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Enhancing Marine Safety for Navigators Around Terengganu Islands

Nur Muhammad Aqil Nadzri[1]*, Nik Muhammad Afiz Harom@ Junoh[1]

[1] Faculty of Maritime Studies, Universiti Malaysia Terengganu

* Corresponding author: aqilnadzri373@gmail.com

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ABSTRACT

The Terengganu Islands, located off the east coast of Peninsular Malaysia, have experienced a significant increase in tourism activities, resulting in higher maritime traffic and potential risks to navigational safety. Common marine activities in the area include snorkelling, scuba diving, boating, canoeing, and fishing. This study aims to evaluate existing navigational safety practices and assess the level of awareness among boaters in the Terengganu Islands, particularly in relation to regulatory compliance and accident prevention. A mixed-methods approach will be adopted, incorporating both primary and secondary data collection. Primary data will be obtained through on-site observations to examine actual navigational safety practices, as well as a structured questionnaire using a Likert scale to assess boaters' awareness and understanding of safe navigation procedures. The survey data will be analysed using a Weighted Scoring Method, in which different navigational safety criteria are assigned weights based on their relative importance, allowing for a comprehensive assessment of overall safety awareness and compliance levels. Secondary data will include a review of relevant literature and expert interviews, focusing on established navigation safety frameworks such as the Convention on the International Regulations for Preventing Collisions at Sea (COLREGs). The findings of this study are expected to contribute to improved understanding and adherence to navigational safety regulations among boaters in the Terengganu Islands. The proposed recommendations aim to enhance safety awareness, strengthen compliance with established standards, and ultimately reduce the risk of maritime accidents in the region.

Keywords: Navigational safety; Boater awareness; Maritime traffic; Weight Scoring Method

1. Introduction

1.1 Background of Research

Safe navigation is a fundamental responsibility of boaters to ensure the safety of all individuals on the water and to prevent maritime accidents. This requires adherence to established navigational rules and the effective use of navigational tools, including nautical charts, compasses, and GPS systems, as well as maintaining proper situational awareness (Formela et al., 2019).

A clear understanding of waterway markers, buoys, and channel markers is essential for identifying safe routes. Additionally, defensive boating practices, such as maintaining a safe distance from other vessels and adjusting speed according to sea and weather conditions, play a crucial role in promoting navigational safety.

Regular vessel maintenance and checks on onboard safety equipment, including life jackets and distress signals, further enhance overall safety at sea.In recent years, the Terengganu Islands have experienced a significant increase in tourism, leading to higher maritime activity and growing concerns regarding navigational safety (Department of Marine Park Malaysia, 2023).

Media reports from outlets such as New Straits Times and The Star have highlighted several incidents, including accidents near Perhentian Island on May 13, 2017, and near Redang Island on August 8, 2022. This study focuses on Perhentian, Redang, and Kapas Islands, aiming to examine current navigational safety practices and assess the level of awareness among boaters operating in these waters. The findings are expected to provide valuable insights and practical recommendations to improve navigational safety across the Terengganu Islands.

1.2 Problem Statement

The Terengganu Islands, located off the east coast of Peninsular Malaysia, have seen a steady increase in tourist activities over the years. With attractions such as snorkelling, scuba diving, boating, canoeing, and fishing, the area has become a popular destination for both local and international visitors. However, this rise in tourism has also brought about heavier boat traffic, raising concerns over navigation safety in the surrounding waters. As the sea becomes more crowded, it is important to examine the current navigation practices in place and assess how aware boaters are of the rules and regulations designed to keep everyone safe on the water.

1.3 Research Questions

1) What are the safety navigation practices currently implemented around the Terengganu Islands?

2) To what extent are boaters in the Terengganu Islands aware of navigation safety requirements?

3) What strategies can be recommended to improve boaters' awareness of navigation safety in the Terengganu Islands?

1.4 Research Objectives

1) To assess the safety navigation practices around Terengganu Islands.

2) To evaluate boaters' awareness of navigation safety in the Terengganu Islands.

3) To propose strategies for enhancing boaters' awareness of navigation safety.

1.5 Scope of Study

This research focuses on the safety navigation practices and the level of awareness among boaters operating around the Terengganu Islands, specifically in the areas of Perhentian, Redang, and Kapas Islands. These locations have experienced a significant increase in maritime activity due to tourism, which includes boating, snorkelling, scuba diving, canoeing, and fishing.

The study is limited to local boat operators and small vessel users involved in tourism and transportation services within these areas. The research assesses the current navigation safety measures in place, evaluates boaters' awareness of maritime regulations particularly the COLREGs and explores strategies to enhance safety practices. Data collection involves field observations, surveys using a Likert scale, literature reviews, and expert interviews to gain a comprehensive understanding of the navigation safety challenges and potential improvements.

1.6 Justifications of the Research

The growing popularity of the Terengganu Islands as a tourist destination has led to a significant increase in boating and water-based activities, resulting in higher traffic in surrounding waters. While these developments contribute positively to the local economy, they also raise serious concerns about navigation safety.

Current safety navigation practices in the area appear to be insufficient, and there is a noticeable lack of awareness among boat operators regarding proper navigational procedures and international regulations such as the COLREGs. This research is necessary to highlight these shortcomings and provide insights into the actual safety practices being followed. By assessing the level of awareness among boaters and identifying the gaps in compliance, this study aims to support the development of more effective strategies and educational efforts.

The findings will directly benefit boat operators by enhancing their understanding of safe navigation and indirectly protect tourists who rely on these services. In the context of increasing tourism activity, improving safety navigation is not only timely but also essential to ensure sustainable and secure marine tourism in the Terengganu Islands.

2. Literature Review

2.1 Safety Navigation

Safety refers to the condition of being free from dangers, whether caused by natural events or human error (Nas, 2015). In the context of navigation, it involves all tasks related to determining, maintaining, and adjusting a vessel's course and speed while considering surrounding traffic and conditions. Navigation is often viewed as a profession, an activity, and an applied science (Józef et al., 2008). The safety of navigation focuses on preventing collisions, groundings, and other navigational mistakes that could endanger lives, the environment, or property (Osnin & Rahman, 2018). It requires a combination of proper training, the use of modern technology, clear communication, and compliance with regulations to ensure vessels can travel safely. Two major international conventions are important in this area: the International Convention for the Safety of Life at Sea (SOLAS) of 1974 and the Convention on the International Regulations for Preventing Collisions at Sea (COLREGs) of 1972. Since 1959, the International Maritime Organization (IMO) has introduced various conventions, guidelines, and standards to improve maritime safety (IMO, 2017).

2.2 Malaysia's Navigation Framework

The Malaysia has been a member of the IMO since 1971 and currently serves as a Council Member under Category C, which represents countries with strong maritime interests (MARDEP, 2017). The Marine Department of Malaysia (MARDEP) is responsible for applying and enforcing international maritime standards in Malaysian waters. One of MARDEP's key roles is to ensure that navigation aids—like buoys, beacons, and lighthouses— are properly installed and maintained according to IMO and IALA (International Association of Marine Aids to Navigation and Lighthouse Authorities) standards (MARDEP, 2016; MARDEP, 2017). With increasing vessel traffic, these aids to navigation are critical not only for guiding ships safely but also for preventing maritime accidents. The Ministry of Transport Malaysia, through MARDEP, ensures that navigational aids are available, reliable, and properly managed along the country's coastline (Ministry of Transport Malaysia, 2023).

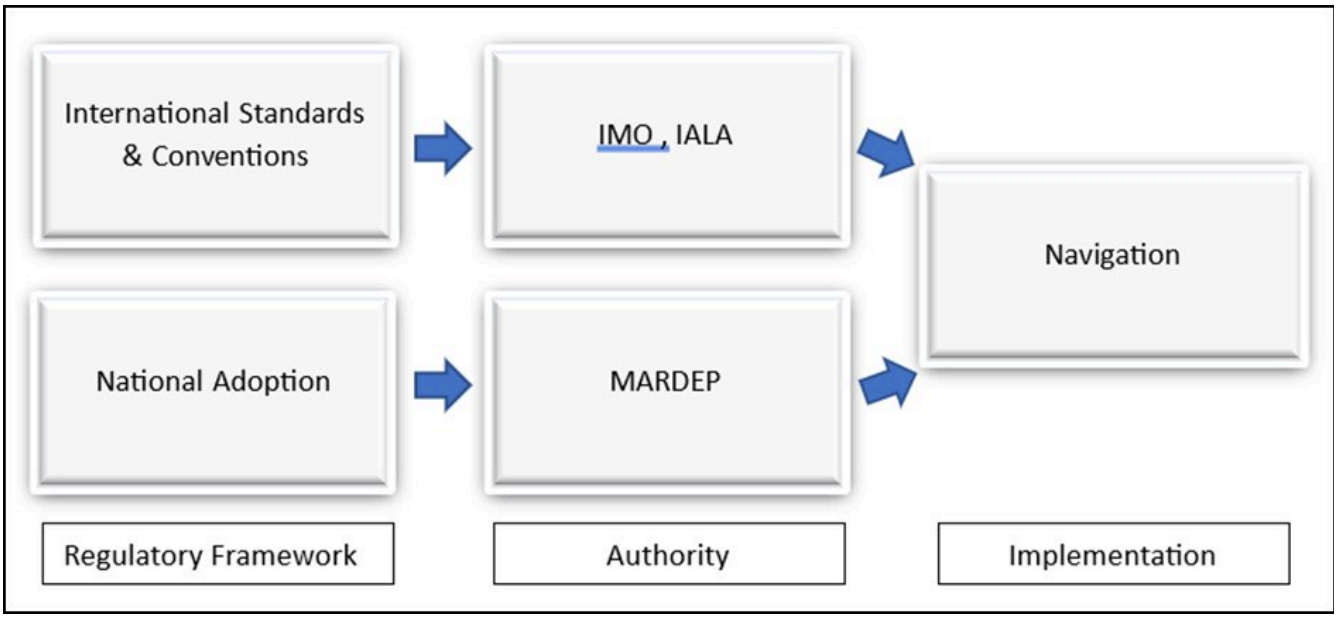


Figure 1. Regulatory framework for navigation.

2.3 Factor Influencing Malaysian Maritime Students' Career Interest

The The 1972 Convention on International Regulations for the Prevention of Collisions at Sea (COLREGs) went into impact in 1977. Aside from COLREGs, the IMO issued number of resolutions and codes concerning COLREG execution. Collision avoidance is thought to help prevent groundings, collisions with fixed barriers, and ships collision. The COLREGS contains 41 rules in total, divided into six sections: Part A is for general

information; Part B is for steering and sailing; Part C is for lights and shapes; Part D is for sound and light signals; Part E is for exemptions; and Part F is for verification of compliance with the Convention's provisions. There are four Annexes containing technical requirements for lights and shapes and their positioning; sound signalling appliances; additional signals for fishing vessels operating in close proximity; and international distress signals (IMO, 2019).

Compliance with the COLREGs is essential for ensuring maritime safety and reducing the risk of accidents and collisions. It is the responsibility of all mariners to become acquainted with these regulations and apply them in their daily operation. These regulations are essential in preventing collisions, promoting maritime safety, and facilitating the smooth and efficient flow of international maritime traffic by providing clear standards and guidelines for vessel conduct and interaction.

3. Methodology

3.1 Introduction

This chapter outlines the research design and methodology adopted to examine navigational safety practices and assess the level of awareness among boaters operating around the Terengganu Islands. The methodology section explains the overall research approach, study area, sampling strategy, data collection methods, and data analysis techniques employed to achieve the research objectives. A quantitative research approach was adopted to allow for the systematic measurement and comparison of boaters' awareness and compliance with navigational safety practices. Data were collected through a structured questionnaire administered to boaters operating in selected areas of the Terengganu Islands, including Perhentian, Redang, and Kapas Islands. The responses were analysed using the Weighted Scoring Method (WSM), whereby key navigational safety criteria were assigned weights based on their relative importance, informed by relevant literature and expert judgement. This method enabled the ranking and evaluation of safety awareness levels and practices, providing a clear and structured assessment to support meaningful conclusions and recommendations.

3.2 Research Framework

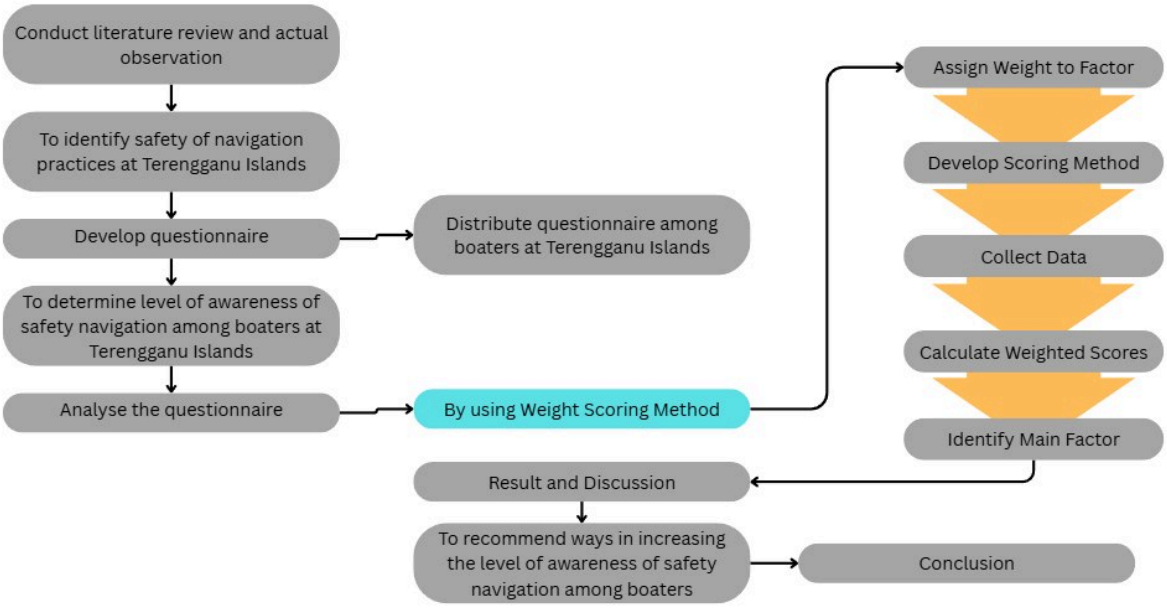


Figure 2. Research framework

3.3 Data Collection Strategy

In this research, a comprehensive data collection strategy was employed to achieve the research objectives. The strategy encompassed a combination of primary and secondary data collection methods, including surveys, actual observations, literature review, and expert opinion. By utilizing multiple approaches, an overall understanding of safe navigation in Terengganu Islands was obtained.

3.4 Primary Data

Primary data collection which is actual observations and site visit were conducted in the research area to gain insights into the current state of safe navigation. This method involved precisely observing and describing the behaviours and phenomena (Kumar, 2022). Through these observations, researchers were able to develop a clear understanding of the prevailing conditions and practices in the field. Surveys using questionnaires are a commonly employed research method for collecting data from a large number of participants in a structured manner.

The questionnaire design is crucial, with clear and unbiased questions formulated to address the research objectives. Likert scales are widely used in survey research due to their effectiveness in evaluating opinions, attitudes, or behaviours. Likert scales are widely used in survey research due to their making it simple to put into practise personality traits or opinions (Pritha Bhandari, 2020). By employing this scale, respondents were able to express their agreement or disagreement with statements regarding the COLREGs, enabling the researchers to assess their level of awareness and compliance.

Expert opinions were sought as an additional data collection method. Expert opinions are valuable in ensuring the social and methodological validity of scientific research. By engaging with experts who possess knowledge, cultures, and experiences in the field, the researchers obtained insights and solutions to pertinent issues. This method contributed to the research's credibility and facilitated long-term predictions and problem-solving.

3.5 Secondary Data

Th Secondary data collection is a research strategy that involves gathering pre- existing data from various sources, such as published reports, academic journals, government databases, or organizational records (Martins et al., 2018). This method allows researchers to analyse existing data that has been collected for other purposes, providing valuable insights and supporting their research objectives. This secondary data could contain information that was collected in the past and is being considered for reuse for new questions for which the information collected wasn't originally intended.

A literature review is a particular approach to collecting data. The literature review played a crucial role in this regard, as it involved an extensive examination of scholarly articles, books, and relevant sources related to safe navigation. The literature review also helps to establish the theoretical structure by defining the topic's core concepts as well as its various aspects and complexity (Boumezrag & Bey Boumezrag, 2022). This allowed for the synthesis of existing knowledge, identification of core concepts, and exploration of various aspects and complexities associated with the topic.

3.6 Data Sampling Strategy

The study adopts a purposive sampling technique, where participants are intentionally selected based on specific characteristics that align with the research objectives. In this case, the primary criterion is that respondents must be active boaters who operate in the waters around Terengganu Islands. This non-probability sampling method is appropriate for exploratory research where the goal is to gain insight from individuals with direct experience and relevance to the subject matter. It ensures that the data collected is rich, focused, and highly applicable to the research questions.

3.7 Target Population

This study focuses on evaluating and improving the level of awareness regarding safety navigation among boaters around Terengganu Islands. To ensure the findings are relevant and meaningful, a structured sampling strategy is employed, supported by both primary and secondary data sources.

3.8 Expert Interview

In accordance with the research framework, expert interviews were conducted to support the findings of this study and to provide professional validation of the results obtained from the Weighted Scoring Method (WSM) analysis. This qualitative component was incorporated to obtain in-depth insights from individuals with specialised knowledge and practical experience in maritime navigation safety, maritime operations, and maritime education.

The expert interviews served a supporting role by offering professional perspectives on navigational safety practices and validating the ranked safety awareness criteria identified through the questionnaire survey. These expert insights enhanced the interpretation of the quantitative findings and ensured that the results were consistent with real operational conditions, regulatory requirements, and industry practices within the Terengganu Islands. Careful planning was undertaken to ensure the effectiveness and relevance of the interviews.

Two key documents guided the interview process: an interview plan, which focused on identifying and selecting suitable experts based on their experience in navigation safety and maritime operations, and an interview guide, which consisted of structured questions aligned with the research objectives. These tools ensured that the interviews remained focused, systematic, and effective in supporting the overall objectives of the study and strengthening the validity of the research findings.

4. Results and Discussions

4.1 Results Objective 1

The study's first objective, to assess safety navigation practices in Terengganu Islands, has been achieved through data gathering and analysis. Actual observations and site visits in the research area offer a clear understanding of the current safety navigation practices. The study identified types of vessels present on Terengganu Islands, including UMT Boat, Speed Boat, Fishing Boat, Water Taxi, and Passenger Boat.

Table 1. Analysis type of vessel based on actual observation.

Actual Observation	Type of vessel
Figure 3: Jetty at Pulau Redang.	Speed boat
Figure 4: Water taxi at Pulau Perhentian Kecil	Water taxi
Figure 5: Fishing vessel at Pulau Perhentian Kecil.	Fishing vessel
Figure 6: Speed boat at Pulau Perhentian Besar	Pasengger boat
Figure 7: UMT boat at Pulau Kapas	UMT boat



Figure 3. Jetty at Pulau Redang.



Figure 4. Water taxi at Pulau Perhentian Kecil



Figure 5. Fishing vessel at Pulau Perhentian Kecil.



Figure 6. Speed boat at Pulau Perhentian Besar



Figure 7. UMT boat at Pulau Kapas

Boaters in Terengganu Islands commonly use Aids to Navigation (AToN) in their daily navigation, as revealed by the study. Various typical AToNs have been set up in the region, as outlined in Table 4. The MARDEP has organized these AToNs to ensure safe passage for mariners.

Table 2. Analysis of Aid to Navigation (AToN) based on actual observation.

Type of Mark	Location	Function
Figure 8: Pulau Kapas Lighthouse	Pulau Kapas	The lighthouse is currently active and has a focal plane of 29 meters (95 feet). It emits a white flash every 10 seconds and is mounted on a approximately 10-meter (33 feet) steel post. Situated on a promontory on the southwest coast of the island (Rowlett, 2023).

Type of Mark	Location	Function
Figure 9: Pulau Pinang Lighthouse	Pulau Redang	The lighthouse is currently active with a focal plane of 132 meters (433 feet). It emits a white flash every 10 seconds and is housed in a 10-meter (33 feet) square white skeletal tower with a one-story keeper's house. Located on the southernmost of the Redang Islands, it is known as the Pulau Pinang Lighthouse (Rowlett, 2023).
Figure 10: Pulau Perhentian Besar Lighthouse	Pulau Perhentian Besar	The lighthouse is active, emitting a white flash every 7 seconds from a height of 44 meters (144 feet). It stands on a 10-meter (33 feet) structure and is located on the southwest tip of Perhentian Besar (Rowlett, 2023).
Figure 11: Seabelle Rock Lighthouse	Pulau Perhentian Kecil	The lighthouse is active, producing a white flash every 4 seconds from a focal plane of 9.5 meters (32 feet). It is a modern light situated on a 10-meter (33 feet) structure off the east coast of Terengganu state in the Perhentian Islands, which is an archipelago of coral islands and reefs (Rowlett, 2023).



Figure 8. Pulau Kapas Lighthouse



Figure 9. Pulau Pinang Lighthouse



Figure 10. Pulau Perhentian Besar Lighthouse



Figure 11. Seabelle Rock Lighthouse

The questionnaire administered to boaters, including tourist boats and fishing vessels, will assess their level of awareness regarding safety navigation practices. The Likert scale method was used to measure their agreement or disagreement with statements related to safety navigation.

4.2 Part A: The demographic information about the respondent.

A total of 123 people was sampled among boaters at Terengganu Islands. Table 3 below shows the profile analysis based on Gender of samples. A total of 120 (100%) of the study sample were male boaters and a total of 3(2.4%) were female boaters.

A total of 123 people was sampled among boaters at Terengganu Islands. Table 4 below shows the profile analysis based on Age of samples. A total of 20 (16.3 %) study samples aged 20 years and below, a total of 57 (46.3 %) study samples aged between 21 years to 40 years, a total of 37 (30.1 %) study samples aged between 41 years to 60 years, and a total of 9 (7.3%) study samples aged more than 60 years.

A total of 123 people was sampled among boaters at Terengganu Islands. Table 5 below shows the profile analysis based on Marriage Status of samples. A total of 83 (67.5 %) study samples status is married, a total of 37 (30.1 %) study samples status is single, a total of 3 (2.4 %) study samples are divorced.

A total of 123 people was sampled among boaters at Terengganu Islands. Table 6 below shows the profile analysis based on Race of samples. A total of 115 (93.5%) of the race study samples are Malay, a total of 3 (2.4 %) of the race study samples are Chinese, a total of 2 (1.6%) of the race study samples race are Indian and total of 3 (2.4%) of the race study samples race are others.

A total of 123 people was sampled among boaters at Terengganu Islands. Table 7 below shows the profile analysis based on Nationality of samples. A total of 123 (100%) of the study sample are Malaysian boaters and none of them are others nationality boaters.

A total of 123 people was sampled among boaters at Terengganu Islands. Table 8 below shows the profile analysis based on Education Level of samples. A total of 54 (43.9 %) study's education level sample has a SPM, a total of 20 (16.3 %) study's education level sample has a Certificate, a total of 8 (6.5 %) study's education level sample has Diploma / Degree / Master / Phd, a total of 8 (6.5 %) study's education level has a Competency Certificate (COC) and total of 33 (26.8 %) study's education sample are others.

A total of 123 people was sampled among boaters at Terengganu Islands. Table 9 below shows the profile analysis based on Type of Boat of samples. A total of 4 (3.3 %) study samples type of boat is UMT Boat, a total of 83 (67.5 %) study samples type of boat is speed boat, a total of 20 (16.3 %) study samples type of boat is fishing boat and a total of 16 (13 %) study samples type of boat are others.

A total of 384 people was sampled among boaters at Terengganu Islands. Table 10 below shows the profile analysis based on Years of Experience of samples. A total of 26 (21.1 %) study samples based on years of experience between less than five (5) years, a total of 20 (24.4%) study samples based on years of experience between six (6) year to ten (10) years, a total of 67 (54.5 %) study samples based on years of experience more than 10 years.

The scale for Level of Awareness based on percentage of score was adopted from Thakrar et al., (2014) will be used to determine level of awareness of safety navigation among boaters at Terengganu Islands.

Table 3. Analysis of Profiles by Gender of Samples

Gender	Number (n)	Percent (%)
Male	120	97.6
Female	3	2.4
Total	123	100

Table 4. Analysis of Profiles by Age of Samples

Age (years)	Number (n)	Percent (%)
20 and Below	20	16.3
21-40	57	46.3
41-60	37	30.1
60 and Above	9	7.3
Total	123	100

Table 5. Analysis of Profiles by Status of Samples

Marriage Status	Number (n)	Percent (%)
Married	83	67.5
Single	37	30.1
Divorced	3	2.4
Total	123	100

Table 6. Analysis of Profiles by Race of Samples

Race	Number (n)	Percent (%)
Malay	115	93.5
Chinese	3	2.4
Indian	2	1.6
Others	3	2.4
Total	123	100

Table 7. Analysis of Profiles by Nationality of Samples

Nationality	Number (n)	Percent (%)
Malaysian	123	123

Nationality	Number (n)	Percent (%)
Others	0	0
Total	123	100

Table 8. Analysis of Profiles by Education Level of Samples

Education Level	Number (n)	Percent (%)
SPM	54	43.9
Certificate	20	16.3
Diploma / Degree / Master / Phd	8	6.5
Competency Certificate (COC)	8	6.5
Others	33	26.8
Total	123	100

Table 9. Analysis of Profiles by Type of Boat of Samples

Type of Boat	Number (n)	Percent (%)
UMT Boat	4	3.3
Speed Boat	83	67.5
Fishing Boat	20	16.3
Others	16	13
Total	123	100

Table 10. Analysis of Profiles by Years of Experience of Samples

Years of Experience	Number (n)	Percent (%)
Less than 5 years	26	21.1
6years to 10 years	20	24.4
More than 10 years	67	54.5
Total	123	100

Table 11. Level of Awareness based on percentage of score.

Percentage Score (%)	Level of Awareness
70-100	Highly Aware
40 - 69	Moderately Aware
0 - 39	Lowly Aware

4.3 Part B: The level of awareness among the boaters about safety navigation

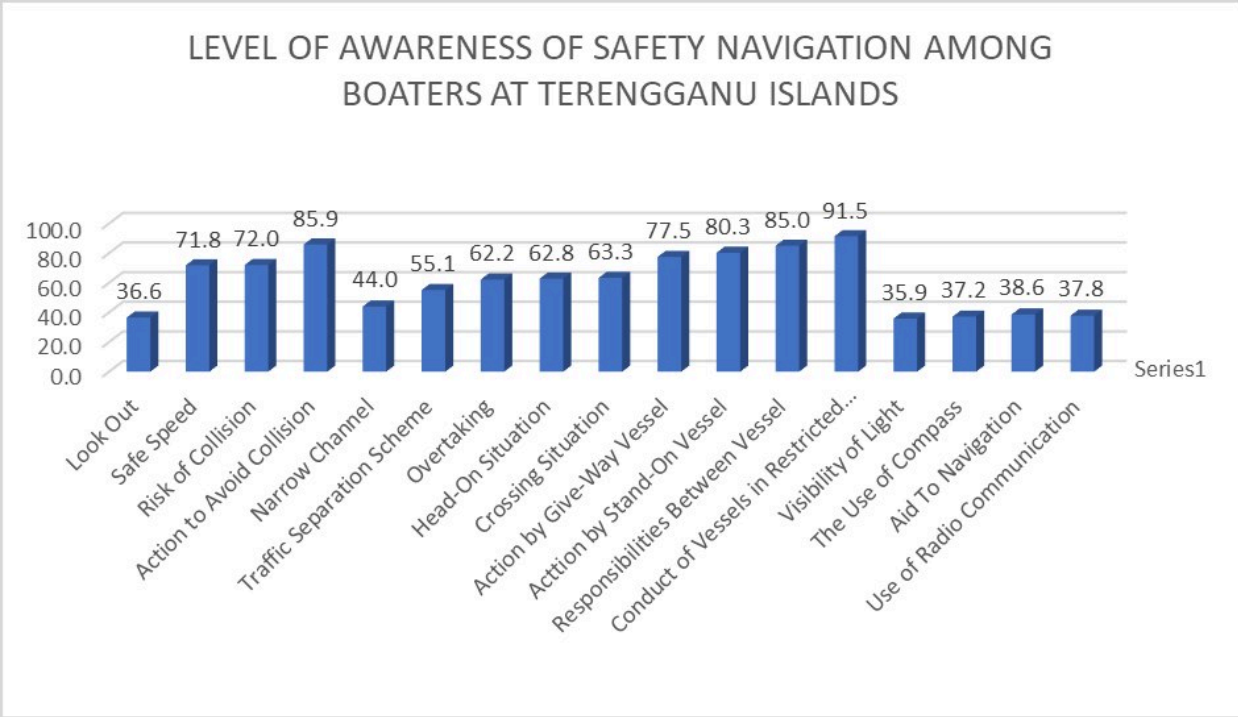


Figure 12. Level of awareness of safety navigation among boaters at Terengganu Islands

Table 12. Level of awareness based on percentage of score

Safety of Navigation	Percentage Score (%)	Level of Awareness
Look Out	36.6	Lowly Aware
Safe Speed	71.8	Highly Aware
Risk of Collision	72.0	Highly Aware
Action to Avoid Collision	85.9	Highly Aware
Narrow Channel	44.0	Moderately Aware
Traffic Separation Scheme	55.1	Moderately Aware
Overtaking	62.2	Moderately Aware
Head-On Situation	62.8	Moderately Aware
Crossing Situation	63.3	Moderately Aware
Action by Give-Way Vessel	77.5	Highly Aware
Action by Stand-On Vessel	80.3	Highly Aware
Responsibilities Between Vessel	85.0	Highly Aware
Conduct of Vessels in Restricted Visibility	91.5	Highly Aware
Visibility of Light	35.9	Lowly Aware
The Use of Compass	37.2	Lowly Aware
Aid To Navigation	38.6	Lowly Aware
Use of Radio Communication	37.8	Lowly Aware

From table above, it shows that the understanding of safety navigation knowledge and application varies from each respondent. The data highlights varying levels of awareness among respondents regarding safety navigation concepts. Notably, Look Out (36.6%), The Use of Compass (35.9%), Aid to Navigation (37.2%), and

Use of Radio Communication (38.6%) exhibit low awareness. Narrow Channel (44%), Traffic Separation Scheme (55.1%), Overtaking (62.2%), Head-On Situation (62.8%), and Crossing Situation (63.8%) fall into the moderately aware category. Concepts such as Safe Speed (71.8%), Risk of Collision (72%), Action to Avoid Collision (85.9%), Action by Give-Way Vessel (77.5%), Action by Stand-On Vessel (80.3%), Responsibilities Between Vessels (85.0%), and Conduct of Vessels in Restricted Visibility (91.5%) are highly aware among respondents.

4.4 Results Objective 3

Enhancing physical maritime infrastructure and strengthening the technical competency of mariners. Expert interviews conducted for this study emphasize that Navigation Safety Infrastructure remains the foundation of maritime security. By investing in clear signage and navigational buoys, as recommended by the Maritime and Port Authority of Singapore (2019), authorities can significantly improve route recognition. This is particularly critical in Narrow Channel Navigation, where prominent markers are essential for preventing groundings and collisions in restricted waters (Maritime Studies South Africa, 2020). Furthermore, the human element is addressed through proposed training and visibility protocols. Experts highlighted that technical proficiency in VHF radio usage and Aids to Navigation (AtoN)—supported by Transport Canada (2023)—is vital for clear ship-to-ship coordination. To complement this, basic navigation workshops focusing on compass use and proper light signals, as advocated by Abdullah et al. (2018), ensure that vessels remain visible and predictable even in low-visibility conditions. Finally, the findings suggest a need for stricter adherence to standardized maneuvering signals. By reinforcing protocols for Overtaking, Head-on, and Crossing situations, the risk of human error is reduced through proactive risk assessment and clear intent (USCG Navigation Center, 2023; IALA, 2023). When these maneuvers are executed within well-signed Traffic Separation Schemes (TSS), as regulated by the International Maritime Organization (2019), the overall safety of the maritime traffic environment is significantly bolstered.

5. Conclusions

This study successfully achieved its objectives through a multi-faceted methodological approach that integrated primary field research with expert consultation. Firstly, actual observations and site visits provided critical on-the-ground insights into the operational landscape, documenting the types of vessels in use, the navigation behaviors of boaters, and the current condition of navigation aids.

Secondly, the questionnaire survey served as a vital tool for assessing boaters' safety awareness, allowing for a quantitative analysis that pinpointed specific areas where knowledge gaps exist. Thirdly, these findings were enriched by expert opinions from Marine Department officials and competent seafarers, alongside a review of regulatory literature, ensuring that the study's insights were both practically grounded and theoretically robust.

The outcomes of this research offer a comprehensive overview of the navigation safety ecosystem in the Terengganu Islands. By correlating the assessment of boaters' awareness with observed practices, the study has formulated practical, evidence-based recommendations to enhance regional safety standards. Ultimately, this research makes a significant contribution to both the maritime industry and the academic body of knowledge. It highlights the emerging safety challenges posed by increasing tourism activities, provides a detailed examination of Malaysia's current navigation safety framework, and underscores the critical importance of aligning local practices with international maritime conventions to ensure safer waters for all.

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Declaration of generative AI and AI-assisted technologies in the writing process

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made solely by the author, in full compliance with University's academic integrity and ethical guidelines.

Conflict of Interest

Author declare no conflict of interest

Author Contributions

Nur Muhammad Aqil Nadzri was involved in conceptualizing the study, designing the research methodology, and critically reviewing and revising the manuscript. Nik Muhammad Afiz Harom@ Junoh was responsible for developing and presenting visual elements, including figures and tables, as well as providing supervision and guidance throughout the research process.

Data Availability Statement

No public data available

Ethics Statement

Consent was obtained from all participants prior to their participation in this study.

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