

Training Vessel Effectiveness in Practice-Based Maritime Vocational Education: A Case Study at Barombong

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Abstract— Maritime vocational education requires authentic learning environments that enable cadets to connect theoretical knowledge with the operational realities of shipboard work. However, the educational contribution of institution-owned training vessels remains insufficiently examined, particularly in the Indonesian maritime education context. This study aimed to analyze the effectiveness of the training vessel at Politeknik Pelayaran Barombong as a practice-based learning environment and to identify the institutional conditions influencing its use. A descriptive qualitative case study was conducted involving 17 informants, comprising 14 cadets, one instructor, and two shipping-industry representatives. Data were collected through in-depth interviews, participatory observation, and document analysis and were examined using thematic analysis and source triangulation. The findings indicate that the training vessel helped cadets apply classroom knowledge in navigation, machinery monitoring, communication, watchkeeping, and emergency-response activities. Onboard practice also strengthened discipline, teamwork, confidence, adaptability, safety awareness, and professional responsibility. The vessel exposed cadets to physical, operational, social, and psychological conditions resembling actual maritime work. Nevertheless, limited access, maintenance requirements, insufficient technical support, and weak industry collaboration constrained the continuity and depth of learning. The study concludes that a training vessel is most educationally valuable when it is managed as an integrated practice-based maritime learning ecosystem supported by curriculum alignment, operational readiness, competent personnel, and sustained industry collaboration.

Keywords— *cadet competence; maritime vocational education; onboard learning; practice-based learning; training vessel.*

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I. INTRODUCTION

Indonesia's geographical character as a large archipelagic state makes the availability of competent maritime personnel essential to the movement of passengers, commodities, energy, and national logistics. Maritime transportation depends not only on adequate vessels, ports, and navigation infrastructure but also on seafarers who can operate equipment safely, make decisions under pressure, communicate within a hierarchical organization, and adapt to demanding shipboard conditions. Maritime vocational education must therefore produce graduates who are able to transform classroom knowledge into reliable occupational performance. This expectation is consistent with the development of competence-based and work-based vocational education, which emphasizes the integration of knowledge, practical performance, professional behavior, and workplace requirements [1]–[3].

The need for practice-oriented education is particularly important in Maritime Education and Training (MET) because maritime competence is

performative, contextual, and safety-critical. Cadets are expected to interpret navigation data, monitor machinery, conduct watchkeeping, communicate operational instructions, respond to emergencies, and work collaboratively in confined and dynamic environments. These abilities cannot be developed adequately through theoretical instruction alone. The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) establishes minimum international requirements for seafarer competence, certification, and watchkeeping and reinforces the importance of practical training in preparing personnel for safe ship operation [4].

MET institutions are also facing rapid changes in the nature of maritime work. Digital navigation, integrated bridge systems, automated machinery, remote monitoring, artificial intelligence, cybersecurity, sustainability requirements, and the development of Maritime Autonomous Surface Ships are reshaping the competencies expected from future seafarers [5]–[8]. Recent studies indicate that maritime graduates will continue to require conventional operational and maritime competencies while also needing digital literacy, systems thinking, analytical judgment, adaptability, and the ability to interact effectively with increasingly automated technologies [36]–[39]. Consequently, MET institutions must provide learning environments that connect traditional seamanship, emerging technology, safety awareness, and human-centered professional competence.

Within this context, a training vessel offers a distinctive form of practice-based learning. Unlike classroom instruction, which primarily explains concepts, or simulation, which represents selected operational

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situations, a training vessel places cadets within an actual shipboard environment. Cadets encounter real equipment, vessel movement, noise, restricted spaces, operational schedules, communication structures, safety rules, and collective responsibilities. The vessel therefore provides opportunities for cadets to observe, perform, receive feedback, reflect on their actions, and relate theoretical concepts to operational consequences. Such learning reflects the principles of experiential, situated, and workplace-based education, in which competence develops through participation in authentic or near-authentic occupational practices [1], [2], [9], [10].

Previous maritime studies have established the educational importance of onboard experience. Emad and Roth [9] demonstrated that maritime competence cannot be separated from the practices through which it is performed and assessed. Mori and Manuel [10] subsequently showed that onboard seafarer training is grounded in experiential, situated, and workplace-learning traditions. Mori [11] further argued that the implementation of onboard training is influenced not only by its pedagogical objectives but also by management arrangements, institutional capacity, and operational conditions. Recent stakeholder research similarly indicates that onboard training enables cadets to apply theoretical knowledge in realistic situations, gain professional experience, and understand shipboard culture, although its implementation may be constrained by curriculum differences, trainer competence, financial limitations, living conditions, and inconsistencies among training providers [34].

Onboard learning also contributes to the development of technical and non-technical competence. Technical competence includes the operation and interpretation of navigation instruments, machinery-system monitoring, radio communication, watchkeeping, route planning, emergency response, and compliance with safety procedures. Non-technical competence includes communication, teamwork, leadership, discipline, situation awareness, confidence, resilience, adaptability, problem-solving, and professional responsibility [12]–[14], [18]. These two categories are interdependent. For example, the correct execution of an emergency drill requires procedural knowledge, communication, command response, teamwork, emotional control, and timely decision-making. Likewise, safe navigation requires not only the ability to interpret equipment but also vigilance, coordination, judgment, and situational awareness. Contemporary research on future maritime operations continues to affirm that operational, digital, cognitive, and interpersonal competencies must be developed as an integrated competence profile rather than as separate educational outcomes [37]–[39].

However, the presence of a training vessel does not automatically produce effective learning. Its educational contribution depends on whether cadets receive sufficient and equitable access, whether practice is systematically connected to curriculum outcomes, whether instructors provide structured guidance and feedback, and whether the vessel and its equipment remain operational and safe. Effectiveness is also influenced by the availability of technical personnel,

maintenance funding, practice schedules, assessment procedures, and collaboration with shipping companies. Studies of structured shipboard programs and post-internship experiences indicate that the quality of planning, supervision, assessment, and workplace exposure affects the extent to which cadets develop practical understanding and occupational readiness [15]–[17]. Research on simulator curricula likewise shows that maritime learning is shaped by interactions among regulations, institutional policies, technology, instructor capability, curriculum design, and industry needs [35].

This institutional dimension creates an important practical problem for maritime vocational education. Training vessels are resource-intensive learning facilities. Their operation requires competent crews and technical personnel, fuel, maintenance, safety inspection, equipment renewal, scheduling, and sustained financial support. When vessel availability is limited or the number of cadets is high, individual practice time may be reduced. When maintenance is delayed, some equipment or operational activities may not be available for learning. When industry collaboration is weak, institutional practice may also become disconnected from current commercial operations and emerging competency expectations. These challenges are consistent with wider concerns about technological integration, human-resource readiness, organizational change, and institutional–industry alignment in maritime education [11], [19]–[21].

The practical issue at Politeknik Pelayaran Barombong reflects this broader tension between pedagogical potential and institutional capacity. The institution uses a training vessel to provide cadets with direct experience of navigation equipment, machinery systems, communication procedures, watchkeeping routines, emergency drills, and shipboard discipline. Such activities have the potential to bridge the gap between classroom learning and actual maritime work. Nevertheless, the educational value of the vessel may be affected by limited access, maintenance requirements, technical-personnel capacity, instructional arrangements, and the extent of cooperation with the shipping industry. The central problem is therefore not merely whether the institution possesses a training vessel, but how effectively the vessel is transformed into a structured, accessible, relevant, and sustainable learning environment.

A. Research Gaps

The existing literature reveals four related gaps. First, much of the MET literature focuses on particular educational components, including e-learning, simulation, maritime English, digital competence, leadership, autonomous shipping, or curriculum transformation [5]–[8], [22]–[25], [36]–[39]. These studies are valuable, but they frequently examine one modality or competency domain at a time. Comparatively limited attention has been given to how an institution-owned training vessel integrates several forms of learning simultaneously, including navigation, engineering, safety, communication, professional behavior, and adaptation to shipboard conditions.

Second, previous onboard-training studies have predominantly examined sea service, internships, commercial-ship placement, cadets' post-internship preparedness, or general stakeholder perspectives on onboard training [10], [15]–[17], [34]. These contexts differ from an institution-owned training vessel, which operates within an educational organization and is directly influenced by institutional scheduling, curriculum integration, instructional supervision, maintenance policy, and internal resource allocation. The educational dynamics of such a vessel therefore require separate empirical examination.

Third, existing studies generally recognize either competence outcomes or implementation challenges, but fewer studies connect the two within one analytical framework. Technical and non-technical competencies are often discussed separately from vessel readiness, instructor facilitation, technical staffing, maintenance capacity, and industry collaboration. As a result, there remains a need to explain how cadet-level learning experiences interact with institution-level conditions to shape the overall educational contribution of a training vessel.

Fourth, empirical research on institution-owned training vessels in Indonesian maritime vocational education remains comparatively limited. The Indonesian context is important because maritime institutions must prepare cadets for national and international shipping while managing differences in facilities, institutional resources, industry access, and geographical conditions. A context-sensitive case study is therefore needed to understand how training-vessel learning operates in practice rather than assuming that findings from simulation centers, commercial ships, or maritime institutions in other countries can be transferred directly.

B. Research Approach and Uniqueness of the Study

This study addresses these gaps by conceptualizing the training vessel as a *practice-based maritime learning ecosystem* rather than merely as a physical facility. Within this ecosystem, educational effectiveness emerges from interactions among cadets, instructors, practical activities, vessel equipment, safety procedures, curriculum objectives, maintenance systems, institutional resources, and industry expectations. Effectiveness is understood in this qualitative study as the vessel's perceived and observed capacity to connect theory and practice, support competence development, expose cadets to realistic working conditions, and provide learning that is institutionally sustainable. It is not interpreted as a statistically measured causal effect.

The study is distinctive in four respects. First, it examines an institution-owned training vessel rather than focusing exclusively on simulators, commercial-ship internships, or mandatory sea service. Second, it analyzes technical competence, non-technical competence, workplace exposure, and institutional capacity within a single case. Third, it draws upon multiple forms of evidence, including cadet and stakeholder perspectives, direct observation, and institutional documentation. Fourth, it connects micro-

level learning experiences with meso-level institutional arrangements and broader industry expectations. This integrated approach extends previous discussions of onboard learning by explaining not only what cadets learn but also the conditions that enable or constrain that learning [3], [8], [11], [21], [34], [35].

C. Research Questions and Objective

Based on the identified problems and research gaps, the study addresses the following research questions:

1. How does the training vessel connect classroom-based maritime knowledge with onboard practical learning at Politeknik Pelayaran Barombong?
2. How does training-vessel practice contribute to the development of cadets' technical and non-technical competencies?
3. How does the training vessel expose cadets to the physical, operational, social, and psychological conditions of maritime work?
4. What institutional conditions enable or constrain the educational use of the training vessel?

Accordingly, this study aims to analyze the educational effectiveness of the training vessel as a practice-based learning environment at Politeknik Pelayaran Barombong. Specifically, it examines theory–practice integration, technical and non-technical competence development, exposure to realistic maritime working conditions, and the institutional factors affecting the continuity and quality of vessel-based learning. Through this analysis, the study proposes a holistic interpretation of the training vessel as a practice-based maritime learning ecosystem and provides a conceptual basis for strengthening maritime vocational education in Indonesia and comparable institutional contexts

II. LITERATURE REVIEW

2.1 Practice-Based Learning in Maritime Vocational Education

Vocational education prepares learners for occupational settings by integrating knowledge, practical skills, professional behavior, and workplace expectations. Competence-based education emphasizes demonstrated performance, while work-based learning develops competence through employment-like tasks [1]–[3]. These principles are crucial in maritime education because shipboard work requires technical knowledge, discipline, situational awareness, communication, and judgment simultaneously.

Practice-based learning becomes meaningful when linked to explicit outcomes, conceptual preparation, guidance, feedback, and reflection. Cadets must understand how, why, and when actions are performed, how they affect other systems, and what risks arise from error. The STCW Convention reinforces this through practical demonstration and assessment in navigation, engineering, communication, emergency response, and watchkeeping [4]. Training vessels therefore place cadets in realistic settings where knowledge becomes action.

2.2 Training Vessels as Onboard Learning Environments

A training vessel is an institutionally managed ship providing experience with maritime equipment, procedures, safety practices, and shipboard organization. Unlike classrooms, it exposes cadets to actual systems, restricted spaces, routines, movement, hierarchy, and safety responsibilities. Unlike commercial internships, it gives institutions greater control over objectives, supervision, scheduling, tasks, and assessment.

Onboard learning is rooted in experiential, situated, and workplace-based learning. Emad and Roth show that training may become disconnected from occupational reality when competence standards are too abstract [9]. Mori and Manuel explain that effective onboard learning requires observation, guided participation, repeated practice, feedback, and increasing responsibility [10]. Mori adds that management, resources, and operational constraints shape learning quality [11].

Training vessels bridge classrooms, simulators, and commercial ships. Classrooms provide concepts; simulators offer controlled scenarios; training vessels add physical and operational authenticity; and commercial ships provide full-scale experience. Their contribution is strongest when theory, simulation, assessment, and sea service are connected.

2.3 Theory–Practice Integration

Maritime education often separates navigation, engineering, safety, communication, and watchkeeping, whereas shipboard operations require them together. Training-vessel practice connects concepts with equipment, procedures, and consequences. Navigation becomes meaningful through radar, GPS, compasses, electronic charts, route planning, and radio communication. Engineering becomes concrete through machinery, indicators, sound, vibration, and heat. Emergency procedures become realistic when cadets respond to commands, assume roles, communicate, and coordinate movement.

Effective integration requires preparation, onboard demonstration, supervised performance, feedback, and reflection. Without this sequence, onboard activity may become passive observation. Cadet numbers, practice time, instructor ratios, vessel condition, and equipment readiness determine whether the vessel develops competence or merely provides exposure.

2.4 Development of Technical Maritime Competence

Technical competence includes navigation, engineering, watchkeeping, communication, emergency response, and safety. Navigation requires interpreting information, relating it to environmental conditions, communicating findings, and supporting safe decisions. Engineering requires understanding machinery, instruments, and troubleshooting. Watchkeeping develops attention, observation, reporting, and continuous responsibility. Emergency drills combine procedures with role allocation, command response, equipment use, communication, and emotional control. Structured shipboard programs improve preparedness when objectives, supervision, assessment, and

documentation are clear [15], [16]. Post-internship studies show that workplace exposure strengthens confidence, professional understanding, and readiness, although outcomes depend on supervision and opportunities [17]. Onboard learning should therefore be structured rather than incidental.

2.5 Non-Technical Competence and Professional Formation

Safe maritime performance also depends on communication, teamwork, leadership, discipline, situational awareness, decision-making, adaptability, resilience, confidence, and responsibility [12]–[14], [18]. Communication must be clear and timely; teamwork is essential because maritime tasks require coordination. Discipline develops through schedules, safety rules, duties, and command structures, while confidence grows through supervised practice.

Technical and non-technical competencies are inseparable. Navigation requires communication and vigilance; engine monitoring requires responsibility; safety drills require teamwork and emotional control; and watchkeeping requires discipline and awareness. Training-vessel learning should therefore assess integrated performance rather than treat behavioral competence as optional.

2.6 Exposure to Real Maritime Working Conditions

Training vessels expose cadets to physical, operational, social, and psychological conditions that classrooms cannot fully reproduce, including movement, weather, noise, restricted space, duty schedules, hierarchy, stress, fatigue, seasickness, and concentration. Such exposure supports adaptation by showing that understanding a procedure differs from performing it under realistic conditions.

Realism must remain controlled and ethical. Fatigue, stress, and discomfort are not educational goals; they become meaningful only when cadets learn to manage them safely. Simulation complements this process by allowing repeated practice of rare or high-risk scenarios without danger [13], [25]. Its effectiveness also depends on curriculum, instructors, preparation, technology, assessment, and resources [35]. These environments should therefore be intentionally connected.

2.7 Institutional Capacity and Training-Vessel Effectiveness

Effectiveness depends on vessel availability, maintenance, readiness, instructors, technical personnel, scheduling, safety management, curriculum integration, assessment, and industry partnership. Limited access reduces practice and feedback, while delayed maintenance may interrupt learning. Technical personnel prepare systems, inspect equipment, troubleshoot problems, and support instructors. Instructors must connect activities to outcomes, explain systems, manage risk, observe performance, and provide feedback [20], [21], [35].

Stakeholder research shows that curriculum differences, trainer competence, finances, onboard conditions, and weak institutional–industry collaboration

can reduce benefits [34]. Industry involvement is important for curriculum review, commercial-ship access, internships, joint assessment, equipment support, and feedback on graduate readiness.

2.8 Maritime Digitalization and Future Competency Requirements

Digital navigation, automation, artificial intelligence, cybersecurity, remote operation, and Maritime Autonomous Surface Ships are reshaping maritime education [5]–[8], [25]. Future professionals need conventional seafaring competence together with digital, analytical, and human–automation skills. Research emphasizes information technology, systems integration, cybersecurity, critical thinking, communication, leadership, situational awareness, and decision-making [36], [37], [39].

Technological change increases rather than removes the human element because people remain responsible for monitoring, interpretation, exception management, ethical judgment, and emergencies. Skill resilience is essential: maritime professionals need transferable foundations and the ability to update competencies as technologies and regulations evolve [38]. Training vessels remain relevant because they provide operational grounding linked to digital systems, simulators, and automation.

2.9 Training Vessel as a Practice-Based Maritime Learning Ecosystem

Training-vessel effectiveness arises from pedagogical, technical, human, institutional, and occupational dimensions. Pedagogy includes preparation, practice, feedback, assessment, and reflection. Technical capacity includes navigation, engineering, communication, and safety systems. Human factors include participation, instructor competence, teamwork, discipline, confidence, and professional identity. Institutional factors include curriculum, funding, maintenance, staffing, safety governance, and quality assurance. Occupational factors include STCW requirements, technological change, employer expectations, and industry collaboration. Effectiveness has three interdependent forms. Pedagogical effectiveness converts theory into contextual understanding; competence effectiveness develops integrated technical and non-technical performance; and institutional effectiveness sustains safe, accessible, structured, and industry-relevant learning. This ecosystem perspective explains how learner outcomes are shaped by institutional resources and industry expectations and supports the study objective of analyzing theory–practice integration, competence development, realistic maritime exposure, and conditions influencing training-vessel use..

III. METHOD

3.1 Research Design

This study employed a descriptive qualitative case-study design to examine the educational effectiveness of

a training vessel in practice-based maritime vocational education at Politeknik Pelayaran Barombong. The qualitative approach was selected because the study sought to understand how participants experienced, interpreted, and evaluated training-vessel-based learning within its actual institutional setting. Qualitative inquiry is appropriate for investigating complex educational phenomena whose meanings are closely connected to their social, operational, and organizational contexts [26], [27].

The study focused on a bounded case: the use of an institution-owned training vessel as part of the maritime learning system at Politeknik Pelayaran Barombong. The case was bounded by the institution, the training-vessel environment, the participants involved in onboard learning, and the educational activities conducted through the vessel. A case-study design enables an in-depth analysis of a contemporary phenomenon using multiple sources of evidence and is particularly useful when the phenomenon cannot be separated easily from its institutional context [28].

In this study, effectiveness did not refer to a statistically measured causal effect. It referred to the perceived and observed contribution of the training vessel to four educational dimensions: the integration of classroom theory with onboard practice, the development of technical and non-technical competencies, exposure to realistic maritime working conditions, and the institutional conditions enabling or constraining vessel-based learning. This operational interpretation was consistent with the qualitative research questions and prevented the findings from being treated as statistically generalizable evidence.

3.2 Research Setting

The study was conducted at Politeknik Pelayaran Barombong in Makassar, South Sulawesi, Indonesia. The institution was selected because it uses a training vessel to support practical education for maritime cadets. The vessel serves as an onboard learning environment in which cadets encounter navigation equipment, machinery systems, communication procedures, watchkeeping routines, emergency drills, safety requirements, and shipboard discipline.

The setting was relevant because maritime competence requires more than classroom understanding. Cadets must be able to apply knowledge and procedures in operational environments involving actual equipment, spatial limitations, safety responsibilities, hierarchical communication, and changing physical conditions. This requirement is consistent with the practical orientation of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers and with the experiential foundations of onboard maritime learning [4], [9], [10].

Politeknik Pelayaran Barombong also provided an appropriate institutional case for examining the interaction between pedagogical value and organizational capacity. The study therefore considered not only the learning activities performed onboard but also vessel access, instructional support, maintenance

requirements, technical capacity, curriculum relevance, and connections with the maritime industry.

3.3 Participants and Sampling

Participants were selected through purposive sampling. This technique was appropriate because the study required information from individuals who possessed direct experience or relevant knowledge of training-vessel utilization. In qualitative research, purposive sampling prioritizes the relevance and informational value of participants rather than statistical representation [26], [29].

The study involved 17 participants consisting of 14 cadets, one instructor or lecturer, and two shipping-industry representatives. The cadets were selected because they had directly participated in onboard learning activities and could explain how the vessel influenced their understanding, competence, confidence, and adaptation to shipboard conditions. The instructor was included to provide information concerning learning objectives, instructional procedures, supervision, and the pedagogical role of the vessel. The industry representatives contributed external perspectives on the relevance of the competencies developed through vessel-based practice to maritime workplace expectations.

Operational and institutional information concerning vessel condition, maintenance requirements, technical support, and learning documentation was also examined through direct observation and document analysis. Vessel-related personnel were not counted as a separate participant category because the verified participant composition consisted of the three groups stated above. The inclusion of learner, educator, and industry perspectives enabled the researchers to compare evidence across different stakeholder positions and strengthened source triangulation [27], [30].

3.4 Research Instruments

The researcher served as the primary instrument in collecting, interpreting, and analyzing the qualitative data. This role involved asking questions, observing onboard activities, examining institutional documents, identifying meaningful patterns, and interpreting the findings within the maritime education context. In qualitative inquiry, the researcher is central to the analytical process because participants' experiences and institutional practices must be understood contextually rather than treated as isolated variables [26].

Three supporting instruments were used to structure the data-collection process: a semi-structured interview guide, an observation sheet, and a document-review format. The interview guide contained core questions related to theory-practice integration, technical competence, non-technical competence, maritime working conditions, learning challenges, institutional constraints, and industry relevance. Semi-structured interviews allowed the same general topics to be explored across participants while permitting follow-up questions based on their respective experiences [29]. The observation sheet was used to record onboard learning activities, cadet-instructor interactions, equipment use, safety practices, communication routines,

shipboard discipline, and evidence of the application of classroom knowledge. The document-review format was used to organize information obtained from institutional reports, training records, operational records, curriculum-related materials, and other documents associated with the educational use of the vessel. Using several instruments enabled the researchers to compare reported experiences with observed practices and documentary evidence [28], [31].

3.5 Data Collection Procedures

Data were collected through in-depth interviews, participatory observation, and document analysis. These three techniques were selected to capture participants' interpretations, actual learning practices, and the institutional context supporting training-vessel utilization.

In-depth interviews were conducted with the 14 cadets, one instructor, and two shipping-industry representatives. Cadet interviews explored their experiences of applying classroom knowledge onboard, using maritime equipment, participating in safety procedures, adapting to shipboard conditions, and developing technical and professional competence. The instructor interview focused on learning objectives, instructional guidance, curriculum integration, supervision, assessment, and limitations affecting onboard practice. The industry interviews examined workplace expectations, graduate readiness, and the relevance of competencies developed through the training vessel. Interviews were conducted flexibly so that participants could explain their experiences while the researcher maintained consistency with the study questions [27], [29].

Participatory observation was conducted during activities associated with the training-vessel learning environment. The observation focused on navigation-related practice, machinery-system familiarization, safety drills, communication routines, watchkeeping-related activities, cadet coordination, instructor guidance, and compliance with onboard procedures. Observation was important because several dimensions of maritime competence—including procedural discipline, teamwork, communication, safety awareness, and task performance—are demonstrated through action and may not be captured completely through interviews alone [9], [10].

Document analysis was used to provide contextual and corroborating evidence. The documents examined included relevant institutional reports, training records, curriculum-related materials, operational documents, and records concerning vessel-based learning. Documentary evidence was used to clarify the institutional position of the training vessel, verify information obtained during interviews and observations, and identify recurring issues relating to learning activities, vessel readiness, and institutional support. Document analysis provides stable and contextual evidence that can complement interviews and observations in qualitative case studies [28], [31].

3.6 Data Analysis

The data were analyzed through an iterative descriptive and thematic process involving data organization, familiarization, coding, theme development, data display, triangulation, and inductive interpretation [32], [33].

First, interview records, observation notes, and documentary materials were organized according to their sources and read repeatedly. This familiarization process enabled the researchers to identify information directly related to the research questions while maintaining the contextual meaning of participants' statements and observed activities.

Second, meaningful data segments were assigned initial codes. The codes represented recurring issues such as classroom-knowledge application, navigation practice, machinery monitoring, emergency drills, communication, watchkeeping, discipline, teamwork, confidence, adaptability, vessel movement, fatigue, limited practice time, maintenance requirements, technical support, and industry collaboration.

Third, related codes were compared and grouped into broader candidate themes. The themes were reviewed against the original data to ensure that they represented recurring patterns rather than isolated comments. This process generated four principal thematic areas: theory–practice integration, technical and non-technical competence development, exposure to realistic maritime working conditions, and institutional conditions affecting training-vessel use.

Fourth, the data were displayed in analytical matrices and narrative summaries. Responses from cadets were compared with the instructor's account, industry perspectives, observation records, and documentary evidence. This comparison allowed the researchers to identify convergent evidence, differences among stakeholder perspectives, and relationships between learning experiences and institutional conditions [30], [32].

Fifth, the themes were interpreted inductively in relation to the research questions and the conceptualization of the training vessel as a practice-based maritime learning ecosystem. The analysis moved from specific experiences and observed activities toward a broader explanation of how pedagogical processes, competence development, vessel conditions, institutional support, and industry expectations interacted.

Descriptive counts were used only to indicate how widely particular themes appeared across participant accounts. They were not used as inferential statistics or as proof of causal effectiveness. The primary basis of interpretation remained the meaning, consistency, contextual depth, and triangulation of the qualitative evidence.

3.7 Trustworthiness

The trustworthiness of the study was addressed through credibility, transferability, dependability, and confirmability [26], [30]. Credibility was strengthened through source and technique triangulation. Source triangulation involved comparing information obtained from cadets, the instructor, and shipping-industry

representatives. Technique triangulation involved comparing interview accounts with observation notes and documentary evidence.

Member checking was conducted by asking selected participants to review whether the researchers' interpretations adequately reflected their experiences and intended meanings. Transferability was supported through a contextual description of the institution, participant groups, training-vessel environment, and principal learning activities. The findings were not intended for statistical generalization but may provide analytical insights for maritime vocational institutions with comparable learning contexts.

Dependability was supported by documenting the stages of participant selection, data collection, coding, theme development, and interpretation. An audit trail was maintained to record methodological decisions and analytical development. Confirmability was strengthened through reflective notes and by connecting each interpretation to evidence obtained from interviews, observations, or documents. These procedures reduced dependence on unsupported researcher assumptions and ensured that the findings remained grounded in the collected data [28], [30].

3.8 Ethical Considerations

The study followed ethical principles applicable to qualitative educational research. Participants were informed about the purpose of the study, the voluntary nature of their participation, the intended academic use of the data, and the protection of confidentiality. Participants were allowed to provide information based on their experiences without being compelled to answer questions they considered inappropriate.

Personal names were not used in the reporting of the findings. Participants were identified only by general roles or participant codes so that their statements could not be linked directly to their identities. Particular care was taken when reporting institutional constraints because such information could relate to operational capacity, educational quality, or organizational management. The data were therefore presented in a manner that preserved analytical meaning without disclosing unnecessary personal or sensitive institutional information [26], [27].

3.9 Methodological Scope and Limitations

The case-study design enabled an in-depth understanding of training-vessel-based learning within a specific maritime vocational institution. However, the study was limited to one institutional case and a purposively selected group of 17 participants. The findings therefore should not be interpreted as statistically representative of all maritime education and training institutions.

The composition of the sample was dominated by cadets, while the instructor and industry perspectives were represented by fewer participants. Consequently, the study primarily reflects learner experiences supported by pedagogical and external industry perspectives. The findings were also influenced by the activities available

during the observation period and by the accessibility of institutional documents.

Despite these limitations, the combination of interviews, participatory observation, document analysis, source triangulation, member checking, and an audit trail provided a credible basis for interpreting the educational contribution and institutional conditions of training-vessel-based learning. The study offers an analytically transferable understanding of how an institution-owned training vessel may function as a practice-based maritime learning ecosystem.

IV. RESULTS AND DISCUSSION

4.1 Participant Profile and Overview of Findings

The study involved 17 participants comprising 14 cadets, one instructor or lecturer, and two shipping-industry representatives. Cadets constituted the largest participant group because they were the principal users of the training vessel and had direct experience of onboard learning. The instructor provided information regarding instructional objectives, supervision, practical activities, and curriculum implementation. The industry representatives contributed external perspectives on the relevance of cadet competence to maritime workplace expectations.

TABLE 1.
PARTICIPANT COMPOSITION

Participant Category	Number	Percentage	Principal Contribution
Cadets	14	82.35%	Onboard learning experiences, competence development, and adaptation
Instructor/Lecturer	1	5.88%	Instructional design, supervision, and learning objectives
Shipping-industry representatives	2	11.77%	Workplace expectations and industry relevance
Total	17	100%	Combined learner, educator, and industry perspectives

The analysis generated four major findings. First, the training vessel connected classroom-based knowledge with onboard practice. Second, it supported the development of technical and non-technical competencies as an integrated process. Third, it exposed cadets to physical, operational, social, and psychological conditions resembling actual maritime work. Fourth, its educational contribution was affected by vessel availability, maintenance requirements, technical support, instructional arrangements, and industry collaboration.

These findings indicate that the training vessel cannot be evaluated only as physical infrastructure. Its educational value emerges from the interaction among cadets, instructors, vessel systems, practical tasks, safety procedures, institutional resources, and occupational expectations. The vessel was therefore interpreted as a practice-based maritime learning ecosystem rather than simply as a location for occasional technical exercises.

TABLE 2.
PRINCIPAL THEMES OF THE FINDINGS

Major Theme	Main Evidence	Educational Meaning
Theory–practice integration	Application of classroom concepts during navigation, machinery, communication, and safety activities	Abstract knowledge was transformed into operational understanding
Technical competence	Navigation instruments, machinery monitoring, emergency procedures, communication, and watchkeeping	Cadets developed familiarity with interconnected vessel operations
Non-technical competence	Discipline, teamwork, communication, confidence, adaptability, and responsibility	Onboard practice formed professional behavior and work habits
Real maritime conditions	Weather, vessel movement, noise, restricted space, fatigue, hierarchy, and routines	Cadets experienced the physical and psychological demands of shipboard work
Institutional conditions	Access, maintenance, technical personnel, scheduling, and industry collaboration	Institutional capacity determined the continuity and depth of learning

4.2 Training Vessel as a Bridge Between Theory and Practice

The first research question examined how the training vessel connected classroom-based maritime knowledge with onboard practical learning. The findings show that cadets understood theoretical material more clearly when they could relate it to actual equipment, procedures, physical conditions, and operational responsibilities.

In navigation-related activities, cadets applied knowledge of route planning, radar observation, Global Positioning System monitoring, compass reading, position identification, and radio communication. Classroom instruction had introduced the purpose and principles of these instruments, but onboard practice allowed cadets to see how information from different sources had to be interpreted together. They learned that

navigation was not a sequence of isolated instrument-reading tasks. It involved continuous observation, comparison of information, communication, judgment, and attention to safety.

A similar pattern appeared in machinery-related learning. Cadets observed engine operation, cooling systems, fuel systems, electrical components, and basic monitoring procedures. Direct exposure enabled them to associate diagrams and theoretical descriptions with the physical arrangement, sound, vibration, temperature, and movement of machinery. These sensory and spatial dimensions made technical concepts more concrete and helped cadets understand that machinery systems function as connected components rather than separate classroom topics.

Safety activities provided another clear example of theory–practice integration. Cadets had previously

learned the stages of fire response, abandon-ship procedures, and man-overboard response. Onboard drills demonstrated that knowledge of procedural steps was insufficient unless cadets could also respond to commands, move safely, use equipment, coordinate with others, and complete tasks within an appropriate period. Practical safety learning therefore required cognitive understanding, physical execution, communication, and emotional control at the same time.

The findings suggest that the training vessel contributed to a progression from conceptual knowledge to operational understanding. This progression involved five interconnected stages: prior classroom learning, instructor explanation, onboard demonstration, supervised cadet performance, and reflection on the completed activity. The educational importance of the vessel did not arise merely because cadets entered a ship. It arose because the ship created conditions in which knowledge had to be used, tested, corrected, and connected to consequences.

This result also clarifies the difference between exposure and learning. Physical presence onboard did not automatically guarantee competence development. Learning became meaningful when cadets were given clear tasks, guided by an instructor, allowed to operate or observe relevant systems, and provided with feedback.

Therefore, the training vessel should not be treated as an optional demonstration facility. It should be incorporated into a structured learning sequence before, during, and after onboard practice.

The deeper significance of this finding is that the training vessel functions as an interface between two educational environments. The classroom provides concepts, terminology, standards, and procedural foundations, while the vessel provides operational context, sensory experience, time pressure, interaction, and responsibility. Neither environment is sufficient independently. Classroom learning without practical application may remain abstract, whereas onboard activity without conceptual preparation may become unstructured exposure. Effective maritime vocational learning requires deliberate integration of both.

4.3 Development of Technical Competence

The second research question examined how training-vessel practice contributed to cadets' technical and non-technical competence. Regarding technical competence, the findings identified five principal areas: navigation, engineering, safety, communication, and watchkeeping

TABLE 3.
TECHNICAL COMPETENCIES DEVELOPED THROUGH TRAINING-VESSEL PRACTICE

Competence Area	Practical Activities	Identified Learning Contribution
Navigation	Radar use, position monitoring, compass reading, route planning, and communication	Better understanding of instrument relationships and operational decision-making
Engineering	Engine monitoring, cooling-system observation, fuel-system awareness, and basic troubleshooting	Greater familiarity with machinery systems and engine-room routines
Safety	Fire, abandon-ship, and man-overboard drills	Improved procedural awareness, role recognition, and emergency readiness
Communication	Radio practice, command response, briefings, and onboard coordination	Clearer, more concise, and disciplined operational communication
Watchkeeping	Duty schedules, observation routines, and operational monitoring	Stronger awareness of vigilance, timing, continuity, and responsibility

Navigation competence developed through interaction with actual navigational instruments and procedures. Cadets did not merely identify equipment; they began to understand how information had to be interpreted within an operating environment. Practical activities required them to consider position, direction, communication, vessel movement, visibility, and safety simultaneously. This multidimensional task structure helped develop operational judgment rather than simple instrument recognition.

Engineering competence was strengthened by direct familiarity with machinery and engine-room conditions. Cadets could observe how temperature, sound, vibration, fluid systems, and monitoring indicators provided information about machinery performance. Although the depth of practice depended on vessel condition, equipment availability, and instructor supervision, onboard exposure helped cadets develop a more realistic understanding of engine-room work.

Safety competence developed through participation in emergency drills. The drills clarified role distribution, reporting procedures, command structures, equipment use, assembly arrangements, and the importance of timely response. Cadets learned that emergency

procedures must be practiced until actions can be performed accurately under pressure. Safety competence therefore involved not only remembering instructions but also developing coordinated and disciplined responses.

Communication competence was embedded in almost every onboard activity. Radio communication, command response, group coordination, and instructor briefings required cadets to communicate clearly and listen carefully. The vessel environment demonstrated that vague or delayed communication could affect task performance and safety. Communication consequently became an operational competence rather than merely a language skill.

Watchkeeping activities developed cadets' understanding of continuity and responsibility. Cadets became aware that maritime operations require sustained attention even when no immediate problem is visible. Observation routines, duty periods, and monitoring activities taught them that vigilance is a continuous professional obligation.

The technical findings show that competence was developed through relationships among systems rather than through isolated tasks. Navigation required communication; machinery monitoring required attention

and responsibility; safety drills required teamwork; and watchkeeping required discipline. Technical competence was therefore inseparable from behavioral and cognitive performance.

The findings do not demonstrate that cadets had achieved full professional mastery. Rather, they show that the training vessel provided an important intermediate environment between classroom instruction and more complex commercial-ship experience. It enabled cadets to build operational familiarity, reduce uncertainty,

recognize system relationships, and prepare for subsequent workplace-based learning.

4.4 Development of Non-Technical Competence and Professional Behavior

The findings show that training-vessel practice also strengthened discipline, teamwork, communication, confidence, adaptability, responsibility, and professional awareness. These competencies emerged through participation in real tasks and routines rather than through separate soft-skills instruction.

TABLE 4.
NON-TECHNICAL COMPETENCIES DEVELOPED THROUGH ONBOARD LEARNING

Competence	Onboard Learning Situation	Identified Effect
Discipline	Duty schedules, safety rules, attendance, and command structures	Greater awareness of punctuality, compliance, and consistency
Teamwork	Group tasks, drills, and shared operational responsibilities	Improved coordination, mutual support, and collective responsibility
Communication	Radio practice, command response, briefing, and peer interaction	More structured, direct, and safety-oriented communication
Confidence	Equipment use, sea exposure, and task completion	Reduced uncertainty and greater readiness to participate
Adaptability	Vessel movement, weather changes, noise, fatigue, and limited space	Increased familiarity with challenging shipboard conditions
Professional responsibility	Hierarchy, assigned duties, safety procedures, and monitoring	Stronger recognition of accountability and occupational standards

Discipline was developed because the vessel required cadets to follow operational schedules, safety instructions, task assignments, and command structures. In the classroom, lateness or inattention may primarily affect the individual learner. Onboard, a delayed or incomplete action may affect a group task or safety procedure. This difference made discipline more tangible and helped cadets understand its operational significance.

Teamwork developed through activities that could not be completed individually. Safety drills, communication exercises, and shared observations required role allocation and coordinated action. Cadets learned that maritime operations depend on the reliability of each team member and that individual performance must support collective objectives.

Communication developed in connection with hierarchy and safety. Cadets had to understand instructions, respond appropriately, report information, and coordinate with peers. The vessel environment encouraged concise communication because excessive, unclear, or inaccurate messages could create confusion. This experience strengthened the relationship between communication quality and operational reliability.

Confidence developed gradually through repeated interaction with unfamiliar equipment and environments. Initial uncertainty was associated with vessel movement, machinery noise, technical systems, and command procedures. As cadets completed supervised activities, they became more willing to participate and less hesitant when facing maritime tasks. This confidence was grounded in experience rather than personal optimism.

Adaptability emerged through exposure to environmental and psychological demands. Cadets encountered weather variation, movement, restricted space, fatigue, seasickness, noise, and unfamiliar routines. These conditions required them to manage discomfort while maintaining attention and completing assigned tasks.

Adaptability therefore involved both physical adjustment and emotional regulation.

Professional responsibility developed when cadets recognized that shipboard tasks had consequences beyond individual assessment. Monitoring equipment, following safety rules, maintaining communication, and completing assigned duties were connected to the functioning of the vessel and the safety of others. The vessel helped shift cadets' orientation from completing academic exercises to fulfilling occupational responsibilities.

A significant finding is that technical and non-technical competencies were formed simultaneously. A navigation exercise strengthened equipment knowledge while also requiring communication, vigilance, and confidence. An emergency drill developed procedural competence while also requiring teamwork, discipline, and emotional control. Engine monitoring strengthened technical understanding while cultivating attention to detail and responsibility.

This integration is important because maritime competence is often divided administratively into technical and non-technical categories, even though actual shipboard performance requires them to operate together. The training vessel revealed that non-technical competence was not supplementary to technical learning. It was one of the conditions enabling technical knowledge to be applied safely and reliably.

4.5 Exposure to Real Maritime Working Conditions

The third research question examined how the training vessel exposed cadets to the conditions of maritime work. The findings identified four interconnected dimensions: physical, operational, social, and psychological.

Physical conditions included vessel movement, weather changes, engine noise, vibration, heat, and restricted working space. These conditions made practice

different from classroom or laboratory learning. Cadets had to maintain attention while adapting to movement, noise, and discomfort. The physical environment therefore influenced how tasks were performed and how information was processed.

Operational conditions included watchkeeping routines, equipment monitoring, navigation activities, safety drills, time-based duties, and compliance with procedures. Cadets encountered the requirement to perform tasks according to schedules and operational sequences rather than according to the flexible timing of ordinary classroom exercises.

Social conditions included hierarchy, division of roles, teamwork, communication protocols, and command response. Cadets learned that shipboard work is organized through clear authority and responsibility structures. They were expected to understand their positions, receive instructions, report correctly, and coordinate with others.

Psychological conditions included fatigue, uncertainty, stress, seasickness, and the need to remain confident and attentive. Although these experiences were uncomfortable, they provided realistic preparation for maritime work. Cadets began to recognize that professional performance at sea requires the ability to function despite physical and emotional challenges.

Exposure to these conditions contributed to professional adaptation. Cadets developed a more realistic understanding of shipboard life and could compare their expectations with actual experience. This process is educationally important because unrealistic

expectations may affect motivation, readiness, and adjustment during later sea service. Early exposure can help cadets identify areas requiring further personal and professional development.

However, the educational value of discomfort must be interpreted carefully. Fatigue, seasickness, noise, and environmental pressure should not be romanticized as learning outcomes in themselves. They become educationally meaningful only when practice is safe, supervised, appropriately designed, and followed by reflection. The purpose is not to subject cadets to unnecessary hardship but to prepare them gradually for conditions they are likely to encounter professionally.

The training vessel therefore served as a controlled transition environment. It was more authentic than classroom instruction but remained within an educational structure where instructors could guide activities and correct errors. This transitional position was one of the vessel's strongest contributions. Cadets could encounter realistic demands before entering higher-risk and more complex commercial-ship environments

4.6 Institutional Constraints and Conditional Effectiveness

The fourth research question examined the institutional conditions enabling or constraining the educational use of the training vessel. Four main constraints were identified: limited vessel availability, high maintenance requirements, insufficient technical support, and limited industry collaboration.

TABLE 5.
INSTITUTIONAL CONSTRAINTS AND THEIR EDUCATIONAL IMPLICATIONS

Institutional Constraint	Practical Manifestation	Educational Implication
Limited vessel availability	One vessel serves many cadets and practice periods are restricted	Reduced individual practice, limited repetition, and unequal learning intensity
High maintenance requirements	Engines, instruments, safety equipment, and vessel systems require continuing expenditure	Interruptions may occur when equipment or vessel systems are not operationally ready
Insufficient technical support	Limited personnel for maintenance, operation, inspection, and troubleshooting	Reduced assistance for instructors and less reliable practical access
Limited industry collaboration	Restricted interaction with commercial vessels and current operational practices	Training may not fully reflect technological and procedural changes in industry

Limited availability affected the amount and quality of practice received by individual cadets. When many learners shared a restricted period onboard, activities could become observation-dominated rather than performance-oriented. Cadets might see a procedure without having sufficient opportunity to repeat it independently. This distinction is important because competence requires practice, correction, and repetition, not only exposure.

Maintenance requirements affected the continuity of learning. A training vessel contains interconnected mechanical, electrical, navigation, communication, and safety systems. When one system is unavailable, the related learning activity may be reduced or replaced by explanation. Maintenance is therefore not merely a technical support issue; it directly influences curriculum delivery.

Technical-personnel limitations also affected educational quality. Instructors may understand learning objectives but still require operational and maintenance

support to prepare equipment, verify safety, troubleshoot systems, and explain specialist functions. Inadequate technical staffing can increase the burden on instructors and restrict the range of activities that can be conducted safely.

Limited industry collaboration affected external relevance. The training vessel provides a valuable institutional environment, but it may not reproduce the full scale, technology, workload, commercial pressure, and organizational complexity of active shipping operations. Industry participation is therefore necessary to update learning activities, provide professional feedback, expand sea-training opportunities, and ensure that vessel-based practice remains aligned with workplace developments.

These constraints demonstrate that the effectiveness of a training vessel is conditional rather than automatic. The vessel showed strong pedagogical value, but the depth and continuity of that value depended on institutional capacity. A well-designed practical

curriculum cannot be implemented consistently when access is restricted or equipment is unavailable. Similarly, an operational vessel may still produce limited learning when activities are not structured, supervised, assessed, and aligned with outcomes.

This finding changes the interpretation of training-vessel effectiveness. Effectiveness should not be evaluated solely through cadet satisfaction or the physical availability of a vessel. It should be assessed through the relationship among educational design,

operational readiness, access, supervision, competence development, and industry relevance.

4.7 Descriptive Distribution of Themes

Descriptive counts were used to indicate how frequently the principal themes appeared across participant accounts. These values were not used as inferential statistics and should not be interpreted as measurements of causal effect.

TABLE 6.
DESCRIPTIVE DISTRIBUTION OF MAJOR THEMES

Major Theme	Participants Reflecting the Theme	Percentage	Interpretation
Theory–practice integration	16	94.12%	Most widely shared perception
Technical competence development	15	88.24%	Very prominent learning contribution
Non-technical competence development	14	82.35%	Strong professional-development contribution
Exposure to maritime working conditions	14	82.35%	Strong contribution to realistic preparation
Institutional constraints	13	76.47%	Widely recognized limitation
Need for stronger industry collaboration	10	58.82%	Relevant institutional-development issue

The distribution shows that theory–practice integration was the most consistently identified theme. Technical competence development was also highly prominent. Non-technical competence and exposure to maritime working conditions appeared in more than four-fifths of participant accounts. At the same time, institutional constraints were recognized by most participants, showing that positive learning experiences coexisted with limitations in implementation.

The descriptive pattern supports two connected interpretations. First, the vessel had a clear and widely perceived educational contribution. Second, participants did not regard its current utilization as fully optimized. The vessel was valued not because every institutional condition was ideal, but because it provided forms of learning that were difficult to obtain through classroom instruction alone.

4.8 Integrated Interpretation of Training-Vessel Effectiveness

The combined findings indicate that training-vessel effectiveness consists of three interdependent dimensions: pedagogical effectiveness, competence effectiveness, and institutional effectiveness.

Pedagogical effectiveness refers to the ability of the vessel to transform classroom knowledge into practical and contextual understanding. This dimension was visible when cadets applied theoretical concepts to actual equipment, procedures, and shipboard situations.

Competence effectiveness refers to the vessel's contribution to integrated technical and non-technical performance. This dimension included navigation, engineering, communication, safety, watchkeeping, teamwork, discipline, confidence, adaptability, and responsibility.

Institutional effectiveness refers to the capacity of the institution to provide access, maintenance, personnel, scheduling, instructional support, assessment, and

industry collaboration. This dimension determined whether pedagogical and competence benefits could be delivered regularly and equitably.

The three dimensions should not be evaluated separately. Strong instructional planning cannot achieve its full purpose when the vessel is unavailable. An operational vessel cannot produce optimal learning without guided activities and assessment. Cadet motivation cannot compensate indefinitely for inadequate practice time, limited technical support, or outdated industry linkage. Overall effectiveness therefore results from alignment among the three dimensions.

This integrated interpretation also shows that the training vessel operates at three analytical levels. At the learner level, cadets acquire experience, competence, confidence, and professional awareness. At the institutional level, curriculum, staffing, maintenance, funding, scheduling, and assessment determine the quality of learning. At the occupational level, industry expectations determine whether the competencies developed remain relevant to maritime work.

Training-vessel effectiveness can consequently be expressed as follows:

Training-vessel effectiveness is the institutionally supported capacity of onboard learning to connect theory with authentic practice, develop integrated maritime competence, and prepare cadets for the operational and professional demands of shipboard work.

This formulation avoids treating effectiveness as a simple consequence of vessel ownership. It emphasizes that educational outcomes emerge through interactions among learners, instructors, equipment, tasks, organizational support, safety culture, and external expectations

V. CONCLUSION

This study concludes that the training vessel at Politeknik Pelayaran Barombong provides substantial educational value as a practice-based maritime learning environment. It connects classroom knowledge with onboard application by enabling cadets to engage directly with navigation instruments, machinery systems, communication procedures, watchkeeping routines, and emergency-response activities. Through this process, theoretical concepts become more concrete, contextual, and operationally meaningful.

Training-vessel practice also contributes to the integrated development of technical and non-technical competencies. Technical learning includes navigation, machinery monitoring, safety procedures, communication, and watchkeeping, while non-technical development includes discipline, teamwork, confidence, adaptability, responsibility, and professional awareness. These competencies are not formed separately because onboard activities require cadets to combine technical knowledge with communication, coordination, vigilance, judgment, and behavioral discipline.

The vessel further prepares cadets for the realities of maritime work by exposing them to physical, operational, social, and psychological conditions resembling shipboard life. Vessel movement, machinery noise, restricted space, hierarchical communication, operational schedules, fatigue, and seasickness help cadets develop more realistic expectations and greater readiness for future sea service. This exposure is educationally valuable when it is conducted safely, systematically, and under appropriate supervision.

However, the effectiveness of the training vessel remains conditional upon institutional capacity. Limited vessel availability, high maintenance requirements, insufficient technical support, restricted practice time, and limited industry collaboration reduce the continuity, depth, and relevance of onboard learning. Therefore, vessel ownership alone does not guarantee effective practice-based education. The training vessel must be operationally ready, accessible to cadets, integrated into the curriculum, supported by qualified instructors and technical personnel, and connected to current maritime-industry requirements.

The main contribution of this study is the conceptualization of the training vessel as a practice-based maritime learning ecosystem consisting of three interdependent dimensions: pedagogical effectiveness, competence effectiveness, and institutional effectiveness. Pedagogical effectiveness connects theory with authentic practice; competence effectiveness develops integrated technical and professional capabilities; and institutional effectiveness sustains access, maintenance, supervision, staffing, and industry relevance. Weakness in any one of these dimensions may reduce the vessel's overall educational contribution.

Accordingly, Politeknik Pelayaran Barombong should strengthen the systematic scheduling of onboard practice, competency-based learning activities, vessel-maintenance planning, technical-personnel capacity, instructor coordination, and partnerships with shipping companies. Future studies may examine training-vessel

effectiveness across several maritime institutions, compare training-vessel learning with simulator and commercial-ship experience, or use mixed-method and longitudinal designs to evaluate competency development over time. Because this study examined one institutional case with a purposively selected participant group, its findings should be interpreted as context-specific analytical insights rather than statistical generalizations.

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