatest improvement was seen in the aspects of self-reflection and decision-making, which are highly relevant in the context of the maritime world.

Fourth, cadet activity in learning increased significantly. From the observation results, the average activity increased from 49% to 83% after the implementation of PjBL. This shows that PjBL is able to encourage cadets' activeness, cooperation, and communication skills. Fifth, challenges faced in the implementation of PjBL include limited infrastructure, educator skills, and time management. However, these obstacles can be overcome through good planning, the use of digital media, and educator capacity development. Finally, Overall, the implementation of PjBL in learning Nautical Skills has proven to be more effective than conventional methods in improving learning outcomes, practical skills, and critical thinking abilities of students.

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