

Enhancing Cadet Competencies through Experiential Onboard Navigational Training: A Quasi-Experimental Study

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ABSTRACT: Experiential learning is fundamental to maritime education because it enables cadets to translate classroom knowledge into practical shipboard competencies essential for safe navigation and professional practice. This study examined changes in navigational knowledge and professional attitudes following onboard navigational training aboard M/V Capt. John B. Lacson among third-year Bachelor of Science in Marine Transportation (BSMT) students. A quasi-experimental one-group pretest–posttest design was employed involving 40 third-year BSMT students during Academic Year 2025–2026. Data were collected using two validated instruments: a 30-item achievement test measuring navigational knowledge and a 30-item attitude questionnaire assessing students' attitudes toward onboard navigational training. Quantitative data were analyzed using descriptive statistics, paired-samples t-test, mean-gain analysis, and Cohen's d, while qualitative responses were examined through thematic analysis. Results showed that navigational knowledge increased from a pretest mean of 13.00 (SD = 2.19) to a posttest mean of 25.00 (SD = 1.43), representing a mean gain of 12.00 points and a very large effect size ($d = 4.45$), with the difference being statistically significant, $t(39) = -28.155$, $p < .001$. Students' attitudes likewise increased from a pretest mean of 3.14 (SD = 0.50), interpreted as High, to a posttest mean of 3.60 (SD = 0.30), interpreted as Very High, with a mean gain of 0.46 and a large effect size ($d = 0.79$), $t(39) = -5.019$, $p < .001$. Thematic analysis further revealed three key themes: integration of theoretical knowledge and practical application, development of confidence and professional readiness, and enhanced safety awareness and teamwork. These findings provide empirical evidence of substantial improvements in students' navigational knowledge and positive changes in their professional attitudes following structured onboard navigational training, while the qualitative findings suggest perceived gains in confidence, readiness, safety awareness, and teamwork. The study highlights the value of authentic shipboard experiences in competency-based maritime education and supports integrating experiential learning into maritime curricula to develop competent, safety-conscious, and industry-ready seafarers.

1 INTRODUCTION

Maritime education plays a critical role in developing competent, safety-conscious seafarers prepared to perform effectively in complex, safety-critical navigational environments. Beyond acquiring theoretical knowledge, maritime training requires cadets to develop the practical competencies,

judgment, communication, and professional attitudes needed for shipboard operations. The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) establishes international minimum standards for seafarer training, certification, and watchkeeping, including competency requirements for deck officers and navigational watchkeeping. The STCW framework also recognizes

the importance of appropriate training methodologies and the development of technical and non-technical competencies relevant to safe maritime operations [4].

A central challenge in maritime education is therefore effectively integrating classroom-based theoretical instruction with authentic operational experience. While classroom instruction provides the conceptual foundation for navigation, shipboard training gives cadets opportunities to apply their knowledge in realistic operational contexts. Research on maritime education and training indicates that practical and simulation-based learning environments can support the development and assessment of professional competencies by allowing learners to engage with navigational tasks, operational decision-making, and realistic bridge situations [5] [10]. Realistic training environments are particularly important in maritime education because navigation involves complex interactions among technical knowledge, situational awareness, communication, decision-making, and teamwork.

Experiential learning provides a theoretical basis for understanding how authentic shipboard experiences can contribute to students' learning and professional development. Kolb [6] conceptualized learning as a process in which knowledge develops through the transformation of experience. From this perspective, learners construct and strengthen knowledge by engaging in concrete experiences, reflecting on those experiences, developing conceptual understanding, and applying what they have learned to subsequent situations. In maritime education, this learning cycle is particularly relevant because cadets can encounter actual navigational operations and subsequently connect those experiences with concepts previously introduced in the classroom. Studies of maritime training have likewise emphasized the importance of realistic and practice-oriented learning environments in supporting competency development and preparing students for professional maritime responsibilities [5] [7].

The development of professional attitudes is also an important dimension of maritime training. Safe navigation depends not only on technical knowledge but also on responsible professional behavior, communication, teamwork, safety consciousness, and confidence in performing assigned duties. Maritime training research has highlighted the importance of developing these technical and non-technical competencies through realistic training and collaborative learning experiences [8] [12]. These competencies align with the broader STCW emphasis on competence, safety, leadership, teamwork, and effective watchkeeping in maritime operations [4].

At John B. Lacson Foundation Maritime University (Arevalo), Inc., the M/V Capt. John B. Lacson provides an authentic shipboard environment in which cadets can experience navigational operations, bridge watchkeeping, safety procedures, and other maritime activities. Unlike simulator-based environments, actual shipboard training exposes learners to the operational context in which maritime competencies are ultimately required. However, despite the importance of onboard training in maritime education, empirical evidence is still needed to show how authentic shipboard navigational experiences are

associated with measurable changes in students' knowledge and professional attitudes. This need is particularly relevant in institutional contexts where training vessels are integrated into maritime education and can serve as authentic learning environments.

The present study addresses this need by examining changes in navigational knowledge and attitudes among third-year Bachelor of Science in Marine Transportation (BSMT) students before and after onboard navigational training aboard the M/V Capt. John B. Lacson. The study used a one-group pretest–posttest quasi-experimental design to measure changes in students' performance and attitudes, and examined qualitative student reflections to provide contextual insight into their learning experiences. Using both objective performance measures and students' reported experiences allows the study to examine not only whether measurable changes occurred but also how students perceived the relationship between theoretical knowledge and authentic shipboard practice.

The study is particularly significant because it evaluates an authentic onboard learning experience rather than relying solely on simulation or perception-based measures. By examining navigational knowledge, attitudes, effect sizes, and qualitative reflections within the same training context, the study provides a more comprehensive assessment of the educational value of structured onboard navigational training. The findings may help improve shipboard training practices and curriculum design by providing evidence on how authentic maritime experiences can support competency-based education, professional development, safety awareness, and readiness for future shipboard responsibilities. The study also contributes to Sustainable Development Goal 4 (Quality Education) by highlighting the role of relevant, practice-oriented learning experiences in developing knowledge and skills for employment and professional practice.

The novelty of this study lies in its empirical evaluation of authentic onboard navigational training using a quasi-experimental one-group pretest–posttest design among third-year BSMT students aboard a university training vessel. While previous maritime education research has extensively examined simulator-based training and technology-supported learning, the present study focuses specifically on an actual shipboard navigational training environment and examines changes across both cognitive and affective learning outcomes. The study further integrates a 30-item navigational knowledge test, a validated 30-item attitude questionnaire, paired-samples statistical analysis, mean-gain analysis, effect-size estimation, and qualitative student reflections. This combination provides evidence of both the magnitude of observed learning changes and students' experiences of theory–practice integration, confidence and professional readiness, safety awareness, and teamwork. The study therefore contributes empirical evidence supporting the use of authentic shipboard experiences as a complementary strategy for strengthening competency-based maritime education.

Guided by this context, the study aimed to evaluate the effectiveness of onboard navigational training conducted aboard the M/V Capt. John B. Lacson among

third-year BSMT students of John B. Lacson Foundation Maritime University (Arevalo), Inc. during Academic Year 2025–2026.

Specifically, this study sought answers to the following questions:

1. What are the pretest and posttest scores of the third-year BSMT students in navigational knowledge before and after undergoing onboard navigational training aboard M/V Capt. John B Lacson?
2. What is the level of students' attitude toward onboard navigational training before and after the training?
3. Is there a significant difference between the students' pretest and posttest scores in navigational knowledge following the onboard navigational training?
4. Is there a significant difference between the students' pretest and posttest attitudes toward onboard navigational training following the intervention?
5. What are the mean gains in the students' navigational knowledge and attitude before and after the onboard navigational training?
6. What is the magnitude of the observed pretest–posttest change in students' navigational knowledge and attitude following the onboard navigational training?
7. What feedback, reflections, or insights can be drawn from the students regarding their experiences during the onboard navigational training?

2 MATERIALS AND METHODS

2.1 Research Design

This study employed a quasi-experimental one-group pretest–posttest research design, supplemented by a qualitative descriptive component, to evaluate the effectiveness of onboard navigational training conducted aboard the M/V Capt. John B. Lacson among third-year Bachelor of Science in Marine Transportation (BSMT) students. The quantitative component involved administering a pretest before the onboard navigational training and a posttest after the training intervention to determine changes in students' navigational knowledge and attitudes toward onboard navigational training.

The one-group pretest–posttest design was appropriate because the study involved an intact group of students scheduled to undergo onboard navigational training as part of their academic program. The design enabled the researchers to compare students' performance and attitude scores before and after the intervention. According to Creswell and Creswell [3], quasi-experimental designs are appropriate for examining changes associated with an intervention when random assignment or a control group may not be feasible.

The study also included a qualitative descriptive component through open-ended questions administered after the training. The qualitative component was not intended to constitute a separate qualitative research design but to supplement the quantitative findings by providing contextual information about students' experiences, reflections, and insights regarding the onboard training. The

responses were analyzed using thematic analysis to identify recurring patterns and themes related to learning transfer, confidence and professional readiness, safety awareness, and teamwork.

Thus, the study primarily used a quantitative quasi-experimental design with a supplementary qualitative descriptive component. Integrating quantitative pretest–posttest results with students' qualitative reflections provided a more comprehensive understanding of the observed changes following the onboard navigational training.

2.2 Participants

The study respondents consisted of 40 third-year Bachelor of Science in Marine Transportation (BSMT) students from one selected section of John B. Lacson Foundation Maritime University (Arevalo), Inc. who underwent onboard navigational training aboard M/V Capt. John B. Lacson during Academic Year 2025–2026.

Purposive sampling was employed because the selected section was specifically scheduled to undergo the onboard navigational training and was accessible to the researchers during the data collection period. All 40 students who met the study criteria and consented to participate were included.

Before the study, the researchers secured permission from the appropriate university authorities, including the BSMT Dean and the Shipboard Training Officer (STO). Participation was voluntary, and respondents were informed of the study's purpose, the confidentiality of their responses, and their right to withdraw at any time without penalty.

2.3 Instrument

Two research instruments were utilized to assess the effectiveness of onboard navigational training aboard M/V Capt. John B Lacson.

The first instrument was a 30-item multiple-choice navigational knowledge test designed to assess students' understanding and application of essential navigational concepts and procedures. The test covered six major domains: (1) International Regulations for Preventing Collisions at Sea (COLREGs); (2) bridge watchkeeping and lookout duties; (3) Electronic Chart Display and Information System (ECDIS) and radar operations; (4) passage planning and ship handling; (5) Bridge Resource Management (BRM) and communication; and (6) safety, emergencies, and shipboard drills. A Table of Specifications (TOS) was developed to ensure appropriate distribution of test items across the identified content domains and alignment with the intended learning objectives and cognitive levels. Each correct answer was assigned one point, with a maximum possible score of 30.

The second instrument was a 30-item attitude questionnaire using a four-point Likert scale ranging from 1 (Strongly Disagree) to 4 (Strongly Agree). The questionnaire assessed students' attitudes toward onboard navigational training across three areas: (a) navigational attitude, (b) attitude toward bridge watchkeeping and teamwork, and (c) safety and

emergency preparedness attitude. These dimensions were treated as components of the overall attitude toward onboard navigational training and analyzed collectively as the study's affective outcome.

To supplement the quantitative data, the posttest questionnaire included open-ended questions to gather respondents' reflections, experiences, insights, and suggestions regarding the onboard navigational training. These qualitative responses provided additional information to interpret the quantitative findings and identify areas for improvement in the training program.

To establish the content validity of the two research instruments, a panel of experts in maritime education, navigation, and research evaluated the instruments. For the multiple-choice knowledge test, the expert review followed the Table of Specifications to ensure the items adequately represented the identified content domains and learning objectives. The items in both instruments were assessed for clarity, relevance, organization, and alignment with the study objectives.

The 30-item navigational knowledge test obtained a Content Validity Index (CVI) of 0.93, while the 30-item attitude questionnaire obtained a CVI of 0.96, indicating excellent content validity for both instruments.

Pilot testing was conducted among BSMT students who were not included in the actual study. Since the navigational knowledge test consisted of dichotomously scored items, the Kuder–Richardson Formula 20 (KR-20) was used to determine its internal consistency. The knowledge test obtained a reliability coefficient of 0.90, indicating excellent internal consistency. For the 30-item attitude questionnaire, Cronbach's alpha was used to determine internal consistency, yielding a reliability coefficient of 0.95, also indicating excellent internal consistency.

These results established that both quantitative instruments demonstrated excellent content validity and internal consistency and were suitable for assessing students' navigational knowledge and attitudes toward onboard navigational training.

2.4 Data Collection

Before conducting the study, the researcher obtained formal approval from the appropriate university authorities. A request letter outlining the study's objectives, procedures, and schedule was submitted for approval.

The data collection process followed a pretest–intervention–posttest procedure consistent with the quasi-experimental research design. During the pretest phase, the 30-item navigational knowledge test and the 30-item attitude questionnaire were administered before the respondents underwent onboard navigational training. The results served as the study's baseline measures.

During the intervention phase, the respondents underwent actual onboard navigational training aboard M/V John B Lacson under the supervision of the Shipboard Training Officer. The training activities included bridge operations, watchkeeping duties, navigational planning, ECDIS handling, radar

observation, bridge resource management, and safety drills.

After completion of the training, the same quantitative instruments were administered as posttests to determine whether changes occurred in the students' navigational knowledge and attitude toward onboard navigational training. Open-ended questions were also administered to gather qualitative feedback regarding the respondents' learning experiences, reflections, and suggestions.

All responses were treated confidentially, and participation remained voluntary throughout the study.

2.5 Data Analysis

The data gathered from the respondents were organized, coded, tabulated, and analyzed using the Statistical Package for the Social Sciences (SPSS).

Descriptive statistics, including frequency counts, percentages, means, and standard deviations, were used to describe the students' navigational knowledge and attitudes before and after the onboard navigational training.

For the 30-item navigational knowledge test, scores were interpreted using a competency-based classification system. A score of 21–30, equivalent to 70% and above, was classified as "Passed," indicating satisfactory knowledge and understanding of onboard navigational concepts and procedures. A score of 0–20 was classified as "Failed," indicating insufficient knowledge and understanding of the identified navigational concepts and procedures.

Mean gain scores were computed by subtracting the pretest mean from the posttest mean (Posttest Mean – Pretest Mean). Positive mean gain values indicate an increase in students' scores following the onboard navigational training.

Paired-samples t-tests were used to determine whether statistically significant differences existed between the pretest and posttest scores in navigational knowledge and attitude toward onboard navigational training. The level of significance was set at $\alpha = .05$. The paired-samples effect size, expressed as Cohen's d_z , was computed to determine the magnitude of the pretest–posttest change. In interpreting the effect sizes, values of approximately 0.20, 0.50, and 0.80 were considered small, medium, and large effects, respectively [2]. Because the study employed a one-group pretest–posttest design without a comparison group, the effect sizes were interpreted as indicators of the magnitude of observed change rather than definitive evidence of causality.

Table 1. Mean Scale, Descriptive Rating, and Indicators for Attitude Toward Onboard Navigational Training

Mean Scale	Descriptive Rating	Indicators
3.51 – 4.00	Very High	The students demonstrated a very positive attitude toward onboard navigational training.
2.51 – 3.50	High	The students demonstrated a positive attitude toward onboard navigational training.

1.51 – 2.50	Low	The students demonstrated a less favorable attitude toward onboard navigational training.
1.0 – 1.50	Very Low	The students demonstrated a very low level of attitude toward onboard navigational training.

Table 2. Mean Scale, Descriptive Rating, and Indicators for Navigational Knowledge Test

Mean Scale	Descriptive Rating	Indicators
21-30	Passed	The students demonstrated satisfactory knowledge and understanding of onboard navigational concepts and procedures.
0-20	Failed	The students demonstrated insufficient knowledge and understanding of onboard navigational concepts and procedures.

For the qualitative component, the open-ended responses collected after the training were analyzed using thematic analysis following Braun and Clarke [1]. The researchers first familiarized themselves with the responses by repeatedly reviewing the students' written feedback. The researchers then generated initial codes from meaningful statements relevant to the research questions and the students' experiences during the onboard navigational training. Related codes were subsequently grouped into categories, from which potential themes were developed. The themes were then reviewed and refined to ensure that they represented meaningful and recurring patterns within the responses. Finally, the themes were clearly defined and named, and the findings were organized to demonstrate how the qualitative responses complemented the quantitative results.

The analysis focused particularly on students' descriptions of theoretical knowledge application, confidence and professional readiness, safety awareness, communication, and teamwork. Selected respondent codes were used to maintain anonymity while demonstrating the basis of the identified themes. Consistent with Braun and Clarke's [1] approach, the thematic analysis was used to identify patterns of meaning within the students' reflections rather than to quantify the frequency of responses. The qualitative findings were treated as supplementary evidence that provided contextual insight into the students' experiences and perceptions of the onboard navigational training.

The researchers ensured that all ethical principles were observed throughout the study. Before data collection, the researchers sought permission from the Research and Development Center of John B. Lacson Foundation Maritime University (Arevalo), Inc., and obtained informed consent from the respondents. Participation in the study was voluntary, and respondents were informed that they could withdraw at any time without penalty.

The researchers strictly maintained confidentiality and anonymity by not requiring respondents to provide personal identifiers in the questionnaire. All data gathered were used solely for academic and research purposes. The researchers complied with the provisions of the Data Privacy Act of 2012 (Republic Act No. 10173) to protect respondents' information.

Additionally, the instruments were designed to avoid discomfort, pressure, or bias. Respondents were assured that their honest responses would be treated

with respect and used only for educational and research purposes related to improving onboard navigational training practices.

3 RESULTS AND DISCUSSION

Pretest and Posttest Scores of the Students in Navigational Knowledge Before and After Undergoing Onboard Navigational Training aboard M/V Capt. John B Lacson

The pretest was administered to determine the baseline navigational knowledge of the third-year Bachelor of Science in Marine Transportation (BSMT) students before undergoing onboard navigational training aboard M/V Capt. John B Lacson. After the onboard navigational training, the same set of questionnaires was administered as a posttest to evaluate improvement in students' navigational knowledge and understanding of maritime operational concepts.

Table 3 presents the pretest and posttest scores of the students in navigational knowledge. Forty (40) third-year BSMT students participated in the study. The students obtained a pretest mean score of 13 with a descriptive rating of "Failed" and a standard deviation of 2.19. This finding indicates that prior to the onboard navigational training, the students demonstrated insufficient knowledge and understanding of navigational concepts, bridge watchkeeping procedures, safety protocols, and shipboard operational practices.

After undergoing the onboard navigational training aboard M/V Capt. John B Lacson, the students achieved a posttest mean score of 25 with a descriptive rating of "Passed" and a standard deviation of 1.43. The increase in mean score from 13 to 25 indicates a substantial improvement in the students' navigational knowledge after exposure to actual shipboard training and practical navigational activities.

The lower standard deviation in the posttest results further suggests that students' scores became more consistent after the training intervention, implying that the onboard navigational training contributed not only to improved performance but also to more uniform learning outcomes among participants.

The findings support the principle of experiential learning, which emphasizes that students strengthen their knowledge by engaging in concrete experiences, reflecting on those experiences, and applying concepts in practical contexts [6]. In maritime education, realistic training environments give learners opportunities to connect theoretical instruction with operational tasks and develop professional competencies. These findings are consistent with previous maritime education research emphasizing the importance of structured instruction, realistic training environments, and assessment in developing maritime and navigational competencies [10] [5].

The results therefore suggest that the observed improvement in navigational knowledge following the onboard training was consistent with the educational value of experiential and practice-oriented maritime training. The substantial increase from the pretest to

the posttest indicates that students performed considerably better after participating in the structured onboard learning experience.

Table 3. Pretest and Posttest Scores of the Students in Navigational Knowledge Before and After Undergoing Onboard Navigational Training aboard M/V Capt. John B Lacson

Test	N	Mean	Descriptive Rating	SD
Pretest	40	13	Failed	2.19
Posttest	40	25	Passed	1.43

Table 4 presents students' attitudes toward onboard navigational training before and after training aboard M/V Capt. John B Lacson. The pretest results showed a mean score of 3.14, a descriptive rating of "High," and a standard deviation of 0.50. This finding indicates that, even before the onboard navigational training, the students already had a generally positive attitude toward navigation, bridge watchkeeping, teamwork, safety awareness, and maritime operational responsibilities.

After the onboard navigational training, the posttest results showed an increased mean score of 3.60 with a descriptive rating of "Very High" and a standard deviation of 0.30. The increase in the mean score demonstrates that the training positively influenced the students' attitudes toward onboard navigational practices and maritime operational learning. The lower standard deviation in the posttest further suggests that the students developed more consistent and favorable attitudes after participating in the actual shipboard training activities.

The improvement in students' attitudes may be attributed to their direct exposure to authentic navigational operations, bridge procedures, safety activities, and collaborative shipboard tasks. Experiential learning gives students opportunities to connect classroom concepts with real professional situations, potentially strengthening engagement and appreciation of their future occupational responsibilities [6]. Maritime training research likewise emphasizes the importance of realistic learning environments, structured instruction, collaborative activities, and opportunities for reflection in developing professional competencies and confidence [8] [10].

The findings therefore suggest that the onboard training experience was associated not only with improved knowledge but also with a more favorable attitude toward navigational activities, teamwork, safety responsibilities, and professional shipboard practice.

Table 4. Level of Students' Attitude Toward Onboard Navigational Training Before and After Undergoing Training aboard M/V Capt. John B Lacson

Test	N	Mean	Descriptive Rating	SD
Pretest	40	3.14	High	0.50
Posttest	40	3.60	Very High	1.30

3.1 Significant Difference Between Pretest and Posttest Scores in Navigational Knowledge

Table 5 presents the results of the paired samples t-test on the pretest and posttest scores of the third-year BSMT students in navigational knowledge after undergoing onboard navigational training aboard M/V

Capt. John B Lacson. The results show that the students obtained a pretest mean score of 13.00 (SD = 2.19), which increased to a posttest mean score of 25.00 (SD = 1.43), yielding a mean difference of 12.00.

The statistical analysis revealed a significant difference between the pretest and posttest scores, $t(39) = -28.155$, $p < .001$. This result indicates that the onboard navigational training had a statistically significant effect on improving the students' navigational knowledge. The large magnitude of the t-value further suggests a strong effect of the intervention on students' learning outcomes.

The substantial increase in posttest scores demonstrates that students performed significantly better after undergoing actual shipboard training. This improvement may be attributed to the experiential nature of onboard training, where cadets were exposed to real navigational operations such as bridge watchkeeping, COLREG application, ECDIS usage, radar plotting, passage planning, and safety drills. Such hands-on learning experiences reinforce theoretical knowledge and enhance cognitive retention and procedural understanding.

The substantial increase in posttest performance indicates that students demonstrated significantly higher navigational knowledge after the training. This finding aligns with the principles of experiential learning, in which direct experience gives learners opportunities to apply, test, and refine knowledge in authentic contexts [6]. Maritime education research has similarly emphasized the importance of structured scenarios, instruction, and assessment in supporting the development of professional navigational competencies [10] [5].

Table 5 Mann-Whitney Test Result on the Pretest Mean Score Performances between the Experimental and Control Groups

Test	N	Mean	SD	Mean Difference	t	df	Sig (2-tailed)
Pretest	40	3.14	2.19	12	-28.155*	39	<.001
Posttest	40	3.60	1.43				

Note. Asterisk (*) means significant at .05 level of probability.

3.2 Significant Difference Between Pretest and Posttest Attitude Toward Onboard Navigational Training

Table 6 presents the results of the paired samples t-test on the students' attitude toward onboard navigational training before and after undergoing training aboard M/V Capt. John B Lacson. The pretest results show that the students obtained a mean attitude score of 3.14 (SD = 0.50), interpreted as "High," indicating that even before the intervention, the students already demonstrated a generally positive disposition toward navigation, bridge watchkeeping, teamwork, and safety-related responsibilities. After the onboard training, the posttest mean increased to 3.60 (SD = 0.30), interpreted as "Very High," suggesting an improvement in their overall attitude toward onboard navigational training and shipboard learning experiences.

The paired-samples t-test revealed a statistically significant difference between the pretest and posttest attitude scores, $t(39) = -5.019$, $p < .001$. This result indicates that the onboard navigational training had a significant positive effect on improving the students'

attitudes toward maritime operations and shipboard responsibilities.

The increase in attitude scores may be attributed to the students' direct exposure to real-life bridge operations, navigational procedures, and safety drills during the onboard training. Experiential learning helps cadets better appreciate the relevance of theoretical concepts, leading to improved motivation, engagement, and a more professional attitude toward maritime duties. When learners are placed in authentic operational environments, their attitudes tend to shift from passive understanding to active appreciation of professional responsibilities.

These findings are consistent with the experiential learning perspective, which suggests that direct engagement with authentic tasks can strengthen learners' understanding and appreciation of professional practice [6]. In maritime training, realistic and collaborative learning environments can also build students' confidence and perceived skill development, particularly when learners have opportunities to participate actively in training activities and receive structured guidance [8] [10].

The observed increase in attitude scores therefore suggests that the onboard training experience was associated with a more favorable disposition toward navigational practice, teamwork, safety, and professional shipboard responsibilities.

Table 6. Paired Samples t-Test on the Pretest and Posttest Scores of Students' Attitude Toward Onboard Navigational Training Before and After Undergoing Training aboard

Test	N	Mean	SD	Mean Difference	t	df	Sig (2-tailed)
Pretest	40	3.14	0.50				
Posttest	40	3.60	1.30	0.46	-5.019*	39	<.001

Note. Asterisk (*) means significant at .05 level of probability.

Table 7 presents the mean gains in students' navigational knowledge and attitude before and after undergoing onboard navigational training aboard M/V Capt. John B Lacson. The results show a mean gain of 12.00 points in navigational knowledge, increasing from 13.00 in the pretest to 25.00 in the posttest. This indicates a substantial improvement in students' cognitive understanding of navigational principles, COLREGs application, bridge watchkeeping procedures, and shipboard operational competencies.

For students' attitude toward onboard navigational training, the mean increased from 3.14 to 3.60, resulting in a mean gain of 0.46. Although the numerical gain is smaller than that observed for the knowledge test, the increase represents a positive shift from a "High" to a "Very High" level of attitude. This suggests that the onboard training experience further strengthened students' confidence, appreciation of bridge operations, teamwork, safety awareness, and professional responsibilities.

Taken together, the mean gains in both outcomes indicate positive changes following the onboard navigational training. The larger numerical gain in navigational knowledge reflects substantial improvement in cognitive performance, while the positive increase in attitude indicates a favorable shift in students' affective and professional dispositions.

These findings are consistent with Kolb's [6] experiential learning perspective, in which concrete experience, reflection, conceptual understanding, and application contribute to learning. The findings also correspond with maritime education research emphasizing the importance of realistic training environments and structured learning activities in developing professional competencies and perceived skill development [10] [8].

Table 7. Mean Gains in Students' Navigational Knowledge and Attitude Before and After Onboard Navigational Training

Variable	Pretest Mean	Posttest Mean	Mean Gain
Navigational Knowledge	13	25	12
Attitude Toward Onboard Navigational Training	3.14	3.60	0.46

Table 8 presents the effect sizes of the onboard navigational training on students' navigational knowledge and attitude. Cohen's d_z was computed to determine the magnitude of the pretest-posttest changes. The results revealed a very large effect for navigational knowledge ($d_z = 4.45$) and a large effect for students' attitude ($d_z = 0.79$).

For navigational knowledge, the effect size of 4.45 indicates an exceptionally large standardized improvement between the pretest and posttest scores. This finding demonstrates that the observed increase in students' navigational knowledge was not only statistically significant but also substantial in magnitude. The effect size greatly exceeds Cohen's [2] conventional benchmark of 0.80 for a large effect, indicating a very large pretest-posttest change in students' navigational knowledge following the onboard training.

For students' attitude toward onboard navigational training, the effect size of 0.79 indicates a large practical effect and is close to the conventional 0.80 threshold for a large effect [2]. This result suggests that the students experienced a meaningful positive change in their reported attitudes toward onboard navigational training following the intervention.

The substantially larger effect observed for navigational knowledge compared with attitude may be partly explained by the different measurement scales and the students' relatively favorable attitude before the training. The pretest attitude mean was already high at 3.14, leaving less room for improvement than the navigational knowledge measure, which had a lower pretest mean of 13.00. Thus, the results indicate that the observed pretest-posttest change was particularly pronounced in cognitive performance, while a meaningful positive change was also observed in students' attitudes.

These findings are consistent with Kolb's [6] Experiential Learning Theory, which emphasizes learning through concrete experience, reflection, conceptualization, and active application. The improvement in both outcomes suggests that opportunities to engage in authentic shipboard activities may have provided students with meaningful experiences through which they could apply and reinforce previously acquired theoretical knowledge in an operational context.

Nevertheless, the effect sizes should be interpreted with caution. Because the study employed a one-group

pretest–posttest design without a comparison group, the effect sizes describe the magnitude of the observed change between the pretest and posttest rather than providing definitive evidence that the onboard training alone caused the improvement. Other factors, including maturation, testing effects, continued classroom instruction, and other academic experiences, may have contributed to the observed changes.

Overall, the results demonstrate substantial observed improvements in navigational knowledge and a meaningful positive change in students' attitudes following the onboard navigational training. The findings provide empirical support for the educational value of structured experiential learning while recognizing the methodological limitations of the research design.

Table 8. Effect Sizes of Onboard Navigational Training on Students' Navigational Knowledge and Attitude

Variable	t-value	N	Cohen's d	z	Interpretation
Navigational Knowledge	-28.155	40	4.45		Very Large
Attitude Toward Onboard Navigational Training	-5.019	40	0.79		Large

3.3 Thematic Analysis of Students' Reflections on the Onboard Navigational Training

The open-ended responses were analyzed using thematic analysis based on Braun and Clarke [1]. The analysis resulted in three major themes: (1) Integration of Theoretical Knowledge and Practical Application, (2) Development of Confidence and Professional Readiness, and (3) Enhanced Safety Awareness and Teamwork. These themes reflected recurring patterns in the students' descriptions of how the onboard navigational training contributed to their understanding of navigation, familiarity with shipboard responsibilities, confidence, safety awareness, communication, and teamwork.

The qualitative findings served as supplementary evidence to the quantitative results. In particular, students' reflections provided contextual insight into the observed increase in navigational knowledge from a pretest mean of 13.00 to a posttest mean of 25.00 and the increase in attitude from 3.14 to 3.60. The themes therefore helped illustrate students' perceptions of how authentic shipboard experiences enabled them to connect theoretical concepts with practical navigational activities and recognize the importance of professional responsibilities, safety, and teamwork.

3.4 Integration of Theoretical Knowledge and Practical Application

The first theme reflects students' perceptions that onboard training provided opportunities to connect classroom concepts with actual navigational activities. Students referred to the practical application of navigational concepts, bridge procedures, COLREGs, radar, ECDIS, and other activities encountered during shipboard operations.

The students' reflections indicate that concepts previously learned in the classroom became more concrete when they were encountered in an actual bridge environment. Rather than viewing navigational concepts only as theoretical requirements, students could observe and participate in activities in which

these concepts were applied under actual operational conditions.

This finding provides contextual support for the substantial increase observed in the students' navigational knowledge from the pretest to the posttest. The quantitative results showed an increase in the mean score from 13.00 to 25.00, while the qualitative responses indicated that students perceived the onboard experience as helpful in understanding the practical application of concepts learned in class.

The finding is consistent with Kolb's [6] Experiential Learning Theory, which emphasizes the role of concrete experience, reflection, conceptualization, and active application in the learning process. It is also consistent with maritime education research emphasizing the importance of structured instruction, realistic training environments, and appropriate assessment in developing maritime and navigational competencies [10] [5].

Overall, this theme suggests that students perceived the actual shipboard environment as an important setting for connecting theoretical knowledge with practical navigational activities.

3.5 Development of Confidence and Professional Readiness

The second theme concerns students' perceptions of increased confidence and preparedness in performing navigational and bridge-related responsibilities. The responses reflected greater familiarity with bridge operations and an increased appreciation of the responsibilities associated with working in an actual shipboard environment.

Students described the onboard experience as an opportunity to become more familiar with the working environment, procedures, and responsibilities associated with navigation. Exposure to actual bridge activities allowed them to observe how navigational duties are performed and how different members of the bridge team contribute to safe operations.

The students' reflections also indicated that the experience helped them recognize the importance of discipline, attentiveness, responsibility, and proper execution of assigned duties. These perceptions are relevant to the quantitative finding that students' attitudes toward onboard navigational training increased from a mean of 3.14, interpreted as "High," to 3.60, interpreted as "Very High."

The qualitative findings therefore provide contextual support for the observed positive change in students' attitudes. However, the responses should be interpreted as students' perceptions of increased confidence and readiness, rather than as direct evidence that their professional competence or performance had objectively increased.

The finding is consistent with research emphasizing the role of realistic and collaborative maritime training environments in supporting perceived skill development and self-efficacy. Renganayagalu et al. [8] found that characteristics of maritime simulation environments can influence students' self-efficacy and perceived skill development. Similarly, experiential learning emphasizes the importance of direct

engagement and reflection in developing learners' understanding of professional practice [6].

Overall, this theme suggests that the onboard training provided students with opportunities to become more familiar with actual maritime responsibilities and to perceive themselves as better prepared for future shipboard duties.

3.6 *Enhanced Safety Awareness and Teamwork*

The third theme centers on students' recognition of the importance of safety, communication, coordination, and teamwork during navigational operations. Their reflections indicated that safe navigation involves not only individual technical knowledge but also effective communication and cooperation among members of the bridge team.

Students recognized that bridge operations require personnel to communicate clearly, coordinate their actions, remain attentive to developing situations, and follow established safety procedures. The onboard training therefore provided students with opportunities to appreciate the relationship between individual responsibilities and the collective performance of the bridge team.

This theme provides additional context for the positive attitude results observed after the training. The students' posttest attitude mean increased to 3.60, indicating a "Very High" level of attitude toward onboard navigational training. The qualitative responses suggest that students particularly appreciated the importance of teamwork, communication, and safety in actual shipboard operations.

The finding is consistent with the emphasis placed on teamwork and communication in maritime crew resource management. Wahl and Kongsvik [12] highlighted the importance of non-technical competencies and crew resource management in maritime operations, particularly in relation to communication, coordination, decision-making, and teamwork. These competencies are also consistent with the broader competency requirements emphasized within maritime education and training frameworks.

Overall, this theme indicates that students perceived the onboard training as an opportunity to better understand the importance of communication, teamwork, and safety in supporting effective and safe navigational operations.

3.7 *Synthesis of the Qualitative Findings*

The three themes collectively demonstrate that the students perceived the onboard navigational training as a meaningful learning experience that extended classroom learning into an authentic shipboard context. The first theme, Integration of Theoretical Knowledge and Practical Application, emphasized the connection between classroom concepts and actual navigational activities. The second theme, Development of Confidence and Professional Readiness, reflected students' perceptions of becoming more familiar with bridge responsibilities and future professional duties. The third theme, Enhanced Safety Awareness and Teamwork, highlighted students'

recognition of the importance of communication, coordination, and safety in actual maritime operations.

These qualitative findings complement the quantitative results. The substantial increase in navigational knowledge from a pretest mean of 13.00 to a posttest mean of 25.00 was supported contextually by students' reflections that actual shipboard activities helped them understand and apply theoretical concepts. Similarly, the increase in attitude from 3.14 to 3.60 was complemented by students' perceptions of greater familiarity with shipboard responsibilities, confidence, safety awareness, and teamwork.

The qualitative findings therefore provide contextual insight into how students perceived the learning experience, while the quantitative findings provide measurable evidence of changes in navigational knowledge and attitude. The two forms of evidence should be interpreted as complementary rather than interchangeable. The quantitative results establish the magnitude and statistical significance of the observed pretest-posttest changes, whereas the qualitative findings help explain the students' experiences and perceptions associated with those changes.

Taken together, the findings support the value of authentic and structured onboard learning as a complementary component of maritime education. Consistent with the principles of experiential learning, the onboard environment gave students opportunities to encounter authentic maritime activities, connect those experiences with previously acquired knowledge, reflect on professional responsibilities, and recognize the importance of applying technical and non-technical competencies in actual shipboard contexts [6]. However, because the qualitative component was supplementary and based on students' self-reported reflections, the themes should be understood as contextual evidence of students' perceptions rather than independent proof of competency development.

4 CONCLUSIONS

1. The third-year BSMT students demonstrated a marked improvement in navigational knowledge following the onboard navigational training. The mean score increased from 13.00 (SD = 2.19) in the pretest, interpreted as "Failed," to 25.00 (SD = 1.43) in the posttest, interpreted as "Passed." The findings indicate that students demonstrated substantially higher performance in the navigational knowledge assessment after participating in the structured onboard training activities.
2. The students demonstrated a positive attitude toward onboard navigational training before the intervention, with a pretest mean of 3.14 (SD = 0.50) interpreted as "High." Following the training, the mean increased to 3.60 (SD = 0.30), interpreted as "Very High." This indicates a positive shift in students' attitudes toward onboard navigational learning, including their perceptions of navigation, bridge watchkeeping, teamwork, safety, and shipboard responsibilities.

3. A statistically significant difference was found between the students' pretest and posttest navigational knowledge scores, $t(39) = -28.155$, $p < .001$. The result indicates that students performed significantly better in the posttest than in the pretest following the onboard navigational training. Given the absence of a comparison group, this finding should be interpreted as evidence of a significant pretest–posttest change rather than definitive proof that the training alone caused the improvement.
4. A statistically significant difference was also found between the students' pretest and posttest attitude scores, $t(39) = -5.019$, $p < .001$. The increase from a "High" to a "Very High" level indicates a significant positive change in students' attitudes toward onboard navigational training following their shipboard learning experience. As with the knowledge results, the finding represents an observed pretest–posttest change and should not be interpreted as establishing causality in the absence of a control or comparison group.
5. The students demonstrated positive mean gains in both measured outcomes following the onboard navigational training. Navigational knowledge increased by 12.00 points, from a pretest mean of 13.00 to a posttest mean of 25.00, while attitude increased by 0.46, from 3.14 to 3.60. These positive mean gains indicate improved navigational knowledge and a favorable shift in reported attitudes following the training.
6. The onboard navigational training was associated with substantial improvements in both navigational knowledge and students' attitudes. Navigational knowledge increased by 12.00 points, from a pretest mean of 13.00 to a posttest mean of 25.00, with a statistically significant difference, $t(39) = -28.155$, $p < .001$, and a very large effect size (Cohen's $d = 4.45$). Students' attitudes increased by 0.46, from a mean of 3.14 to 3.60, with a statistically significant difference, $t(39) = -5.019$, $p < .001$, and a large effect size (Cohen's $d = 0.79$). These findings provide strong evidence of substantial observed improvement following the training, although causal conclusions should be made cautiously because the study employed a one-group pretest–posttest design without a comparison group.
7. The thematic analysis of the students' open-ended responses revealed three major themes: (1) Integration of Theoretical Knowledge and Practical Application, (2) Development of Confidence and Professional Readiness, and (3) Enhanced Safety Awareness and Teamwork. The reflections indicate that students perceived the onboard training as an opportunity to connect classroom knowledge with actual navigational activities, become more familiar with shipboard responsibilities, and recognize the importance of safety, communication, and

teamwork in maritime operations. These qualitative findings provide contextual support for the quantitative results by illustrating how students experienced and perceived the onboard training, while remaining supplementary to the objective measures of navigational knowledge and attitude.

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