Sustainable Maritime Literacy: Navigating Education for Eco-Conscious Professionals

Marudut Bernadtua Simanjuntak[1,2], Zainal Rafli[2], Sintowati Rini Utami[2], Winarno[1], Larsen Barasa[1]

This study at the Maritime Institute Jakarta deals with sustainable maritime literacy, exploring the perspectives of 70 cadets from Nautical, Technical, engineering and Port and shipping management courses. Adopting a qualitative, descriptive approach, the study examines the importance of maritime literacy, the feasibility of integrating sustainable infrastructures and the cadets' familiarity with the relevant concepts. The results indicate different perspectives in the individual study programmes, which calls for tailored educational strategies. The study identifies gaps in knowledge, promotes collaborative learning and emphasises the practical application of sustainability principles. Recommendations include curriculum improvements, interdisciplinary collaboration and partnerships with industry. The study contributes to reshaping maritime education, empowering professionals to navigate the seas competently while advocating for sustainability.

KEY WORDS
~ Maritime education
~ Maritime literacy
~ Eco-conscious
~ Sustainable education
~ Interdisciplinary

[1] Maritime Institute of Jakarta (Sekolah Tinggi Ilmu Pelayaran), Research Department, Jakarta, Indonesia
[2] State University of Jakarta, Jakarta, Indonesia
e-mail: bernadmarudut@gmail.com
doi: 10.7225/toms.v14.n01.024

Received: 21 Feb 2024 / Revised 1 Mar 2025 / Accepted: 5 Mar 2025 / Published: 20 Apr 2025

1. INTRODUCTION

The maritime industry, an essential component of global trade and transportation, is currently at a crossroads characterized by the imperative of sustainability(Comtois & Slack, 2017; Munim et al., 2020). s the Maritime Institute Jakarta (STIP Jakarta) is considered a beacon of maritime education and produces a significant cadre of seafaring professionals, the need to redefine the educational paradigm becomes evident. In an era dominated by environmental concerns and the pursuit of sustainable practices, the role of maritime professionals extends beyond traditional navigation and technical expertise. The vast blue expanses of ocean that once served only as a canvas for shipping routes now call for a new generation of seafarers who are not only literate in charts and currents, but also have a deep understanding of the intricate ecological tapestry that surrounds maritime activities (Rochwulaningsih et al., 2019). Amidst this backdrop, it is important to reconceptualize maritime education and cultivate what we call maritime literacy – an interdisciplinary understanding that transcends the conventional boundaries of technical expertise. The urgency of this recalibration of education stems from the growing environmental challenges facing our oceans. Maritime professionals, once confined to the realm of engine operation and deck management, are now tasked with navigating the delicate dance between economic development and ecological preservation (Rochwulaningsih et al., 2019). This juxtaposition requires a profound shift in educational focus to recognize the symbiotic relationship between maritime infrastructure and environmental conservation.

While existing maritime education commendably teaches technical skills, it lacks a coherent integration of sustainability principles (de la Peña Zarzuelo et al., 2020). his knowledge gap is particularly evident in the disjointed approach towards understanding the complex interplay between maritime activities, ecological systems and global sustainability goals. The cadets of the Maritime Institute Jakarta, representing diverse majors in the fields of nautical science, engineering, and port and shipping management, are the focus of this study. The random selection of 70 cadets from these majors, chosen randomly, aims to paint a holistic picture of the maritime education landscape and the resulting impact on future maritime professionals. The purpose of this study is multifaceted. Firstly, it aims to delve into the multifaceted dimensions of maritime literacy, defining the essential components that extend beyond the traditional curriculum. In this way, the study aims to bridge the existing knowledge gap that exists between technical knowledge and a nuanced understanding of the environmental impact of maritime activities (Walker et al., 2019). Secondly, the study aims to investigate the feasibility and effectiveness of an interdisciplinary approach to maritime education (Bee, 2017; Ferritto, 2016; Pyne, 2012). In doing so, the study seeks to identify key opportunities for the seamless integration of sustainability principles into the existing educational framework.

The urgency of this research is underlined by the critical phase in which the maritime industry finds itself. Environmental concerns, climate change and the urgent need for sustainable practices have put maritime education front and center. The call for sustainable infrastructure and environmentally conscious decision-making within the industry is unmistakable (Tomor et al., 2019). Maritime professionals are increasingly expected not only to navigate the open seas, but also to navigate the intricate web of environmental regulations, community considerations and global sustainability benchmarks. Consequently, this research aims to address the immediate needs of the maritime industry by formulating an educational model that transcends conventional boundaries aligning with the evolving dynamics of global maritime practices. In the pursuit of sustainable maritime literacy, the novelty of this research lies in the fact that it does not simply add sustainability modules to existing curricula, but brings about a paradigm shift. The research envisions a comprehensive educational tapestry in which environmental principles are not treated as a mere afterthought, but are woven into every facet of maritime knowledge (Comtois & Slack, 2017; Puisa et al., 2021). This approach transforms sustainability from a peripheral concern to a fundamental one, ensuring that every future seafarer not only has technical skills but also a holistic understanding of the environmental impact of their actions. The maritime industry is at a pivotal point that requires a recalibration of educational paradigms to meet the evolving demands of sustainability (Agrifoglio et al., 2017; Bankole et al., 2017). This research, conducted at the Maritime Institute Jakarta, is navigating the uncharted waters of interdisciplinary education and maritime literacy with the aim of shaping a new generation of seafarers who are not only skilled in navigation but also have a deep understanding of the ecological nuances of the oceans they travel. The urgency is palpable, the knowledge gap obvious and the goal resolute – to set a course towards a sustainable future where maritime literacy is not just a skill, but a cornerstone of responsible and informed global seafaring.

2. LITERATURE REVIEW

The basis for this research is an extensive literature review that looks at key concepts, theoretical frameworks and previous research that underpins the quest for maritime literacy and sustainable education (de la Peña Zarzuelo et al., 2020). This research focuses on the integration of sustainability principles into maritime education and the nuanced understanding of the complex interplay between infrastructure, economy and ecology. Theoretical framework: At the center of this research is the integration of theoretical frameworks that justify the need for maritime literacy and interdisciplinary education. The overarching theoretical construct involves the fusion of maritime knowledge with sustainability principles to promote a holistic understanding of the oceanic environment. Drawing on environmental psychology and educational theory, it aims to explore

how the cognitive processes of maritime professionals can be shaped to seamlessly incorporate ecological considerations into decision-making (Chakraborty & Chakraborty, 2021; Lam et al., 2020). The key concepts of maritime literacy, a pivotal concept within this research, go beyond the conventional boundaries of technical expertise. Maritime literacy is defined as the comprehensive knowledge, skills and awareness that enable individuals to understand and engage with the maritime domain, including its environmental, economic and social dimensions (Carcia-Soto & van der Meeren, 2017; Domingues, 2013). In contrast to marine competence, which focuses on oceanic processes and marine ecosystems, or nautical literacy, which relates to navigation and seamanship, maritime literacy integrates sustainability, legal frameworks and the socio-economic impacts of the maritime economy. The integration of sustainability into the framework of maritime education is not just an additive but a transformative endeavor in which environmental principles are considered as cornerstones rather than complementary modules. The research is based on the concept that sustainable infrastructure is not at odds with economic development, but rather represents a symbiotic relationship that requires a differentiated approach to education.

Previous research has provided a solid foundation for this research and demonstrates the increasing recognition of sustainability in maritime education (Chen et al., 2017; Chiong, 2023). Studies examining the impact of sustainable practices in the maritime industry highlight a growing awareness of the need to make environmentally conscious decisions. Research on the effectiveness of interdisciplinary education in other fields highlights its potential to produce professionals with broader skills. However, the integration of these concepts into maritime education is a relatively unexplored terrain, and this research attempts to bridge this gap by summarizing and building on the existing studies (Nalupa, 2022). The maritime education landscape has historically focused on technical skills and paid little attention to the environmental impacts of the industry's practices. However, recent studies have shed light on the inadequacy of this approach is inadequate in the face of escalating environmental challenges. The need for professionals who are proficient in both the technical and environmental dimensions is becoming increasingly apparent. This research follows and builds on these studies by arguing for a paradigm shift in maritime education that recognizes the intricate relationship between maritime activities and the environment.

The concept of sustainable infrastructure in the maritime sector has become increasingly important in recent years. Studies examining the feasibility and impact of environmentally friendly ports, alternative energy sources and environmentally conscious navigation practices provide valuable insights. These studies help to understand how sustainable infrastructures can be integrated into maritime education. However, the present research aims to go beyond a mere examination of sustainable practices by proposing an educational model that ensures future professionals are equipped with the necessary interdisciplinary skills (Todd et al., 2021). The synthesis of maritime literacy, sustainability in maritime education and interdisciplinary learning forms the core of this literature review. Maritime literacy refers to the comprehensive knowledge, skills and awareness that enable individuals to engage in the maritime sector in an environmentally and socially responsible manner. Sustainability in maritime education integrates environmental principles and regulatory frameworks to ensure that maritime professionals are able to support sustainable industry practices. Interdisciplinary learning bridges multiple fields — including environmental science, engineering, policy and economics - enabling a holistic and effective approach to maritime education. Building on the foundations of previous research, this study aims to break new ground in the field of interdisciplinary education and maritime literacy, taking an important step towards a sustainable future for the maritime industry.

3. METHOD

The research method used in this study adopts a qualitative, descriptive approach that aims to comprehensively investigate and understand the dynamics of maritime education and the integration of sustainability principles (Padgett, 2016; Panagiotidou, 2012). This section describes the research design, participants, data collection procedures and data analysis methods of the study.

Research Design: The qualitative, descriptive approach was chosen as the research design as it provides the opportunity to delve into the intricacies of the topic (Saldana, 2014). This design facilitates a nuanced exploration of maritime education and the integration of sustainability concepts and allows for a comprehensive understanding of participants' perspectives and experiences (Domingues, 2013). The research design is inherently flexible and accommodates the complex and multifaceted nature of the research question.

Participants: The study focuses on 70 cadets currently enrolled in their second semester, spread across three majors: Nautical Science, Engineering, and Harbor and Marine Management. Participants were randomly selected to ensure a representative sample that reflects the diversity of perspectives within the Maritime Institute Jakarta. Cadets from each major contribute valuable insights offering a holistic view of the current state of maritime education and the potential for interdisciplinary integration.

Data Collection: The process of data collection is multi-layered and corresponds to the qualitative-descriptive nature of the study. First, the researcher undertakes a systematic review of relevant scholarly works to establish a basic understanding of existing practices and gaps in maritime education. The literature is selected according to specific inclusion criteria: (1) peer-reviewed journal articles, conference proceedings, and reports published in the last ten years; (2) studies that address maritime education, sustainability integration, and maritime literacy; and (3) research that utilizes qualitative or quantitative methodologies within maritime-related fields. The literature review process involves extracting key information on theoretical frameworks, research methodologies, key findings and best practices in the field of sustainability education. This synthesis forms the basis for the conceptual framework and research design of the study. Subsequently, cadets are then involved in the research process through survey instruments and open-ended interviews (Creswell & Clark, 2011; Lo Iacono et al., 2016). The surveys are designed to collect quantitative data, while the interviews provide a qualitative dimension that allows participants to express their experiences, perceptions and expectations regarding maritime education and the integration of sustainability. To ensure the validity of the data, a triangulation approach is adopted from (Smith & Shaw, 2019; Willig, 2014). This involves cross-referencing information obtained from literature reviews, surveys and interviews in order to increase the credibility and reliability of the findings. Completing questionnaires as part of data collection requires a careful approach by the researcher to ensure that participants comprehend the questions and provide thoughtful responses that align with the research objectives.

Data Analysis: Data analysis is a systematic and iterative process in qualitative research. The collected data, both quantitative and qualitative, are subjected to thematic analysis. Themes emerge through the identification of patterns, recurring ideas and key concepts within the data. The analysis is conducted recursively so that themes can be continuously refined as the research progresses (Sjunnesson, 2022). The triangulated data from literature reviews, surveys and interviews are brought together to create a comprehensive narrative. The qualitative insights gained from the interviews add depth and context to the quantitative data obtained through the surveys. The analysis is not limited to statistical metrics, but incorporates the richness of participants' narratives to provide a holistic understanding of the current state of maritime education and the prospects for sustainability integration. The research methodology chosen for this study is tailored to the complex and multifaceted nature of researching maritime literacy and sustainable education. The qualitative descriptive approach combined with a diversified participant pool, comprehensive data collection methods and rigorous analysis enables this study to make a meaningful contribution to the field of maritime education and sustainability.

4. FINDINGS

The study included 70 cadets in their Second Semester, randomly selected across Nautical, Technical, and Port and Shipping Management majors. Table 1 illustrates the distribution of participants.

Major	Second Semester Cadets
Nautical Major	23
Technical Major	24
Port and Shipping Management	23
Total	70

Table 1: Distribution of Participants by Major and Semester

Perspectives	Nautical Major (%)	Technical Major (%)	Port and Shipping Management (%)
Strongly Agree	30	25	20
Agree	35	40	30
Neutral	15	10	15
Disagree	10	15	20
Strongly Disagree	10	10	15

Table 2: Overview of Participants' Perspectives on Maritime Literacy

Table 2 provides an overview of the participants' views on maritime literacy in the different majors, based on the survey responses: Maritime literacy is essential for professional competence in the maritime industry. Participants rated their

agreement on a Likert scale (Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree). The findings show that the level of agreement varies across disciplines, indicating a wide range of views on maritime literacy. The results show that 65% of cadets in the nautical major selected "strongly agree" or "agree", indicating that this group is more aware of the importance of maritime competency. In contrast, responses were more varied in the engineering and port and shipping management majors, with a greater proportion of participants selecting "Neutral" or "Disagree" compared to the nautical cadets. This variance illustrates the different engagement with concepts of maritime literacy, which may be influenced by the specific focus of each discipline. By including a Likert scale analysis and detailing the specific survey question, this revision clarifies how the table represents the level of agreement and varying perceptions of participants.

Perspectives	Nautical Major (%)	Technical Major (%)	Port and Shipping Management (%)
Highly Feasible	20	15	10
Feasible	30	25	20
Neutral	20	20	25
Infeasible	15	20	25
Highly Infeasible	15	20	20

Table 3: Cadets' Perceptions of Sustainable Infrastructure Integration

Table 3 shows how the cadets assess the feasibility of integrating sustainable infrastructure into maritime training. The data indicate varying degrees of optimism regarding the feasibility of integrating sustainable infrastructure. It is noteworthy that 50% of nautical majors find it feasible, while engineering majors exhibit a balanced distribution between feasible, neutral and not feasible. The port and Shipping Management majors present a more sceptical outlook, with a significant proportion considering it unfeasible.

Analysis of the findings: he disparities in perspectives among majors underscore the need for a tailored approach to integrating sustainability into maritime education. Nautical majors, which may be more confronted with ecological aspects, show a higher level of awareness and receptivity. In contrast, engineering and port and shipping management majors may need targeted measures to bridge the awareness gap and promote a more coherent understanding of sustainability principles. These findings highlight the importance of a differentiated and major-specific approach to curriculum development. Tailoring educational strategies to address the unique needs and perspectives within each major is crucial for the specific needs and perspectives of individual degree programs. The findings provide a comprehensive insight into cadets' perspectives on maritime literacy and the feasibility of integrating sustainable infrastructures. The major-specific differences underscore the importance of taking a nuanced approach to shaping the future maritime education landscape, ensuring that the principles of sustainability are seamlessly woven into the structure of each degree major.

Familiarity Level	Nautical Major (%)	Technical Major (%)	Port and Shipping Management (%)
Very Familiar	15	10	5
Somewhat Familiar	35	30	20
Neutral	20	15	20
Somewhat Unfamiliar	15	20	30
Very Unfamiliar	15	25	25

Table 4: Cadets' Familiarity with Sustainable Infrastructure Concepts

Table 4 presents cadets' self-reported familiarity with five key sustainable infrastructure concepts in the maritime sector:

A. Energy Efficiency in Maritime Operations
B. Renewable Energy in Maritime Applications
C. Green Ship Technology
D. Sustainable Port Management
E. Climate Adaptation Strategies

Participants rated their familiarity on a Likert scale (Very Familiar, Somewhat Familiar, Neutral, Somewhat Unfamiliar, Very Unfamiliar). The results indicate that a significant proportion of Nautical and Technical majors consider

themselves somewhat or very familiar with sustainable infrastructure concepts, particularly in areas related to energy efficiency and green ship technology. In contrast, Port and Shipping Management majors report higher levels of unfamiliarity, especially regarding renewable energy applications and climate adaptation strategies.

Table 5 delineates cadets' exposure to environmental education, which in this study refers to the integration of sustainability principles, ecological awareness, and environmental regulations within maritime-related coursework. Key topics include marine pollution prevention, sustainable shipping practices, energy efficiency, and international maritime environmental regulations (e.g., MARPOL).

Exposure Level	Nautical Major (%)	Technical Major (%)	Port and Shipping Management (%)
Extensive Exposure	25	20	15
Moderate Exposure	35	30	25
Limited Exposure	20	20	25
Minimal Exposure	10	20	25
No Exposure	10	10	10

Table 5: Cadets' Exposure to Environmental Education in Previous Courses

Cadets responded to the survey question: "To what extent have your previous courses included topics related to environmental education, sustainability, or ecological impact in maritime operations?"

Responses were recorded using a Likert scale (Extensive Exposure, Moderate Exposure, Limited Exposure, No Exposure).

The findings reveal that a majority of cadets across all majors report at least moderate exposure to environmental education in their previous courses. Nautical majors exhibit a higher percentage of extensive exposure, likely due to their curriculum's emphasis on environmental compliance and operational sustainability. In contrast, Technical and Port and Shipping Management majors report more limited exposure, possibly reflecting curriculum differences in these disciplines.

Perception Level	Nautical Major (%)	Technical Major (%)	Port and Shipping Management (%)
Strongly Supportive	25	20	15
Supportive	35	30	25
Neutral	20	20	25
Opposed	10	15	20
Strongly Opposed	10	15	15

Table 6: Cadets' Perception of the Integration of Sustainability in Current Maritime Curriculum

Table 6 outlines cadets' level of agreement regarding the extent to which sustainability principles are integrated into the current maritime curriculum. This data is based on responses to the statement: "The current maritime curriculum adequately integrates sustainability principles into its courses." Participants rated their agreement using a Likert scale (Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree). The findings indicate a general inclination towards agreement across all majors, with Nautical majors exhibiting a higher percentage of strong support for sustainability integration. In contrast, Port and Shipping Management majors tend towards neutrality or mild disagreement, suggesting a perceived gap in sustainability coverage within their curriculum.

The findings in Tables 4, 5 and 6 highlight several critical aspects of the cadets' perspectives on sustainability and environmental education. Self-reported familiarity with sustainable infrastructure concepts indicates that a significant number of cadets, particularly in the Port and Maritime Management major, feel somewhat or very unfamiliar with these concepts. This indicates a possible gap in basic knowledge that needs to be addressed for effective integration. Exposure to environmental education in previous courses is promising, with the majority stating that they had at least moderate exposure to it. However, the differences between majors show that targeted measures are needed to ensure a consistent baseline of environmental knowledge. Nautical majors who focus more intensely on environmental issues can serve as mentors or resources for their fellow engineering and port and marine management majors.

Cadets' perceptions of the integration of sustainability into the current maritime curriculum reflect a generally positive outlook. However, the differences suggest that it is crucial to tailor the approach to each major is crucial. Nautical degree programmes show stronger support, perhaps due to their greater experience and familiarity. The slight rejection in port and shipping management courses could be due to perceived challenges or uncertainties regarding the practical feasibility of integrating sustainability in their specific field. The differentiated findings underline the importance of targeted measures to promote cadets' understanding of sustainable infrastructure and environmental concepts. The differences between fields of study highlight the need for a tailored curriculum that takes into account the particular needs and perspectives of each field of study to ensure a coherent and effective integration of sustainability principles into maritime education. This analysis serves as a basis for future educational strategies and provides a roadmap for nurturing a generation of maritime professionals who not only have technical skills, but are also able to manage the complexities of sustainability in their respective fields.

5. DISCUSSION

The study conducted at the Maritime Institute Jakarta examined maritime literacy and the integration of sustainability in education through structured surveys, interviews, Likert scale analysis and curriculum content review. A diverse sample of 70 cadets from the nautical, engineering and port and shipping management majors took part in the study. The findings show that the cadets differ in their assessment of the importance of maritime literacy, the feasibility of integrating sustainable infrastructures and their familiarity with relevant concepts. These insights were obtained from cadets' responses to structured surveys that asked about their understanding of maritime literacy, their exposure to sustainability-related courses, and their opinions on integrating sustainability into maritime education. In addition, a comparative analysis between fields of study reveals disciplinary differences in cadets' familiarity with sustainability principles and their level of agreement with the role of sustainability in maritime education. These findings provide empirical evidence of how maritime literacy and the integration of sustainability in maritime education are perceived and managed, contributing valuable insights into the ongoing development of sustainable maritime training.

5.1. Findings in Relation to Literature Review

The findings are consistent with the existing literature on the need for a paradigm shift in maritime education towards sustainability. The cadets' views on maritime literacy are consistent with the call for professionals who not only have technical expertise but also a profound understanding of the environmental impact of their decisions. The varying levels of support for integrating sustainability into the curriculum reflect the literature's emphasis on tailoring approaches to different majors. Nautical majors, who have more experience and familiarity with the topic, are more supportive of integration, while port and maritime management majors in particular encounter difficulties. This is consistent with previous studies that emphasize the importance of contextual strategies in interdisciplinary education. The data on cadets' familiarity with sustainable infrastructure concepts adds to the literature on the need for foundational knowledge (Abila, 2016; Kompan & Hrnčiar, 2021). Self-reported unfamiliarity, particularly among port and shipping management students, reflects the literature's emphasis on filling knowledge gaps for effective integration. Exposure to environmental topics in previous courses is consistent with the literature emphasizing the positive impact of prior knowledge on receptivity to sustainability concepts. However, the disparities among majors emphasize the need for targeted interventions, which is consistent with the literature's call for differentiated educational strategies.

The findings indicate that the majority of nautical science students have a strong awareness of the importance of maritime literacy, while engineering and port and marine management students have more diverse perspectives. These differences can be attributed to the traditional focus on technical skills in maritime education, emphasizing the need for a comprehensive paradigm shift that addresses the unique needs of each degree major (Nalupa, 2022). The differences highlight the potential challenges in promoting a unified approach to sustainability across different educational sectors. The data also indicates that a significant number of cadets, particularly in the Port and Maritime Management program, feel little or no familiarity with concepts of sustainable infrastructure (Munim et al., 2020; Plaza-Hernández et al., 2021). This finding underlines the importance of basic knowledge and suggests that targeted educational measures are essential to bridge the existing gaps. The literature supports this notion and emphasizes the importance of a solid understanding of sustainable practices for effective integration into the professional world, and The positive outlook for the integration of sustainability into the current maritime curriculum is encouraging. However, the slight rejection seen particularly in port and shipping management courses should be carefully considered. This rejection could be due to practical problems or uncertainties regarding the applicability of sustainability principles in their field. Addressing these concerns is critical to promoting a consistent commitment to sustainability across all majors. Exposure to environmental education in previous courses is generally positive, with the majority stating that they had at least moderate exposure to it. However, the differences between majors suggest that those nautical studies majors that have had more intensive exposure to the topic could serve as valuable

resources for knowledge transfer within the academic community. This approach to collegial learning is consistent with the literature's focus on collaborative educational strategies.

5.2. Implications

The findings of this study have several implications for future research and educational practice. First, future research should examine in more detail the factors influencing the varying perspectives of subjects and address potential barriers to the integration of sustainability. In addition, longitudinal studies could examine the long-term impact of sustainability-focused education on the professional practices and decision-making of maritime graduates. The research findings underscore the need for targeted interventions to close knowledge gaps and promote a unified commitment to sustainability. Curriculum developers should consider major-specific approaches by incorporating foundational modules to enhance understanding and real-world case studies to contextualize sustainability principles (Bee, 2017). In addition, collaborative initiatives between nautical students and their peers could facilitate knowledge sharing and contribute to a more coherent educational landscape. Research at the Maritime Institute Jakarta has provided valuable insights into maritime literacy and the integration of sustainability into education. The different perspectives of the cadets underline the need for a differentiated and tailored approach in redesigning maritime education. The findings are consistent with the call in the literature for a paradigm shift that emphasizes the importance of foundational knowledge and contextual strategies. The research serves as a foundation for future studies and informs educational practices aimed at developing a generation of maritime professionals who not only have technical skills but are also able to manage the complexities of sustainability in their respective fields. Here are some implications that could be used to underpin the research findings:

Tailor-made educational strategies: The different perspectives of nautical, engineering, port and marine management students highlight the need for tailored educational strategies. Curriculum developers should consider the unique needs and challenges of each major and ensure that foundational knowledge and sustainability principles are seamlessly integrated. This approach is consistent with the broader literature that emphasises the importance of contextualised education.

Addressing knowledge gaps: Students' self-reported lack of familiarity with sustainable infrastructure concepts, particularly in the Port and Shipping Management majors, indicates that there is an urgent need to address knowledge gaps. Targeted educational efforts that focus on building a solid understanding of sustainability practises are imperative. This includes revising the curriculum to include foundational concepts and case studies relevant to each degree major.

Collaborative learning opportunities: Leveraging the positive experiences with environmental education in previous courses, opportunities for collaborative learning should be encouraged. Initiatives to facilitate the transfer of knowledge from nautical students who already have a great deal of experience to their fellow students on engineering and port and marine management courses can bridge gaps and create a more cohesive learning environment.

Practical application of sustainability: The slight rejection seen particularly in port and shipping management courses suggests that there is a need for practical application and real-world relevance of sustainability principles in this area. The integration of case studies, industry partnerships and practical experience into the curriculum can address these concerns and illustrate the tangible impact of sustainability in the maritime sector.

Longitudinal studies: The positive outlook on the integration of sustainability into the current maritime curriculum calls for future longitudinal studies. Assessing the long-term impact of sustainability-focused education on graduates' professional practise and decision-making is essential. Such studies can provide insight into the lasting effectiveness of educational interventions and identify areas for continuous improvement.

6. CONCLUSION

The study conducted at the Maritime Institute Jakarta provided a comprehensive examination of maritime literacy and the integration of sustainability principles in education. The study, which involved 70 cadets from the nautical, engineering and port and marine management programmes, provided valuable insights into the different perspectives and levels of awareness within the academic community. The findings underline the need for a paradigm shift in maritime education, emphasising not only technical skills but also a profound understanding of the environmental impact of decisions in the industry. The different perspectives of the individual majors highlight the importance of tailored educational strategies that take into account the specific needs and challenges of each discipline. Addressing knowledge gaps, fostering collaborative learning opportunities and promoting practical applications of sustainability principles are proving to be critical components for the future of maritime education. The positive outlook for the integration of sustainability is encouraging, but the slight rejection that was observed emphasises the need for differentiated approaches and relevance to the real world. The implications and recommendations derived from the research offer actionable insights for education stakeholders, policy

makers and practitioners in the maritime industry. Improving curricula, fostering interdisciplinary collaboration and promoting partnerships with industry are key recommendations that are consistent with the wider literature and aim to empower future maritime professionals. As the maritime sector moves towards a more sustainable future, the findings of this research contribute to the ongoing dialogue on reshaping maritime education. By incorporating the nuanced perspectives of cadets and taking targeted action, educational institutions can play a critical role in training professionals capable of managing the complex interplay between maritime activities and environmental wellbeing. This research serves as a foundational step in fostering a generation of maritime professionals who not only navigate the seas competently, but also embrace sustainability as an integral part of their professional ethos.

ACKNOWLEDGMENTS

The first author would like to thank the Indonesian Education Fund Management Institute (LPDP) and the Education Service Centre (Puslapdik) under the Ministry of Education, Culture, Study, and Technology (Kemendikbudristek) for allowing him to pursue doctoral studies in State University of Jakarta (UNJ) as well as the publication fund through the Indonesia Education Scholarship (BPI) of Kemendikbudristek, with the LPDP fund.

CONFLICT OF INTEREST

The authors declared no potential conflicts of interest with respect to the research, authorship and publication of this article.

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