RESEARCH ARTICLE

Sustainable maritime education: Integrating environmental science for global competence

Damoyanto Purba[a,1,*], Marudut Bernadtua Simanjuntak[a,3]

[a] Research Department of Science, Research Department and Applied Postgraduate Degree, Maritime Institute (Sekolah Tinggi Ilmu Pelayaran), Jl. Marunda Makmur Cilincing, North Jakarta, Jakarta 14150, Indonesia

[1]damayanto.purba@gmail.com; [2]bernadmarudut@gmail.com

Abstract: This research investigates the integration of Urban Environmental Quality, Materials and Resource Management, and Green and Sustainable Environment within the international maritime education framework at Sekolah Tinggi Ilmu Pelayaran (STIP Jakarta/ Maritime Institute of Jakarta). The study explores cadet experiences in Nautical, Technical, and Port and Shipping Management Majors, analysing theoretical foundations, curriculum satisfaction, practical training, and the incorporation of Environmental Science elements. Utilizing a qualitative descriptive approach, data is gathered through document analysis and self-reported reflections from 100 randomly selected cadets. The findings reveal distinct dynamics across majors, indicating a strong alignment between theoretical foundations and curriculum satisfaction. However, variations exist in the emphasis on practical training and the integration of Environmental Science elements. Port and Shipping Management Majors stand out with a notable commitment to sustainability principles, while Nautical and Technical Majors show potential areas for enhancement. The implications for future research underscore the need for ongoing refinements in curricula to address the evolving demands of the maritime industry. The study contributes to the scholarly discourse on international maritime education, providing insights for academic institutions to foster environmentally conscious and globally competent maritime professionals.

Keywords: global competence; maritime education; maritime professionals; sustainable maritime

For correspondence:
damayanto.purba@gmail.com

Article history:
Received: 4 March 2024
Revised: 26 March 2024
Accepted: 28 March 2024
Published: 31 March 2024

10.22219/jpbi.v10i1.32588

p-ISSN: 2442-3750
e-ISSN: 2537-6204

How to cite: Purba, D., & Simanjuntak, M. B. (2024). Sustainable maritime education: Integrating environmental science for global competence. *JPBI (Journal Pendidikan Biologi Indonesia), 10*(1), 310-319. https://doi.org/10.22219/jpbi.v10i1.32588

Introduction

Maritime education plays a pivotal role in shaping competent seafarers and maritime professionals on a global scale. As well, maritime education stands at the helm of producing adept seafarers and maritime professionals, steering the course towards international excellence (Ghosh et al., 2014; House & Saeed, 2016). Within this realm, the Maritime Institute Jakarta (STIP Jakarta) has emerged as a beacon of maritime education, consistently churning out a substantial cadre of qualified seamen, proficient deck officers, and skilled engine officers. This research embarks on a comprehensive exploration, focusing on a random selection of 100 cadets from three majors – Nautical, Technical, and Port and Shipping Management – within the applied bachelor's degree programme at Maritime Institute Jakarta. Maritime Institute Jakarta (STIP Jakarta) holds a distinguished position as a maritime school offering an international program that adheres to the standards set by the International Maritime Organization (IMO), particularly the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) (Berg, 2013; Sharma et al., 2019). As Semester 2 cadets, the selected individuals represent a cross-section of the institution's commitment to providing a holistic maritime education, preparing cadets to become international/global officers.

The three majors, Nautical, Technical, and Port and Shipping Management, serve as pillars within the academic structure of Maritime Institute Jakarta. The Nautical Major navigates the intricacies of seamanship, the Technical Major delves into the mechanical aspects of maritime operations, and the

Port and Shipping Management Major encapsulates the critical logistical and managerial facets of the industry. This triad forms the basis of our investigation, seeking to unravel the nuances and effectiveness of international maritime education across these diverse disciplines (de Água et al., 2020; Kidd & McCarthy, 2019). The significance of this research lies in its potential to unveil the strengths and areas for improvement within the educational framework of Maritime Institute Jakarta. As the maritime industry evolves in a global context, the demand for proficient and environmentally conscious officers becomes paramount (Cicek et al., 2019). Understanding how well the education aligns with international standards and prepares cadets to meet the challenges of a dynamic maritime environment is crucial for the institute's continuous enhancement and global relevance (Ghosh et al., 2014; Grech et al., 2008). Moreover, the study's focus on Environmental Science within the maritime education landscape adds a layer of significance. The emphasis on Urban Environmental Quality, Materials and Resource Management, and the establishment of a Green and Sustainable Environment aligns with the growing global awareness of the maritime industry's impact on the environment. This research seeks to bridge the gap between maritime practices and environmental stewardship, contributing to the cultivation of officers who not only excel in their profession but also champion sustainability (Chircop, 2015; Fang et al., 2019).

The primary purpose of this research is to conduct a qualitative analysis, employing descriptive methods, to comprehensively understand the educational experiences of the selected 100 cadets from the Nautical, Technical, and Port and Shipping Management Majors. The investigation extends beyond the traditional boundaries of academic inquiry, delving into the practical aspects of maritime education. It aims to unravel how the curriculum, training modules, and overall learning experience contribute to the development of international/global officers. Furthermore, the research intends to critically assess the integration of Environmental Science within the educational framework. By scrutinizing the institute's approach to Urban Environmental Quality, Materials and Resource Management, and the promotion of a Green and Sustainable Environment, the study seeks to elucidate the extent to which cadets are equipped to tackle the environmental challenges of the maritime industry (Gavalas et al., 2022; Plaza-Hernández et al., 2021). In delineating the novelty of this research, it is imperative to highlight the unique intersection of international maritime education, diverse academic majors, and the incorporation of environmental science (Bodin, 2017; McKinley et al., 2020). While previous studies may have explored maritime education in isolation or delved into environmental aspects separately, this research takes a pioneering step in synthesizing these elements. The focus on three distinct majors within a single institution, coupled with a meticulous examination of their alignment with international standards and environmental consciousness, represents an innovative approach in the realm of maritime education research (Ferritto, 2016). This research embarks on an academic exploration that transcends conventional boundaries, aiming to not only assess the efficacy of international maritime education at Maritime Institute Jakarta but also to pioneer a deeper understanding of how environmental science is interwoven into the fabric of preparing the next generation of global maritime officers.

Maritime education, being the cornerstone of producing competent seafarers, operates within a multifaceted framework influenced by various theoretical perspectives (Manuel, 2017). Theoretical underpinnings play a pivotal role in shaping the educational paradigms at institutions such as the Maritime Institute Jakarta (STIP Jakarta), where the overarching goal is to align with international standards and produce officers capable of navigating the complexities of the global maritime arena. The concept of international maritime education, deeply ingrained in the International Maritime Organization's (IMO) International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), serves as a guiding theoretical framework (House & Saeed, 2016). This framework, rooted in global standards, delineates the competencies and knowledge areas essential for seafarers (House & Saeed, 2016; Sharma et al., 2019). Institutions like STIP Jakarta draw upon the STCW framework to structure their curricula, ensuring a harmonized approach to maritime education on an international scale.

Furthermore, the key concept of preparing cadets as international/global officers necessitates a theoretical lens that extends beyond the technicalities of seamanship. The notion of global officer hood integrates elements of cross-cultural competence, international maritime law, and a comprehensive understanding of the socio-economic factors influencing the maritime industry (Cicek et al., 2019). The theoretical foundation here lies in the amalgamation of international relations theory, legal frameworks, and management principles, ensuring that cadets not only excel in their technical roles but also navigate the complexities of the global maritime landscape. In the context of the three majors – Nautical, Technical, and Port and Shipping Management – the theoretical framework expands to encompass specialized knowledge areas. For Nautical majors, navigation theories and celestial navigation principles are fundamental, forming the theoretical bedrock for practical seamanship (House & Saeed, 2016). Technical majors draw upon engineering theories, embracing principles of mechanical systems, thermodynamics, and propulsion. Port and Shipping Management majors, on the other hand, delve into logistics and supply chain management theories, grounded in principles of efficient port operations and global trade dynamics.

Environmental Science, a central focus of this research, brings forth a theoretical framework grounded in ecological principles and sustainability theories (Holbrook & Rannikmae, 2009; McKinley et al., 2020; Scholz & Binder, 2011). Urban Environmental Quality, as a key concept, draws from urban ecology, environmental health, and city planning theories. The idea is to evaluate how the maritime education provided at STIP Jakarta integrates theories of urban environmental quality into the training of future officers, ensuring they comprehend the impact of maritime activities on urban ecosystems (Edirisinghe et al., 2016; Ferritto, 2016). Materials and Resource Management, another critical concept, finds its theoretical foundation in resource economics, circular economy principles, and sustainable resource management theories. The aim is to investigate how the education at STIP Jakarta equips cadets with the theoretical knowledge to manage materials and resources in a manner that aligns with sustainable practices. The overarching concept of promoting a Green and Sustainable Environment is underpinned by ecological sustainability theories, environmental policy frameworks, and conservation principles. This theoretical lens scrutinizes the extent to which STIP Jakarta incorporates green practices and instils a sustainability mindset among cadets, preparing them to contribute to environmentally responsible maritime practices (Ghosh et al., 2014).

In the review of previous relevant studies, investigations into maritime education have traditionally focused on compliance with STCW standards, technical competencies, and industry-relevant skills. However, a notable gap exists in the literature concerning the integration of Environmental Science within maritime education (Benintendi et al., 2020; Walker et al., 2019). This research, by merging international maritime education theories with Environmental Science principles, aims to fill this void, offering a pioneering perspective that expands the discourse on preparing global officers to include environmental stewardship. The literature review establishes the theoretical foundations that underpin international maritime education, emphasizing the integration of theoretical frameworks from global standards to specialized knowledge areas. The research's unique contribution lies in its synthesis of international maritime education theories with Environmental Science principles, creating a novel perspective that addresses the evolving needs of the maritime industry.

Method

This study adopts a qualitative descriptive approach to delve into the educational experiences of 100 cadets enrolled in their Second Semester at Maritime Institute Jakarta (STIP Jakarta). The research design is framed within the context of exploring the preparedness of these cadets as international/global officers, with a particular emphasis on the alignment with International Maritime Organization's (IMO) International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) (Chen et al., 2017; Döring & Horden, 2022). The three majors under scrutiny are Nautical, Technical, and Port and Shipping Management, representing diverse facets of maritime education. The study focuses on a randomly selected sample of 100 cadets, each situated in their Second Semester across the three majors – Nautical, Technical, and Port and Shipping Management. This purposive sampling strategy ensures a representative cross-section of the cadet population, offering insights into the nuances of each major's educational landscape (Brenker et al., 2017; Merriam & Grenier, 2019). The diverse perspectives of cadets contribute to a comprehensive understanding of the educational framework at Maritime Institute Jakarta.

The data collection process in this research unfolds through a combination of document analysis and self-reported reflections from the cadets. Document analysis involves a meticulous examination of academic papers, course syllabi, and institutional policies related to the curriculum and training modules within each major (Chilisa, 2019; Fischer & Miller, 2017). This aspect aims to unveil the theoretical foundations and practical components embedded in the educational structure (Kasemsap, 2021). Complementing document analysis, self-reported reflections are garnered through carefully designed questionnaires and interview protocols. Cadets are provided with open-ended questions that encourage them to reflect on their educational experiences, encompassing aspects such as curriculum satisfaction, practical training efficacy, and perceived preparedness for international maritime roles (Bankole et al., 2017; Mori & Manuel, 2023). These reflections offer a qualitative depth to the research, capturing the subjective insights of the cadets. The cadets' self-reported reflections also extend to their understanding of Environmental Science elements within the curriculum. Questions probe into their awareness of Urban Environmental Quality, Materials and Resource Management, and the promotion of a Green and Sustainable Environment. Through this approach, the research aims to uncover the cadets' perspectives on the integration of environmental science in maritime education.

Data analysis in this qualitative descriptive study involves a thematic approach, wherein patterns and themes are identified from the gathered information (Panagiotidou, 2012). The document analysis output is subjected to content analysis, unveiling recurrent themes within the academic documents and institutional policies. This aids in constructing a robust understanding of the theoretical underpinnings of each major. The self-reported reflections from the cadets undergo a thorough thematic coding process (Fischer & Miller, 2017; Saldana, 2014). Emergent themes related to curriculum satisfaction, practical

training, and perceptions of international preparedness are identified. Moreover, a separate coding framework is applied to the reflections on Environmental Science elements, discerning cadets' viewpoints on the incorporation of sustainability principles in their education. The thematic analysis is followed by a cross-sectional examination of patterns across the three majors. This comparative approach seeks to highlight disparities and commonalities in the educational experiences, providing a nuanced portrayal of the strengths and potential areas for enhancement within each major (Omariba, 2021). The research method employed in this study ensures a holistic exploration of international maritime education at Maritime Institute Jakarta. By combining document analysis and self-reported reflections, the qualitative descriptive approach captures the multifaceted dimensions of the cadets' educational journey, shedding light on the theoretical foundations, practical applications, and environmental science integration within Nautical, Technical, and Port and Shipping Management Majors.

Results

Environmental Science elements within the curriculum

The findings of this research shed light on the nuanced aspects of international maritime education at Maritime Institute Jakarta (STIP Jakarta), focusing on the educational experiences of 100 cadets from Nautical, Technical, and Port and Shipping Management Majors in their Second Semester. The exploration encompasses theoretical foundations, practical training, and the integration of Environmental Science elements within the curriculum. The data collected through document analysis and self-reported reflections offer a comprehensive view, as detailed in the Table 1 and Table 2.

Table 1. Overview of Curriculum Components

Major	Theoretical Foundations	Practical Training	Environmental Science Integration
Nautical	Strong emphasis on navigation theories and celestial navigation principles	Practical seamanship includes celestial navigation exercises	Limited inclusion of Environmental Science elements
Technical	Grounded in engineering theories, encompassing mechanical systems, thermodynamics, and propulsion principles	Rigorous practical training in engineering operations	Minimal integration of Environmental Science aspects
Port and Shipping Management	Theoretical focus on logistics and supply chain management principles	Practical exposure to port operations and management	Recognizable integration of sustainability principles in logistics and resource management

Table 2. Cadets' Perspectives on Curriculum Satisfaction and International Preparedness

Major	Curriculum Satisfaction	Perception of International Preparedness
Nautical	High satisfaction with navigational and seamanship modules	Mixed perceptions, with some cadets expressing confidence and others seeking more global exposure
Technical	Positive feedback on engineering modules, desire for more practical exposure	Varied perspectives, with some cadets feeling adequately prepared and others desiring a broader international perspective
Port and Shipping Management	Generally satisfied with logistics and management modules	Consistent positive outlook, with cadets expressing confidence in their international preparedness

Theoretical Foundations: The analysis of theoretical foundations reveals distinct characteristics across the three majors. Nautical majors exhibit a robust emphasis on navigation theories and celestial navigation principles, aligning with the demands of seamanship. Technical majors, on the other hand, draw extensively from engineering theories, encompassing mechanical systems, thermodynamics, and propulsion principles. Port and Shipping Management majors showcase a theoretical focus on logistics and supply chain management principles, providing a comprehensive understanding of the managerial facets of the maritime industry (Gavalas et al., 2022; Munim et al., 2020).

Practical Training: Practical training emerges as a crucial component within each major. Nautical majors undergo rigorous practical seamanship training, including celestial navigation exercises to hone their

navigational skills. Technical majors engage in hands-on experiences in engineering operations, solidifying their grasp of mechanical systems and propulsion. Port and Shipping Management majors receive practical exposure to port operations and management, fostering a practical understanding of logistics and supply chain dynamics.

Environmental Science Integration: The integration of Environmental Science elements within the curriculum reveals varying degrees of emphasis. Nautical majors exhibit a limited inclusion of Environmental Science elements, with a predominant focus on traditional maritime disciplines. Technical majors show minimal integration of Environmental Science aspects, concentrating primarily on engineering principles. In contrast, Port and Shipping Management majors display a recognizable integration of sustainability principles in logistics and resource management, indicating a commitment to environmental stewardship (Scholz & Binder, 2011).

Curriculum Satisfaction: The analysis of curriculum satisfaction indicates that cadets across the majors generally express contentment with their respective modules. Nautical cadets exhibit high satisfaction with navigational and seamanship components, reflecting a strong alignment between theoretical foundations and practical training. Technical cadets provide positive feedback on engineering modules but express a desire for more hands-on experiences. Port and Shipping Management cadets, overall, report satisfaction with logistics and management modules.

Perception of International Preparedness: Perceptions of international preparedness vary among cadets. Nautical cadets present mixed perspectives, with some expressing confidence in their readiness for international roles, while others seek more exposure. Technical cadets display varied perspectives, with some feeling adequately prepared and others desiring a broader international outlook. Port and Shipping Management cadets consistently express confidence in their international preparedness, reflecting a positive alignment between the curriculum and global expectations.

In conclusion, the findings illuminate the diverse facets of international maritime education at Maritime Institute Jakarta, offering insights into theoretical foundations, practical training, and the integration of Environmental Science elements. The data, supported by detailed tables, provides a nuanced understanding of curriculum satisfaction and cadets' perceptions of international preparedness across Nautical, Technical, and Port and Shipping Management Majors.

Urban Environmental Quality, Materials and Resource Management, Green and Sustainable Environment

The examination of Urban Environmental Quality, Materials and Resource Management, and Green and Sustainable Environment within the context of international maritime education at Maritime Institute Jakarta unfolds through the lens of Nautical, Technical, and Port and Shipping Management Majors. The data, presented in the Table 3, is derived from a combination of document analysis and cadets' self-reported reflections.

Table 3. Integration of Environmental Science Elements

Major	Urban Environmental Quality	Materials and Resource Management	Green and Sustainable Environment
Nautical	Limited focus on urban environmental quality; Emphasis on seamanship	Minimal consideration for resource management; Primarily oriented towards maritime materials	Limited incorporation of sustainability principles in navigational practices
Technical	Limited emphasis on urban environmental quality; Engineering focus dominates	Limited integration of resource management; Engineering-centric approach to materials	Minimal consideration for sustainable practices within engineering operations
Port and Shipping Management	Recognizable integration of urban environmental quality in logistics; Awareness of environmental impacts	Substantial focus on sustainable resource management; Emphasis on efficient logistics	Strong commitment to a green and sustainable environment; Emphasis on eco-friendly logistics and management practices

Empowered

Urban Environmental Quality: The analysis of Urban Environmental Quality integration across majors reveals a varied landscape. Nautical majors exhibit a limited focus on urban environmental quality, with an emphasis on traditional seamanship practices. Technical majors mirror this limited emphasis, with the engineering-centric focus dominating discussions on environmental aspects. In contrast, Port and Shipping Management majors showcase a recognizable integration of urban environmental quality in logistics education, fostering an awareness of environmental impacts within the urban context.

Materials and Resource Management: In terms of Materials and Resource Management, Nautical majors

exhibit minimal consideration for resource management, primarily orienting towards maritime materials in navigation. Technical majors mirror this trend with a limited integration of resource management, maintaining an engineering-centric approach to materials. Port and Shipping Management majors, however, stand out with a substantial focus on sustainable resource management, emphasizing efficient logistics and responsible handling of resources.

Green and Sustainable Environment: The commitment to a Green and Sustainable Environment varies significantly across the three majors. Nautical majors display a limited incorporation of sustainability principles in navigational practices. Technical majors follow suit, with minimal consideration for sustainable practices within engineering operations. On the contrary, Port and Shipping Management majors showcase a strong commitment to a green and sustainable environment. Their emphasis on eco-friendly logistics and management practices positions them as leaders in integrating environmental sustainability into their educational framework (Table 4).

Table 4. Cadets' Perceptions of Environmental Science Integration

Major	Awareness of Environmental Elements	Perception of Integration
Nautical	Limited awareness of environmental elements; Minimal perceived integration	Limited willingness to implement in future career
Technical	Varied awareness of environmental elements; Limited perceived integration	Mixed willingness to implement in future career
Port and Shipping Management	High awareness of environmental elements; Recognizable perceived integration	Strong willingness to implement in future career

Critical Analysis of Environmental Science Integration

Awareness of Environmental Elements: Cadets across the majors exhibit varying levels of awareness of Environmental Science elements. Nautical majors demonstrate limited awareness, with minimal perceived integration of environmental considerations in their education. Technical majors present varied levels of awareness, with a limited perceived integration of environmental elements. Port and Shipping Management majors, however, showcase a high awareness of environmental elements, indicating a notable emphasis on environmental education within their curriculum.

Perception of Integration: The perception of environmental science integration is nuanced among cadets. Nautical majors perceive minimal integration, reflecting the limited emphasis on environmental considerations in navigational practices. Technical majors present a mixed perception, with some cadets recognizing the importance of environmental elements but acknowledging the limited integration within their technical focus. Port and Shipping Management majors demonstrate a recognizable perceived integration, aligning with the substantial emphasis on sustainability principles in their logistics and management education.

The findings of this research provide a comprehensive exploration of international maritime education at Maritime Institute Jakarta (STIP Jakarta), unveiling critical insights into the educational experiences of cadets across Nautical, Technical, and Port and Shipping Management Majors. The discussion is framed within the context of theoretical foundations, curriculum satisfaction, practical training, and the integration of Environmental Science elements, aligning with the literature review and the critical analysis of findings.

Theoretical Foundations and Curriculum Satisfaction: The alignment between theoretical foundations and curriculum satisfaction is a pivotal aspect of maritime education. The literature review emphasized the importance of theoretical frameworks derived from international standards, particularly the International Maritime Organization's (IMO) International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW). The findings reveal that Nautical, Technical, and Port and Shipping Management Majors demonstrate a commitment to theoretical underpinnings aligned with their respective disciplines. Nautical majors exhibit a strong emphasis on navigation theories and celestial navigation principles, resonating with the traditional emphasis on seamanship in maritime education (de Água et al., 2020; Erdogan & Demirel, 2017). Technical majors draw extensively from engineering theories, reflecting the industry's reliance on sound technical knowledge. Port and Shipping Management majors maintain a theoretical focus on logistics and supply chain management principles, in line with the managerial facets of the maritime industry. Cadets across the majors generally express satisfaction with their curriculum, indicating an alignment between theoretical foundations and the educational experience.

Practical Training and Curriculum Satisfaction: Practical training emerges as a vital component in preparing cadets for real-world maritime challenges. The literature review highlighted the industry's demand for practical competencies and skills, particularly in compliance with STCW standards. The findings demonstrate a varied landscape of practical training across Nautical, Technical, and Port and

Shipping Management Majors. Nautical majors undergo rigorous practical seamanship training, reflecting a commitment to hands-on experiences in navigational practices. Technical majors engage in practical engineering operations, aligning with the industry's demand for technical expertise. Port and Shipping Management majors receive practical exposure to logistics and management, fostering a tangible understanding of industry dynamics. The alignment between practical training and curriculum satisfaction indicates that STIP Jakarta recognises the importance of preparing cadets with the necessary practical skills. *Integration of Environmental Science Elements:* The literature review underscored the significance of integrating Environmental Science elements within maritime education, particularly focusing on Urban Environmental Quality, Materials and Resource Management, and the establishment of a Green and Sustainable Environment. The findings offer a nuanced view of the integration of these elements across the three majors. Nautical majors exhibit a limited focus on Urban Environmental Quality and minimal consideration for Materials and Resource Management, reflecting a traditional emphasis on navigational practices rather than environmental considerations. Technical majors mirror this trend, with an engineering-centric approach dominating discussions. Port and Shipping Management majors stand out with a recognizable integration of Urban Environmental Quality in logistics education, a substantial focus on sustainable resource management, and a strong commitment to a green and sustainable environment. The findings reflect a varied emphasis on environmental science elements, suggesting a potential area for enhancement in the curricula of Nautical and Technical Majors to align more closely with contemporary environmental considerations.

Cadets' Perceptions of Environmental Science Integration: The critical analysis of Environmental Science Integration explored cadets' awareness, perception of integration, and willingness to implement environmental principles in their future careers. The findings reveal varied dynamics across Nautical, Technical, and Port and Shipping Management Majors. Nautical cadets demonstrate limited awareness and perceived integration of environmental elements, resulting in a limited willingness to implement environmental principles in their future careers. Technical cadets present mixed levels of awareness and perceived integration, with a varied willingness to implement environmental principles. Port and Shipping Management cadets exhibit high awareness, a recognizable perceived integration, and a strong willingness to implement environmental principles. These findings highlight the need for increased emphasis on environmental awareness and integration within the curricula of Nautical and Technical Majors to align with the growing importance of sustainability in the maritime industry.

Alignment with Research Objectives and Theoretical Frameworks: The discussion of findings aligns with the research objectives, systematically exploring the theoretical foundations, curriculum satisfaction, practical training, and the integration of Environmental Science elements within international maritime education. The theoretical frameworks derived from international standards, particularly STCW and broader Environmental Science principles, offer a robust foundation for evaluating the preparedness of cadets as international/global officers. The findings not only confirm the alignment between theoretical foundations and curriculum satisfaction but also reveal areas of improvement, particularly in the integration of Environmental Science elements. The recognition of the varied dynamics across the three majors allows for a targeted discussion on potential enhancements to curricula, ensuring that all cadets are well-equipped to navigate the complexities of the maritime industry, including its environmental considerations. *Implications for Future Research and Academic Practice:* The discussion of findings lays the groundwork for future research and academic practice within the context of international maritime education. The identified variations in curriculum satisfaction, practical training, and the integration of Environmental Science elements prompt considerations for ongoing enhancements to educational practices. Future research could delve deeper into the specific challenges and opportunities within each major, exploring innovative ways to integrate Environmental Science principles into Nautical and Technical curricula. Additionally, investigations into the long-term impacts of maritime education on cadets' professional practices and environmental stewardship could provide valuable insights for academic institutions and industry stakeholders.

The findings of this research contribute to the ongoing discourse on international maritime education, offering valuable insights into theoretical foundations, curriculum satisfaction, practical training, and the integration of Environmental Science elements. The discussion aligns with the literature review, emphasizing the importance of theoretical frameworks and environmental considerations in preparing cadets as international/global officers. The critical analysis of findings provides a nuanced perspective, acknowledging the strengths of STIP Jakarta's educational framework while also pinpointing areas for improvement. The implications for future research and academic practice underscore the need for continuous refinement of curricula to meet the evolving demands of the maritime industry. Through such endeavours, academic institutions can play a pivotal role in shaping environmentally conscious and globally competent maritime professionals.

Conclusion

This research has delved into the intricacies of international maritime education at Maritime Institute Jakarta (STIP Jakarta), dissecting the experiences of cadets across Nautical, Technical, and Port and Shipping Management Majors. The findings provide a comprehensive snapshot of the theoretical foundations, curriculum satisfaction, practical training, and the integration of Environmental Science elements within the educational framework. The alignment between theoretical foundations and curriculum satisfaction reflects STIP Jakarta's commitment to providing a robust educational experience rooted in international standards. The emphasis on practical training, although varying across majors, underscores the recognition of the industry's demand for hands-on competencies.

The integration of Environmental Science elements reveals a notable commitment within Port and Shipping Management Majors, but also highlights potential areas for improvement in Nautical and Technical Majors. The varied dynamics in cadets' awareness, perception of integration, and willingness to implement environmental principles indicate the need for a more concerted effort to instil sustainability values across all majors. The implications for future research and academic practice underscore the continuous refinement needed to meet the evolving demands of the maritime industry. As the maritime sector navigates towards a future marked by environmental consciousness and global competence, academic institutions play a pivotal role in shaping professionals who are not only adept in their technical roles but are also stewards of sustainable practices. This research contributes to the scholarly discourse on international maritime education, providing a foundation for further investigations into the challenges and opportunities within each major. As the maritime industry continues to evolve, academic institutions must remain agile, consistently adapting their curricula to produce officers who can adeptly navigate the complexities of a globalised and environmentally conscious maritime landscape.

Acknowledgement

The author would like to thank the Principal, Head of Research division, lecturers and cadets of Maritime Institute of Jakarta (STIP Jakarta) for the successful research. The author also thank the institute for the publication fund through the *Program Pendanaan Penelitian dan Anggaran Penelitian – Sekolah Tinggi Ilmu Pelayaran Jakarta* (Maritime Institutu of Jakarta).

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Author Contributions

D. Purba: methodology, writing original draft preparation, and review and editing. **M .B. Simanjuntak:** analysis, writing original draft preparation, and review and editing.

References

Bankole, O. A., Lalitha, V. V. M., Khan, H. U., & Jinugu, A. (2017). Information technology in the maritime industry past, present and future: focus on lng carriers. *2017 IEEE 7th International Advance Computing Conference (IACC)*, 759–763.

Benintendi, R., Gòmez, E. M., De Mare, G., Nesticò, A., & Balsamo, G. (2020). Energy, environment and sustainable development of the belt and road initiative: The Chinese scenario and Western contributions. *Sustainable Futures*, *2*, 100009.

Berg, H. P. (2013). Human factors and safety culture in maritime safety. *Marine Navigation and Safety of Sea Transportation: STCW, Maritime Education and Training (MET), Human Resources and Crew Manning, Maritime Policy, Logistics and Economic Matters*, *107*, 107–115.

Bodin, Ö. (2017). Collaborative environmental governance: Achieving collective action in social-ecological systems. *Science*, *357*(6352), eaan1114.

Brenker, M., Möckel, S., Küper, M., Schmid, S., Spann, M., & Strohschneider, S. (2017). Challenges of multinational crewing: a qualitative study with cadets. *WMU Journal of Maritime Affairs*, *16*, 365–384.

Chen, X., Bai, X., & Xiao, Y. (2017). The application of E-learning in maritime education and training in China. *TransNav: International Journal on Marine Navigation and Safety of Sea Transportation*, *11*(2), 349–354.
Chilisa, B. (2019). *Indigenous research methodologies*. Sage publications.
Chircop, A. (2015). *The international maritime organization*.
Cicek, K., Akyuz, E., & Celik, M. (2019). Future skills requirements analysis in maritime industry. *Procedia Computer Science*, *158*, 270–274.
de Água, P. M. G. B., da Silva Frias, A. D., Carrasqueira, M. de J., & Daniel, J. M. M. (2020). Future of maritime education and training: blending hard and soft skills. *Pomorstvo*, *34*(2), 345–353.
Döring, A., & Horden, P. (2022). *Mediterranean Sea-Creature: Maritime Metaphor in the Philosophy of Friedrich Nietzsche BT - Metaphors and Analogies in Sciences and Humanities: Words and Worlds* (S. Wuppuluri & A. C. Grayling (eds.); pp. 481–498). Springer International Publishing. https://doi.org/10.1007/978-3-030-90688-7_23
Edirisinghe, P., Zhihong, J., & Lixin, S. (2016). The direction of maritime education and training development: A conceptual approach. *Proceedings of the 1st International Conference on Maritime Education and Training, Dalian Maritime University, 15th October*.
Erdogan, O., & Demirel, E. (2017). New Technologies in maritime education and training, Turkish experiment. *Universal Journal of Educational Research*, *5*(6), 947–952.
Fang, S., Wang, Y., Gou, B., & Xu, Y. (2019). Toward future green maritime transportation: An overview of seaport microgrids and all-electric ships. *IEEE Transactions on Vehicular Technology*, *69*(1), 207–219.
Ferritto, V. R. (2016). Maritime education factors and presenteeism: a comparative quantitative study. *WMU Journal of Maritime Affairs*, *15*, 353–380.
Fischer, F., & Miller, G. J. (2017). *Handbook of public policy analysis: theory, politics, and methods*. Routledge.
Gavalas, D., Syriopoulos, T., & Roumpis, E. (2022). Digital adoption and efficiency in the maritime industry. *Journal of Shipping and Trade*, *7*(1), 11.
Ghosh, S., Bowles, M., Ranmuthugala, D., & Brooks, B. (2014). On a lookout beyond STCW: Seeking standards and context for the authentic assessment of seafarers. *15th Annual General Assembly of the International Association of Maritime Universities, IAMU AGA 2014-Looking Ahead: Innovation in Maritime Education, Training and Research*, 77–86.
Grech, M., Horberry, T., & Koester, T. (2008). *Human factors in the maritime domain*. CRC press.
Holbrook, J., & Rannikmae, M. (2009). The meaning of scientific literacy. *International Journal of Environmental and Science Education*, *4*(3), 275–288.
House, D., & Saeed, F. (2016). *The seamanship examiner: for STCW certification examinations*. Taylor & Francis.
Kasemsap, K. (2021). Promoting critical thinking in the modern learning environments. In *Research Anthology on Developing Critical Thinking Skills in Students* (pp. 36–59). IGI Global. https://doi.org/10.4018/978-1-7998-3022-1.ch003
Kidd, R., & McCarthy, E. (2019). Maritime education in the age of autonomy. *WIT Transactions on The Built Environment*, *187*, 221–230.
Manuel, M. E. (2017). Vocational and academic approaches to maritime education and training (MET): Trends, challenges and opportunities. *WMU Journal of Maritime Affairs*, *16*, 473–483.
McKinley, E., Acott, T., & Yates, K. L. (2020). Marine social sciences: Looking towards a sustainable future. *Environmental Science & Policy*, *108*, 85–92.
Merriam, S. B., & Grenier, R. S. (2019). *Qualitative research in practice: Examples for discussion and analysis*. John Wiley & Sons.
Mori, Y., & Manuel, M. E. (2023). An Exploration of the theoretical foundations of onboard seafarer training: A Systematic Review of the literature. *TransNav: International Journal on Marine Navigation & Safety of Sea Transportation*, *17*(4).
Munim, Z. H., Dushenko, M., Jimenez, V. J., Shakil, M. H., & Imset, M. (2020). Big data and artificial intelligence in the maritime industry: a bibliometric review and future research directions. *Maritime Policy & Management*, *47*(5), 577–597.
Omariba, A. (2021). Technology-Enhanced Classroom to enhance critical thinking skills. In *Research Anthology on Developing Critical Thinking Skills in Students* (pp. 488–506). IGI Global. https://doi.org/10.4018/978-1-7998-3022-1.ch025
Panagiotidou, M.-E. (2012). *Intertextuality and literary reading: a cognitive poetic approach*.
Plaza-Hernández, M., Gil-González, A. B., Rodríguez-González, S., Prieto-Tejedor, J., & Corchado-Rodríguez, J. M. (2021). Integration of IoT technologies in the maritime industry. *Distributed Computing and Artificial Intelligence, Special Sessions, 17th International Conference*, 107–115.

Saldana, J. (2014). *Thinking qualitatively: Methods of mind*. SAGE publications.
Scholz, R. W., & Binder, C. R. (2011). *Environmental literacy in science and society: from knowledge to decisions*.
Sharma, A., Kim, T., Nazir, S., & Chae, C. (2019). Catching up with time? Examining the STCW competence framework for autonomous shipping. *Proceedings of the Ergoship Conference, Haugesund, Norway*, 24–25.
Walker, T. R., Adebambo, O., Feijoo, M. C. D. A., Elhaimer, E., Hossain, T., Edwards, S. J., Morrison, C. E., Romo, J., Sharma, N., & Taylor, S. (2019). Environmental effects of marine transportation. In *World seas: an environmental evaluation* (pp. 505–530). Elsevier.