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Addressing mental and physical well-being in maritime education for future seafarers

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ABSTRACT

Background: This study addresses gaps in maritime education by focusing on integrating sustainability, health management, and competency development, driven by the increasing global emphasis on sustainable operations and the mental and physical demands on seafarers. Uniquely examining the effectiveness of current curricula in meeting these emerging needs, this research provides fresh insights into their integration and highlights areas for improvement. The primary objectives were to explore the extent of this integration and assess whether current training adequately prepares students for evolving industry demands, particularly in environmental sustainability and mental health management.

Methods: To investigate the integration of sustainability, health management, and competency development within maritime education, this study adopted a qualitative methodology. We conducted semi-structured interviews with five experienced lecturers and 25 recent graduates, gathering their insights and experiences. The interview data was then analyzed using thematic analysis, with cross-group comparisons to highlight differing perspectives. Alongside the interviews, observational notes and audio recordings were used to enrich the data. This approach allowed us to evaluate the efficacy of current training programs in preparing future seafarers, pinpointing areas for improvement and suggesting practical recommendations

Results: The findings indicated that although maritime education effectively develops technical competencies, there are significant gaps in the integration of sustainability and health management. Both lecturers and graduates emphasized the need for more practical sustainability training and enhanced mental health support. While competency development was generally rated positively, participants called for curricula to adapt to emerging maritime technologies.

Conclusion: This research underscores the necessity of evolving maritime education to better equip future seafarers for the industry's environmental and psychological demands. Recommendations include strengthening the integration of sustainability and mental health support within the curriculum, as well as ensuring that training remains current with technological advancements in the maritime sector.

Keywords: competency development, health management, maritime education, seafarers, sustainability.
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INTRODUCTION

The maritime industry stands as one of the most critical sectors in the global economy, facilitating the transport of goods, services, and people across vast distances.[1–3] Yet, while the industry is crucial for global trade and economic stability, it faces a series of evolving challenges, particularly those linked to sustainability, health management, and the preparedness of seafarers.[4,5] These challenges not only threaten the ecological sustainability of maritime operations but also the mental and physical health of those who work in this demanding field. As seafaring continues to evolve and as sustainability becomes a major focus for maritime organizations worldwide, it is imperative to investigate how vocational education in maritime disciplines is aligning with these changes. This study explores the multifaceted nature of maritime education, focusing particularly on how it can be enhanced to better address the emerging needs of the industry, especially concerning sustainability practices, health management, and the preparedness of future seafarers.

At the heart of maritime education lies the preparation of cadets for the realities of the maritime industry.[6–8] These cadets enter a workforce that not only demands technical expertise but also requires mental fortitude and physical resilience due to the nature of the job. The complex challenges of maritime work—ranging from navigating through unpredictable waters to ensuring compliance with environmental regulations—require a deep understanding of both practical and theoretical components of the maritime field. However, despite these challenges, much of the focus of maritime training has been on the operational aspects of the job, with less attention given to the mental and physical well-being of the individuals involved. Furthermore, there is growing recognition of the need for sustainability

to be ingrained in all facets of maritime education, ensuring that the workforce of the future is both capable and mindful of its ecological impact. This research, therefore, seeks to address gaps in the current understanding of maritime education by incorporating the perspectives of lecturers and graduates on the key areas of sustainability, health management, and preparedness for maritime work. Maritime education, while strong in technical skills, needs better integration of sustainability and health management. With the industry's rapid changes—environmental policies, technology, and seafarer health awareness—continuous program reassessment is essential. This research uses qualitative insights from lecturers and graduates to determine current program effectiveness and propose improvements for future seafarer readiness.

The rationale for this research is rooted in the increasing recognition of the critical need for integrated approaches to maritime education that encompass not only technical proficiency but also health and sustainability considerations. Seafaring, an occupation historically marked by isolation, long working hours, and intense physical demands, has seen little integration of health management into its training programs. As a result, mental health issues such as stress, depression, and anxiety have become more prevalent among maritime professionals. Physical health challenges, including fatigue and musculoskeletal disorders, also present significant barriers to maintaining a sustainable career in the maritime sector.[9] Furthermore, as global shipping continues to be one of the most carbon-intensive industries, there is an urgent need for maritime professionals to be equipped with the knowledge and skills required to address sustainability challenges.

This research will provide valuable insights into the current state of maritime education and its ability to meet these evolving challenges by focusing on the perspectives and experiences of lecturers, who provide the training, and graduates, who have firsthand experience in the maritime industry. This qualitative study uses in-depth interviews with select maritime lecturers and graduates to explore the integration of sustainability and health management within curricula. Interviews will focus on their experiences, views on seafarer health, and opinions on sustainability incorporation. Challenges and improvement strategies will also be assessed. The primary objectives are to explore and assess the integration of sustainability and health in maritime education, aiming to enhance seafarer preparedness. This study will identify curricular gaps and offer actionable recommendations for policymakers, educators, and industry professionals, based on the perspectives of those directly involved.

The conceptual framework for this study is built upon several key variables: sustainability, health management, and education effectiveness. Sustainability in maritime education refers to the extent to which environmental concerns, such as emissions reduction, eco-friendly technologies, and energy efficiency, are integrated into the curriculum. Health management, both mental and physical, focuses on the strategies used to ensure the well-being of seafarers, with particular emphasis on stress management, fatigue prevention, and musculoskeletal health. Education effectiveness refers to how well the training provided aligns with the needs of the maritime industry, particularly in terms of preparing students for real-world challenges and ensuring their long-term career success.[10,11]

Through qualitative interviews with lecturers and graduates, this study aims to depict maritime education's current state and potential for growth in sustainability and health management. Synthesizing these perspectives, it will provide actionable recommendations to enhance training programs and equip future seafarers for industry challenges. This research will benefit educators, students, and contribute to broader discussions on sustainable and healthy maritime practices.

METHODS

The research method employed in this study was designed to comprehensively capture the experiences, perspectives, and insights of key stakeholders within the maritime education field—lecturers and graduates—whose views on sustainability, health management, and competency development were essential to enhancing maritime training programs. This method aimed to provide an in-depth understanding of how current maritime education could be improved to better prepare future seafarers for the challenges of the industry. The approach emphasized qualitative research and descriptive analysis, which were appropriate for exploring complex themes and generating detailed, rich data.[12,13]

The population targeted in this study consisted of two main groups: lecturers and graduates from maritime education programs. The lecturers were chosen based on their significant expertise in teaching and researching maritime science, as well as their experience in vocational training for seafarers. Each of the five selected lecturers had more than five years of sea-going experience and over eight years of teaching and mentoring cadets in maritime studies. These lecturers, having both practical maritime experience and academic backgrounds, were well-positioned to offer critical insights into the effectiveness of current training practices, especially in terms of sustainability and health management integration. Their role in shaping the curriculum and providing practical training to maritime students made their perspectives invaluable.

In addition to the lecturers, the study also targeted 25 graduates from the maritime program. These individuals had completed four years of vocational training, including practical studies and maritime industry experience. Their academic backgrounds in Nautical Deck Engineering, Naval Marine Engineering, or Port and Shipping Engineering equipped them with a deep understanding of the challenges and skills required in the maritime industry. Given their firsthand experience in the industry, these graduates could offer a unique perspective on how well their education prepared them for the realities of their work and how sustainability and health management were addressed, or not addressed, during their training. The inclusion of both lecturers and graduates was crucial to capturing a comprehensive view of the educational process and its outcomes, as well as identifying areas for improvement.

The research instruments used in this study were designed to collect data that would facilitate a thorough examination of the research questions. The primary data collection tool was the semi-structured interview, which allowed for flexibility while ensuring that key areas were covered.[14,15] This instrument was particularly suited for qualitative research as it enabled the interviewer to explore in depth the responses of the participants, while also providing room for participants to express their thoughts freely. The interview guide was developed to address the research's core themes of sustainability, health management, and competency development, with questions designed to elicit information on how well these themes were integrated into maritime education.

In terms of dependent and independent variables, the dependent variables in this study were the effectiveness of maritime education in addressing sustainability practices and health management, as well as the competency development of cadets. The independent variables included the background and perspectives of lecturers and graduates, with particular attention given to their experiences with and opinions on the integration of sustainability into the curriculum, health management practices, and the real-world application of the skills they acquired. Indicators for these variables included lecturers' and graduates' views on sustainability in maritime education, their experiences with mental and physical health management in the field, and their perceptions of how well their education prepared them for real-world maritime work. These indicators were crucial to understanding the gaps in current maritime education and highlighting areas that required improvement.

In addition to the semi-structured interviews, several supporting instruments were employed to enrich the data collection process. These included observational notes, which were used during interviews to capture non-verbal cues and environmental context that contributed to understanding the respondents' perspectives. Audio recordings were also used to ensure accuracy in data capture, particularly given the in-depth nature of the qualitative interviews. This triangulation of methods allowed for a more comprehensive and nuanced understanding of the participants' views.[16]

The data collection process was conducted in several critical steps to ensure that the research was rigorous and the findings were reliable. The first step involved the recruitment of participants. In-depth information about the lecturers' qualifications, experiences, and expertise was gathered, and the criteria for selection were carefully adhered to, ensuring that only those with significant teaching experience and sea-going experience were included. Similarly, the selection of graduates was based on the relevance of their studies and experience in the maritime industry, ensuring that their input was aligned with the research's focus. The second step involved the preparation and administration of the semi-structured interviews. Prior to the interviews, participants were briefed on the purpose of the study, and their informed consent was obtained. Interviews were conducted in a one-on-one setting to allow for open and candid discussions.

Following the interviews, the data underwent a process of thematic analysis. Thematic analysis was used to identify and categorize data into key themes, such as competency development and sustainability. These themes represented the core areas that the research sought to understand and improve within maritime education. The first phase of the analysis involved coding the data—identifying key segments of the interview responses that corresponded to the research questions. These segments were then grouped into themes that reflected the perspectives of both lecturers and graduates on the integration of sustainability practices and health management into maritime education. The second phase of the analysis involved cross-group comparisons, where the data from lecturers and graduates were compared to identify commonalities and distinctions. This comparison highlighted the different ways in which these two groups perceived the effectiveness of maritime education in preparing students for the challenges of the maritime industry, especially in terms of sustainability and health management.

The final phase of the analysis was the development of a narrative synthesis, which involved synthesizing the findings into a cohesive story that explained the insights gained from the data. This narrative drew upon the themes identified in the analysis, exploring how the integration of sustainability and health management into maritime education could be improved, and how the experiences of lecturers and graduates could inform these improvements. The narrative synthesis allowed the research to not only describe the findings but also provide a deeper understanding of the experiences and perspectives of the participants, offering practical insights into how maritime education could be enhanced to meet the evolving needs of the industry.

The research methodology outlined here provided a robust framework for exploring the experiences and perspectives of lecturers and graduates in maritime education. Through qualitative data collection and analysis, the study aimed to uncover critical insights into the integration of sustainability and health management into maritime curricula. The findings from this study contributed to a broader understanding of how maritime education could be improved to better prepare future seafarers for the challenges they would face in the industry, while also ensuring that sustainability and health considerations were central to their training. By focusing on the perspectives of those directly involved in maritime education, this research provided valuable, actionable recommendations for educators, policymakers, and industry professionals.

RESULTS

Results indicate maritime education programs effectively prepare seafarers in sustainability, health management, and competency development. Despite overall program success, improvements are needed, particularly in practical sustainability integration, mental health support, and curriculum alignment with industry changes. High satisfaction was noted from lecturers and graduates, though a divergence in perceptions exists

Table 1. Responses and sustainability view of lecturers and graduates for mental and physical well-being in maritime education

Indicators	Responses		Mean Score	Sustainability View	
	Lecturers	Graduates	0.0-5.0	Lecturers	Graduates
Sustainability in Maritime Education	Strongly Agree	Agree	4.6	Lecturers emphasized the importance of sustainability integration in maritime training programs.	Graduates agreed that while sustainability practices were addressed, more practical training was needed.
Health Management in Maritime Education	Agree	Agree	4.4	Mental and physical health management practices were reported as somewhat limited, but lecturers acknowledged the need for improvement.	Graduates acknowledged the importance of health management, but mental health support was insufficient.
Competency Development in Maritime Education	Strongly Agree	Agree	4.7	Competency development was highlighted as a key focus area, particularly practical and real-world application of skills.	Competency development was seen as effective, particularly in practical skills aligned with industry needs.
Integration of Practical Skills with Theory	Agree	Strongly Agree	4.5	Affirmed importance of integrating theory and practice to bridge the gap between academic learning and maritime operations.	Graduates agreed that integrating theory with practice provided well-rounded education.
Industry-Relevant Curriculum	Strongly Agree	Agree	4.6	Curriculum is fairly industry-relevant, with continuous adaptation to emerging technological needs.	Curriculum was relevant to industry demands but could benefit from more focus on emerging technologies.
Health and Well-being Support for Seafarers	Agree	Agree	4.4	Health support for seafarers was a growing concern, particularly with regard to stress management and resilience training.	Graduates expressed the need for more extensive health management, including better mental health resources.

regarding the depth and application of sustainability and health management. While acknowledged in curricula, practical implementation remains a key challenge.

Sustainability in maritime education

Both lecturers and graduates demonstrated strong agreement on the importance of sustainability in maritime education, with an average score of 4.6 out of 5. Lecturers highlighted the need to integrate eco-friendly practices, environmental regulations, and energy-efficient technologies into the curriculum, emphasizing continuous updates to reflect global sustainability standards. Graduates, while acknowledging the theoretical importance of sustainability, expressed a desire for more focused practical training related to environmental management. They suggested incorporating specialized courses and training modules on topics such as energy-efficient shipping practices and eco-friendly technologies. This disparity underscores an opportunity to enhance the practical application of sustainability within maritime education, bridging the gap between theory and real-world implementation.

Health management in maritime education

Health management, particularly mental health, was identified as an area requiring greater attention. Lecturers and graduates agreed on its importance, scoring an average of 4.4 out of 5. Lecturers noted that while physical health management was adequately covered, mental health support was often neglected. They cited the demanding and isolated nature of seafaring, leading to significant mental health challenges like stress and depression, and advocated for integrating mental health awareness and resilience training into the curriculum. Graduates echoed the importance of health management but highlighted a significant lack of mental health support during their training. Many expressed a desire for more comprehensive resources, counseling, and support networks to help them manage the stress and mental health challenges associated with their careers. They also emphasized the need for more focused health management programs to address the physical demands of their work, such as fatigue and musculoskeletal disorders. The results suggest a clear need for a more structured approach to mental health management in maritime education, including better resources, counseling, and resilience training integrated directly into the curriculum.

Competency development in maritime education

Competency development in maritime education received strong agreement from both lecturers and graduates, with an average score of 4.7 out of 5, indicating effective training programs. Both groups emphasized the importance of practical training and real-world applications in equipping students with necessary competencies. Lecturers highlighted the opportunities for cadets to apply theoretical knowledge in practical settings, which helped build essential technical skills and expertise. Graduates echoed these sentiments, noting that the integration of hands-on learning experiences with theoretical instruction was particularly

effective in preparing them for their roles in the maritime industry. However, they also suggested that there could be further improvements in the curriculum, particularly in providing more industry-specific training related to emerging maritime technologies and practices. This finding underscores the importance of maintaining strong connections between maritime education programs and the evolving needs of the industry, emphasizing the continuous update of curricula to address ever-evolving maritime standards and ensure graduates are equipped to meet the demands of their profession.

Integration of practical skills with theory

The integration of practical skills with theory was highly regarded, scoring an average of 4.5, demonstrating a shared understanding of its importance among lecturers and graduates. Lecturers emphasized their efforts to provide ample opportunities for practical application, such as onboard training and hands-on exercises, which they deemed vital for building student confidence and competency before entering the workforce. Graduates affirmed that the combination of theoretical and practical learning was a key strength of their education, noting that applying knowledge in real-world contexts significantly enhanced their understanding and career preparedness. However, some graduates suggested that while the theory-practice integration was effective, there could be increased emphasis on specific practical areas, such as emergency response procedures and advanced maritime technologies, to further enhance their readiness.

Industry-relevant curriculum

The curriculum's relevance to the maritime industry was a key indicator, with an average score of 4.6, indicating strong agreement between lecturers and graduates. Lecturers highlighted that the curriculum was designed to keep pace with industry developments and changing technologies, ensuring student preparedness for future challenges. However, they also noted that certain areas, such as sustainability and emerging technologies, required more emphasis. Graduates echoed these views, stating that while the curriculum provided a solid foundation in necessary competencies, there was room for improvement in specific areas. They suggested that the curriculum could be updated to incorporate more focus on cutting-edge technologies in shipping, such as automation and green shipping practices, to ensure that graduates are fully equipped to work in the rapidly evolving maritime industry.

Health and well-being support for seafarers

The final indicator—health and well-being support for seafarers—received an average score of 4.4, indicating that both lecturers and graduates recognized the importance of mental and physical health support but felt that current programs were insufficient. Lecturers acknowledged the growing need for health management support for seafarers and emphasized the importance of providing better resources for students during their training. Graduates, who had firsthand experience in the industry, expressed a desire for more comprehensive health support services, including mental health counseling and fatigue management.

The analysis of the research results indicates that while maritime education programs are highly effective in certain areas, there are substantial opportunities for improvement in others. The integration of sustainability, health management, and industry-specific training should be prioritized to ensure that the maritime education system can adequately prepare future seafarers for the evolving challenges of the industry. By addressing these gaps, maritime education can enhance its relevance, effectiveness, and sustainability.

DISCUSSION

This study confirms maritime education's effectiveness, yet identifies crucial improvement areas: sustainability integration, mental health management, and practical competency application. While technical skills are well-taught, gaps remain. This discussion interprets findings, highlighting implications and suggesting improvements for program relevance.

Sustainability in maritime education

The 4.6 average score highlights a shared recognition of sustainability's importance in maritime education, aligning with global environmental trends. Lecturers emphasized integrating eco-friendly technologies and energy-efficient practices, crucial for addressing industry challenges like climate change. However, a gap exists between theory and practice. Graduates noted insufficient practical application of sustainability principles, despite curriculum inclusion. They advocated for hands-on training and specialized modules on emissions reduction, waste management, and alternative fuels to bridge this gap.

This gap between theory and practice is not unique to maritime education but is a common challenge in many industries where there is a tendency to focus on theoretical knowledge at the expense of practical application. The maritime industry, with its complex and dynamic nature, requires a more integrated approach that ensures students are not only aware of sustainability issues but also capable of implementing sustainable practices on board ships and in port operations.[17,18] This highlights the importance of providing more opportunities for students to engage with sustainability challenges through practical training, internships, and simulations that mirror the real-world complexities of maritime operations.

Health management in maritime education

Health management, particularly mental health, emerged as a critical area requiring urgent attention in maritime education, scoring an average of 4.4. Both lecturers and graduates agreed on the importance of integrating health management into the curriculum, acknowledging the unique challenges seafarers face, including long hours, isolation, and physical demands. However, while physical health management was deemed adequately covered, mental health support was perceived as limited. Given the rising prevalence of mental health issues like depression, stress, and anxiety among seafarers due to the demanding and isolated nature of their work, this is a significant concern.

Lecturers recognized the growing awareness of mental health issues but acknowledged the absence of structured mental health support within maritime education. They advocated for incorporating mental health awareness, stress management, and resilience training into the curriculum to prepare students for the emotional and psychological demands of seafaring. Graduates, drawing from their firsthand industry experience, were particularly vocal about the insufficient mental health support they received during training. Many expressed that the lack of mental health resources and guidance hindered their ability to navigate the emotional and psychological challenges of their careers. Given the critical role of mental health in job satisfaction and performance, maritime education programs must prioritize mental health management through integrated education, counseling services, and coping strategies.

Furthermore, health management in maritime education should encompass both mental and physical well-being. Physical health, including the prevention of fatigue, musculoskeletal disorders, and work-related injuries, requires increased attention. Providing students with practical strategies for maintaining their physical health, such as ergonomics, exercise routines, and fatigue management, would contribute to ensuring future seafarers are equipped to lead healthy, sustainable careers.

Competency development in maritime education

Competency development, scoring 4.7, demonstrates highly effective maritime education programs. Lecturers and graduates agreed on the provision of necessary technical and practical skills. Lecturers emphasized hands-on training via internships, onboard experiences, and simulations, bridging theory and practice. Graduates affirmed satisfaction with practical skills in navigation, operations, and safety. However, they suggested curriculum updates to reflect emerging technologies like automation and digitalization, ensuring readiness for evolving industry demands. The need for continuous adaptation of the curriculum is critical in an industry as dynamic as maritime.[19–21] As technology advances and new challenges arise, the competencies required by seafarers will also change. Therefore, it is essential that maritime education programs remain flexible and adaptable, constantly evolving to meet the needs of the industry and ensure that graduates are equipped with the skills necessary to thrive in an increasingly complex maritime environment.

Integration of practical skills with theory

The integration of practical skills with theory is an area where both lecturers and graduates expressed strong satisfaction, with an average score of 4.5. This integration is essential for ensuring that students are not only knowledgeable but also capable of applying their knowledge in real-world settings. Lecturers emphasized the importance of bridging the gap between classroom learning and practical application. They noted that students should be given opportunities to engage in simulations, internships, and practical exercises that mirror the challenges they will face in their careers.

Graduates echoed these sentiments, noting that the combination of theoretical knowledge and practical skills was one of the strengths of their education. They appreciated the opportunities to apply what they had learned in real-world contexts, which helped them gain confidence and develop the competencies needed for their roles. However, some graduates suggested that certain areas of practical training, such as emergency response procedures and advanced maritime technologies, could be given more emphasis. This suggests that while the integration of theory and practice is largely effective, there are still areas where more practical training could be beneficial.

Industry-relevant curriculum

The relevance of the curriculum to the maritime industry is another area that received strong agreement from both lecturers and graduates, with an average score of 4.6. Both groups agreed that the curriculum is generally aligned with the needs of the maritime industry, with a focus on the skills and knowledge required for maritime operations. Lecturers emphasized the importance of continuously updating the curriculum to reflect the latest industry trends and technological advancements. However, they also noted that certain areas, such as sustainability and emerging technologies, could benefit from more attention.

Graduates also expressed satisfaction with the relevance of the curriculum but pointed out that there were gaps in certain areas, particularly in relation to new technologies, such as automation, digital navigation systems, and green shipping practices. These findings highlight the need for maritime education programs to stay abreast of the latest industry developments to ensure that graduates are fully prepared for the demands of the modern maritime workforce.

Health and well-being support for seafarers

The final indicator—health and well-being support for seafarers—received an average score of 4.4, indicating that both lecturers and graduates agree on the importance of health support but feel that current programs are insufficient. Lecturers highlighted the need for better mental health resources and resilience training, while graduates expressed a desire for more comprehensive health support services. This finding underscores the critical need for maritime education to address health and well-being as a central component of training, ensuring that future seafarers are not only physically capable but also mentally prepared for the challenges of their careers.

The findings of this research suggest that while maritime education programs are effective in several key areas, there is a pressing need for improvement in others. The integration of sustainability practices, health management (particularly mental health), and the real-world application of competencies should be prioritized to ensure that maritime education remains relevant and effective in preparing students for the challenges they will face in the industry.[22–24] By addressing these gaps, maritime education programs can better equip future seafarers with the skills, knowledge, and resilience required to succeed in an increasingly complex

and environmentally conscious maritime industry.

CONCLUSION

This research highlights maritime education's effectiveness and identifies key improvement areas: sustainability integration, mental health support, and curriculum alignment with emerging technologies. While technical skills are strong, practical sustainability training and mental health resources need enhancement. Competency development excels in hands-on experience, but should incorporate advanced technologies and emergency procedures. Maritime education must evolve to integrate sustainability, mental health, and technological advancements, ensuring future seafarers are prepared for the dynamic maritime industry.

ETHICAL CONSIDERATION

All participants provided informed consent after the Ethics Committee of Sekolah Tinggi Ilmu Pelayaran Jakarta, Indonesia reviewed and approved the research protocol, numbers SK/STIP/75/2025 and ST//37/Puket/1/11/2025.

CONFLICT OF INTEREST

No conflict of interest declared.

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AUTHOR CONTRIBUTIONS

TC, LB, and MBS designed the study, gathered data, conducted literature reviews, and drafted the manuscript, while WW, CP, and RR contributed to data collection, literature searches, and manuscript review.

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