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Comparison of bridge simulation training for undergraduate students at different maritime institutions worldwide

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1. Table of content

List of Tables

List of Figures

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Abstract

Background

Maritime safety relies heavily on the competence of seafarers, which is regulated globally by IMO and the STCW Convention. As simulator-based training is a tool to achieving these competences, understating the operational uniformity of this training is essential. This project investigates the standardisation of maritime simulator training by examining four core variables: curricula design, training duration and organisation, scenario design, and briefing and debriefing practices. Concurrently, modern maritime educations utilise simulator-based training to simulate realistic scenarios

Methodology

This study employed a quantitative approach to analyse the integration of simulator-based training in a global perspective. Operational regarding curricula, time usage, scenario design, and briefing and debriefing procedures were measured. Hypothesis testing was conducted to evaluate variations across the sampled population of training providers.

Results

The data demonstrate that international maritime institutions maintain a highly uniform approach to simulator-based training. Specifically, the respondent consensus regarding the use of simulators in regard to the research questions was high. The statistical resulted in the rejection of the null hypothesis confirming that no significant differences are expected within the wider population.

Conclusion

The findings indicate that the maritime education sector has achieved a high degree of international standardisation in simulator utilisation. This uniform approach ensures that regardless of the institution, seafarers receive consistent, high-quality training that aligns directly with STCW requirements, thereby strengthening global maritime safety and the mutual recognition of certificates.

Keywords: STCW, Simulator-based training, Briefing and Debriefing, Globally

1. Introduction

1.1. Background

According to the International Chamber of Shipping (n.d.), about 90% of the global trade is carried by the international shipping. The worldwide population serving on international merchant ships is estimated to be 1,892,720 seafarers, of whom 857,540 are officers, thus constituting a major part of the global workforce. Working at sea is dangerous, as conditions change quickly, placing high demands on seafarers. In such an environment, it is crucial to possess the knowledge and skills required to perform safe and secure operations. This is why International Maritime Organization (IMO) established the STCW Convention. STCW stands for Standards of Training, Certification and Watchkeeping for Seafarers. The convention sets minimum requirements for the training, certification, and watchkeeping of both prospective and current seafarers (Sjøfartsdirektoratet, n.d.).

Simulator-based training has emerged as a cornerstone of modern maritime education, primarily due to its ability to provide a safe and controlled environment for practising complex manoeuvring without real-world risk and expenses. Unlike traditional shipboard training, simulators allow trainees to experience critical emergency scenarios and rare navigational challenges that would be impossible or too dangerous to replicate at sea. The opportunity to learn from mistakes in a risk-free setting is essential for developing both technical proficiency and the cognitive decision-making skills required of modern deck officers (Wahl, 2020; Wahl & Giskeødegård, 2025).

Despite the convention´s international scope, training practices vary significantly across different countries and institutions. Some nations and institutions utilise integrated programmes where students complete the sea-time (cadetship) as part of their education (Karahalil et al., 2023; Warsash Maritime School, n.d.), while others provide entirely institution-based training, requiring students to complete their cadetship after graduation to obtain their officer certification. Furthermore, the use of simulator-based training and access to training ships vary (Karahalil et al., 2023). This diversity in educational approaches forms the background for this project, which aims to compare the use of simulator-based training in maritime programmes educating deck officers across different countries.

While existing literature offer some insight into simulator training within specific national contexts, there is a notable lack of comprehensive global research on the subject. While Nazir et al. (2019) conducted a comparative study on maritime simulator-based training across Europe, they highlighted the need for a more global investigation. They concluded that, although simulator training practices across Europe may appear similar due to standardised procedures, the actual implementation of these protocols can lead to dissimilarities. Consequently, this study aims to contribute to the further development of cross-border simulator training by mapping potential differences. Such findings may provide valuable insights for curriculum developers globally or highlight areas requiring further research. Although there is no established consensus on the optimal pedagogical approach, all training must comply with the mandatory minimum requirements of the STCW Convention (IMO, 2010).

The objective of this project is to examine whether simulator-based training in the education of deck officers varies internationally and, if so, to identify the nature of these variations. Consequently, the study intends to facilitate knowledge sharing to enhance simulator-based learning globally.

1.1.1. Problem

The overall aim in this project is to conduct a comparative analysis of various pedagogical approaches to simulator training at different educational institutions. This is divided into two main research objectives, further subdivided into four research questions.

Research objective:
RO1: How is nautical simulator training implemented for deck officers at the participating maritime institutions in terms of training duration and organisation, curriculum design, scenarios design and briefing procedures?

RO2: Determine whether significant variations exist and, if so, to evaluate the strength and magnitude of these differences.

Research questions:

RQ1: How does the curriculum design integrate simulator training to facilitate structured competency development, and in what ways does the curriculum align with IMO´s STCW requirements?

RQ2: What are the variations in training duration and organizational structures for simulator-based learning across the selected institutions?

RQ3: What characterizes the scenarios in terms of navigational complexity – specifically regarding different coastal navigation and meteorological conditions – and how is the inclusion of stress-inducing factors such as time-critical decisions-making?

RQ4: How are briefing and debriefing procedures performed?

The comparison:

Based on the finding from RQ1-RQ4, what are the most significant differences between the countries regarding their implementations of bridge simulator training? Are there any significant differences?

This project conducts a comparative analysis of various pedagogical approaches to simulator training at different educational institutions.

2. Theory

2.1. The STCW Convention and STCW Code

The STCW Convention is an international agreement among various parties around the world, which establishes the minimum requirements for the training, certification and watchkeeping of seafarers globally through the STCW Code. By doing so, it enhances maritime safety and ensures a qualified international maritime workforce. In this context, parties refer to the sovereign states and national maritime authorities that have ratified the convention, thereby committing to implement its mandatory standards within their domestic education systems. Established by the International Maritime Organization (IMO), the convention was adopted in 1978 and entered into force in 1984. The original 1978 convention consisted of six chapters and a technical annex. Following the major 1995 revision, amendments were not integrated into the original articles of the Convention but were instead placed as an attachment to the Convention, referred to as the STCW Code. Two additional chapters were introduced, and the Code currently comprises eight chapters addressing various maritime safety and training requirements (IMO, 1995; Marfag, n.d.).

Several amendments have been adopted since its implementation. The amendments are frequently referred to as "Resolution 2" or simply the Annex (IMO, 1995, 2010; Marfag, n.d.). The most significant update regarding navigational simulator training is the Manila Amendments of 2010 (IMO, 2010). During the 2010 Manila conference, member states revised and expanded the STCW Code, adopting numerous amendments. These included specific standards for simulation training and requirements for instructors, objectives and briefing procedures. These high-level requirements define the essential components of practical simulator instructions, forming the foundation for training frameworks of educational institutions (IMO, 2010).

The convention provides both mandatory minimum requirements and recommended guidelines to elevate maritime competence internationally. Each party of the convention is responsible for ensuring that educational institutions within their jurisdiction adhere to these standards, particularly concerning instruction and training.

The STCW Code is divided into Part A and Part B. Part A consists of mandatory requirements, detailed in the annex, which establish minimum standards and maintenance protocols required by all parties to enhance the convention´s effectiveness. Part B provides recommended guidelines intended to assist the parties in implementing and applying the necessary actions to maximize the convention´s impact in a uniform manner (IMO, 2010). While part B is outside the scope of this project, part A will be discussed in more detailed below.

A key provision in Part A is Regulation A-I/12, which specifically addresses the use of simulators in maritime training. Under this regulation, mandatory simulator-based training is only required for Radar simulation and Automatic Radar Plotting Aid (ARPA). While, simulator-based training could be utilized as a pedagogical tool for other competencies, the regulation does not mandate its use for these specific areas. Instead, it establishes general performance standards for simulators when they are employed for mandatory training and assessment. Regarding training the performance standards mandate that simulators utilized for compulsory training must satisfy specific criteria to ensure educational efficiency. Primarily, the equipment must be suitable for the intended learning objectives and capable of replicating the functional characteristics of shipboard systems. This includes a level of physical and behavioural realism that accounts for the equipment's inherent limitations and potential malfunctions, allowing trainees to acquire relevant professional skills. Furthermore, the simulator must provide a controlled and versatile operating environment capable of generating diverse scenarios, including emergency, hazardous conditions or unusual situations relevant to the learning objectives. The technical system design must facilitate a functional interface for interaction between the trainee, the simulated environment, and the instructor. Finally, the technology must enable instructors to effectively control, monitor and record exercises to provide a basis for comprehensive student debriefing (IMO, 2010).

The regulation A-I/12 also sets detailed standards for training and assessment procedures, where briefing and debriefing are key requirements. According to the regulations, instructors conducting mandatory simulator-based training are responsible for ensuring a structured pedagogical process. This includes providing students with comprehensive briefings and sufficient time for planning and equipment familiarization prior to the beginning of any exercise. Simulation inputs must be carefully aligned with the specific learning objectives and the experience level of the participants. Furthermore, the regulations mandate continuous monitoring of the exercises, supported by objective evaluation tools such as audio and visual recordings. A critical component of the process is the debriefing phase, which must verify that the learning objectives have been achieved and that the demonstrated operational skills meet professional standards. The Code also emphasizes the value of peer assessment during debriefing and requires that all simulator scenarios are thoroughly designed and pre-tested to ensure their suitability for the intended educational outcomes (IMO, 2010).

Regarding the requirements for passage planning, watchkeeping, the use of ECDIS, ship manoeuvring and handling, cargo handling, stowage and securing, these are all well-defined in Table A-II/1 in the STCW Code. This table refers to the specification of minimum requirements for officers in charge and masters but is not explicitly linked to the mandatory use of simulators. These requirements could be achieved and assessed both with approved simulator-based training and/or approved training ship experience (IMO, 2010). This implies that in terms of methods for demonstrating competence in these fields, simulators could be used but are not strictly necessary if experience on a training ship is a part of the education (IMO, 2010). In some institutions, this remains the preferred method of education for becoming a deck officer (Karahalil et al., 2023; Warsash Maritime School, n.d.)

While the STCW Code sets the international minimum requirements regarding the safety and training of seafarers, all the parties to the convention may implement national guidelines to further elevate seafarer education standards. Nevertheless, the STCW Code remains the foundational building block of the global regulatory framework (IMO, 2010). This regulatory framework forms the foundation of Maritime Education and Training (Wahl & Giskeødegård, 2025).

2.2. Maritime Education and Training

Maritime Education and Training (MET) is the standard international term used by IMO, researchers and educators to describe the entire system of education and training seafarers. MET institutions refers to universities, maritime colleges, vocational schools and simulator training centres that develop educational programs and practical training designed to equip seafarers with the competencies required by the maritime industry. MET is globally regulated by IMO based in the regulations made in the STCW Convention (Wahl & Giskeødegård, 2025). A primary objective of MET is to enhance navigational safety within the shipping industry. High-quality MET is therefore essential for seafarers globally, as it enables them to acquire knowledge and skills to mitigate risk and execute operations effectively, all while ensuring safety to life at sea.

Despite its benefits, MET faces significant challenges, including high investment and operational cost – particularly regarding onboard ship training – as well as being time-consuming (Xue et al., 2024). To address these issues, simulator-based training has a long standing history within MET (Wahl & Giskeødegård, 2025). Utilising simulators provides a risk-free environment where students can apply theoretical knowledge in practice, and it is consequently regarded as a vital safety measure (Wahl, 2020). Furthermore, simulator-based training is an effective method for reproducing realistic shipboard scenarios, allowing students to gain practical experience and develop the competences needed to handle unexpected scenarios in future maritime operations (Xue et al., 2024). In training as future seafarers, students must develop non-technical skills such as collaboration, communication, management, and decision-making, in addition to mastering core theoretical elements and the regulatory frameworks governing their future roles (Harrington, 2025).

As specified in the STCW Code, maritime education must also provide students with training in voyage planning and execution, cargo handling and stowage, the operation of shipboard equipment, and the care of persons. It also covers safety at the operational level, risk management and leadership. While simulators must be actively used for radar and ARPA training, they are also highly effective for the previously mentioned areas (IMO, 2010).

Shulman (2005) describes signature pedagogies in the professions as standardized teaching methods designed to shape the fundamental ways in which future professionals are educated for their respective fields. Giskeødegård and Wahl (2025) have researched which type of signature pedagogies utilised in MET institutions in Norway and found that simulator-based training, with a heavy emphasis on practical experience in both design and reflection, is considered a cornerstone in the Norwegian nautical education. Advanced ship simulators represented the most prevalent form of simulation, utilised by 88.9% of the respondents. Among these users, 75.5% engage with the technology on a weekly basis or more frequently. They found a consensus among instructors regarding teaching methodologies, which remains consistent regardless of their academic background, age, or institutional association (Giskeødegård & Wahl, 2025). The various pedagogical approaches utilised within MET institutions will be further examined in the following section.

2.3. Pedagogical approaches

A diverse range of pedagogical approaches is used to facilitate a productive and effective learning environment. For the education of deck officers, simulator-based training - which often is combined with experiential learning, problem-based learning, and team-based learning – is central. All these types of learning will be examined later. In higher education, the curriculum typically follows a progressive structure: beginning with a foundational theoretical approach before gradually introducing practical application and increasing scenario complexity.

The STCW Convention, mandates that simulators must be utilized in specific sections of MET to meet international standards (IMO, 2010). The earliest references regarding use of simulators in MET dates to the 1960s, where the primary focus was technical training of different instruments such as radars. Since then, the implementation and integration of simulators in MET have changed significantly, primary in response to technical advancements, evolving regulatory frameworks and a paradigm shift in pedagogical approaches (Wahl & Giskeødegård, 2025). Today, simulators are commonly used in areas of bridge operations and navigation, cargo handling, anchor handling, GMDSS training, engine control and offshore operation training. The range of different types of simulators is wide, spanning from simple desktop simulators to highly realistic full-mission simulators and advanced virtual reality simulators (Karahalil et al., 2023).

2.3.1. Simulator-based training

In maritime professional studies, simulator-based training relies heavily on the “learning by doing” principle, using simulators as a tool in getting the basic skills needed in ship manoeuvring and navigation, engine control, cargo handling and more (Karahalil et al., 2023). Through targeted simulation exercises, the students acquire technical, procedural and operational skills, which directly enhances their professional proficiency. Following the training, students demonstrate a deeper understanding of the decision-making process and the potential consequences of their actions. Consequently, they develop the ability to prioritize tasks effectively when navigating complex traffic situations or managing emergency operations (Karahalil et al., 2023).

Despite the evident advantages of the use of simulators in practical training, the primary challenge lies in designing and organizing the simulator-based training program in a way that gives the students the best learning outcome. Designing an effective training program requires identifying objectives, creating exercises that suits the available simulators, preparing assessment, doing situational analysis and writing content for the programme (Karahalil et al., 2023).

According to the IMO (2012) Train the Simulator Trainer and Assessor Model Course 6.10, simulator sessions are divided into four core stages: briefing, planning, the simulation exercise, and debriefing. However, since it is common for students to complete their preparations and planning prior to the session, Karahalil et al. (2023) focus on three operational stages in relation to simulator sessions: briefing, conducting the exercise, and debriefing. During the briefing, students are introduced to the scenario and its specific learning objectives, providing them with an initial understanding of the expectations and requirements. During the simulation exercise, students aim to achieve these objectives within a replicated bridge environment that utilizes digital projections to simulate a realistic maritime environment. Finally, the debriefing provides students with constructive feedback on their performance, helping them understand how to improve their practical skills in future exercises. By encouraging students to reflect on their actions rather than just receiving information, debriefing serves as the vital link that enhances the overall experiential learning process (Karahalil et al., 2023; Walker, 2005). To understand how simulator sessions actively facilitate this experiential learning, it is necessary to examine how the operational stages of simulation correspond with the phases of reflective and practical experience.

2.3.2. Experiential learning

Experiential learning is a pedagogical approach defined as the process where knowledge is created thought the transformation of experience. Within MET, Kolb´s Experiential learning theory provides a robust framework for understanding how deck officers develop operational competences during simulator-based training. The core element of Kolb´s experiential learning cycle are the four-stage cycle: concrete experience, reflective observation, abstract conceptualization, and active experimentation (Kismantoro & Cahyadi, 2026), in which can directly by linked to how the simulator-based training is structured(Røds, 2025). Kismantoro and Cahyadi (Kismantoro & Cahyadi, 2026) states that simulator-based instruction allows students to progress though all four stages sequentially. The learning cycle engage students in the learning process, and it is utilised as an adaptive template for countless of applications in diverging educational programmes (Kolb & Kolb, 2018).

2.3.3. Problem-based learning

Problem-solving skills are highly valuable attribute for a deck officer to have, yet they can be challenging to foster within an educational context. One effective approach to achieving this is through problem-based learning (PBL). PBL is characterised by ill-structured problems which do not have any single correct solutions. These problems are often complex and require the students to prepare thoroughly, gather relevant information beforehand, and engage in critical thinking (Bendeliani & Torstensdotter, 2026).

In PBL, the problem itself is essential for the learning process and learning outcome, as students must arrive at a solution either independently or in teams, and thereby developing their problem-solving and decision-making skills. The PBL should be moderately ill-structured, thereby challenging the students without overwhelming them (Bendeliani & Torstensdotter, 2026).

While not all challenges are suited for PBL, research indicates that it is effective during simulator-based medical training. Specifically, Euliano and Mahla (1999) emphasize the importance of developing problem-solving skills through simulator-based training as it prepares students for rare but critical cases that they may otherwise seldom encounter. This approach is equally applicable to the maritime sector, where the student engages with real-world scenarios, thereby fostering their theoretical knowledge to practical contexts and enhancing their critical thinking. Consequently, PBL is particularly valuable in simulator-based training for complex scenarios such as collision avoidance, coastal navigation, transit through traffic-dense areas, navigation in adverse weather conditions, and in search and rescue; as all of these facilitate the development of technical and practical skills (Nyairo et al., 2025).

2.3.4. Teamwork

While PBL is a common approach during simulator-based learning, team-based learning (TBL) is also widely used. According to Dolmans et al. (2015), a combination of both PBL and TBL is beneficial. Since effective teamwork is essential for all onboard activities, it is important to enhance collaborative learning during the education (Wahl, 2020). Recognizing the importance of the human element, the 2010 Manila Amendments to the STCW Convention introduces mandatory training requirements in in teamwork. Seafarers at the operational level must now develop teamwork skills (IMO, 2010). Consequently, following the 2010 amendments, the maritime training institutions worldwide had to update their curricula to incorporate these vital skills.

2.3.5. Briefing and debriefing

As earlier mentioned, briefing is meant to prepare the student for the upcoming simulator exercise in terms of scenario, learning objectives and other important information needed to execute the exercise. Further, it is important that learning objectives and scenarios, are clearly defined and communicated to the student. This is because briefing structure and content is shaped by the foundational framework provided by the defined learning objectives (Sellberg & Erntsson, 2025).

Briefing may also include demonstration, such as a basic walkthrough of the bridge instrument functionality and procedures for ship-to-port and ship-to-ship communication. While such demonstrations are more prevalent in early years, ensuring students are familiar with the instruments before advancing to more challenging scenarios, they remain a common practice throughout the entire program at several institutions (Sellberg & Erntsson, 2025). Sellberg and Erntsson (2025) states that, rather than being purely preparatory, briefings are fundamental to the establishment of a structured and productive pedagogical framework. The briefing process facilitates the setting of clear expectations by providing context to the upcoming scenario and articulating the specific learning objectives. Consequently, this enhances the student's comprehension of the interface between abstract concepts and the practical challenges they will encounter. The briefing is thereby a crucial step, ensuring the students fully understand the requirements of the upcoming simulator exercise. This preparation provides them with the opportunity to perform optimally, relative to their current level of experience.

For more complexed simulator scenarios, some institutions use a flipped classroom model. Here the students are expected to prepare for the upcoming simulator session by discussing the upcoming exercise with fellow student, carry out route planning and self-studying of relevant procedures, all before the briefing begin. This enables the student to develop strategies for the upcoming simulator and begin the thinking process early (Sellberg & Erntsson, 2025).

It is important to facilitate discussion during the briefing phase, and how the questions are phrased is one of them, inviting the students to think for themselves. There are several different methods for promoting open dialog, and how you ask the questions are one of them. Open-ended questions are useful to further provoke the students thinking process and to express their thoughts for the upcoming exercise. An example for this is: "How have you planned the route?". Follow-up questions could also be useful in this matter. Another tool is speculative questions, for instance asking how the student will act if weather conditions change. In this way the student could show that they have taken into account that other weather conditions, than the one outlined from the beginning, could occur (Sellberg & Erntsson, 2025).

While briefing is crucial for the learning outcome of simulator-based training, so is debriefing. Debriefing is the process of discussion and critical reflection following a specific event or situation. While debriefing in professional fields is often used to facilitate the processing of emotions following a negative outcome, such as incidents or accidents, in an educational context, it serves as a post-simulator tool aimed at translating theoretical knowledge into practical skills. Post-simulator debriefing is typically structured around questioning students on how the simulator exercise was conducted, evaluating the performance, discussing what could be done differently, and exploring various “what-if” scenarios to highlight key learning points (Lourenwall, 2016). Fratoni (2025) found that while feedback during debriefing generally is supportive, specific and well-timed, there is often limited room for active dialog, peer-to-peer feedback, and student agency. Nevertheless, debriefing encourages the students to process what happened, why it happened, and how alternative outcomes could be achieved through different actions. It helps relate the simulation exercise to the learning objectives of the course, providing greater depth to the experiential learning process (Walker, 2005).

2.3.6. Scenario design

During analysis of the transcribed interviews Harrington et al. (2025) found that when developing simulations scenarios, educators prioritize realism, authenticity, and functional fidelity. Central to their approach is the concept of validity, ensuring a transparent connection between simulator-based training and actual maritime operations. By drawing on the instructors´ professional experience, this approach ensures that scenarios are both authentic and specifically tailored to address the practical challenges participants may encounter in their fields. The focus of scenario design transcends mere than aesthetics or technological fidelity; instructors also prioritize the replication of authentic communication patterns found in real-world environments to facilitate Bridge Resource Management. Instructors emphasize that exercises must directly mirror real-life onboard scenarios. However, this pursuit of realism must be carefully managed to prevent excessive student stress and to ensure that the primary learning objectives remain the focal point. Instructors emphasize that scenario design must be driven by well-defined learning objectives, ensuring that maritime training remains structured and goal oriented. The instructors interviewed also prioritize the development of student confidence by customizing exercises to meet varying proficiency levels. By adjusting the difficulty for both high-performing and struggling students, instructors maintain high levels of motivation and ensure that training remains compatible with individual capabilities (Harrington et al., 2025).

In accordance with Table A-II/2 of the STCW Code, which outlines the minimum requirements for Masters and Chief Mates on vessels of 500 gross tonnage or more, candidates must be capable of planning and conducting a voyage under all conditions. This involves utilizing approved methods for plotting ocean tracks while accounting for restricted waters, meteorological hazards such as ice and limited visibility, extensive tidal effects, traffic separation schemes, and vessel traffic service areas. This training may be conducted on a training ship or through simulator-based training (IMO, 2010). Consequently, when the majority of training is conducted in simulators, these components must be integrated into the scenario design.

3. Methodology

When conducting a study, one must carefully consider the appropriate methodology, including what or who is to be investigated and how the research will be executed. These considerations are especially critical in the early stages and are referred to as research design in the academic world. Research methods are generally categorized into quantitative and qualitative approaches. The former utilizes numerical data and data and statistics for collection and analysis such as experimental studies or surveys, whereas the latter relies on qualitative data acquires through methods such as interviews (Johannessen et al., 2025).

The initial research design intended to analyse institutions curricula to establish a baseline of various training methodologies, to be utilized both in the thesis and in the development of a survey. However, obtaining sufficiently detailed documentation for thorough and systematic scientific analysis proved challenging. As a result, the methodology was revised to only utilize a quantitative method, specifically a survey for data collection. Statistical Package for the Social Sciences (SPSS) is utilized for the data cleaning, analysis, and the generation of figures and tables. The survey was developed to provide data on time allocation and the organization of curriculum design, simulator-based training, scenario design, and briefing and debriefing procedures.

3.1. Survey and Data coding

An online survey was made at Nettskjema.no and used to collect data about the use of simulator at the different institutions.

The survey followed a semi-structured design, incorporating both open-ended and closed-ended questions. While most of the questions utilised a predefined, single-choice format, a few open questions were included to gather specific information, such as the name of the respondent's institution. This approach allowed for the identification of multiple respondents from the same institutions, thereby helping to mitigate significant bias in the analysis. It was important to emphasize that these institutional names are not included in the thesis itself, as they were collected solely to distinguish between responses from various institutions within the same country.

The survey was made by the intention of answering to different projects, thereby it was designed to answer different aspects of the use of simulators as an educational tool. One of the projects was to collect comprehensive data on how Maritime Education and Training (MET) institutions organize, deliver, and evaluate simulation-based training as part of COAST – Centre of Excellence in Maritime Training and Assessment - Focus Area 4. The other project, in which this thesis is based on, aimed to compare the use of simulators for training purposes across different institutions globally, focusing on aspects such as training duration and organization, briefing procedures, curriculum design, and the nature of the scenarios incorporated in the training.

The survey is structured into seven thematic sections, ranging from A to G, covering the full spectrum of simulator training. These range from institutional organization and resource allocation, through pedagogical design and briefing/debriefing practices, to assessment frameworks and curriculum alignment with international standards. The complete survey is provided in Appendix I. Since the survey is used in both projects, only a specific selection of questions has been extracted for this study. Specifically, data from section A through E were applied in the analysis, where section A and B contain the demographics of the respondents and their respective institutions. An overview of the selected questions for the comparative analysis included in this project is provided in Table 1-Table 5 underneath.

Considerable effort has been dedicated to formulating high-quality survey questions designed to address the research questions of this project. Likert scale statements were widely utilized across most sections of the survey to capture the respondents´ perspective and opinions regarding the various themes. Regarding RQ1, the questions were developed by carefully reviewing the Manila Amendments section A-I/12, which outlines the mandatory standards for simulator training. For RQ2, specific questions were included to gather data on the total number of simulator hours completed by each student. Furthermore, Likert scale statements were used to assess the respondent perspectives on scenario characteristics (RQ3) and briefing and debriefing procedures (RQ4). In addition to A-I/12, Table A-II/1 and table A-II/2 in the STCW Code, along with IMO Model Course 6.10, serves as the primary framework for developing the survey questions.

Following the completion of the survey, a notification form was submitted to The Norwegian Agency for Shared Services in the Education and Research for data protections assessment. The project was subsequently approved. A codebook was developed within the Nettskjem.no prior to the distribution of the survey. To ensure a seamless integration of variables into SPSS during the data collection and data cleaning phase, each variable was clearly labelled in the codebook to easily identify which survey question it represented. To mitigate the risk of respondents misunderstanding, a pilot was conducted to identify and rectify poorly formulated questions or response alternatives before the finale distribution. This was achieved by distributing the pilot survey to instructors and lectures at the home institution, UiT, and valuable adjustments were made based on constructive feedback. Furthermore, considerable time was invested in collecting contact information, specifically email addresses, to facilitate the distribution of the survey. The survey was specifically designed for institutions that utilise simulators in the training of deck officers, a focus that was clearly communicated to the responders in the introductory section of the survey.

3.3 Survey distribution and data collection

Distribution was conducted via email, targeting directly at professors, instructors and other academic staff deeming to have sufficient knowledge to simulator training protocols. Where appropriate, recipients were encouraged to forward the survey to colleagues possessing the relevant knowledge.

In total, the survey has been distributed to approximately 275 email addresses to people working at different MET institutions across about 50 countries. A remining email was sent after one-two weeks. Several of the emails was sent to people working at the same institutions.

The data from Nettskjema.no was collected after four weeks, after a friendly reminder was sent out to the respondents via email. When the data collection ended, the number of respondents was 67, which was considered satisfactory for this student project.

SPSS was utilized for the statistical analysis. To facilitate the data, a semicolon-separated file (.txt) was transferred from Nettskjema.no to the university's cloud storage platform and subsequently imported into a new SPSS dataset. The codebook was transferred as a SPSS syntax file, and the syntax was opened and run in the prepared dataset.

3.4 Data selection

As this project aims to compare different variables regarding simulator-based training across different countries, the independent variable is the country represented by the respondents. The type of institutions defined as both an independent and a dependent variable, while all other variables are defined as dependent variables in this project. To clarify which survey questions address the specific research questions, Table 2, Table 3, Table 4, and Table 5 has been provided below. Additionally, Table 1 have been provided to clarify the questions used for the demographic data. In these five tables, the type of variable is described for all the selected questions utilised in this project. The tables are categorized into respondent´s and institutional demographics, RQ1 – Curriculum design, RQ2 – Training duration and organization, RQ3 – Scenario characteristics and RQ4 – Briefing and Debriefing procedures.

3.4.1 Respondents and institutional demographics

Table 1: Survey questions regarding respondent's demographics

Question in survey	**Variable**
What country is your institution located in?	Independent
Which of the following best describes the type of institution you currently work at?	Dependent/ independent
What is your current role at the institution?	Dependent
How many years of experience do you have working at a Maritime Education and Training (MET) institution?	Dependent
What is the highest level of education you have completed?	Dependent
How many years of operational sea service do you have?	Dependent
If you have operational sea going experience, which shipping domain did you primarily work in?	Dependent
Which of the following qualifications are required for simulator instructors at your institution? (Multiple Choice)	Dependent
Does your institution have a formal professional development plan or policy for simulator instructors?	Dependent
How many students and trainees are enrolled annually in programmes that include simulator-based training at your institution?	Dependent
What is the duration of the programme at your institution leading to a deck officer Certificate of Competency (CoC)? (Multiple Choice)	Dependent

3.4.2 RQ1 – Curriculum design

RQ1: How does the curriculum design integrate simulator training to facilitate structured competency development, and in what ways does the curriculum align with IMCO´s STCW requirements?

Table 2: Survey questions related to RQ1

Question in survey	**Variable**
In which year(s) of the curriculum is simulator-based training conducted? (Multiple Choice)	Dependent
Please indicate your level of agreement to the following statements regarding curriculum:	
Simulator training is introduced at a suitable stage of the program	Dependent
Learning objective for each simulation session is clearly defined	Dependent
Simulator sessions are aligned with the formal course learning outcome	Dependent
The simulator curriculum reflects the regulatory requirements (STCW)	Dependent
The simulator curriculum reflects recommendations for training given in IMO model courses	Dependent
The simulator curriculum is annually reviewed	Dependent
The timetable allows sufficient time between sessions for preparation and feedback	Dependent
The frequency of simulator sessions supports skill development	Dependent

3.4.3 RQ2 – Simulator training duration and organisation

RQ2: What are the variations in training duration and organizational structures for simulator-based learning across the selected institutions?

Table 3: Survey questions related to RQ2

Question in survey	Variable
How many compulsory courses include simulator-based training as a core component?	Dependent
How many simulator sessions are typically conducted per course?	Dependent
What is the average duration of a single simulator session?	
What is the typical instructor-to-student ratio during simulator sessions at your institution?	Dependent
Please indicate your level of agreement with the following statements:	Dependent
Simulator sessions are well coordinated	Dependent
Simulator sessions are well organized	Dependent
Adequate resources (equipment, manuals, technical support, etc.) are provided for each simulator session	Dependent
Organizational support ensures that simulator sessions run smoothly without interruptions	Dependent

3.4.4 RQ3 – Scenario characteristics

RQ3: What characterizes the scenarios in terms of navigational complexity – specifically regarding different coastal navigation and meteorological conditions – and how is the inclusion of stress-inducing factors such as time-critical decisions-making?

Table 4: Survey questions related to RQ3

Question in survey	Variable
Please indicate your level of agreement to the following statements regarding scenario development:	Dependent
Simulator scenarios reflect realistic operational situations	Dependent
There is a plan for improving the complexity of scenarios as the training progresses	Dependent
Scenarios test students´ decision-making skills under pressure	Dependent
Scenarios incorporate bridge management and teamwork	Dependent
There are tailor-made scenarios for testing students´ stress tolerance	Dependent
Scenarios include navigation in narrow/coastal waters	Dependent
Scenarios include navigation in high traffic / congested waters	Dependent
Scenarios include navigation in challenging conditions including current, waves, and strong wind	Dependent

Scenarios include emergency situations (e.g., SAR, MOB, collision, grounding)	Dependent
Scenarios include radio contact with shore authorities and other vessels	Dependent
Students are able to utilise all available instruments across simulator scenarios	Dependent

3.4.5 RQ4 – Briefing and Debriefing procedures

RQ4: How are briefing and debriefing procedures operationalized, and what role do they play in the overall pedagogical framework?

Table 5: Survey questions related to RQ4

Question in survey	**Variable**
Please indicate your level of agreement with the following statements regarding briefing:	Dependent
Briefing is provided before each simulator session	Dependent
Guidance is provided during each simulator session	Dependent
Debriefing is provided after each simulator session	Dependent
The objectives of each simulator session are communicated effectively before the session begins	Dependent
Participants are encouraged to ask questions and seek clarification during the briefing	Dependent
Students receive individual feedback after each simulator session	Dependent
Peer feedback is facilitated among students	Dependent

3.5 Data cleaning and transformation

As respondents used different spellings for the same institutions, cleaning the data was necessary to ensure proper categorisation. This involved standardizing the various spellings into a single uniform name for each institution to ensure consistency across the dataset. Subsequently, a new variable, was created in SPSS to group respondents by institution. This facilitated a comparison of responses within the same institution to identify consistent patterns regarding simulator use. Ensuring consistency in the responses from each institution strengthens the validity and academic weight of the findings. This process is particularly helpful in situations where data are inconsistent or appear improbable. By cross-verifying responses within the same institution, it becomes possible to identify and address potential outliners.

Since special characters are not permitted in SPSS, the codebook had to be altered where <, > or + had been used in the response options. Subsequently, the measurement levels had to be set to the correct categories; scale, nominal or ordinal. Likert-scale questions were set as ordinal, submission ID, answering time and number of courses with simulator-based training were set as scale. The remaining variables were set as nominal.

To calculate the total volume of simulator-based training, a new composite variable had to be computed. Since the two dependent variables *number of sessions* and *duration of session* both utilized predefined intervals, these required a data cleaning process to enable accurate multiplication. The cleaning was conducted by recoding the categories into numerical values based on their mid-points. This transformation ensured that all the variables in the new computed variable was set to scale, thus permitting multiplication. The final variable derived from the product of the number of courses, the number of sessions per course, and duration of each session, resulting in a scale variable representing the total hours of simulator-based training per institution that facilitated quantitative comparison analysis and inferential testing. However, a methodological challenge arose as both the variable number of sessions and duration of session had a response option stating varies significantly. Because this option lacks a numerical value, these specific responses could not be integrated into the quantitative summation. To ensure statistical integrity, these cases were treated as missing data during the aggregation process and were subsequently excluded from the descriptive and inferential analysis. Consequently, the effective sample size for the statistical testing of this specific metric was reduced to 79.1% (n=53). Conversely, the frequency of the “varies significantly” response was retained as a separate descriptive finding to illustrate curriculum flexibility.

3.6 Data storage

To ensure data security, the data was stored exclusively on the university´s secure cloud storage platform. Access to the dataset was restricted to only authorized project members via password-protected accounts. When conduction analysis using SPSS from a home network, a Cisco Secure Client was utilised to establish an encrypted VPN connection to the university network, ensuring that no data was transmitted over unsecure public or private networks. In fact, the SPSS would not run before the connection was established. All data was fully anonymised prior to the analysis.

3.7 Comparative analysis

A descriptive comparative analysis was conducted to provide a detailed overview of the dataset. This stage of the analysis focused on identifying patterns and trends across different countries without making broader statistical generalizations.

Firstly, frequency tables were generated to summarise the distribution of respondents across the dependent variables. To examine the relationship between the independent variable country and the different dependent nominal variables, crosstabulations was produced. These tables provided a clear representation of how responses were distributed across different nations, facilitation a nuanced comparison of the maritime education system in the sample. To facilitate a clearer comparison, the data in the crosstabulations have been modified to generate heat maps, providing a more visual representation of the distribution for each response. For a detailed breakdown of the number of responses for each option per country, please consult the crosstabulations in Appendix II when referred to in the findings or the discussion. These tables have not been included in the main rapport due to space considerations.

This approach provided a clear, proportional overview of the distribution of responses of how different institutions organize the simulator training. There are three cases in the dataset where respondents have the possibility to select multiple answers. Since the total count of responses exceeds the number of individual participants per country in these cases, the data was visualised as absolute frequencies in crosstabulations.

To initiate the comparative analysis of the nominal and ordinal variables, crosstabulations were generated to gain an initial overview of the sample data. Additionally, stacked bar charts were utilised to visualise the findings (Peter Statistics, n.d.-a). Please note that the percentages in Figure 10, Figure 14, Figure 15, Figure 16, are rounded to the nearest whole number. For the sake of consistency, these rounded values are also utilised throughout the text in these sections.

3.8 Inferential analysis

Since the data in this dataset are not normally distributed, and many variables are measured as ordinal, a non-parametric approach for the inferential analysis is the most appropriate option. Consequently, a non-parametric Kruskal-Wallis 1-way ANOVA test was utilized to examine potential differences between countries when examined these ordinal variables. This test was selected as the independent and dependent variables did not meet the assumption of normality requires for a standard parametric ANOVA test. The Kruskal-Wallis test is particularly suitable for comparing multiple groups when a standard ANOVA or t-test is inappropriate. Furthermore, the Kruskal-Wallis test is particularly suitable for this study as it ranks the data rather than comparing means, making it robust against outliers and skewed distribution (Peter Statistics, n.d.-b).

In this analysis, country served as the independent nominal variable, while the dependent variables consisted of ordinal variables, including as Likert scale statements and questions regarding the number of courses, number of sessions, and number of hours per session. For statements using a Likert scale, ranking from strongly disagree to strongly agree, the data are inherently ordinal, meaning they have a defined rank but inconsistent intervals between values. This also applied for the variables for the number of courses, sessions, and hours per session, despite the answer categories being divided into brackets. The brackets maintained a logical ranking and were therefore classified as ordinal. However, because the latter two variables included a qualitative, predefined answer option, "varies significantly", responses within this category had to be excluded from the dataset prior to testing. This was achieved by treating the "varies significantly" as missing values for both the number of sessions and the number of hours per sessions.

The Kruskal-Wallis test is the standard procedure for comparing such ordinal data across multiple groups (Peter Statistics, n.d.-b). To ensure a minimum level of statistical reliability, countries with fewer than three respondents were excluded from the inferential comparative analysis. This mean that the seven countries included in the statistical tests is Denmark, Egypt, India, Latvia, Netherlands, Norway and the Philippines. While a Kruskal-Wallis 1-way ANOVA test is robust to unequal group sizes, results from smaller cohorts should be interpreted with caution due to reduced statistical power. In case of significant Kruskal-Wallis test a post-hoc pairwise comparison was performed using the Bonferroni correction for multiple comparisons. Only adjusted p-values, adj. Sig., below 0.05 were considered statistically significant to reduce the risk of “false positive” results (Peter Statistics, n.d.-c).

The null hypothesis was that the distribution of the dependent variable is the same across categories for the independent variable. The significant level of <0.05 was testet to retain or reject the null hypothesis.

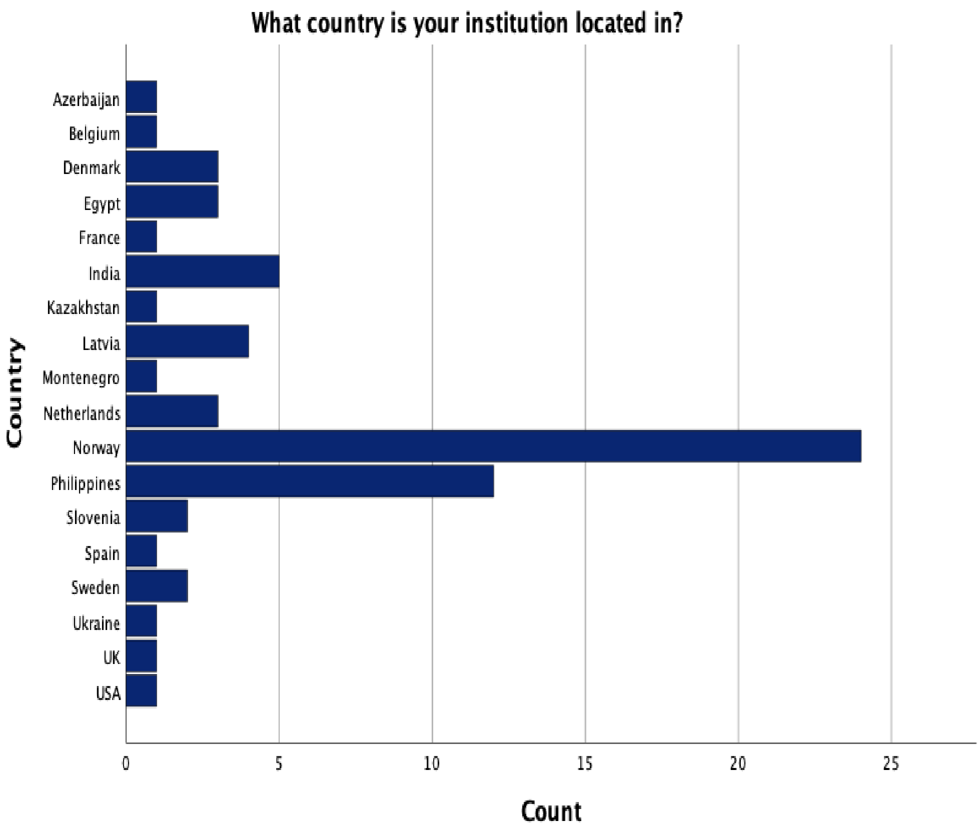
4 Findings

4.3 Descriptive comparative analysis

This initial descriptive section serves to highlight the geographical variations in the dataset. A descriptive comparative analysis was conducted to provide an overview of the geographical distributions of the respondents´ representing institutions. The dataset consists of 67 participants from 33 different institutions across 18 countries. Due to anonymisation, the names of the institutions have been excluded from this analysis.

4.3.1 Respondents’ and institutional demographics

The descriptive findings for respondents’ frequency by countries are presented in Figure 1. The data provide an overview of the distribution of participants’ responses, illustrated by both percentage and frequency. As depicted, the majority of respondents reported representing Norway (35.8%, n=24) and the Philippines (17.9%, n=12), followed by India (7.5%, n=5), Latvia (6%, n=4), Egypt (4.5%, n=3), Denmark (4.5%, n=3), the Netherlands (4.5%, n=3), Slovakia (3%, n=2), and Sweden (3%, n=2). Additionally, Azerbaijan, Belgium, France, Kazakhstan, Montenegro, Spain, Ukraine, the United Kingdom, and the USA were each represented by one participant (n=1), accounting for 1.5% of the total representation for each country.



	N	%
Azerbaijan	1	1.5%
Belgium	1	1.5%
Denmark	3	4.5%
Egypt	3	4.5%
France	1	1.5%
India	5	7.5%
Kazakhstan	1	1.5%
Latvia	4	6.0%
Montenegro	1	1.5%
Netherlands	3	4.5%
Norway	24	35.8%
Philippines	12	17.9%
Slovenia	2	3.0%
Spain	1	1.5%
Sweden	2	3.0%
Ukraine	1	1.5%
UK	1	1.5%
USA	1	1.5%

Figure 1: Frequency of respondents by country, count and percentages

The institutional distribution across the 18 representative countries is depicted in

Figure 2. As showed the **Error! Reference source not found.**, among the total sample (N=67), universities represented the largest category (49.3%, n=33), followed by maritime collages (29.9%, n=20), simulator training centres (11.9%, n=8), and vocational collages (9%, n=6). As shown in Table 6, several countries are represented by a single institutional type.

Figure 2: Distribution of institutional type, percentage

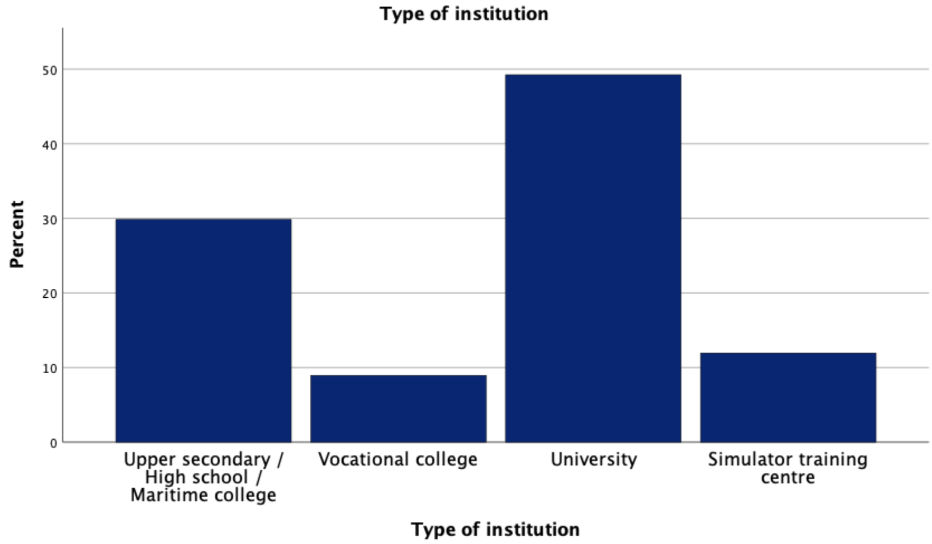


Table 6: Crosstabulation for institutional type across country, count

		Type of institution				
		Upper secondary/ High school/ Maritime college	Vocational college	University	Simulator training centre	Total
Country	Azerbaijan	1	0	0	0	1
	Belgium	1	0	0	0	1
	Denmark	0	0	2	1	3
	Egypt	0	0	1	2	3
	France	1	0	0	0	1
	India	0	0	4	1	5
	Kazakhstan	0	0	1	0	1
	Latvia	2	0	2	0	4
	Montenegro	0	0	1	0	1
	Netherlands	0	0	0	3	3
	Norway	6	5	13	0	24
	Philippines	9	0	3	0	12

	Slovenia	0	0	2	0	2
	Spain	0	0	1	0	1
	Sweden	0	0	2	0	2
	Ukraine	0	0	0	1	1
	UK	0	0	1	0	1
	USA	0	1	0	0	1
Total		20	6	33	8	67

Table 7 illustrates the geographical distribution of the respondents' roles across the represented countries, while Figure 3 show overall role distribution in percentage. The majority of respondents identified as professors, senior lecturers, lecturers or instructors. Globally, instructor is the most prevalent role (31.3%, n=21), followed by lecturer (20.9%, n=14). Senior lecturer and professor are evenly distributed, each accounting for 16.4% (n=11) of the total sample, while the remaining 14.9% (n=10) identified as other. The dataset is heavily influenced by the two largest countries in the cohort. In Norway (n=24), the distribution is led equally by lecturers and instructors (33.3%, n=8), followed by senior lecturers (20.8, n=5). In contrast, the Philippines (n=12) shows a high concentration within a single category, with a substantial majority identifying as instructors (83.3), n=10). For a detailed breakdown of the single national cohorts, please consult Table 7.

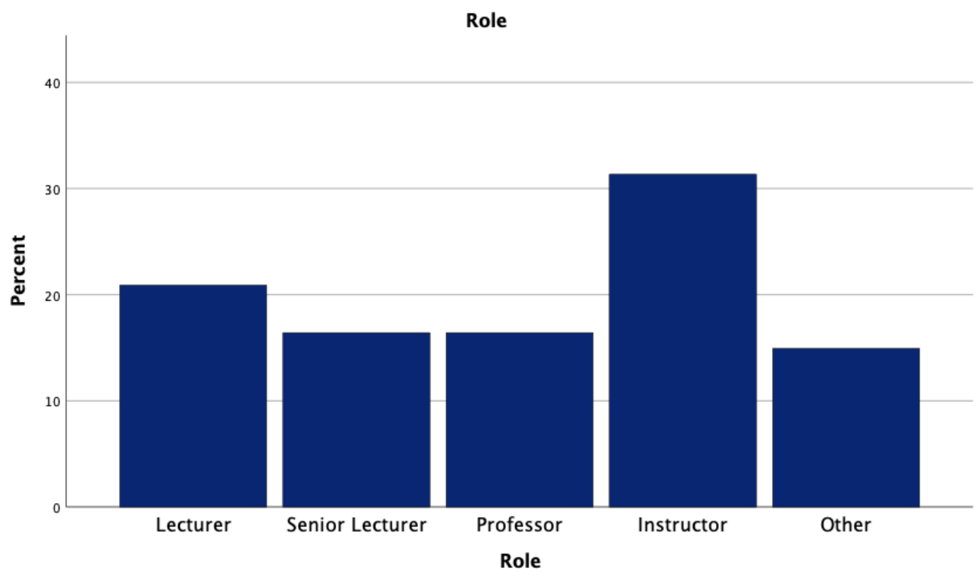


Figure 3: Role distribution, percentage

Table 7: Crosstabulations of role across country, count

		Role					
		Lecturer	Senior Lecturer	Professor	Instructor	Other	Total
Country	Azerbaijan	0	0	1	0	0	1
	Belgium	0	0	0	0	1	1
	Denmark	0	1	1	1	0	3
	Egypt	0	2	1	0	0	3
	France	0	0	1	0	0	1
	India	1	1	2	0	1	5
	Kazakhstan	0	0	0	0	1	1
	Latvia	2	0	0	0	2	4
	Montenegro	0	0	1	0	0	1
	Netherlands	1	0	0	2	0	3
	Norway	8	5	1	8	2	24
	Philippines	0	1	1	10	0	12
	Slovenia	0	0	1	0	1	2
	Spain	1	0	0	0	0	1
	Sweden	1	0	0	0	1	2
	Ukraine	0	0	0	0	1	1
	UK	0	1	0	0	0	1
	USA	0	0	1	0	0	1
Total		14	11	11	21	10	67

Table 8 illustrates the geographical distribution of experience working at a MET institution across the represented countries, while Figure 4 depicts the overall distribution of MET experience. The respondent´s level of experience working at a MET institution varied, jet was generally high. Nearly 50% of the total sample reported to have experience of 11 years or more (31.3%, n=21), followed by 2-5 years (22.4%, n=15) and 6-10 years (19.4%, n=13). The remaining participants reported either less than two years (14.9%, n=10) or more than 20 years (11.9%, n=8). In Norway, the highest concentrations is within the 11-20 years brackets 33.3%, n=8). In contrast, the Philippines (n=12) leans towards shorter tenures, with most respondents reporting 2.5 years (41.7%, n=5) of less than two years of experience (33.3, n=4). Egypt shows a highly experienced profile with a majority possessing over 20 years of experience (66.7%, n=2. For a detailed breakdown of the other national cohorts, please consult Table 8.

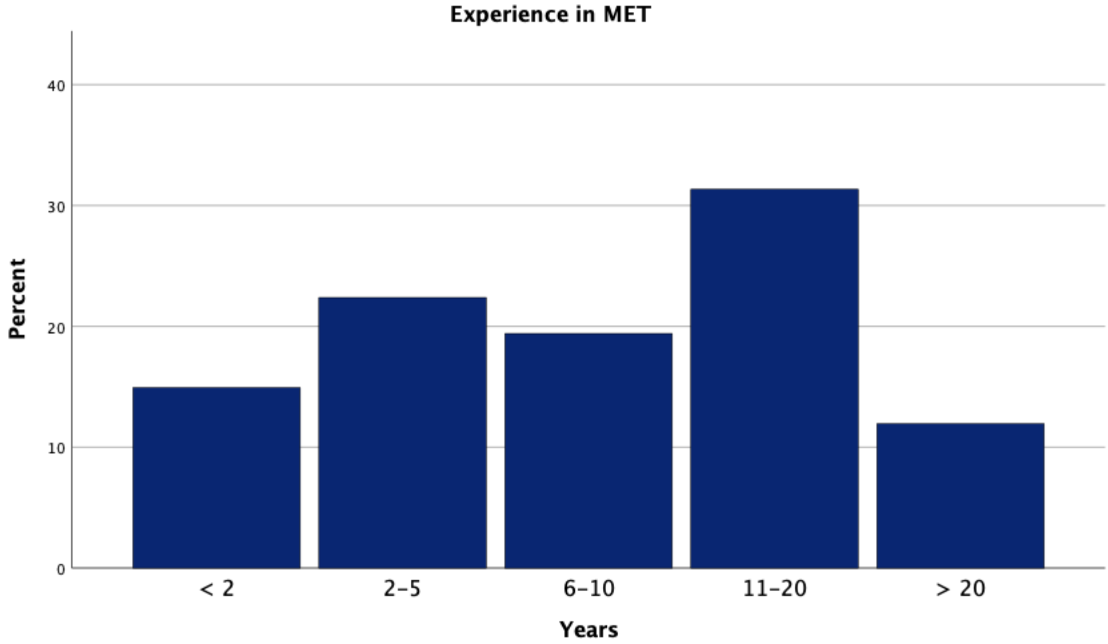


Figure 4: Experience in MET, percentage

Table 8: Crosstabulation of years in MET across country, count

		Years of experience MET					
		< 2	2-5	6-10	11-20	> 20	Total
Country	Azerbaijan	0	0	0	1	0	1
	Belgium	0	0	1	0	0	1
	Denmark	0	0	0	2	1	3
	Egypt	0	0	0	1	2	3
	France	0	0	0	0	1	1
	India	1	1	2	1	0	5
	Kazakhstan	0	0	0	1	0	1
	Latvia	0	1	2	0	1	4
	Montenegro	0	0	0	1	0	1
	Netherlands	0	2	0	0	1	3
	Norway	4	6	5	8	1	24
	Philippines	4	5	2	1	0	12
	Slovenia	1	0	0	1	0	2
	Spain	0	0	0	1	0	1
	Sweden	0	0	0	1	1	2
	Ukraine	0	0	0	1	0	1
	UK	0	0	0	1	0	1
	USA	0	0	1	0	0	1
Total		10	15	13	21	8	67

Table 9 illustrates the geographical distribution of educational levels across the represented countries, while Figure 5 depicts the overall distribution of the respondent’s highest level of education. A majority of respondents had a bachelor's degree, master's degree, or PhD degree. A smaller portion reported a maritime or vocational college diploma as their highest level of educational attainment. For a detailed breakdown of the other national cohorts, please consult Table 9.

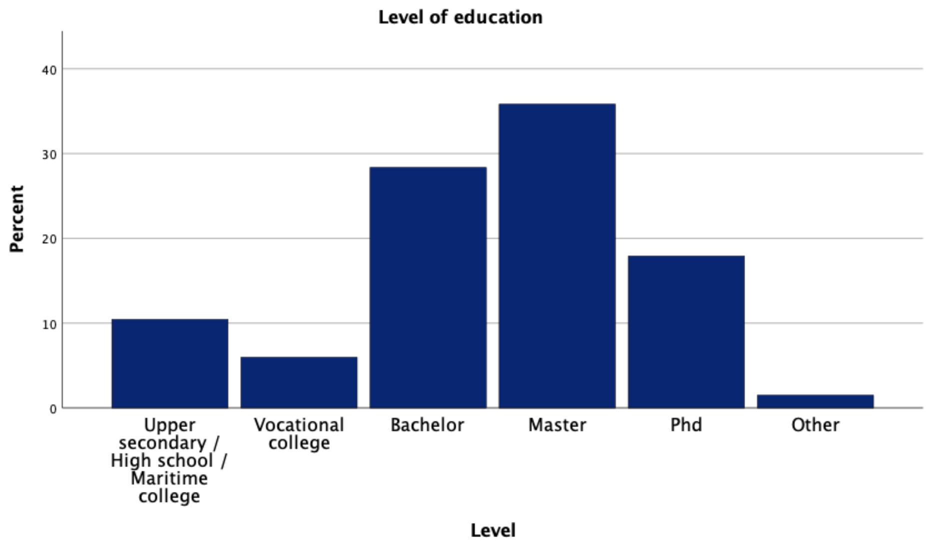


Figure 5: Educational level, percentage

Table 9: Crosstabulation of level of education across county, count

		Level of education						
		Upper secondary / High school / Maritime college	Vocational college	Bachelor	Master	Phd	Other	Total
Country	Azerbaijan	1	0	0	0	0	0	1
	Belgium	0	0	0	1	0	0	1
	Denmark	1	0	0	1	0	1	3
	Egypt	0	0	0	1	2	0	3
	France	1	0	0	0	0	0	1
	India	2	0	0	2	1	0	5
	Kazakhstan	0	0	0	1	0	0	1
	Latvia	0	0	2	2	0	0	4
	Montenegro	0	0	0	0	1	0	1
	Netherlands	0	0	2	1	0	0	3
	Norway	2	4	5	11	2	0	24
	Philippines	0	0	9	1	2	0	12
	Slovenia	0	0	0	1	1	0	2
	Spain	0	0	0	1	0	0	1
	Sweden	0	0	1	0	1	0	2

	Ukraine	0	0	0	0	1	0	1
	UK	0	0	0	0	1	0	1
	USA	0	0	0	1	0	0	1
Total		7	4	19	24	12	1	67

Table 10 illustrates the geographical distribution of the respondent's operational sea service across the represented countries, while Figure 5 depicts the overall distribution of the respondent seagoing experience. The majority of the respondents reported seven or more years of seagoing experience. Norway and the Philippines, the two countries with the highest representation, showed greater diversity in experience level, whereas single participants from Azerbaijan, Montenegro, Ukraine, UK and USA reported over 10 years of seagoing experience. Furthermore, the respondent from Kazakhstan reported over 20 years´ experience. For a detailed breakdown of the other national cohorts, please consult Table 10

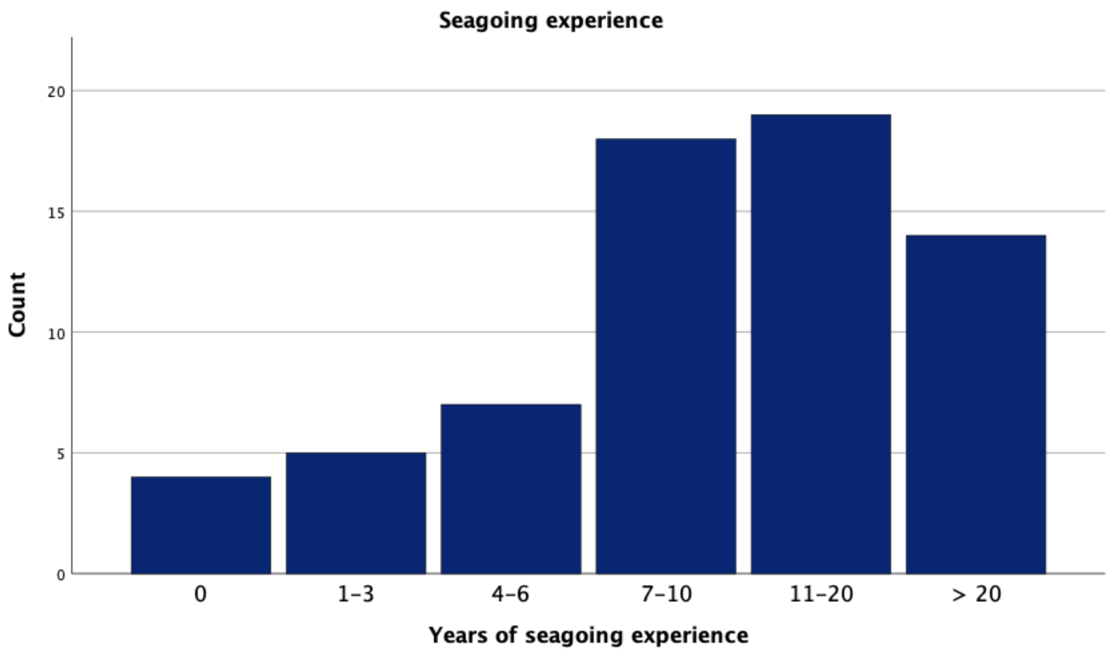


Figure 6: Operational Sea service, percentage

Table 10: Crosstabulation of seagoing experience across country, count

		Years of seagoing experience						
		0	1-3	4-6	7-10	11-20	> 20	Total
Country	Azerbaijan	0	0	0	0	1	0	1
	Belgium	0	0	1	0	0	0	1
	Denmark	0	0	0	2	0	1	3
	Egypt	0	0	0	1	1	1	3
	France	0	0	0	1	0	0	1
	India	1	0	0	0	2	2	5
	Kazakhstan	0	0	0	0	0	1	1
	Latvia	1	0	2	0	0	1	4
	Montenegro	0	0	0	0	1	0	1
	Netherlands	0	0	1	0	1	1	3
	Norway	1	2	3	7	7	4	24
	Philippines	0	2	0	4	3	3	12
	Slovenia	0	1	0	1	0	0	2
	Spain	1	0	0	0	0	0	1
	Sweden	0	0	0	2	0	0	2
	Ukraine	0	0	0	0	1	0	1
	UK	0	0	0	0	1	0	1
	USA	0	0	0	0	1	0	1
Total		4	5	7	18	19	14	67

Table 11 illustrate the geographical distribution of which shipping domains the respondent has primarily have worked at, across the represented countries. Figure 7 visualise the overall distribution of shipping domains. Merchant shipping is the most prominently represented sector among the respondents´ previous experience, especially respondents from the Philippines reported Merchant shipping as their main shipping domain. While participants Norway reported a high number for the offshore/oil and gas industry, the respondent from Kazakhstan was the only one that reported experience with inland waterways like lakes and rivers. For a detailed breakdown of the other national cohorts, please consult Table 11.

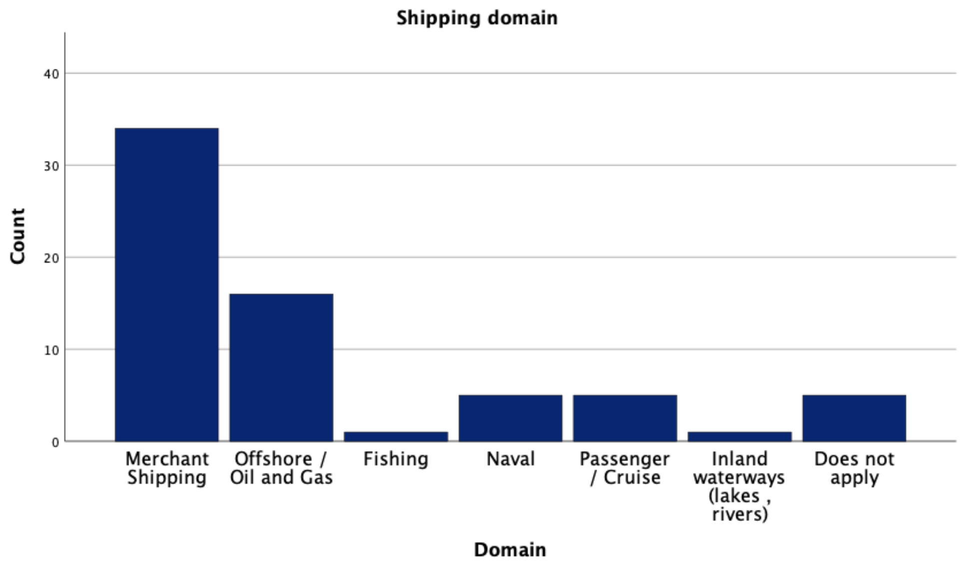


Figure 7: Shipping domain, percentage

Table 11: Crosstabulation of shipping domain across country, count

		Shipping domain							
		Merchant Shipping	Offshore / Oil and Gas	Fishing	Naval	Passenger / Cruise	Inland waterways	Does not apply	Total
Country	Azerbaijan	0	1	0	0	0	0	0	1
	Belgium	0	0	0	0	1	0	0	1
	Denmark	2	0	0	0	1	0	0	3
	Egypt	2	0	0	0	0	0	1	3
	France	1	0	0	0	0	0	0	1
	India	4	0	0	0	0	0	1	5
	Kazakhstan	0	0	0	0	0	1	0	1
	Latvia	3	0	0	0	0	0	1	4
	Montenegro	1	0	0	0	0	0	0	1
	Netherlands	2	0	0	0	1	0	0	3
	Norway	4	13	1	3	2	0	1	24
	Philippines	10	2	0	0	0	0	0	12
	Slovenia	1	0	0	1	0	0	0	2
	Spain	0	0	0	0	0	0	1	1
	Sweden	1	0	0	1	0	0	0	2
	Ukraine	1	0	0	0	0	0	0	1
	UK	1	0	0	0	0	0	0	1
	USA	1	0	0	0	0	0	0	1
Total		34	16	1	5	5	1	5	67

The distribution of instructor qualifications across the 18 represented countries is presented in **Error! Reference source not found.**. Since this question allowed for multiple responses, several participants selected more than one duration bracket. Consequently, the total number of recorded responses ($n=174$) exceeds the actual number of individual respondents (N=67), and percentage are therefore not reported as they would provide little value.

Globally, pedagogical qualifications (n=46) and Valid STCW CoC Management level (n=45) represent the most prevalent credentials within the dataset, followed closely by simulator-specific instructor certification (n=37). In contrast, holding a higher education degree in a relevant field (n=14) is substantially less common, while only a single respondent reported that no formal qualifications were required. Within the larger national subgroups, distinct qualification profiles emerge. In Norway (n=24), pedagogical qualifications (n=19) and management level STCW certificates (n=16) are heavily represented, alongside a high frequency of simulator-specific certifications (n=11). The Philippines (n=12) displays similar findings on operational and management-level STCW certificates (n=6 and n=9 respectively) but shows lower relative frequency of simulator-specific instructor certifications (n=3). Denmark, Egypt and the Netherlands, all represented by three respondents (n=3), exhibit a highly uniform trend, with almost all respondents holding both management-level and simulator-specific certificates, as well as pedagogical qualifications.

Table 12: Crosstabulation for country and qualifications

		Qualifications							
		CoC Operational level	CoC Management level	Simulator instructor certification	Pedagogical qualification	Higher education	No formal qualifications required	Other	Total
Country	Azerbaijan	1	1	1	1	1	0	0	1
	Belgium	0	1	0	1	0	0	0	1
	Denmark	0	2	3	3	1	0	0	3
	Egypt	0	2	2	2	1	0	0	3
	France	1	1	1	1	0	0	0	1
	India	1	3	3	3	1	0	0	5
	Kazakhstan	1	1	1	0	1	0	0	1
	Latvia	2	2	4	3	1	0	1	4
	Montenegro	1	1	1	1	0	0	0	1
	Netherlands	1	1	3	3	1	1	0	3
	Norway	5	16	11	19	2	0	3	24
	Philippines	6	9	3	4	2	0	2	12
	Slovenia	1	0	1	2	1	0	1	2
	Spain	1	1	1	1	1	0	0	1
	Sweden	1	1	0	1	0	0	1	2
	Ukraine	0	1	0	0	0	0	0	1
	UK	0	1	1	1	0	0	0	1
	USA	1	1	1	0	1	0	0	1
Total		23	45	37	46	14	1	8	67

The distribution of responses regarding the presence of a development plan is illustrated in Figure 8. The descriptive data demonstrate that a substantial majority of the respondents reported having a development plan in place (71.6%, n=48). Conversely, the remaining 28.4% (n=19) of the respondents stated that no such plan was established.

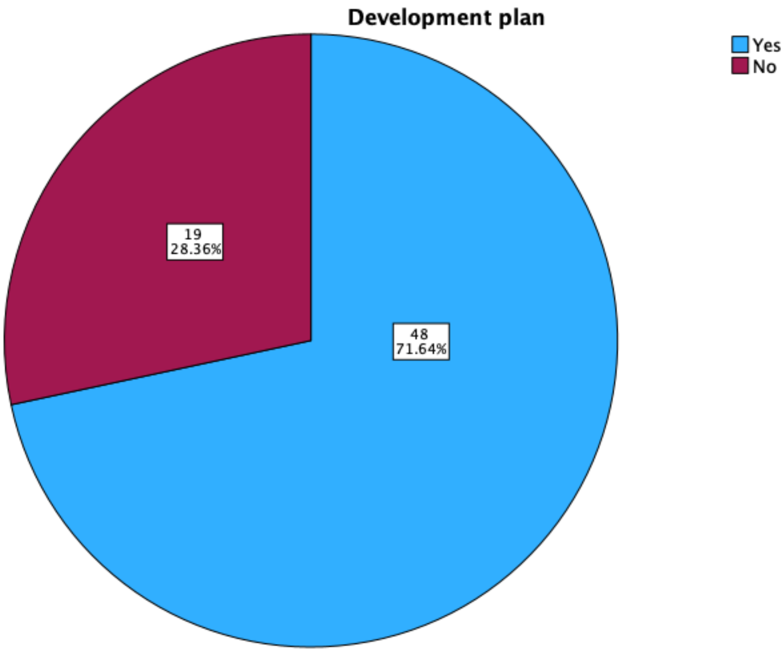


Figure 8: Development plan in count and percentage

Error! Reference source not found. illustrate the geographical distribution annually student enrolment across the represented countries. **Error! Reference source not found.** present the cross-tabulation of annual student enrolment across the 18 represented countries. The data reveal a clear geographical disparity in institutional capacity between the participating nations. Several countries are characterised by samples consisting entirely of high student enrolment. A student enrolment exceeding 500 per year accounts for the entire national sample in Egypt (n=3), as well as by the single representations of Ukraine (n=1), the UK (n=1), and the USA (n=1). Similarly, institutions with a capacity of 201-500 students are reported by the single representations from Azerbaijan (n=1), Belgum (n=1), Kazakhstan (n=1), and Spain (n=1). In contrast, the larger national cohorts display a more distributed capacity profile. Norway (n=24) is heavily characterized by smaller to mid-sized institutions, with the majority of respondents reporting an annual enrolment of 51-100 students or fewer (n=22). Conversely, the Philippines (n=12) leans heavily towards the upper end of the spectrum, with 11 out of 12 respondents reporting an institutional capacity exceeding 200 students annually. For the remaining nations, such as Denmark (n=3), India (n=5), and Latvia (n=4) the responses are divided between distinct mid-range student brackets.

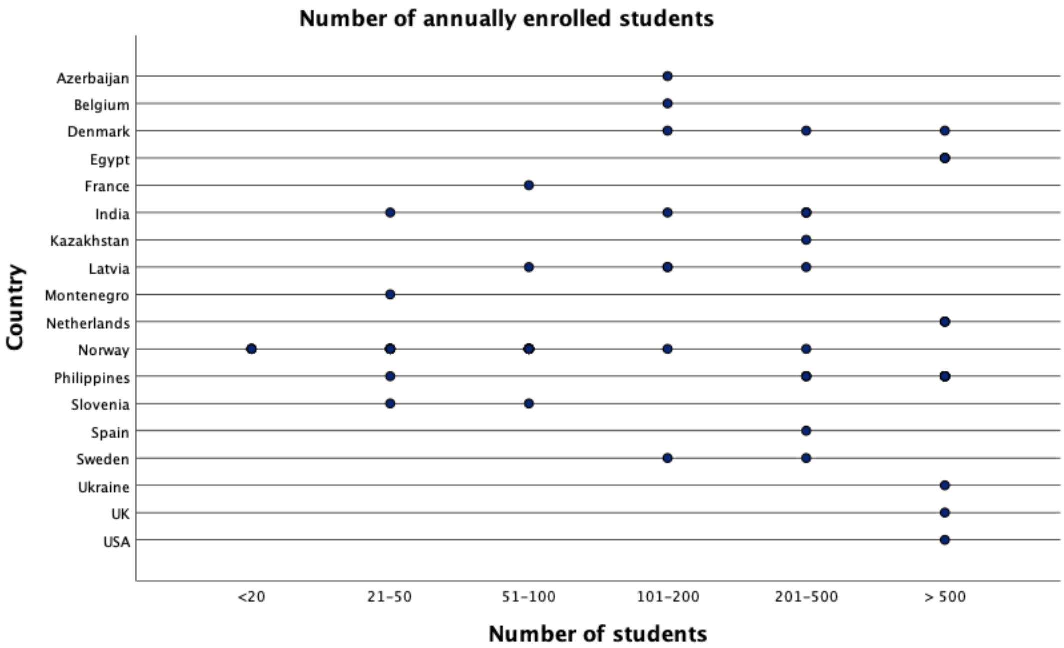


Figure 9: Scatter plot of number of annually enrolled students

Table 13: Crosstabulation of number of annually student enrolment by country, count

		Number of students						
		<20	21-50	51-100	101-200	201-500	> 500	Total
Country	Azerbaijan	0	0	0	1	0	0	1
	Belgium	0	0	0	1	0	0	1
	Denmark	0	0	0	1	1	1	3
	Egypt	0	0	0	0	0	3	3
	France	0	0	1	0	0	0	1
	India	0	1	0	1	3	0	5
	Kazakhstan	0	0	0	0	1	0	1
	Latvia	0	0	1	2	1	0	4
	Montenegro	0	1	0	0	0	0	1
	Netherlands	0	0	0	0	0	3	3
	Norway	4	7	11	1	1	0	24
	Philippines	0	1	0	0	3	8	12
	Slovenia	0	1	1	0	0	0	2
	Spain	0	0	0	0	1	0	1
	Sweden	0	0	0	1	1	0	2
	Ukraine	0	0	0	0	0	1	1
	UK	0	0	0	0	0	1	1
	USA	0	0	0	0	0	1	1
Total		4	11	14	8	12	18	67

Error! Reference source not found. presents a cross-tabulation comparing the type of institution with the annual number of enrolled students. The findings demonstrate that universities (n=33), while displaying a wide internal variation, depict a strong concentration within the larger capacity brackets, particularly between 201 and 500 students (n=10). Simulator training centres (n=8) are characterized by a high volume of student enrolment, with the vast majority (n=7) reporting a capacity exceeding 500 students annually. The category upper secondary/high school/maritime collages (n=20) display a wider internal variation, with individual institutions distributed across all size brackets, though peaking at more than 500 students (n=7). Finally, vocational collages constitute the smallest institutional category (n=6), with most cases clustered below the 100-student threshold.

Table 14: Crosstabulation of number of annually student enrolment by institutional type, count

		Number of students						
		<20	21-50	51-100	101-200	201-500	> 500	Total
Type of institution	Upper secondary/High school /Maritime college	1	2	5	3	2	7	20
	Vocational college	0	3	2	0	0	1	6
	University	3	6	7	4	10	3	33
	Simulator training centre	0	0	0	1	0	7	8
Total		4	11	14	8	12	18	67

4.3.2 RQ 1 – Curriculum design

The detailed distribution of programme duration across the 18 represented countries is presented in **Error! Reference source not found.**. Since this question allowed for multiple responses, several participants selected more than one duration bracket. Consequently, the total number of recorded responses ($n=75$) exceeds the actual number of individual respondents (N=67), and percentage are therefore not reported as they would provide little value.

Overall, a 3-year or 4-year structure represent the most prevalent framework globally, accounting for the highest frequency of selections within the dataset. While smaller national subsamples (n=1) generally report a single uniform programme length, the largest cohorts exhibit more internal variations. For instance, Norway (n=24) shows a concentration around 3-year (n=13) and 1–2-year (n=10) brackets. In contrast, the Philippines (n=12) leans towards longer structures, with the majority of respondents reporting a duration of 4 years or more. Detailed institutional counts for all 18 countries are available in **Error! Reference source not found.**.

Table 15: Crostabulaton of programe duration by country, count

		Duration				
		1–2 years	3 years	4 years	More than 4 years	Total
Country	Azerbaijan	0	0	1	0	1
	Belgium	0	0	1	0	1
	Denmark	0	0	2	1	3
	Egypt	0	0	2	2	3
	France	1	1	0	0	1
	India	2	4	1	0	5
	Kazakhstan	0	0	0	1	1
	Latvia	0	1	1	3	4
	Montenegro	0	1	0	0	1
	Netherlands	0	0	3	0	3
	Norway	10	13	4	0	24
	Philippines	0	3	5	4	12
	Slovenia	0	1	1	0	2
	Spain	0	0	1	0	1
	Sweden	0	0	2	0	2
	Ukraine	0	0	1	0	1
	UK	0	1	0	0	1
	USA	0	0	1	0	1
Total		13	25	26	11	67

The cross-tabulation in **Error! Reference source not found.** outlines when simulator-based training is conducted within the programmes. Since this question allowed for multiple responses, several participants selected more than one duration bracket. Consequently, the total number of recorded responses ($n=107$) exceeds the actual number of individual respondents (N=67), and percentage are therefore not reported as they would provide little value.

As depicted in **Error! Reference source not found.** the simulator training was introduced at an early stage, during the first year, in Egypt, India, Norway, and Sweden. The majority of represented countries conduct simulator-based training throughout all years, whereas Montenegro, Slovenia and Spain do not introduce and conduct it until the second year. Finally, for Kazakhstan and Ukraine, the data show that introducing simulator-based training commences during the student's third year.

Table 16: Crosstabulation of when conducted simulator-based training by country, count

		Conducted					
		1st year	2nd year	3rd year	4th year	Throughout all years	Total
Country	Azerbaijan	0	0	0	0	1	1
	Belgium	0	1	1	1	0	1
	Denmark	0	0	0	0	3	3
	Egypt	1	0	0	0	2	3
	France	0	0	0	0	1	1
	India	2	3	3	0	1	5
	Kazakhstan	0	0	1	0	0	1
	Latvia	0	2	2	1	1	4
	Montenegro	0	1	1	0	0	1
	Netherlands	0	1	1	0	2	3
	Norway	15	13	5	1	9	24
	Philippines	0	6	7	0	4	12
	Slovenia	0	1	2	0	0	2
	Spain	0	1	1	1	0	1
	Sweden	1	1	0	1	1	2
	Ukraine	0	0	1	1	0	1
	UK	0	0	0	0	1	1
	USA	0	0	0	0	1	1
Total		19	30	25	6	27	67

Figure 10 present the respondents level of agreement regarding various aspects of the simulator curriculum. Overall, the data demonstrate a predominantly agreeing perceptions, with high level of agreement across most statements. The highest degree of consensus was observed regarding the alignment with regulatory requirements from the STCW code, where 91% (n=61) of the respondents either agreed or strongly agreed. Similarly, a substantial majority reported that learning objectives for each session are clearly defined (87%, n=58) and that simulator training is introduced at suitable stage of the program (84%, n=56). Statement s concerning the annual review of the curriculum and the inclusion of IMO model course recommendations showed more varied responses. Regarding the annual review, 66% (n=44) expressed agreement, while 21% (n=14) remained natural and 14 % (n=9) disagreed. Similarly, for the recommendations given in IMO model courses, 73% (n049) agreed, whereas 16% (n=11) provided a neutral response. Across all statements, the proportion of respondents who strongly disagree remaining low, ranging between 5% and 8%.

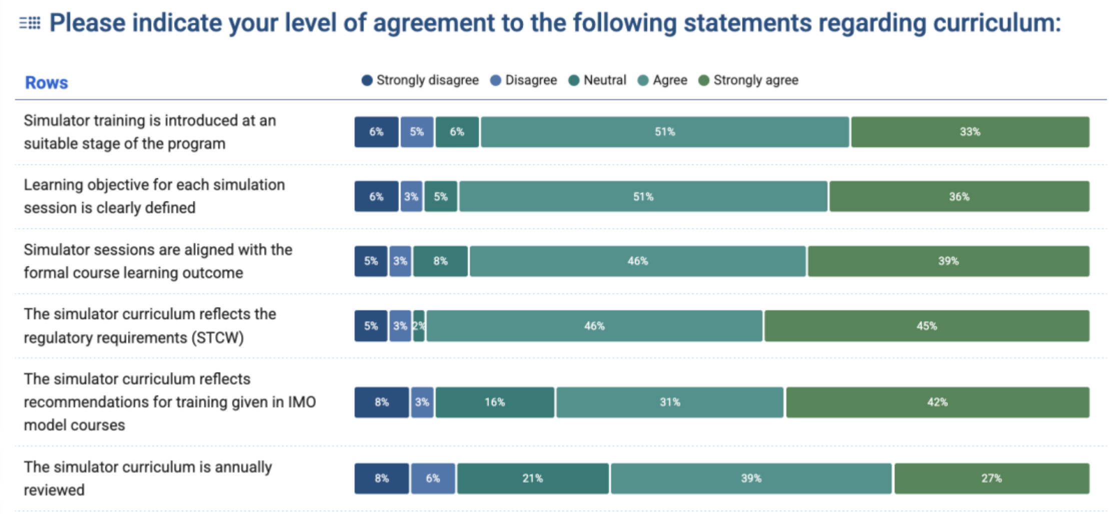


Figure 10: Summary of Likert scale responses regarding curriculum: Percentage and count distribution

4.3.3 RQ 2 – Training duration and organizational structures

Figure 11 illustrates the medial total hours allocated to simulator training across the participating countries. Notably, the mean values for each nation correspond precisely with the medians, as depicted in figure W in Appendix II. However, it should be noted that there are 14 missing cases (20.9%) in analysis, as the predefined qualitative answers "varies significantly" had to be excluded from the quantitative summation as detailed in Table 17. The data from Figure 11 reveal substantial variations in training volume between the nations.

As detailed in Appendix II, Denmark reports the highest median volume of simulator training, with two respondents (n=2) reporting 36 hours and 875 hours respectively, resulting in a total median of 455 hours. Egypt's three respondents (n=3) are distributed across 144, 180 and 500 hours. In contrast, the USA is represented by a single respondent (n=1) who reported 225 hours. Notably, one respondent is missing from the Danish subsample, and both Denmark and Egypt have previously been identified as comprising a combination of university and simulator training centre representations.

For the countries clustered in the mid-range volume, Spain (n=1) and the UK (n=1) are represented by a single respondent reporting 144 and 112.5 hours respectively. Sweden´s sample consists of two (n=2) respondents reporting 84 and 200 hours, while Ukraine is represented by a single respondent (n=1) reporting 120 hours. Belgum (n=1) reported 96 hours. India (n=4) exhibits internal variations, ranges from 24 to 392 hours. Norway (n=23) represents the largest national subsample in this specific analysis, demonstrating a widely dispersed distribution with individual responses spanning from 11.25 hours to 750 hours.

The lowest training volumes are found in Kazakhstan (n=1) and Montenegro (n=1), with both countries represented by a single respondent reporting 3.75 hours and 4.5 hours respectively. Low-range volumes are also observed in Azerbaijan and Latvia with both n=1 and 60 hours, France (n=1) with 45 hours, and the Netherlands (n=2) with reported 48 and 72 hours. Finally, the Philippines (n=6) exhibits a lower-range cluster, with individual values distributed between 12 and 192 hours.

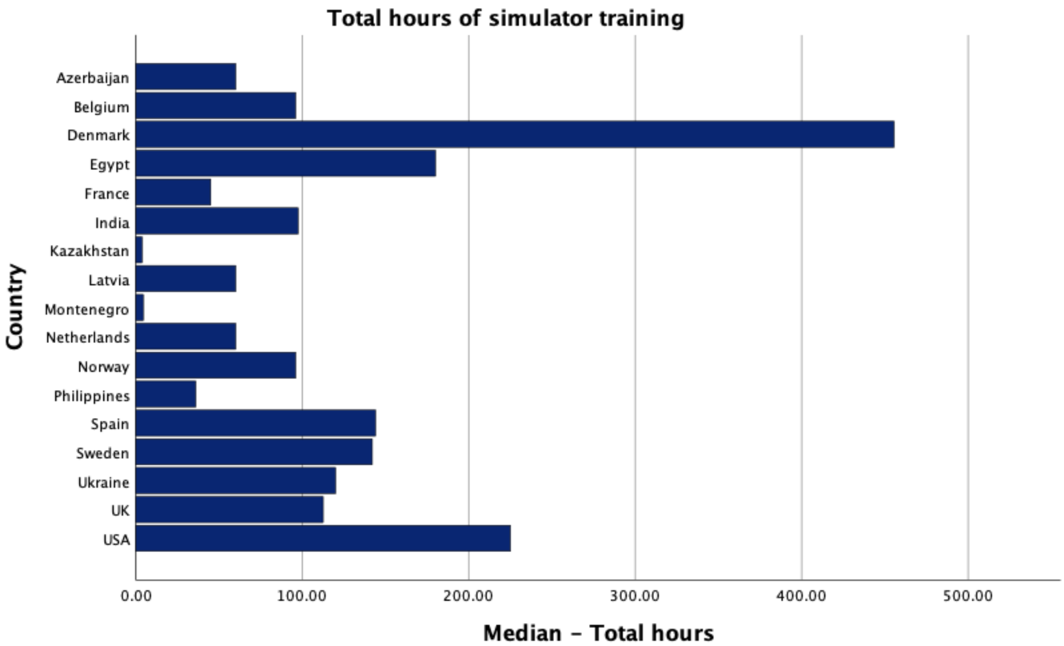


Figure 11: Median total hours of simulator training

A visual inspection of the boxplot in Figure 9 regarding total number of hours revealed distinct distributional characteristics across countries, as well as several statistical outliers. Explicitly, four extreme outliners were identified based on their case row numbers; 42, 54, and 57 within the Norwegian sample, and row 22 within the Philippine sample. These specific data points demonstrate a substantial deviation from the rest of the sample within their respective countries.

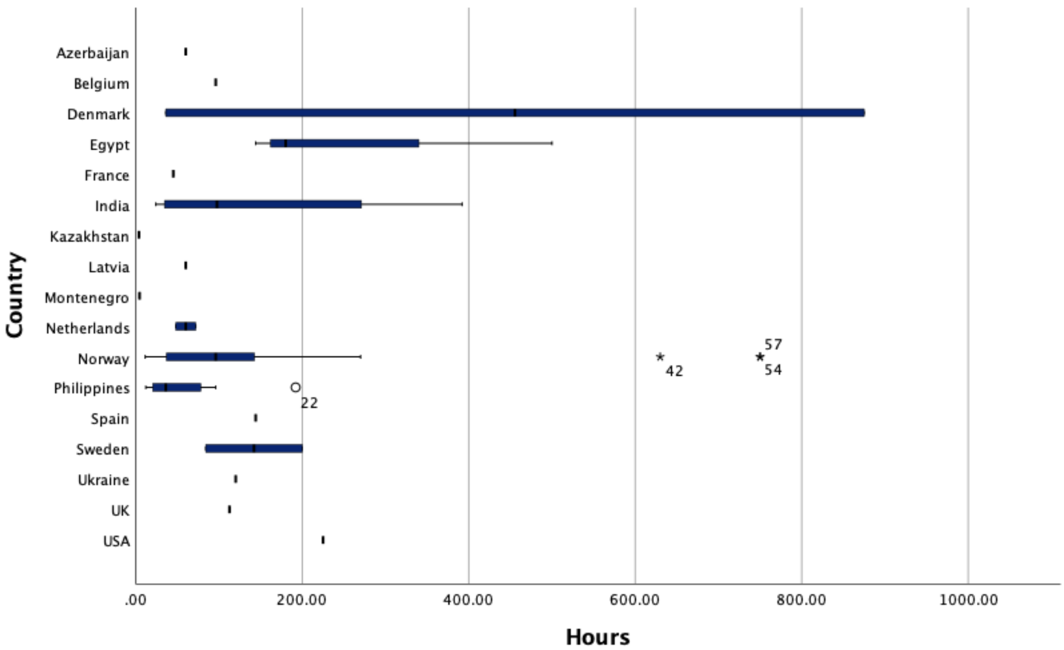


Figure 12: Box plot of total hours of simulator training, by country

The missing cases for this specific matric arise directly from respondents selecting the qualitative option “Varies significantly" instead of a fixed time bracket, depicted in Table 17, **Error! Reference source not found.** and **Error! Reference source not found.**. Consequently, these missing values are located within the samples representing Denmark, India, Latvia, the Netherlands, and Slovenia where the option accounts for 20% to 50% of the national responses. A minor segment from the Norwegian cohort also selected this option.

Table 17: Missing values for aggregated simulator hours

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Country * Total hours of simulator training	53	79.1%	14	20.9%	67	100.0%

As illustrated in Table 18 the geographical distribution of the ratio between instructor and student, across the represented countries. Figure 13 visualise the overall distribution of the ratio. Distinct institutional patterns emerged between the two sample Is primarily concentrated around moderate ratio structures, specificity between 1:5 and 1:12. In contrast, the Philippines sample leans toward denser layouts, with half of its respondents operating within a 1:2 to 1:4 ratio. Extreme ratios exceeding 1:12 remain rare across the global sample, with India being the minor exception. Finally, the ‘varies significantly’ category was selected by a small minority, driven mainly by respondents from Norway, the Philippines and Latvia.

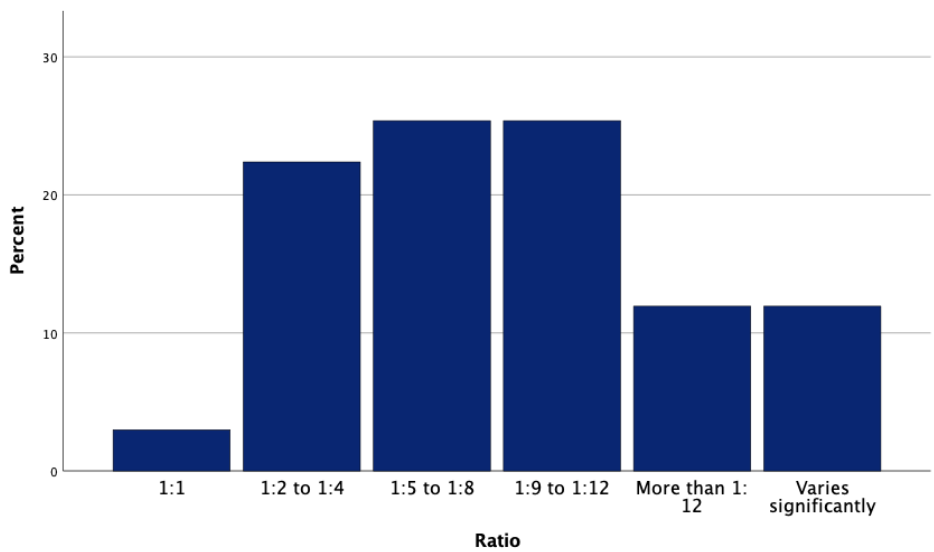


Figure 13: Instructor-to-student ratio, percentage

Table 18: Crosstabulation of instructor-to-student ratio across country, count

		Ratio						
		1:1	1:2 to 1:4	1:5 to 1:8	1:9 to 1:12	More than 1:12	Varies significantly	Total
Country	Azerbaijan	0	0	0	0	1	0	1
	Belgium	0	0	1	0	0	0	1
	Denmark	0	1	2	0	0	0	3
	Egypt	1	1	0	1	0	0	3
	France	0	0	1	0	0	0	1
	India	0	1	0	3	1	0	5
	Kazakhstan	0	1	0	0	0	0	1
	Latvia	0	0	0	2	0	2	4
	Montenegro	0	0	1	0	0	0	1
	Netherlands	0	3	0	0	0	0	3
	Norway	0	2	9	7	3	3	24
	Philippines	1	6	1	0	2	2	12
	Slovenia	0	0	0	1	0	1	2
	Spain	0	0	1	0	0	0	1
	Sweden	0	0	0	1	1	0	2
	Ukraine	0	0	1	0	0	0	1
	UK	0	0	0	1	0	0	1
	USA	0	0	0	1	0	0	1
Total		2	15	17	17	8	8	67

The respondent's level of agreement regarding various aspects of the simulator training sessions is depicted in Figure 14. Similar to the findings concerning the curriculum, the data demonstrate a high degree of consensus across all statements. The strongest level of agreement related to the impact of training on shill development, where 89% (n=60) of the respondents agreed that the frequency of sessions supports the progression. Furthermore, a high proportion of the cohort reported that sessions are well coordinated (88%, n=59) and well organised (86%, n=58), with a combined strongly disagree and disagree rate of 8% or less for these statements. Responses regarding organisational and recourse-related support depicted a slightly more variation, although the overall trend remained one of agreement. A total of 76%(n=51) agreed that organisational support ensures that sessions run smoothly, while 13% (n=9) provided a neutral response. Similarly, concerning the adequacy of resources such as equipment and technical support, 72% (n=48) expressed agreement, whereas 16% (n=11) remained neural and 12% (n=8) disagreed. Across all statements, the level of strong disagreement was minimal, consistently remaining at 5% (n=3) or below.

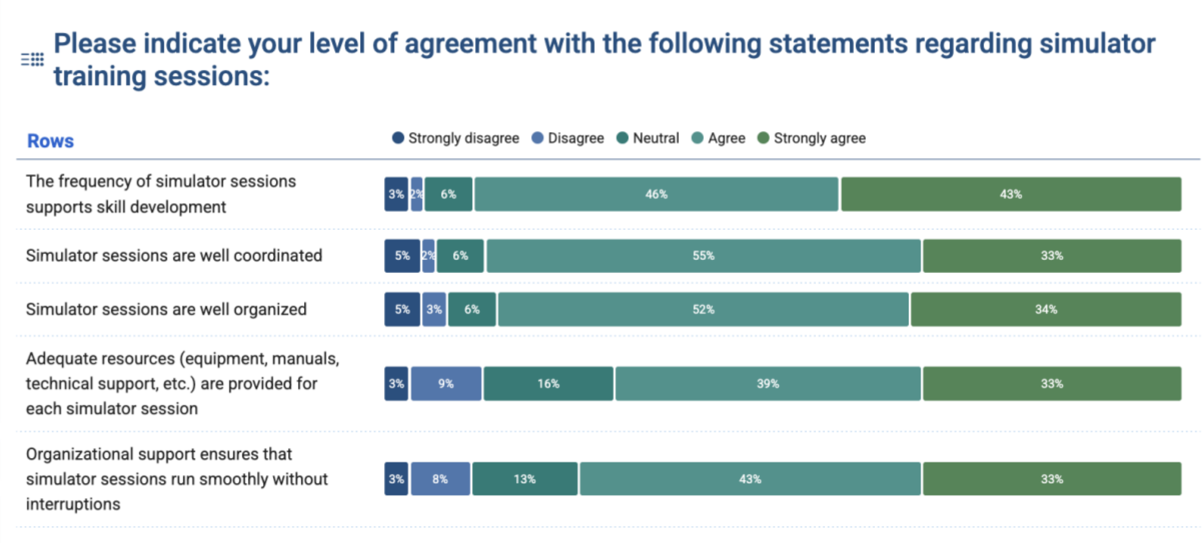


Figure 14: Summary of Likert scale responses regarding simulator sessions: Percentage and count distribution

4.3.4 RQ 3 – Scenario design

The respondents' perceptions regarding scenario development are illustrated in Figure 15. Overall, the data demonstrate a strong consensus that the simulator scenarios align with realistic operational demands and technical requirements. The highest level of agreement was observes concerning navigation in specific environments and emergency handling. Specifically, 93% (n=62) agrees or strongly agrees that scenarios include navigation in narrow or coastal waters, while 91% (n=61) reported the same for high-trafficked/congested waters. Furthermore, 90% (n=60) of the respondents expressed agreement regarding the inclusion of emergency situations and the realism of operational situations (93%, n=62).

While the general trend remaining one of agreement, statements regarding the testing of students´ psychological factors depicted more varied responses. Although a majority agrees that scenarios are tailor-made for testing stress tolerance (58%, n=39), this statement also received the highest neutral response rate in this section at 33% (n=22). Similarly, regarding the testing of decision-making skills under pressure, 79% (n=53) expressed agreement, while 13% (n=9) remained neutral. Disagreement across all statements regarding scenario design was low, consistently remaining at 10% (n=6) or below.

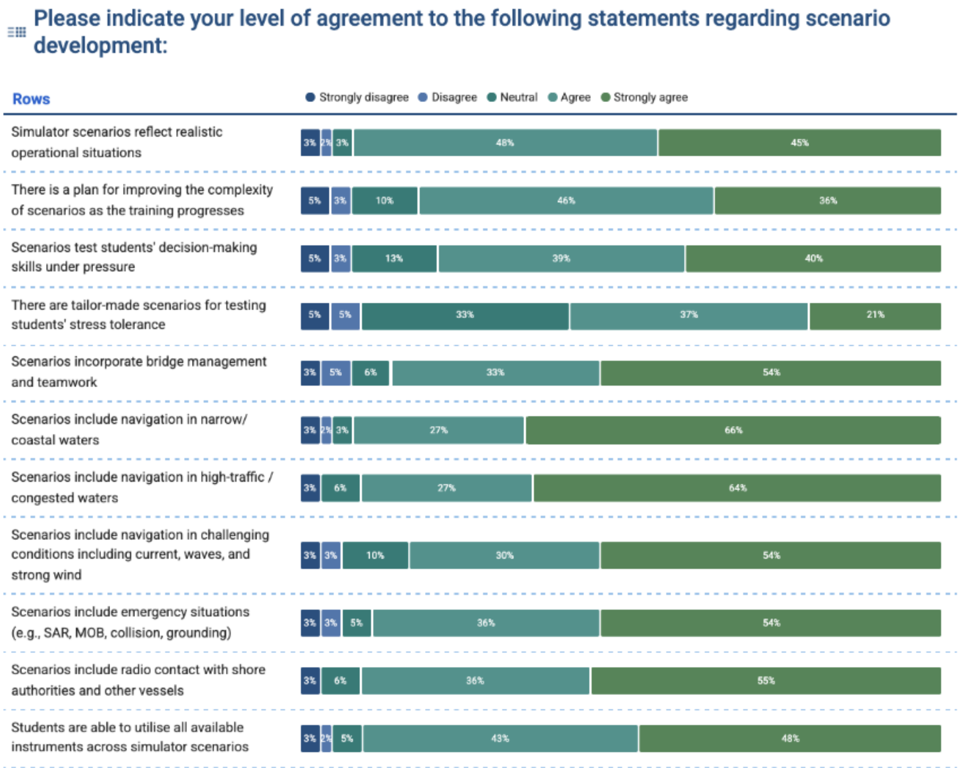


Figure 15: Summary of Likert scale responses regarding scenario design: Percentage and count distribution

4.3.5 RQ 4 – Briefing and debriefing procedures

The findings regarding briefing and debriefing practices are depicted in Figure 16. These findings demonstrate a particularly high level of consensus, with a substantial majority of the cohort selecting the strongly agree and agree category across all statements.

The highest level of agreement reported for the encouragement of questions during briefing and the provisions of guidance s during sessions, where 94% (n=63) and 90% (n=60) of respondents respectively expressed agreement. Notable, 63% (n=42) of the participants strongly agrees that the students are encouraged to seek clarifications during the briefing phase. Similarly, the provision of debriefing after each session reached a high level of consensus (88%, n=59), with the largest single strongly agree response rate in this section at 61% (n=41).

Effective communication of learning objectives and the consistent provision of briefing before each session also depicted strong support, with agreement levels of 87% (n=58) and 92% (n=62) respectively. Neutral responses remained low across all items, peaking at 9% (n=6) regarding the communication of objectives. Strongly disagreement was minimal, with no more that 5% (n=3) of the total sample expressing any form of disagreement with the statements in this section. Furthermore, only a single respondent (2%, n=1) reported disagreeing within this section.

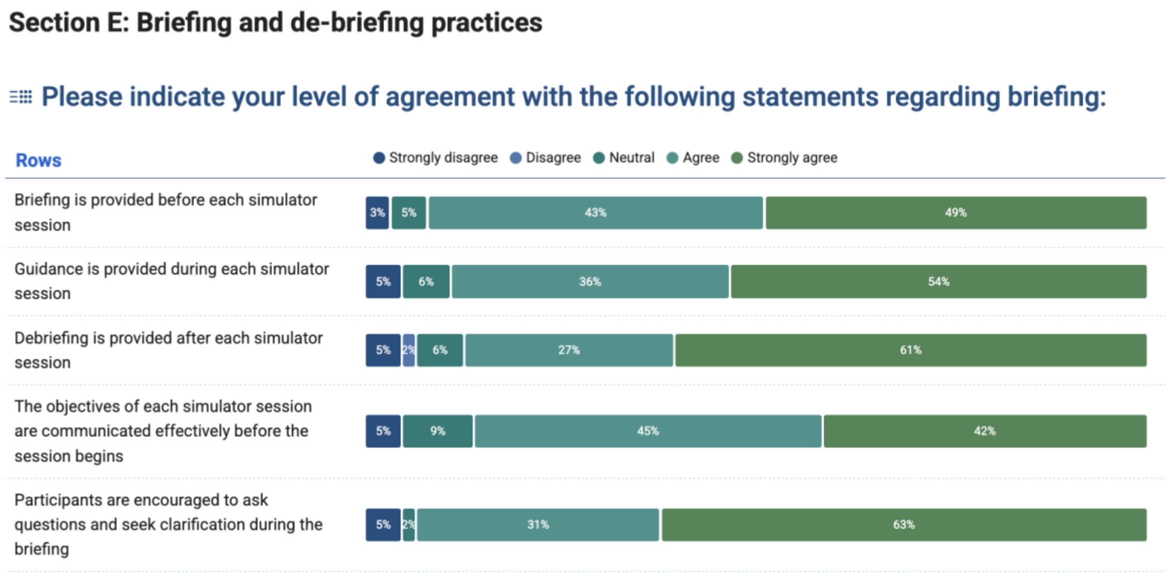


Figure 16: Summary of Likert scale responses regarding briefing and debriefing procedures: Percentage and count distribution

4.3.6 Inferential analysis

In the following section, tables are shown for the Kruskal-Wallis test results for the independent variable Country Recoded and various dependent ordinal variables. The Kruskal-Wallis showed significant (2-sided) levels for three ordinal variables, these were the following:

- The simulator curriculum reflects recommendations for training given in IMO model courses
- Adequate resources (equipment, manuals, technical support, etc.) are provided for each simulator session

- The objectives of each simulator session are communicated effectively before the session begins

A pos-hoc pairwise comparison was done to all the three variables, none of which showed significant levels. These numbers are shown in tables in this section. Also tables for the missing variables doing the inferential analysis is shown here.

Table 19: Overview over missing values for Country Recoded

Statistics

Country_Recoded

N	Valid	54
	Missing	13

Table 20: Kruskal-Wallis test results for RQ 1 - Curriculum design across Country Recoded

	Null Hypothesis	Sig.[a,b]	Decision
1	The distribution of Simulator training is introduced at a suitable stage of the program is the same across categories of Country Recoded.	.330	Retain the null hypothesis.
2	The distribution of Learning objective for each simulation session is clearly defined is the same across categories of Country Recoded.	.232	Retain the null hypothesis.
3	The distribution of Simulator sessions is aligned with the formal course learning outcome is the same across categories of Country Recoded.	.125	Retain the null hypothesis.
4	The distribution of The simulator curriculum reflects the regulatory requirements (STCW) is the same across categories of Country Recoded.	.956	Retain the null hypothesis.
5	The distribution of The simulator curriculum reflects recommendations for training given in IMO model courses is the same across categories of Country Recoded.	.023	***Reject the null hypothesis.***
6	The distribution of The simulator curriculum is annually reviewed is the same across categories of Country Recoded.	.051	Retain the null hypothesis.
7	The distribution of The frequency of simulator sessions supports skill development is the same across categories of Country Recoded.	.063	Retain the null hypothesis.

Table 21: Test summary for Kruskal-Wallis test, IMO across Country Recoded

Independent-Samples Kruskal-Wallis Test Summary

Total N	54
Test Statistic	14.715[a]
Degree Of Freedom	6
Asymptotic Sig. (2-sided test)	.023

a. The test statistic is adjusted for ties.

As Table 20 and Table 21 depicts the Kruskal-Wallis test showed that the recoded country variable had a significant effect on the question “What is the typical instructor-to-student ratio during simulator sessions at your institution?”, $\chi^2(6, N = 54) = 14.715$, $p = .023$. However, a post-hoc test using Dunn's test with Bonferroni correction showed no adj. significant differences for any of the pairwise comparisons. This meaning that

This means that the null hypothesis is retained, and that there are no significant differences between the countries.

Table 22: Missing values for number of sessions conducted per course

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Country Recoded * How many simulator sessions are typically conducted per course?	43	64.2%	24	35.8%	67	100.0%

Table 23: Kruskal-Wallis test results for RQ – Training duration and organisation across recoded countries

	Null Hypothesis	Sig.[a, b]	Decision
1	The distribution of How many compulsory courses include simulator-based training as a core component? is the same across categories of Country Recoded.	.070	Retain the null hypothesis.
2	The distribution of How many simulator sessions are typically conducted per course? is the same across categories of Country Recoded.	.083	Retain the null hypothesis.
3	The distribution of What is the average duration of a single simulator session? is the same across categories of Country Recoded.	.970	Retain the null hypothesis.
4	The distribution of What is the typical instructor-to-student ratio during simulator sessions at your institution? is the same across categories of Country Recoded.	.031	***Reject the null hypothesis.***
5	The distribution of Simulator sessions is well coordinated is the same across categories of Country Recoded.	.050	Retain the null hypothesis.
6	The distribution of Simulator sessions is well organized is the same across categories of Country Recoded.	.151	Retain the null hypothesis.
7	The distribution of Adequate resources (equipment, manuals, technical support, etc.) are provided for each simulator session is the same across categories of Country Recoded.	.097	Retain the null hypothesis.
8	The distribution of Organizational support ensures that simulator sessions run smoothly without interruptions is the same across categories of Country Recoded.	.132	Retain the null hypothesis.

Table 24: Test summary for Kruskal-Wallis test ratio

Independent-Samples Kruskal-Wallis Test Summary

Total N	47
Test Statistic	13.857[a]
Degree Of Freedom	6
Asymptotic Sig. (2-sided test)	.031

a. The test statistic is adjusted for ties.

As Table 23 and Table 24 depicts the Kruskal-Wallis test showed that the recoded country variable had a significant effect on the question “What is the typical instructor-to-student ratio during simulator sessions at your institution?”, $\chi^2(6, N = 47) = 13.857$, p =.031. However, a post-hoc test using Dunn's test with Bonferroni correction showed no adj. significant differences for any of the pairwise comparisons.

This means that the null hypothesis is retained, and that there are no significant differences between the countries.

Table 25: Missing values for total hours

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Country Recoded * Total hours of simulator training	42	62.7%	25	37.3%	67	100.0%

Table 26: Kruskal- Wallis test ot the total hours simulator training

	Null Hypothesis	Sig.[a,b]	Decision
1	The distribution of Total hours of Simulator training is the same across categories of Country Recoded.	.384	Retain the null hypothesis.

Table 27: Kruskal-Wallis test regarding RQ 3 – Scenario design across recoded countries

	Null Hypothesis	Sig.[a, b]	Decision
1	The distribution of Simulator scenarios reflect realistic operational situations is the same across categories of Country Recoded.	.096	Retain the null hypothesis.
2	The distribution of There is a plan for improving the complexity of scenarios as the training progresses is the same across categories of Country Recoded.	.090	Retain the null hypothesis.
3	The distribution of Scenarios test students decision-making skills under pressure is the same across categories of Country Recoded.	.742	Retain the null hypothesis.
4	The distribution of There are tailor-made scenarios for testing students stress tolerance is the same across categories of Country Recoded.	.072	Retain the null hypothesis.
5	The distribution of Scenarios incorporates bridge management, and teamwork is the same across categories of Country Recoded.	.723	Retain the null hypothesis.
6	The distribution of Scenarios include navigation in narrow/coastal waters is the same across categories of Country Recoded.	.695	Retain the null hypothesis.
7	The distribution of Scenarios include navigation in high-traffic/congested waters is the same across categories of Country Recoded.	.699	Retain the null hypothesis.
8	The distribution of Scenarios include navigation in challenging conditions including current, waves, and strong wind is the same across categories of Country Recoded.	.431	Retain the null hypothesis.
9	The distribution of Scenarios includes emergency situations (e.g., SAR, MOB, collision, grounding) is the same across categories of Country Recoded.	.314	Retain the null hypothesis.
10	The distribution of Scenarios include radio contact with shore authorities and other vessels is the same across categories of Country Recoded.	.443	Retain the null hypothesis.
11	The distribution of Students are able to utilise all available instruments across simulator scenarios is the same across categories of Country Recoded.	.570	Retain the null hypothesis.

a. The significance level is .050.
b. Asymptotic significance is displayed.

Table 28: Kruskal-Wallis test results regarding RQ 4 – Briefing-related variables across recoded countries

	Null Hypothesis	Sig.[a,b]	Decision
1	The distribution of Briefing is provided before each simulator session is the same across categories of Country Recoded.	.238	Retain the null hypothesis.
2	The distribution of Guidance is provided during each simulator session is the same across categories of Country Recoded.	.556	Retain the null hypothesis.
3	The distribution of Debriefing is provided after each simulator session is the same across categories of Country Recoded.	.273	Retain the null hypothesis.
4	The distribution of The objectives of each simulator session are communicated effectively before the session begins is the same across categories of Country Recoded.	.033	***Reject the null hypothesis.***
5	The distribution of Participants are encouraged to ask questions and seek clarification during the briefing is the same across categories of Country Recoded.	.559	Retain the null hypothesis.

Independent-Samples Kruskal-Wallis Test Summary

Total N	54
Test Statistic	13.678[a]
Degree Of Freedom	6
Asymptotic Sig. (2-sided test)	.033

a. The test statistic is adjusted for ties.

Table 29: Test summary Kruskal-Wallis test briefing of objectives

As Table 28 and Table 29 depicts, the Kruskal-Wallis test showed that the recoded country variable had a significant effect on the statement “the objectives of each simulator session are communicated effectively before the session begins”, $\chi^2(6, N = 54) = 13.678, p =.033$. However, a post-hoc test using Dunn's test with Bonferroni correction showed no adjusted significant differences in any of the pairwise comparisons.

This means that the null hypothesis is retained, and that there are no significant differences between the countries.

5 Discussion

The primary objective of this study was to examine curriculum design, training duration and organisation, scenario design, and briefing end debriefing procedures across different countries. To contextualise the core findings and evaluate their generalisability, it is essential to critically assess the empirical foundation upon which this study rests. Therefore, this chapter begins with a comprehensive review of the sample characteristics and the methodological limitations identified during data collection, particularly concerning variations in country representation. Following these methodological reflections, the chapter critically discusses the primarily descriptive findings, as well as reflection on the inferential analysis.

While the STCW Convention provides a global regulatory framework for simulator-based training, the significant variations in how these standards are implemented may have implications for maritime safety. Variations in time allocations, scenario complexity, and pedagogical methods could lead to inconsistent competency levels among officers entering the international workforce. Furthermore, a lack of standardized training practices may complicate the seamless cross-border mobility of seafarers.

The rapid advancement of maritime technology is continuously reshaping the training landscape. As ships become more sophisticated and crew sizes decrease, the reliance on high-fidelity simulators for skill enhancement becomes even more critical. Consequently, understanding the global landscape of simulator-based training is essential to ensure that maritime education not only meets regulatory minimum requirements but also evolves to meet the demands of a rapidly changing industry.

5.3 Survey justification

The primary reason for choosing a survey as the method for this project, was the ability to reach a broad audience. Since the objective was to map and compare the simulator-based training on a global scale, this was the most appropriate choice. Furthermore, electronic distribution simplified the logistics of data collections and allowed for the gathering of substantial information in a short timeframe, as it eliminated the need to schedule and conduct individual interviews. This saved time both for the participants and the researcher. As the survey was anonymous, it was more likely that the respondents were honest when their identity was protected, reducing the risk of interviewer bias where the presence of a researcher may influence the answers. Because every participant received identical questions and predefined response options, the data is highly consistent, making it easier to compare across different countries. The structured nature of a survey also makes the study easy to replicate for future researchers who wish to verify the findings or track changes over time.

There are, however, inherent limitations to this method, as responses are largely predefined to facilitate subsequent analysis and in this way the data will lack depth. Surveys typically capture what people think, but not necessarily why, lacking the nuanced and rich detail that qualitative interviews provide. Increasing the number of open-ended questions complicates the analytical process and was in this regard limited in the survey. Furthermore, there were a risk of misinterpretation, where respondents may misunderstand a specific question, potentially leading to bias in the data. To mitigate this risk, it was important to conduct a pilot study to identify and rectify poorly formulated questions or response alternatives before the finale distribution. Achieving a high response rate also remained a significant challenge in this globally distributed survey, as low number of participants could make it difficult to generalize the findings to the entire maritime industry. Additionally, participants may have felt inclined to provide socially desirable or professional answers, for instance by overreporting their adherence to the STCW guidelines to present themselves or their institution in a better light. This phenomenon must be considered when interpreting the results.

Nevertheless, a survey was deemed the most effective method for data collections, considering the target population and the design of the research questions.

5.4 Respondent demographics

As shown, the highest frequency of respondents is from Norway. Not surprising, as contact information for Norwegian institutions was more readily accessible, facilitating a more efficient distribution process. Notably, the Philippines provided more than ten responses. As most of the respondents from the Philippines belong to the same institutions, it is probably that the survey was forwards internally among colleagues, as requested in the introduction of the survey. This mean that the response from the Philippines is anticipated to be consistent in regard of institutional demographics which the findings also depicted.

Due to the variation in the number of respondents across countries, the data may be less robust for nations with lower representation. Specifically, countries such as Azerbaijan, Belgium, France, Kazakhstan, Montenegro, Spain, Ukraine, the United Kingdom, and the USA are represented by only a single respondent, which limits the reliability of the findings for these specific countries. Consequently, it was more statistically valid to do a comparative inferential analysis of Norway, the Philippines, India, Latvia, the Netherlands, Egypt, and Denmark. Nevertheless, the descriptive findings from all the countries were still considered to hold value, as they provide a broader perspective on the global picture.

Universities were the most represented institution. This trend was anticipated, as contact information for deck officers training programmes was more readily available for universities than for maritime colleges, vocational colleges or simulators training centres. As the Table 6show, respondents from Netherland and Ukraine worked at a simulator training centre, which was also the case for a portion of respondents from Denmark and Egypt. Furthermore, Norway and the Philippines, alongside Belgium, Azerbaijan, Latvia and France had a notable number of participants representing maritime colleges. The majority of respondents identified as professors, senior lecturers, lecturers or instructors. However, a considerable number of participants selected ‘other’. This could suggest that some of the respondents work in administrative roles or hold alternative positions that were not explicitly listed in the questionnaire. However, this cannot be determined with certainty due to the lack of qualitative data. The respondent´s level of experience working at a MET institution varied, jet was generally high. Nearly 50% reported having 11 years of experience or more. This, and the fact that most of the respondents identified as professors, senior lecturers, lecturers or instructors, indicates that the participants, for the most part, possesses extensive experience in educating deck officers at a MET institution.

The majority of the respondents reported seven or more years of seagoing experience, with a large proportion having 11 years’ experience or more. These findings suggest that many seafarers spend several years at sea before becoming instructors, lecturers, professors, or assuming other roles working at a MET institution. While Merchant shipping is shown to be the most prominently represented sector among the respondents’ previous experience, some respondents from Azerbaijan, Norway, and the Philippines reported experience in the offshore/oil and gas industry. The single respondent from Kazakhstan was the only one to report experience with inland waterways, such as lakes and rivers. The latter is expected, given the country´s lack of a coastline.

Regarding qualifications, the findings indicated that a valid Certificate of Competency (CoC) at the management level, simulator-specific instructor certification, and pedagogical qualifications are the requirements most frequently reported across the represented countries. The Netherlands is the only responding nation to report that no formal qualifications are required. However, as this respondent also selected several other qualification criteria, this result should likely be regarded as a typographical error or a response bias. Furthermore, Latvia, Norway, the Philippines, Slovenia, and Sweden all reported additional qualification requirements beyond the predefined categories.

The findings shows that while the majority of institutions have a development plan, 19 respondents answered negatively to this question. This discrepancy may suggest either that a portion of the staff is unaware of the plan's existence, or that the institution indeed lacks such a structured plan.

The data indicate that a substantial number of institutions enrols more than 100 students annually in programmes incorporating simulator-based training. However, as this number appeared unexpectedly high, a cross-tabulation between the institutional names and number of students was performed. This analysis revealed that several participants from the same institutions reported conflicting figures. Since most of the institutions have reported two or three different answers, it is likely that the question was not specified enough, leading to misinterpretation of the question. Although 'enrolled annually' in this context was intended to refer to the annual intake of new students, some respondents may have interpreted it as the total number of students across the entire programme, which would significantly inflate the figures. Furthermore, despite the fact that the survey introduction explicitly stated that the scope was limited to deck officer education, it is possible that some respondents also included students from maritime engineering programmes, thereby increasing the variance in the reported data.

It is noteworthy that Norway is the country where certain institutions reported fewer than 20 students. This may be since several Norwegian institutions offer only a single programme for deck officer education. In contrast, institutions in other countries often provide multiple pathways to qualification. For instance, in the United Kingdom, it is more common to have various programmes training deck officers, ranging from HND Nautical Science, BSc (Hons) Nautical Science and FdSc Nautical Science (Warsash Maritime School, n.d.).

Furthermore, it is important to observe that respondents from Egypt, the Netherlands, and Ukraine, all of whom reported more than 500students annually, predominantly identifies as simulator training centres. It is understandable that such centres experience a higher annual throughput than traditional institutions. However, a distinction must be made between full-time academic students and short-term course participants. Consequently, this question should have been more precisely formulated to avoid such misunderstandings and cautions should be exercised when drawing definitive conclusions from this specific data.

5.5 RQ 1 – Curriculum design

The duration of programmes leading to a CoC, varies internationally. While a period of one to two years is reported in France, India and Norway, this appears to be less common from a global perspective. Both respondents from France and Norway have reported that the institutions they represented was a maritime college, which may explain this finding. More common among the overall sample in this data is an education of three or four years, and in some countries also more than 4 years was common.

The data in **Error! Reference source not found.** depicts a clear divide in how maritime nations structure the timeline for deck officer education. The fact that a three-year og four-year framework is the most prevalent globally suggest that the majority of countries favor a comprehensive academic degree model. In contrast, the internal variations seen in the larger cohort, particulary Norway, highlight a more flexible approach to maritime education. The concentration around both three-year and a shorter one-to-two-year programmes in Norway reflects different educational pathways. Shorter programmes are often characteristic of specialised maritime or vocational colleges that focus strictly on the operational STCW requirements, rather than broader academic qualifications. This structural discrepancy creates an interesting point for discussion regarding global standardisation. While the STCW Code (IMO, 2010) establishes uniform competence requirements for what an officer must know, it does not regulate the time is should take to achieve them. Consequently, the international workforce consists of officers who have undergone different lengths of training. This variation suggests that while global maritime education is procedurally aligned on paper, the depth of the educational foundation differs across borders, which may have implications for the baseline competence of officers entering the global fleet. Nevertheless, a higher number of years is not necessarily better than a shorter duration, as it is the content filling of these years that matters. It is also important to note that a higher percentage of student enrolled in shorter programmes may already possess prior seagoing experience.

The data in Figure 10 depicts a strong consensus that simulator curriculum is well-structured. The high agreement regarding alignment with the STCW code proves that maritime academies are strictly driven by international regulations. This mandatory framework ensures global uniformity, which may be the reason that the respondents also agree that learning objectives are clear and that simulation is introduced at a suitable stage. While the scores for annual reviews and the inclution of IMO model courses show a slightly more variation in the responses, the overall trend remains highly positive across all aspects of the curriculum, confirming that the current training framework are widely accepted by the respondents.

5.6 RQ 2 – Training duration and organisation

A visual inspection of the boxplot regarding for total number of hours revealed distinct distributional characteristics across countries, as well as several statistical outliers. Explicitly, four extreme outliners were identified. Consequently, the findings from this analysis should be interpreted with caution. Although Egypt and India displayed high individual values, with large whiskers, these data point were not classified as statistical outliers. Notable the respondents from Denmark had reported the highest number of hours. Rather than reflecting a genuine operational divergence across all Danich institutions, the extrema dispersion is highly likely an artifact of the low response rate and a small sample size from this specific country. When a sample contains too few respondents, the statistical power diminishes, preventing the model from establishing a reliable central tendency or identifying a ‘normal’ baseline. Consequently, the boxplot is forced to expand across the full range of the responses to accommodate a few isolated data points, in this way possible masking any potential outliers. Furthermore, it is worth noting that the newly aggregated variable for total hours already contained a substantial amount of missing data, which subsequently weakens the strength of the analysis. There should be taken into account that Denmark’s and Egypt high reported number of hours could due to the fact that simulator training centres is anticipating having more hours of simulator training than other institutions.

A notable contradiction emerges within the Egyptian sample regarding the instructor-to-student ratio, which highlights potential methodological issues. As shown in the findings Egypt reported an instructor-to-student ratio of 1:1, while having previously stated that over 500 students were enrolled annually. This further strengthens the possibility that the question regarding student enrolment were poorly formulated or easily misinterpreted.

The finding in figure Figure 14 depicted that staff working at MET institutions in are highly agreeing with how the simulator sessions are organized. The most essential finding is that 89% (n=60) of the respondents agree that the frequency of these sessions support student progression. This high percentage proves that educators view training continuity as vital for skill development. From a pedagogical perspective, frequent sessions are important to keep Kolb´s experiential learning cycle at a high level of effectiveness. When instructors run sessions regularly, it allows them to guide students effectively though the complete cycle; from the concrete experience on the simulator bridge, through reflection during debriefing, to the active experimentation in the next session, before foundational skills begin to fade. The results also depicts that the staff find the sessions well-coordinated (88%) and well-organised (86%). This suggest that maritime institutions have successfully established structured operational practices for their training teams. Beyond the pedagogy itself, a similar agreeing trend is visible regarding provided resources and organizational support. The latter in which can help minimize the risk for interrupted training sessions.

5.7 RQ 3 – Scenario design

The findings regarding scenario design shows a clear professional consensus among instructors that simulator scenarios are highly realistic and align sell with actual operational demands. The strongest agreement centres on the practical navigation in challenging environments, such as narrow, costal, and high-traffic waters, alongside emergency handling. This uniform alignment suggest that maritime institutions globally prioritise the core technical and navigational skills required to satisfy STCW standards regarding the certification of deck officers. Because respondents heavily validate the realism of these operational situations, it confirms that simulators are successfully being utilised to replicate the hazardous, real-world conditions that deck officers face at sea, as also mentioned by (Karahalil et al., 2023).

5.8 RQ 4 – Briefing and debriefing procedures

The findings in Figure 16 depict a profound and uniform consensus among the respondents regarding the vital roles of both briefing and debriefing in simulator-based training. The exceptionally strong agreement concerning the encouragement of questions and clarifications during the briefing phase highlights that the respondents prioritise a clear cognitive foundation before any exercise begins. This is practise is closely aligned with the STCW Code (2010), which mandates that simulator exercises must be preceded by an effective briefing of the learning objectives. Ensuring that student fully comprehend these operational parameters and expectations not only maximise the educational value of the simulation but also directly fosters a safer learning environment during the simulator sessions. Similarly, the strong support for consistent debriefing after each session underscores its position as a cornerstone of the experiential learning cycle. Instructors clearly recognise that the simulator exercise itself is incomplete without a structured reflective period. By providing immediate feedback and communicating learning objectives effectively, educators are able to guide students from a concrete operational experience to critical reflection, while utilising Kolb's (2018) learning cycle doing so. The minimal neutral or disagreeing responses across all statements further prove that these structured pedagogical practices are universally accepted as standard operational protocols across global MET institutions.

6 Conclusion

In conclusion, while the dataset provides valuable institutional insights, the findings must be interpreted with strict caution due to several prominent methodological limitations. The analysis is constrained by an asymmetric cross-country sample size, highlighted by a low response rate for most of the countries. Furthermore, the presence of extreme statistical outliners in the Norwegian and the Philippines samples, alongside critical measurement errors – such as the contradictory ratio and enrolment reporting within the Egyptian data – strongly underscores the potential for survey misinterpretation and a few poorly formulated questions. Cumulative missing data further diminishes the statistical power. Consequently, these distributional anomalies and the sample constraints limit the generalisability of the results.

Nevertheless, because several of the questions that generated these conflicting responses were not part of the research questions, the overall value and validity of this project remain intact. The core variables central to the four research questions did not exhibit these structural contractions, despite the aggregated total hours variable, and the consensus toward especially Likert scale statements about curriculum design, training and organisation, scenario design, and briefing and debriefing procedures was in general very high. This demonstrates that MET institutions worldwide adhere to common standards while utilising recognised pedagogical framework for practical learning. The infernal analysis also confirms that, since the null hypothesis was rejected, no significant differences are expected within the population. Consequently, this indicates that maritime training institutions share a relative uniform approach regarding how simulators are utilised in training.

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8 Appendix I

The survey is uploaded together with the thesis.