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Research Article

Awareness of Deck Faculty on Current Maritime Technology and Industry Trends and Perceived Appropriateness of the Bachelor of Science in Marine Transportation Curriculum: A Basis for Curriculum Enhancement

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Abstract

The continuous advancement of maritime technologies, particularly Artificial Intelligence (AI) and Maritime Autonomous Surface Ships (MASS) call for a corresponding enhancement of maritime higher education curricula to meet the evolving demands of the global industry. While other countries have begun integrating these developments into their academic programs, limited studies in the Philippines have examined how the Bachelor of Science in Marine Transportation (BSMT) curriculum adapts to these changes. This study sought to assess the awareness of deck faculty on current maritime technologies and industry trends, as well as their perceptions of the appropriateness of the existing BSMT curriculum at PNTC Colleges, with the aim of recommending enhancements. Using a quantitative descriptive-comparative design, data were gathered through a validated survey questionnaire administered to all 30 deck faculty members and analyzed using descriptive statistics and a t-test. Results showed that the faculty were generally aware of AI applications (median = 4) but only moderately aware of MASS (median = 3). The curriculum was perceived as appropriate in content, implementation, and relevance (median = 4), and statistical analysis confirmed no significant difference ($p = 0.13 > 0.05$) between awareness of emerging technologies and perceptions of curriculum appropriateness. The results showed that while the BSMT curriculum adequately addresses traditional competencies, it has not yet fully integrated technological advancements. Hence, it is recommended to include learning outcomes on these emerging technologies in core courses or other institutional programs to include the competencies on digitalization particularly in AI and MASS, and offer electives focused on maritime innovations to ensure alignment with industry demands and global standards.

Keywords: Artificial Intelligence; BSMT; Curriculum; MASS

1. INTRODUCTION

The increasing digitalization and developing dynamics of the maritime industry prompt a reevaluation of how connected systems and Internet of Things (IoT) can be utilized to advance the next phase of ship development (Sullivan, 2020). The technology-led innovations introduced by the Maritime 4.0 paradigm are expected to propel the future maritime ecosystem, enabling innovation-driven manufacturing processes of smart vessels designed with fully integrated maritime environment (Mitra, 2023).

These technological advancements lead us towards the changes in education's dynamics and delivery globally (Sharma and Nashir, 2021). With the rapid technological evolution, Maritime Higher Education Institutions (MHEI) face challenges in modernizing the curricula and instructional approaches to align with the demands of the digital era (Hasan & Salem, 2025). One notable development for Maritime Education and Training (MET) is the evolution of maritime simulators. These simulators, once limited to navigation and ship handling, have transformed into highly advanced systems capable of replicating complex scenarios and operational conditions (Nautilus, 2021, as cited by Karahil, M., et al., 2024).

In response to the evolving maritime industry, some universities around the world have taken steps to incorporate the developing technological trends into their curricula.

The Indian Maritime University (IMU) in India included the subject 'Artificial Intelligence and Autonomous Ships' in its program structure for the Bachelor of Science in Nautical Science. This subject aims to address the intersection of Artificial Intelligence (AI), Machine Learning (ML), cybersecurity, IoT, and big data, in light of the development and implementation of Maritime Autonomous Surface Ships (MASS). Nanyang Technological University in Singapore injected a 3-unit course on 'Introduction on Data Science and Artificial Intelligence' for their curriculum on Bachelor of Science in Maritime Studies.

Additionally, MOKPO National Maritime University (MMU) in South Korea offers a course on 'Autonomous Operation for Smart Ships' as part of its advanced major courses for fourth-year students in the Division of Marine Transportation. Furthermore, Korea Maritime and Ocean University (KMOU) has taken a significant step by establishing a dedicated Division for Maritime AI & Cybersecurity within its College of Maritime Sciences, focusing on AI and cybersecurity. This division aims to cultivate artificial intelligence and cybersecurity experts as maritime professionals responsible for overseeing the operations and management of future vessels.

The Philippines, being the largest supplier of seafarers globally (Maritime Administration Authority, 2022), has 83 recognized MHEIs, of which 77 are authorized to offer the Bachelor of Science in Marine Transportation (BSMT) and 69 are eligible to offer the Bachelor of Science in Marine Engineering (BSMarE) for Academic Year 2024–2025 (Commission on Higher Education, 2024).

In recent years, the maritime education curriculum in the Philippines has undergone continuous revisions. Several CHED Memorandum Orders (CMOs) and Joint CHED-MARINA Memorandum Circulars (JCMMCs) have been implemented by the Commission on Higher Education (CHED) and the Maritime Industry Authority (MARINA) across MHEIs nationwide. The most recent, JCMMC No.1, series of 2023, serves as the latest set of Policies, Standards, and Guidelines (PSGs) for maritime education, governing the implementation of both BSMT and BSMarE programs in the country. Under previous PSGs, the BSMT program required a minimum of 175 credit units, covering professional courses, Onboard Training (OBT), Physical Education (PE), the National Service Training Program (NSTP), and general education subjects, as outlined in CMO No. 20, series of 2013, through CMO No. 67, series of 2017, up to JCMMC No. 01, series of 2022. However, in its latest revision, the required minimum has been reduced to 165 credit units. The professional courses in the BSMT program include subjects in Navigation, Seamanship, Deck Watchkeeping, Meteorology, Maritime Communications, Basic Marine Engineering, Maritime Law, MARPOL, and Management. These courses are designed to comply with the relevant provisions of the STCW Convention, 1978, as amended. On the other hand, maritime courses such as 'Trends, Issues and Breakthroughs in the Maritime Industry' and 'Emerging Technologies in Maritime Industry' are options to be offered by MHEIs as two out of 10 elective courses where institutions may opt not to include in their program of the study.

With the minimum requirements for maritime education curriculum based on the STCW Convention, 1978, with its significant 2010 Manila amendments, the integration of emerging technologies poses both challenges and opportunities for MHEIs (Maghorimi, 2023).

In light of the above, this study aims to evaluate the Bachelor of Science in Marine Transportation (BSMT) curriculum to determine whether gaps exist between the program and current maritime technological trends. Addressing these gaps will help strengthen the curriculum framework and ensure that the BSMT program remains aligned with global maritime standards. In doing so, this study also aligns with the United Nations Sustainable Development Goal (SDG) 4, which advocates for inclusive and equitable quality education.

2. MATERIALS AND METHODS

The researcher used quantitative research approach in this study, specifically descriptive-comparative design to describe and compare characteristics of a population. Survey was used to gather data from both deck faculty members PNTC Colleges. The variables of this study included the respondent's profile and their insights on current maritime trends and technological advancements.

The researcher adhered to the established ethical standards, particularly concerning the involvement of human participants. Permissions were obtained from the appropriate institutional authorities, company representatives, and individual respondents prior to the commencement of the survey. All sources and scholarly works cited in this study were properly acknowledged through in-text citations and included in the reference list, in accordance with academic standards.

Research Locale and Participants

The research was conducted at PNTC Colleges, an MHEI located in Dasmariñas City, Philippines. This institution was selected as the research locale since the respondents are primarily based here.

The researcher gathered data from the total population of 30 deck faculty members of PNTC Colleges.

Instruments

Instrumentation

A self-made survey questionnaire was developed for this study and administered through Google Forms. The instrument consists of three parts:

- Part I gathers the respondents' demographic profile, addressing SOP 1.
- Part II explores the respondents' level of awareness of emerging maritime trends and technological advancements using a 5-point Likert scale (1 = Fully Not Aware, 5 = Fully Aware), addressing SOP 2.
- Part III evaluates the perceived appropriateness of the BSMT curriculum according to the respondents' perceptions using also a 5-point Likert scale (1 = Very Inappropriate Aware, 5 = Very Appropriate), addressing SOP 3.

Validation of instrument

Validity test

The content validity of the questionnaire was consulted to the Research Officer and Field Experts to ensure appropriateness of the instrument content.

Reliability test

The survey questionnaire was pre-tested to 10 Deck Faculty Members of PNTC Colleges to determine if there are errors in the questionnaire or areas that need revisions or improvement.

Cronbach's a coefficient was used by the statistician to check the internal consistency reliability of the survey questions. The questionnaire measuring the level of awareness of deck faculty on emerging trends and maritime technological advancements, and the respondents' level of perception on the appropriateness of the BSMT curriculum yielded an excellent result of 0.95.

Data Collection

The following procedure were followed throughout the process to obtain data for this research:

Survey for Deck Faculty Members:

1. The survey for deck faculty was developed, approved and validated;
2. The researcher coordinated with the Dean for College of Maritime Education to conduct the survey;
3. The researcher sought permission from the respondents through an informed consent;
4. After receiving informed consent, survey questionnaire via Google Form was distributed to respondents;
5. The results of the survey questionnaire were collected by the researcher upon completion of the respondents.
6. The researcher screened the survey questionnaire if it was completely answered; and
7. The results from the survey questionnaire were tabulated and analyzed using Microsoft Excel.).

Data Analysis

Survey responses were analyzed using descriptive statistics and inferential statistics. One-tailed t-test was used to determine if there is a significant difference between the implemented BSMT curriculum and the emerging maritime technological trends.

3. RESULTS AND DISCUSSION

Quantitative Findings and Interpretation

Table 1

Demographic profile of the respondents in terms of rank on board

Current rank onboard	Frequency	Percentage
Officer-in-Charge of Navigational Watch	18	60.00%
Management Level Officer	12	40.00%

Total	30	100.00%

Based on the data in Table 1, most of the deck faculty respondents at PNTC Colleges are serving as Officer-in-Charge of a Navigational Watch, comprising 60% of the total population. The remaining 40% belong to the Management Level Officer category, which includes Captains and Chief Mates.

Table 2

Demographic profile of the respondents in terms of years of seagoing experience

Years of seagoing experience	Frequency	Percentage
0 -3 years	2	6.66%
4 -6 years	5	16.67%
7 – 9 years	5	16.67%
10 years and above	18	60.00%
Total	30	100.00%

As shown in Table.2, most of the respondents (60%) have accumulated 10 years or more of seagoing experience, indicating extensive maritime exposure. Both the 4–6 years and 7–9 years categories account for 16.67% each, while only 6.66% of the respondents have 0–3 years of sea service.

Table 3

Demographic profile of the respondents in terms of the year of latest disembarkation

Year of latest disembarkation	Frequency	Percentage
2023 – 2025	9	30.00%
2020 – 2022	10	33.34%
2017 – 2019	6	20.00%
2014 – 2016	1	3.33%
2013 and below	4	13.33%
Total	30	100.00%

Table 3 reveals that the highest proportion of respondents (33.34%) last disembarked between 2020–2022, coinciding with the COVID-19 pandemic period. 9 respondents (30%) disembarked more recently, between 2023–2025, thereby gaining firsthand experience with the latest innovations and technologies on board. Meanwhile, 20% of respondents last disembarked in 2017–2019, 3.33% in 2014–2016, and 13.33% in 2013 and earlier, suggesting a range of recency in seafaring experiences.

Table 4

Demographic profile of the respondents in terms of vessel trade route

Vessel trade route	Frequency	Percentage
International	28	93.33%
Domestic	2	6.67%
Total	30	100.00%

According to Table 4, a significant majority of the respondents (93.33%) have served in the international trade route, while only 6.67% reported seagoing experience in domestic waters. This highlights a stronger orientation toward global maritime operations among the faculty members.

Table 5

Demographic profile of the respondents in terms of years of service in MHEI

Years of service in MHEI	Frequency	Percentage
0 -3 years	23	76.67%
4 -6 years	3	10.00%
7 – 9 years	0	0%
10 years and above	4	13.33%
Total	30	100.00%

Although a large portion of respondents possess over 10 years of seagoing experience as represented in Table 2, their tenure in maritime higher education institutions (MHEIs) is comparatively shorter. As shown in Table 5, the majority (76.67%) have served in MHEIs for only 0–3 years. Three respondents (10%) have 4–6 years of teaching experience, while four respondents (13.33%) have been in service for more than 10 years. Notably, no respondents fall within the 7–9 years category.

Table 6

Demographic profile of the respondents in terms of the year of latest disembarkation

	Frequency	Percentage
Navigation	21	70.00%
Seamanship	17	56.67%
Management	10	33.33%
Deck Watchkeeping	21	70.00%
Elective/Others	5	16.67%

Table 6 presents the courses taught by the deck faculty. Navigation and Deck Watchkeeping are the most handled, each taught by 21 respondents. Seventeen respondents have taught Seamanship courses, while ten have handled Management courses. A smaller number, five respondents, reported teaching electives and other institutional subjects such as SHP and PRB courses.

Table 7

Level of awareness of the deck faculty on current maritime technology and industry trends

Technological advancements in the maritime industry	Median	Descriptive equivalent
Artificial Intelligence (AI)		
1. Awareness on the existence of Artificial Intelligence (AI) in the maritime industry.	4	Aware
2. Awareness on the use of AI for risk analysis and management (e.g., AI-powered risk management).	4	Aware

3. Awareness on the use of AI to enhance crew resource management (e.g., SmartPredict System).	4	Aware
4. Awareness on the use of AI in handling hazardous materials.	4	Aware
5. Awareness on the use of AI for predictive maintenance.	4	Aware
6. Awareness on the use of AI in optimizing navigation systems.	4	Aware
7. Awareness on the potential challenges that AI may pose in the maritime industry.	4	Aware
8. Awareness on any subject in the institution dedicated to AI.	4	Aware
9. Awareness on any lesson in the syllabus that relates to AI.	4	Aware
Maritime Autonomous Surface Ships (MASS)		
1. Awareness on the existence of Maritime Autonomous Surface Ships (MASS).	4	Aware
2. Awareness on the different degrees of autonomy in MASS.	3	Neither Aware nor Not Aware
3. Awareness on how MASS are controlled and monitored.	3	Neither Aware nor Not Aware
4. Awareness on the legal, regulatory, and ethical issues associated with MASS.	3	Neither Aware nor Not Aware
5. Awareness on the potential benefits of MASS to the seafaring profession.	3	Neither Aware nor Not Aware
6. Awareness on the challenges that MASS may pose to seafarers in the near future.	3	Neither Aware nor Not Aware
7. Awareness on any subject in the institution dedicated to MASS.	3	Neither Aware nor Not Aware
8. Awareness on any lesson in the syllabus that relates to MASS.	3	Neither Aware nor Not Aware

Table 7 presents the level of awareness of the respondents on the technological advancements in the maritime industry, specifically on Artificial Intelligence (AI) and Maritime Autonomous Surface Ships (MASS).

For Artificial Intelligence (AI), the median of 4 suggests that the respondents are generally aware of its applications in the maritime industry. The data gathered shows that the respondents have been aware of AI and all its implications.

On the other hand, awareness of Maritime Autonomous Surface Ships (MASS) was lower, with a median of 3, interpreted as neither aware nor not aware. While respondents were aware of the general existence of MASS (4) in the gathered data, they showed limited knowledge of its specific dimensions, garnering a median of 3 on all its applications. This suggests that there is may be a gap in formal instruction and professional discourse concerning autonomous vessels.

To support this, Angeles and Perona (2022) found in their study that 480 students are only moderately familiar with AI, having a median of 3.00 and a mean of 3.36, and similarly with MASS, which gained a median of 3.00 and a mean of 3.12, indicating that the respondents are only moderately familiar with MASS as well.

Table 8

Perceived appropriateness on the BSMT curriculum of PNTC Colleges

Appropriateness of BSMT curriculum of PNTC Colleges	Median	Descriptive equivalent
Contents		
1. Appropriateness of the courses included in the BSMT curriculum in relation to real-life maritime situations.	4	Appropriate
2. Appropriateness of the contents and topics of BSMT subjects in terms of coverage.	4	Appropriate
3. Appropriateness of the BSMT curriculum content in reflecting the most recent developments in the maritime industry.	4	Appropriate

4. Appropriateness of the contents and topics of BSMT subjects in terms of accuracy and level of detail.	4	Appropriate
5. Appropriateness of the learning materials in terms of alignment with the detailed teaching syllabus.	4	Appropriate
Implementation		
1. Appropriateness of the overall implementation of the BSMT curriculum at PNTC Colleges.	4	Appropriate
2. Appropriateness of the methods of communicating the subjects' learning outcomes to students.	4	Appropriate
3. Appropriateness of the resources provided by PNTC Colleges to students, faculty, and staff for implementing the BSMT curriculum.	4	Appropriate
4. Appropriateness of the training and support provided to faculty and staff for effective curriculum implementation.	4	Appropriate
5. Appropriateness of the strategies implemented by key officials in implementing the BSMT Curriculum.	4	Appropriate
Relevance to the current demands		
1. Appropriateness of the BSMT curriculum subjects in addressing current trends and emerging technologies in the maritime industry.	4	Appropriate
2. Appropriateness of the topics and learning outcomes of BSMT subjects in terms of addressing present-day maritime technological advancements.	4	Appropriate
3. Appropriateness of the lessons taught in preparing BSMT students for real-world maritime scenarios.	4	Appropriate
4. Appropriateness of the lessons in equipping BSMT students for future challenges and developments in the maritime industry.	4	Appropriate
5. Appropriateness of the measures made by the institution in preparation for the emerging technologies in the maritime industry.	4	Appropriate

Table 8 presents the perceived appropriateness of the BSMT curriculum in terms of contents (4), implementation (4), and relevance to current demands (4). The median for all factors indicates that the respondents find the curriculum aligned with the needs of maritime education.

The contents of the curriculum having the median of 4 indicates that the courses and subjects included in the BSMT program are appropriate to real-life maritime situations. This suggests that the foundation of the curriculum remains structured.

In terms of implementation, with a median result of 4 shows that respondents also perceived the actual delivery of the curriculum as appropriate, same with the result for the relevance to current demands reflecting the same median of 4. This indicates that the BSMT curriculum is perceived as appropriately preparing students for real-life situations. Overall, the findings suggest that the BSMT curriculum at PNTC Colleges is appropriate across all three dimensions—contents, implementation, and relevance.

Similar with the results in the study of Angeles and Perona (2022), most of the respondents in their study believed that their current education was sufficient in preparation for future developments in the maritime industry such as MASS. Student's skepticism on AI's reliability and decision-making abilities in complex scenarios had influenced their perception on MASS, thus hindering full acceptance of the technology).

4. CONCLUSIONS

Based on the findings of this study, the following conclusions were drawn in accordance with the stated problems:

Demographic Profile of the Respondents

Most of the respondents in this study were Officer-in-Charge of a Navigational Watch (60%) with substantial seagoing experience of 10 years or more (60%). Majority of these respondents last disembarked between 2020–2022 (33.34%), where most

of them are engaged in international trade (93.33%). However, while most of the respondents have extensive shipboard experience, their tenure in Maritime Higher Education Institutions (MHEIs) is comparatively shorter, with 76.67% of which only have 0–3 years of service. Navigation and Deck Watchkeeping were the most frequently taught courses. This simply indicates that while the respondents possess strong maritime backgrounds as based on the years of seagoing service, their teaching experience is relatively new.

Level of awareness of the deck faculty on current maritime technology and industry trends

Respondents were generally aware of AI (4) as presented in Table 3.7 but showed limited awareness of MASS (3). This suggests that there is only a moderate familiarity with technological advancements in the maritime industry, indicating a gap of knowledge in MASS that needs to be addressed through formal instruction or training.

Level of appropriateness of the BSMT curriculum

The BSMT curriculum was perceived as appropriate across contents (4), implementation (4), and relevance to current demands (4). This recommends that the BSMT curriculum is effective in covering traditional seamanship skills.

Significant difference between awareness and curriculum appropriateness

The t-Test analysis showed no significant difference between faculty awareness on maritime technological trends and their perception of the curriculum's appropriateness ($p = 0.13 > 0.05$). This shows that although the curriculum is viewed as sound for the current industry standards, such perception does not necessarily equate to technological inclusiveness.

In summary, the BSMT curriculum is strong in addressing traditional competencies but does not yet fully reflect the fast-moving advancements of maritime technology. Limited awareness of MASS among faculty highlights the need for a stronger association between industry trends and academic instruction. To ensure long-term relevance, the curriculum must be enhanced through the integration these technological trends to enable the PNTC cadets to acquire both conventional seamanship skills and the digital competencies required by an evolving maritime profession. With continuous review and adaptation, the BSMT program can remain aligned with international standards and technological advancements.

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