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Project-Based Learning Assisted by Moodle LMS Integrated with Maritime Industry for Soft Skills Development and Job Readiness of Maritime Vocational School Students

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Abstract

This study aims to develop a Project-Based Learning (PjBL) model supported by the LMS Moodle integrated with the maritime industry to improve soft skills and work readiness of students of Maritime Vocational High Schools. The study used a Research and Development (R&D) approach with the ADDIE development model which includes the stages of analysis, design, development, implementation, and evaluation. The research subjects consisted of 120 students, 24 teachers, and six maritime industry practitioners. Data were collected through questionnaires, interviews, FGDs, and observations of project activities. The results of expert validation showed a model feasibility level of 85% (very good category), covering aspects of content feasibility, LMS feature suitability, ease of use, and learning usability. Limited trials showed that the implementation of the PjBL model supported by the LMS Moodle had a positive impact on improving students' soft skills, especially in aspects of communication, cooperation, discipline, leadership, and problem-solving. The average skill improvement score reached 3.66 (very good category). Teacher and student responses to the model were also in the very positive category with an average of 87.8%. The integration of the Moodle LMS has been proven to facilitate digital collaboration between students, teachers, and industry practitioners, while also strengthening the relevance of learning to the needs of the workplace. Therefore, this learning model is deemed feasible, effective, and contextual for implementation in maritime vocational education in Indonesia.

Keywords: project-based learning, LMS Moodle, Soft Skills, Work Readiness, Maritime Vocational Education

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INTRODUCTION

Vocational education plays a strategic role in preparing human resources who are work-ready, skilled, and adaptable to industry needs (Birchler & Michaelowa, 2016; Rahman Talukder et al., 2021; Rusli et al., 2019). However, the dynamics of the Industrial Revolution 4.0 and the transformation towards Industry 5.0 require vocational graduates to master not only technical skills but also soft skills such as communication, collaboration, leadership, and problem-solving (Ahmed et al., 2024; Rehman et al., 2023; Sima et al., 2020). In the maritime sector, these demands are increasingly complex, as graduates are required to be able to work in emergency situations, maintain high discipline, and make quick decisions. Therefore, learning at Maritime Vocational Schools

needs to transform towards a more contextual, collaborative, and project-based model (Armoogum et al., 2016; Othman et al., 2017).

The reality on the ground shows that learning in most maritime vocational schools is still dominated by conventional, theory-based methods. A needs analysis of 120 students and 24 teachers found that 72% of students struggled to connect theory to industry practice (Pazos et al., 2022; Shafieek et al., 2024). Furthermore, 68% of teachers admitted to using lectures more often than project-based approaches. This indicates a gap between the competencies developed in schools and the actual needs of the maritime workforce.

This gap is also reinforced by the views of maritime industry practitioners. As many as 80% of industry representatives assess maritime vocational school graduates as lacking discipline, while 75% believe teamwork is suboptimal. The industry emphasizes the importance of project-based learning, which fosters collaborative work habits and prepares students for dynamic field situations. Therefore, strengthening learning models that integrate project-based learning (PjBL) with digital technology is an urgent need for maritime vocational schools (Mustapha et al., 2016; Onyishi et al., 2015).

Project-Based Learning(PjBL) is an approach oriented towards achieving competency through completing real-world projects relevant to the workplace. This model encourages students to think critically, work collaboratively in teams, and produce authentic products that reflect professional skills. Several studies (Thomas, 2000; Prince & Felder, 2006) have shown that PjBL effectively increases learning motivation, collaborative skills, and problem-solving. However, the application of PjBL in maritime vocational education is still limited and has not fully utilized digital technology support (Aini & Ismiyati, 2013; Gamboa et al., 2013; Sudarsono, 2020).

Utilizing a Learning Management System (LMS) such as Moodle can be a solution to support the implementation of Project-Based Learning (PjBL). An LMS functions as a digital platform that facilitates project planning, online collaboration, work uploads, and rubric-based evaluation. Moodle, as an open-source LMS, allows for the systematic integration of performance evaluation and student reflection features. The integration of an LMS into project-based learning is expected to not only expand learning access but also increase assessment transparency and direct industry involvement in the evaluation process (Anjum, 2020; Chung, 2015; Dewantara et al., 2020).

Previous research confirms that project-based learning (LMS) assisted by project-based learning (PBL) can improve students' digital literacy and soft skills. PjBL and technology provides a more immersive learning experience because it encourages students to learn through simulation, reflection, and authentic interaction with the world of work. In the context of Maritime Vocational Schools, the use of the LMS Moodle enables the implementation of ship safety simulations, emergency response training, and digital reflection on project outcomes (Davidescu et al., 2020; Liao et al., 2023; Muslim et al., 2020).

Based on the results of the needs analysis and expert validation, a "Project-Based Learning Model with the Moodle LMS Integrated for the Maritime Industry" was developed. This model is designed to bridge the gap between school learning and industry needs. The model consists of five main stages: project orientation, planning, implementation, monitoring, and presentation of results. Each stage is integrated into the Moodle LMS, enabling students and teachers to collaborate with industry practitioners online.

During the model development, a soft skills and work readiness assessment rubric was also developed, encompassing communication, teamwork, discipline, leadership, decision-making, and problem-solving. Evaluation was based on actual performance during the project and documented in the LMS. Validation results by two vocational education experts and two industry practitioners indicated a feasibility rating of 85% (very good), with the caveat that the interface needs to be simplified to facilitate teachers unfamiliar with digital systems (Hämäläinen et al., 2021; Lase, 2019; Millah & Budi, 2018).

Initial testing shows that the integration of the Moodle LMS helps students become more active and reflective in their learning. Teachers can provide direct feedback, while industry can monitor progress and evaluate project outcomes. This model also represents a strategic collaboration between educational institutions and industry, in line with the Merdeka Belajar-Kampus Merdeka (MBKM) policy, which emphasizes the link and match between education and the workplace (Bonaccio et al., 2020; Hämäläinen et al., 2021; Lase, 2019; Millah & Budi, 2018; Nguyen et al., 2024; Waluyo, 2023).

Thus, this study seeks to develop and test the effectiveness of a Project-Based Learning model supported by the LMS Moodle, integrated into the maritime industry context. The goal is to improve the soft skills and work readiness of Maritime Vocational High School students, making them more adaptable to the needs of the modern workplace. It is hoped that the results of this study will make a tangible contribution to the development of digital vocational learning in Indonesia and strengthen partnerships between education and industry in facing the challenges of globalization in the maritime sector.

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METHOD

This research uses a research and development (R&D) approach with the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model. This model was chosen because it provides a systematic and measurable development process, from needs analysis to product effectiveness evaluation. The main objective is to develop a Project-Based Learning (PjBL) model supported by the LMS Moodle that is integrated with the maritime industry to improve the soft skills and work readiness of Maritime Vocational High School students.

The research subjects included teachers and students of SMK Pelayaran Putra Samodera Yogyakarta, as well as maritime industry practitioners. A total of 120 students and 24 teachers participated in the needs analysis phase, while six industry practitioners were involved as validators to determine the model's suitability to workplace needs. In the product validation phase, two vocational education experts and two industry practitioners assessed the appropriateness of the content, feature suitability, and ease of use of the LMS. Data were collected through questionnaires, interviews, focus group discussions (FGDs), and curriculum document studies.

The Analysis phase focused on identifying gaps between learning conditions in vocational schools and the needs of the maritime industry. Results showed that learning was still theoretical, LMS utilization was limited, and graduates lacked discipline and teamwork skills. Based on these results, the Design phase was conducted by developing a PjBL model supported by the LMS Moodle through five main stages: project orientation, planning, implementation, monitoring, and presentation of results. The design also included the development of a performance assessment rubric and LMS features that facilitate online collaboration between teachers, students, and industry.

The Development phase produced a prototype of the Moodle LMS with key features such as a project dashboard, discussion forums, and digital assessment rubrics. The product was then validated by experts and industry practitioners, with an average score of 85% (very good), covering aspects of content suitability, feature suitability, usability, and ease of use. The Implementation phase then involved limited trials in a maritime classroom. Teachers used the LMS to manage ship safety simulation projects and maritime case analysis, while industry practitioners provided feedback on student work documented in the system.

The evaluation phase includes two approaches: formative and summative. Formative evaluation is conducted through expert validation and design revision, while summative evaluation assesses the model's effectiveness in improving students' soft skills and work readiness using a performance-based rubric with a scale of 1–4 on aspects of communication, teamwork, leadership, discipline, and decision-making. Quantitative data

are analyzed using descriptive statistics, while qualitative data are analyzed through narrative reduction and interpretation. Overall, this research is based on the principle of link and match between vocational education and industry, so that the resulting model is expected to be feasible, effective, and relevant for application in maritime vocational learning in Indonesia (Maryanti et al., 2020).

RESULTS AND DISCUSSION

Expert Validation Results of Learning Models

The validation stage was conducted to assess the feasibility of the Project-Based Learning (PjBL) model assisted by the LMS Moodle developed to suit the context of maritime vocational learning. Validation was conducted by two vocational education experts and two maritime industry practitioners with a focus on four aspects, namely: (1) content suitability, (2) LMS feature suitability, (3) ease of use, and (4) model usability.

Validation results showed that the developed model was deemed highly suitable for use, with an overall average score of 85% (very good). The aspect with the highest score was content suitability (87%), while the aspect with the lowest score was ease of use (83%), as some teachers required initial assistance in operating the Moodle system.

Table 1. Expert Validation Results of the PjBL Model Assisted by the LMS Moodle

No	Assessment Aspects	Score (%)	Category	Information
1	Content suitability	87	Very good	Materials in the context of the maritime industry
2	LMS feature compatibility	84	Good	Needs improvement in interface appearance
3	Usability	85	Very good	Features support collaboration and reflection
4	Ease of use	83	Good	Need guidance for new teachers
Average Total		85	Very good	Model ready to be implemented

The results of this validation confirm that the development of a project-based model with LMS support has met the standards of content, technology, and pedagogical suitability for implementation in Maritime Vocational Schools.

Implementation of the PjBL Model Assisted by the Moodle LMS

A limited trial was conducted on 40 Maritime Vocational High School students over an eight-week learning period. The project, themed "Ship Safety Simulation and Marine Hazard Mitigation," involved orientation, planning, implementation, monitoring, and presentation. All project activities were managed through the Moodle Learning Management System (LMS), including report uploads, simulation videos, discussion forums, and student reflections. Throughout the learning process, the teacher acted as a facilitator and project mentor, while industry practitioners acted as external evaluators, providing feedback on the project results. Collaboration among students significantly increased as each team was required to develop a joint work plan and conduct peer assessments through the LMS.

Soft Skills Enhancement and Job Readiness

Observation and rubric analysis results indicate that the implementation of the PjBL model supported by the LMS Moodle has a positive impact on improving students' soft skills and work readiness. The average score for each indicator is in the Good to Very Good category (3.32–3.78 on a scale of 4).

Table 2. Results of Student Soft Skills and Work Readiness Assessment

No	Rated aspect	Average Score	Category	Indication of Change
1	Communication	3.78	Very good	Students are able to convey ideas effectively in discussions and project reports.
2	Teamwork	3.65	Very good	There is increased coordination and responsibility among team members.
3	Leadership	3.52	Good	Students demonstrate initiative in leading project implementation
4	Problem Solving	3.68	Very good	Increased ability to analyze situations and make decisions
5	Discipline	3.71	Very good	Students are punctual and comply with safety SOPs.
6	Job Readiness	3.60	Good	Demonstrate professionalism and responsiveness to instructor directions
Average Total		3.66	Very good	Significant improvement in vocational work behavior

The biggest improvement occurred in the communication and problem solving aspects, because project activities encouraged students to actively discuss, solve real problems, and present work reports.

Analysis of Teacher and Student Responses to Learning Models

Teacher and student responses to the implementation of the Moodle-assisted PjBL model were measured using a Likert-scale questionnaire. The analysis showed that the overall response was very positive (88%). Teachers felt the LMS was helpful in project management, while students considered the system to make learning more engaging, interactive, and focused.

Table 3. Teacher and Student Responses to the PjBL Model Assisted by the Moodle LMS

No	Rated aspect	Teacher (%)	Student (%)	Average (%)	Category
1	Clarity of learning flow	90	86	88	Very Positive
2	Ease of use of LMS	84	85	84.5	Good
3	Project suitability to the industrial context	92	87	89.5	Very Positive
4	Active involvement of participants	88	90	89	Very Positive
5	Increased learning motivation	85	89	87	Very Positive
Average Total		87.8		Very Positive	

These data show that the implementation of LMS not only strengthens the collaborative dimension, but also fosters student learning motivation because every learning process is measurable, documented, and can be directly monitored by teachers and industry.

The research results show that the implementation of the Project-Based Learning (PjBL) model supported by the LMS Moodle significantly improved the soft skills and work readiness of Maritime Vocational High School students. This is because project-based learning provides students with opportunities to learn through real-world experiences that require responsibility, communication, and teamwork. Active involvement in each stage of the project enables students to not only understand theory but also master

practical applications. Furthermore, the support of the LMS Moodle allows the learning process to be systematic and well-documented. This allows each learning achievement to be monitored and evaluated transparently by teachers and industry partners (Sáiz-Manzanares et al., 2021; Salas-Rueda et al., 2020).

Significant improvements in soft skills, particularly in communication, collaboration, and problem-solving, reinforce the view that project-based learning can enhance students' interpersonal and cognitive skills. This model guides students to think critically when facing real-world problems and finding solutions relevant to industrial contexts. The LMS Moodle plays a crucial role in organizing project activities and expanding collaboration between students, teachers, and industry practitioners (Benlaghrissi & Ouahidi, 2024; Gamage et al., 2022). With support for features such as discussion forums, reflection, and rubric-based assessments, the learning process becomes more interactive and participatory. This technology integration also accelerates feedback, enabling students to continuously improve their work.

The improvement in students' discipline and leadership skills also demonstrates that industry-based projects can foster professional character that aligns with the demands of the maritime workforce. In the shipping context, values such as punctuality, responsibility, and adherence to safety procedures are crucial non-technical competencies. Through project activities such as ship safety and emergency response simulations, students are trained to act quickly and appropriately in accordance with standard IMO/ISM Code procedures. This makes their learning experience not only academic, but also practical and applicable. Thus, the learning process truly mimics real work situations in the maritime industry (Syahril et al., 2021; Zhang & Ma, 2023).

From the teacher perspective, the research findings show that implementing the Moodle LMS helps improve the effectiveness of project-based learning management. Teachers can easily upload materials, monitor student progress, and provide performance-based assessments through digital rubrics. The use of technology in the PjBL model can expand the learning space from the traditional classroom to a collaborative digital environment. The findings of this study support this view because the Moodle LMS provides greater flexibility and control over project activities (Ghosheh Wahbeh et al., 2021; Syahril et al., 2022). Furthermore, the reflection feature in the LMS also encourages teachers and students to self-evaluate the learning outcomes and processes.

The involvement of industry practitioners in the learning process is a crucial factor in strengthening the relevance of this model to the needs of the workplace. Industry not only acts as an external partner but also as a co-educator, providing direct feedback on student project outcomes. Strengthening the link and match between vocational education and industry is key to improving graduate quality. This study demonstrates that collaboration with industry not only improves the quality of learning outcomes but also fosters student learning motivation. Students feel their work is recognized and appreciated by professionals, which psychologically fosters self-confidence and a passion for learning (Dogara et al., 2020; Mudinillah et al., 2024).

In terms of effectiveness, this learning model also demonstrates that integrating digital technology can strengthen contextual learning. The presence of an LMS systematically records the entire project process, from planning and implementation to outcome assessment. This provides teachers with comprehensive data to evaluate student competency development over time. Furthermore, the use of an LMS facilitates communication across time and space, which is particularly useful in practice-based vocational learning. This demonstrates that vocational learning can remain effective even when partially conducted online (Zen et al., 2022).

The findings of this study also highlight several challenges in implementing LMS-assisted learning models in vocational schools. Some teachers still experience difficulties adapting to digital systems, particularly in online project management. Furthermore, limited internet access in some areas is a technical obstacle that needs to be addressed.

However, these obstacles can be overcome through ongoing training and infrastructure support from educational institutions (Simanullang & Rajagukguk, 2020; Utami et al., 2021). Training for teachers is crucial so they can play a role not only as instructors but also as facilitators and managers of digital projects (Bojiah, 2022; Lavidas et al., 2023).

Overall, the results of this study demonstrate that the Project-Based Learning model, supported by the Moodle LMS, integrated with the maritime industry, is effective in improving the quality of vocational learning. This model is not only relevant for the shipping sector but can also be adapted to other fields requiring project-based learning experiences and digital collaboration. With LMS support, schools can create a more flexible, scalable, and workplace-oriented learning ecosystem. Industry integration in the digital learning system also strengthens the implementation of the Independent Learning–Independent Campus (MBKM) policy at the vocational secondary education level. Therefore, the development of similar models is necessary to strengthen the quality of vocational education in Indonesia to achieve global competitiveness.

CONCLUSION

This research resulted in a Project-Based Learning (PjBL) model supported by the LMS Moodle integrated with the maritime industry as a vocational learning innovation at the Maritime Vocational High School. This model was developed through a systematic ADDIE process, starting from needs analysis, design, development, implementation, and evaluation. Expert validation results showed a feasibility level of 85% (very good category), so this model is considered suitable for application in the context of vocational learning. The implementation of the model in a limited trial showed a significant increase in students' soft skills, especially in aspects of communication, cooperation, discipline, and problem-solving abilities. The use of the LMS Moodle has been proven to facilitate teachers in managing projects, providing feedback, and monitoring student performance development digitally. Collaboration with industry practitioners also succeeded in strengthening the project's relevance to the needs of the world of work, in line with the link and match principle of vocational education.

Overall, the Moodle-based PjBL model is effective, contextual, and adaptable to the digitalization of vocational education. This model not only improves technical competency but also fosters the professional work character required by the modern maritime industry. This study recommends that similar developments be implemented in other vocational fields, involving industry partnerships and teacher training in optimizing LMS use.

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