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ARTICLE

Formative assessment in maritime simulator-based higher education

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Abstract
Assessment in maritime simulator-based education has traditionally been informal and subjective based on instructor experience. Recent research suggests that a more objective and formal approach could be beneficial. Formative assessment has attracted significant attention from higher education institutions. Thus, this study aimed to examine the current practice of formative assessment in maritime simulator-based education, with a special emphasis on simulator instructors' teaching methods. A qualitative approach with observations and interviews was used in the study since it could provide deep insights into educators' motivations and understandings of how to meet the educational needs of their students. The findings inform the formative assessment strategies may explicitly enhance maritime education.

Keywords Maritime simulator-based education · Formative assessment · Learning · Feedback · Learner · Teacher

1 Introduction

The International Maritime Organisation (IMO) determines the training requirements and relevant certificates for seafarers working onboard ships. Maritime training is provided in accordance with the International Convention on Standards of Training, Certification, and Watchkeeping for Seafarers (STCW) (IMO 1978). The maritime education curriculum is both guided and constrained by the STCW Code.

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At the university level, the fundamental goal of maritime education and training (MET) is to supply significant knowledge, skills and competencies for ship management. The STCW Code sets the methods for demonstrating competence and the criteria for evaluating competence. In a competency-based assessment system, the purpose of assessment is to collect sufficient evidence of individuals being able to perform or behave to a specified standard in a defined role. The assessment technique varies with the different domains, namely cognitive (what the learner should know), psychomotor (what skills the learner should be able to perform), and affective (how the learner feels or modifies his/her attitude) (IMO 2012).

According to the STCW Convention, simulator use is mandatory for certain parts of the MET curriculum (IMO 2010). Today, simulators are commonly used in the areas of bridge operations, offshore operation training and oil rigs, cargo handling, engine control, towing, and anchor handling. There is a range of simulators spanning from desktop-based simulators with the limited replicability of onboard task functions to some more recent and highly realistic full-mission and immersive virtual reality simulators. The potential of using simulators in training and assessment is clear; however, designing a simulator-based training programme requires situational analysis, identifying objectives, selecting simulators and creating exercises, organising, writing content for the programme, and preparing assessment mechanisms.

The IMO's Train the Simulator Trainer and Assessor Model Course 6.10 (2012, p. 88) document divides simulation sessions into four components: briefing, planning, simulation exercise and debriefing. However, in practice, before a session starts, students complete their preparations with the given pre-assignments and teams created. Thus, planning generally occurs before the briefing. Therefore, in this study, simulator training was considered to have three stages: briefing, conducting the exercise and debriefing. During the briefing stage, the instructor introduces the upcoming scenario and learning objectives to all students. After the briefing, the simulation exercise runs in the simulator, replicating the physical space of a ship's bridge with digital projections of the marine environment. Afterward, debriefing is carried out. Debriefing helps students integrate their theoretical knowledge with practical experience (Hontvedt and Arnseth 2013). Once the tasks and activities associated with outcomes are clearly defined, it is possible to assess trainees using simulators (IMO 2012). It is a common practice that all training and educational efforts will include a stage of assessment and evaluation to monitor whether the training objectives have been met. In addition, feedback is vital and generally given during the debriefing phase in maritime simulator courses. The feedback has a formative function when it provides students with information on what they need to improve and why and how they can improve (Black and Wiliam 1998).

In recent years, formative assessment has been demonstrated to improve student understanding and featured substantially within course design and delivery (Morris et al. 2021). This study examines the research question, "What is the current practice of formative assessment in maritime simulator-based education?" This study aims to inform the development of effective practices within the maritime simulator curriculum. The following section will provide an outline of how Norwegian maritime colleges and universities offer marine simulator education and training. Then, formative assessment will be discussed.

2 Maritime education and simulator training in Norway

A Bachelor of Science in Nautical Science opens up the possibilities for a career both at sea and on land in the maritime industry. Nautical studies form the basis for becoming a master; after completing sailing time, graduates can get the opportunity to start work as a deck officer on all types of vessels all over the world. In Norway, maritime higher education is a 3- or 4-year programme offered in Nautical Sciences Colleges/Universities such as the University of South-Eastern Norway (USN), Western Norway University of Applied Sciences (HVL), Norwegian University of Science and Technology (NTNU) and The Arctic University of Norway (UiT). Three distinct study programs are available at HVL: Nautical Science (3-year program), Nautical Science with operational cadet training (4-year program), and Nautical Science/y-veg (3-year program) (HVL 2023). Conversely, NTNU, USN, and UiT all offer a 3-year bachelor's degree in nautical science (NTNU 2023; UiT 2023; USN 2023). The 3-year Bachelor of Nautical Science program meets the requirements of STCW A-II/1 and A-II/2 and is oriented toward the future occupation of deck officers. However, in order to be able to issue a certificate, there are requirements for both theoretical education and practical training on board. The Norwegian Maritime Directorate requires 12 months of systematic training on board in order to be able to issue a deck officer's certificate class 3 (D3) (Sdir 2022). HVL's four-year Bachelor of Science in Nautical Science with integrated practice is the first program of its kind in Norway. This practical management education provides applicable employment upon completion of the study. Thus, graduates will be completed the mandatory minimum requirements for certification of officers in charge of a navigational watch on ships of 500 gross tonnage or more.

Students enrolled in 3-year programmes must acquire a total of 180 European credit transfer and accumulation system (ECTS) credits and must complete a compulsory Navigation I-II-III and IV courses. Students have 200 or more total hours on navigational simulators in these navigation courses. Simulator programmes start from the first year and are well-integrated throughout the programmes. Also, a minimum of 80% participation is required in simulator exercises (MARKOM 2020). These courses cover the knowledge requirements in accordance with the relevant parts of these chapters: STCW code A-II / 1 function 'Navigation at the operational level' and STCW code A-II / 2 function 'Navigation at the management level' (IMO 2010). Learning objectives include learning to use electronic map systems as an aid in coastal navigation, open water navigation and for route planning, the assessment of necessary margins for safe sailing, the use of a compass, echosounder, satellite navigation systems, steering control system, land-based navigation systems, automatic radar plotting aid, and automatic identification system, and the application of international rules to avoid collisions at sea (HVL 2022).

2.1 Maritime education and simulator training process

Learning methods for navigation courses typically consist of lectures (theory) and simulator exercises (practice). The theory lessons are generally provided first, followed by practical exercises being conducted using the simulators. Numerous

studies in maritime education aim to improve simulator exercises (Hontvedt and Arnseth 2013; Jamil and Bhuiyan 2021; Mallam et al. 2019; Nazir et al. 2019; Pan et al. 2021; Sellberg 2017). Sellberg (2017) investigates how the maritime instructor applies general learning principles to specific situations during simulation-based learning activities. In this analysis, the phases of simulator-based training are examined on the basis of the theoretical foundations of a situated action approach and face-to-face interactions. The findings of this study have similarities in Norway's nautical institutions. To gain a better understanding of the simulator training process, four Norwegian institutions were visited, various simulator exercises were observed, and instructors were interviewed informally. Based on these data, the process of simulator-based training is described in the following section.

Before the simulator exercise, instructors share prereading materials and documents about upcoming scenarios that include the ship type, the sea area where the exercise will take place, and the exercise's requirements. According to this information, students — as teams — prepare presentations about their voyage plans, prepare their paper charts, read about the national and international regulations, and determine their roles as bridge teams.

Briefings and debriefings are held in a classroom next to the simulators before and after the simulator exercises. Instructors use common tools such as projectors, televisions and whiteboards. In a classroom set up with desks facing the board and the screen, groups of students sit together.

During the briefing session, students share their plans with the instructor and other teams and explain how they will navigate and operate the ship. Each group is given the same task; however, students are not made aware of unforeseen circumstances, such as the ship traffic situation in the exercise. What students know is how they should use instruments and the collision prevention regulations and how they need to apply these instructions in practice. Instructors first briefly describe the exercise during the briefing. Then, the instructors relate or discuss the more general learning objectives of the upcoming scenario. They explain how to use the tools on the bridge to gather relevant information for making decisions while navigating. While doing so, the instructor associates the applicable national and international maritime regulatory rules. This may vary according to the operation, region and ship type. Instructors tend to point out that the student must always be attentive when using the appropriate instrument(s) based on the situation.

The students cooperate in teams of two to four on each bridge throughout the exercises in the full-mission simulator during the simulator phase of the navigation course. They take turns assuming the different work roles—such as second and third mates, chief mate and a master at the bridge—where the simulator exercises take place. There are several rooms in which student teams can operate vessels simultaneously. The settings of the instruments on the various bridges can be observed and recorded by the instructor. On screens in the instructors` room, instructors can monitor various areas of the students' work. The vessels' actions can also be visualised by radar and electronic charts. When students start to navigate, instructors generally watch them from the instructors' room. Sometimes, instructors roleplay as other vessels or vessel traffic system operators and

provide instructions via radio from the instructors' room with minimal interference. This also helps the students learn how to communicate professionally by radio with other vessels and onshore maritime authorities. Formal communication by radio is in English, and maritime English terms are used. The STCW Code requires that all nautical education programmes maintain a certain level of proficiency in written and spoken English.

In the debriefing phase, a scenario playback is used, laying the groundwork for collective discussions. The instructor provides feedback on how the students performed as a team during the scenario. For instance, the instructor can reflect on whether students followed the collision regulations. On occasion, due to the fact that some instructors come from maritime backgrounds, they sometimes offer previous experiences from maritime accidents and mistakes as examples. Notably, people with shipping experience, such as master mariners, are the preferred instructors at nautical science institutions in Norway. This recruitment system is internationally acknowledged under the STCW Code requirements and is implemented in Norway's national law (MARKOM 2020). According to Sellberg and Wiig (2020), telling stories as a means to discuss, connect and generate new meanings in training serves as an important resource for learning in various academic and professional maritime contexts. After the exercise's general review, the instructor can replay the scenario on the screen to show what students did. In video recordings, it is possible to observe the motion of ships from above. The video recordings of these exercises can last for about 2 h. However, by using the fast-forward and rewind features, the teachers can highlight the exercise's most important components, pause the images, and then let the students view and interpret them again by trying to understand the motivations behind their actions. The replay feature also aids in elaborating on discussions of mistakes made during exercises. To evaluate how the student teams perform in such scenarios, instructors typically point out broad mistakes without criticizing specific students' actions while describing how the group generally performed. The playback of the exercise gives students a chance to rethink their prior actions and enables the instruction and assessment of specific details. Each bridge team's actions during the exercise phase become visible when the scenario is replayed, allowing for feedback on everything that transpired during the exercise. Also, Sellberg (2020) highlighted how the repeated and collaborative monitoring of recordings was helpful for instructors and students to identify potential problems in the dynamic assessment situations they viewed. Students can better prepare for future scenarios by participating in this process each week with various scenarios but using the same techniques. The students are assessed both during and after these training. The section that follows contains extensive information on assessment, particularly during training.

3 Formative assessment

The literature contains several definitions for formative assessment. For instance, Black and Wiliam (1998, pp. 7,8) defined this as "all those activities undertaken by teachers—and their students in assessing themselves—that provide information to be used as feedback to modify teaching and learning activities". In their later work, they also highlighted the importance of both self-assessment and peer roles in learning (Black and Wiliam 2009; Wiliam 2011). Klenowski (2009)

described formative assessment as a daily practice that involves students, teachers and peers—seeking, considering and acting upon information from dialogue, demonstration and observation in ways that advance ongoing learning. According to Brookhart et al. (2010), formative assessment provides teachers and students with a clear understanding of how students are performing in relation to the learning target (also known as the learning goals or objectives) and how they might close the gap between their current understanding and the target. The definition by Fisher and Frey (2014) is presented as follows: 'Formative assessments are ongoing assessments in a classroom, reviews, and observations. Teachers use formative assessment in developing instructional methods, providing feedback to students throughout the teaching and learning process.' Moreover, Popham (2008) defined formative assessment as 'a planned process in which assessment-elicited evidence of students' status is used by teachers to adjust their ongoing instructional procedures or by students to adjust their current learning tactics.' The operative word in this definition is 'process', in that formative assessment takes place during instruction and is used by teachers and students.

In general, aside from a few minor differences, many definitions are comparable. The continuity of observations and evidence for providing feedback to improve learning outcomes are central to all definitions. The definitions provided above may be summed up as follows: formative assessment must be continuous, persistent and interactive to understand learning needs and adapt teaching techniques based on an assessment of student improvement. Therefore, the primary purpose of formative assessment is assessment *for* learning, while the secondary goal is the assessment *of* learning.

Generally speaking, teachers commonly use formative and summative assessments to assess students. Formative assessment, as explained above, is usually an ongoing, informal process conducted before and during instruction that collects data through observations, homework, and question-and-answer sessions to improve teaching and learning. In contrast, summative assessment is a formal, cumulative process conducted after instruction through in-class examinations and projects that evaluates learning outcomes, knowledge, and retention (Dixson and Worrell 2016). The summative assessment aims to record what has been accomplished at various stages. To this end, the assessment should generate a reliable report on the accomplishments of each student (Dolin et al. 2018). In order to select the best tools for the task at hand, teachers must be aware of the objectives of their assessments as well as how they intend to use the results. However, the same processes are involved regardless of whether formative or summative; the primary goal of these processes is to draw conclusions about the students' knowledge, skills, and competencies.

One of the most prevalent criticisms of assessment is that it can be subjective. This indicates that the evaluation is based on the instructor's opinion or interpretation of the student's work, rather than on objective criteria. This may result in grading inconsistencies and unfair treatment of students. Another criticism is that assessment can be high-stakes, meaning that the results can influence a student's future academic or professional opportunities. This can result in anxiety and stress among students, which can have a negative effect on their academic performance.

Formative assessment is a topic that has been studied extensively, and various explanations for formative assessment have been considered in empirical studies and scholarly discussions (Morris et al. 2021). Biggs (1998) criticizes Black and Wiliam's (1998) review for omitting the effects of summative assessment on learning and viewing summative and formative assessment as mutually exclusive. He suggests that "reasonable educational assessment models effectively use both formative and summative assessment." In their further studies, Black and Wiliam (2009) include summative assessment and state that formative assessment is composed of five different types of tasks: "sharing success criteria with learners, classroom questioning, comment-only marking, peer- and self-assessment, and formative use of summative tests." Most critics of formative assessment raise questions of validity, reliability, credibility, trustworthiness, and accountability. However, formative assessment should not be viewed through the lens of summative evaluation (Moeed 2015). Although these criticisms highlight the distinctions between formative and summative assessment, we believe these two types of assessment should complement each other.

Other concerns arise from teachers that misunderstand and misinterpret an activity misnamed formative assessment. Formative assessment's epistemological challenge goes beyond what can be known and by whom. The assumption is that with adequate professional development, the teacher can discover what the student knows by asking questions and responding to them (Moeed 2015). Wiliam and Thompson (2007) states even though there is no "magic bullet" for formative assessment, "sustained professional development focused on minute-by-minute and day-by-day formative assessment can improve students' engagement, enrich the daily experience of educators, and produce substantial increases in students' achievement."

On the other hand, there are criticisms about the theoretical underpinnings for formative assessment. Moeed (2015) criticizes that Wiliam and Thampson (2007) have failed to specify a clear theoretical foundation for the practice. Multiple interpretations and applications of formative assessment principles were found problematic, creating a tension between effective pedagogical approaches and testing for accountability. As discussed in Moeed (2015), we believe it is feasible and sensible to consider various learning theories as a foundation for formative assessment. For instance, the instructor guides the students to comprehend the concepts, allowing them to make connections between their prior knowledge and what they are learning now is an approach from social constructivism. In addition, the instructor gives oral or written feedback, encouraging students to react to and apply is an approach from behaviourism. The instructor determines the student's prior knowledge and designs the subsequent teaching strategies so that students can relate new concepts to what they already know is an approach from constructivism. Moreover, instructors help students to be metacognitive, giving them opportunities to express their ideas while encouraging students to reflect on their learning, which is the cognitive theory approach. The evidence that years of practice in the classroom have provided through formative assessment is incorporated into learning theories. As formative assessment is the focus of this study, subsequent sections will be devoted to discussing its strategies.

3.1 Formative assessment strategies

Black and Wiliam (1998) gained a better understanding of foundational work by reviewing 250 reports on formative assessment. This review examined classroom dialogue, teacher assessment practices, student self-regulation, and various other domains. Their study found that when formative assessment is effectively implemented, it supports student achievement. Building on this initial work, Wiliam and Thompson (2007) created a framework including (Ramaprasad 1983) instructional processes and developed strategies by considering not only teachers but also students and their peers. The three main instructional processes proposed by Ramaprasad (1983) are: Where are the learners in their learning? Where are they going? What needs to be done to get them there? Also, Wiliam and Thompson (2007) presented five strategies for core assessment concepts and linked these processes to three types of people: teachers, learners, and their peers (see Table 1). They stated that teaching is adaptive to students' learning needs and that evidence regarding student learning is used to modify teaching to meet their needs better. These strategies form the basis of our research.

Leahy et al. (2005) presented their work in alignment with these strategies. They examined several approaches for introducing instructors to the core concepts of assessment for learning. They claimed that teachers might make assessments more engaging in their classrooms by providing specific techniques (Leahy et al. 2005). Strategies from Wiliam and Thompson (2007) and several techniques from Leahy et al. (2005) are outlined below.

The first strategy aims to ensure that learners understand where they are going by clarifying and sharing learning intentions and understanding the criteria for success. For example, one standard technique involves circulating work samples, such as the previous year's class lab reports, to prompt a discussion about quality. Teachers share the responsibility for learning with the learners and should prioritise their assessments for learning practices. When teachers know how students are progressing and where they are having trouble, they can use this information to make the necessary instructional adjustments. They can also use this evidence to adapt their instruction to meet their students' learning needs better.

The second strategy is eliciting evidence and engineering effective classroom discussions, tasks and activities to determine where students are in their learning. Teachers can find out where students are by observing their performance and the results of physical tasks. For instance, many teachers devote a significant percentage of their class time to question-and-answer sessions or whole-class discussions; however, instead of introducing students to new information, these sessions can frequently serve to reinforce their previous understanding. In addition, teachers can check on students' knowledge while they are still in a class by carefully considering the questions they ask. If students' prior knowledge is not considered, they may fail to understand new concepts.

Additionally, getting students with perceptions of quality to present some anonymised works from the previous year's class, look at different levels of quality and discuss what's good about certain ones and what's missing from others can help students transition from quality control to quality assurance.

Table 1 Formative assessment strategies. Adapted from Wiliam and Thompson (2007)

	Where the learner is going	Where the learner is right now	How to get there
Teacher	Clarifying and sharing learning intentions and criteria for success	Engineering effective classroom discussions, activities and tasks that elicit evidence of learning	Providing feedback that moves learners forward
Learner	Understanding learning intentions and criteria for success	Activating learners as the owners of their own learning	
Peer	Understanding and sharing learning intentions and criteria for success	Activating learners as instructional resources for one another	

The third strategy involves providing feedback that moves learners forward. The primary purpose of feedback is not to improve the student's work but rather to improve the student`s competencies. Feedback can be supportive if it specifically addresses what the student needs to do to improve. Teachers must consider how students engage with feedback messages. Teachers can use formative assessments to provide feedback to students about their progress and to guide decisions about the next steps in the learning process, thereby closing the gap between the learner's current and desired states. Ramaprasad's (1983) definition suggests that feedback is information about the gap between the actual level and the reference level of a system parameter, which is used to alter the gap somehow.

The fourth strategy involves activating students as owners of their learning. Learners create understanding and become independent learners. Thus, they can determine what they are learning and when they are not learning, as well as what they need to do about it if they are not learning. For effective learning, teaching is about creating situations in which sometimes teachers tell students what they need to do and at other times get them to work on their own or get peers to help them. Teachers must help students become effective learners, develop the skills to monitor where they are and establish a range of learning tactics for themselves. Thus, students are expected to be involved in adaptive learning, reasoning, argumentation, communication, active learning and critical thinking. Moreover, interpersonal skills (e.g. responsibility, collaboration and cooperation) all stem from engaging learners in the formative assessment process as active agents in their learning (Black and Wiliam 1998).

The fifth strategy involves utilising students as learning resources for one another. Students frequently communicate more successfully with one another than with their teachers, while feedback from peers increases engagement. Thus, students need to be activated as learning resources for one another and as owners of their learning. Moreover, the formative assessment allows students to compare their thoughts with their peers and question their ideas.

Consequently, we believe that the strategies put forward by Wiliam and Thompson are well-aligned for maritime simulator-based education instructors.

The findings from the present study are expected to enlighten simulator instructors in constructing formative assessments that promote conceptual change and learner-centred simulation education.

4 Methodology

4.1 Method

This study will investigate the current formative assessment practices in maritime simulator-based education. A qualitative approach to understanding current practice and the motivations of instructors will be undertaken to explore this.

Qualitative methods have been developed to comprehensively understand the broad range of individual perspectives through textual interpretation, with the most prevalent interviewing and observation (Creswell and Poth 2016). Therefore, examining the interactions and behaviours in simulator environments is an appropriate approach. The data used in this study were collected through interviews and observations of simulator teaching practice. Using informal interviews during observation enabled teaching staff to explain the motivations behind their practices. The semi-structured interviews combined closed- and open-ended questions, with ad hoc follow-up questions by the interviewer to ensure that the true meaning was understood (Newcomer et al. 2015). This study also used semi-structured interviews to understand the teaching strategies and instructors' experiences and opinions on simulator education for background information and to gain an instructional perspective. The next sections explicitly present this process.

4.2 Procedure

A literature review was conducted to gather background knowledge to understand the teaching and regulatory environment and pedagogical approaches in use prior to the observations taking place. The setting for this study was the maritime simulator centres in nautical sciences colleges/universities in Norway. We performed face-to-face and virtual interviews with key university staff involved in simulator teaching. Three interviews were conducted with three universities, two from one university for a total of 11 personal interviews. Considering the simulator training phases, the instructors' activities, objectives and actions were observed. During the observations, informal interviews were conducted in the control room with the simulator instructors. Finally, semi-structured interviews were conducted to supplement the observations. The interviewees are all males between the ages of 29 and 60 who have worked in the maritime sector professionally. The interviewees have all had extensive experience (4–17 years) working as instructors. They were invited to discuss their experiences and perceptions. The interviews lasted 30–70 min (median 50 min) and were audio-taped and transcribed. Data collection was conducted in 2022. The questionnaire is presented in Table 2. The questions were designed to collect information about current practice-related formative assessment strategies used in simulator courses, including how instructors plan and prepare for these

Table 2 Questionnaire

	Questions
1	How do you create a course plan and simulator exercise?
2	What are the intended learning outcomes?
3	Please describe your preferred method of briefing students
4	Tell me about your preferred method of debriefing students
5	How do you offer feedback?
6	When do you prefer to provide feedback? (During exercise, debriefing, after class)
7	Is there any reaction from students to the feedback they receive?
8	How well-prepared do you think the students are to take part in the simulator activities?
9	What should they do to get ready for the class? In what way do you lead them?
10	Tell me about the dynamics between the students
11	Please explain how you take charge as an instructor
12	Do you have anything to add related to simulator courses

activities, what they hope students will learn, and how they evaluate student performance and provide feedback. The questions are intended to provide a comprehensive understanding of the instructional design, delivery, and evaluation of simulator exercises within a course, emphasizing promoting effective teaching and learning practices that result in positive student learning outcomes.

The project was approved by the Norwegian Centre for Research Data. All participants have been anonymised and given fictitious names (the letter I refers to an instructor; I1–I11).

4.3 Data analysis

The thematic analysis provides a rich and detailed understanding of experiences, thoughts or behaviours throughout data collection, which can be used to generate new insights and perspectives. Particularly from a learning and teaching perspective, it is a method, not a methodology (Braun and Clarke 2006). This implies that, unlike many qualitative methods, it is not tied to a specific epistemological or theoretical perspective (Maguire and Delahunt 2017). This makes it a highly adaptable method, which is a significant advantage given the diversity of learning and teaching tasks. This type of analysis was carried out on all the collected data from observations, informal interviews conducted during observations and semi-structured interviews. This study adheres to Braun and Clarke's (2006) framework. This is arguably the most influential method, at least in the social sciences, because it provides clear and practical framework for thematic analysis.

The first step was the transcription of all interviews and familiarisation with the entire data set by reading them several times. Upon completion of step 1, initial codes were created and modified as the coding process progressed. Braun and Clarke (2006) distinguish between semantic and latent levels of codes. Semantic codes are "…within the explicit or surface meanings of the data, and the analyst is not looking beyond what a participant has said or written." This analysis

identified codes at the semantic level and is representative of a great deal of learning and teaching work. Initial codes included the division of the teaching time into phases: before, during, and after simulation in order to help learners understand the background information about the teaching process (i.e. briefing, simulation and debriefing). After this, the transcripts were read, and excerpts were assigned to those codes. For instance, watching video recordings while providing feedback during the debriefing phase was a recurring theme and was highly relevant to our research question. By breaking down the data relevant to the research question, all relevant aspects of the data are systematically analysed.

Then, we used the five key strategies of Wiliam and Thompson's (2007) theory of formative assessment as an interpretive lens for the data. This involved analysing the data by looking for examples of the five formative assessment strategies. In qualitative data, thematic analysis is a process of identifying patterns or themes. By identifying themes, new insights and perspectives and a better understanding of the underlying trends and patterns in the data gained (Maguire and Delahunt 2017). The initial research question focused on what extent formative assessment strategies in the context of maritime simulator-based instruction utilising. Braun and Clarke (2006) distinguish between top-down or theoretical thematic analysis, driven by the specific research question(s) and/or the analyst's focus, and bottom-up or inductive thematic analysis, driven more by the data itself. This study analysis was more top-down, being driven by the research question, survey questions and Wiliam and Thompson's formative assessment strategies. The five strategies were used as the themes (Table 3) to be examined in the analysis of the interview transcript data. This was undertaken to evaluate whether the evidence supported the Wiliam and Thompson (2007) strategies within the maritime simulator context.

In this step, the extracted excerpts are all thematically categorized, and their fit to Wiliam and Thompson's theory is interpreted. At the conclusion of this step, the codes were organised into broader themes that appeared to a particular aspect of the research question. For instance, a final thematic map that illustrates the relationships between codes and themes is given in Fig. 1. In this example, 'providing feedback that moves learners forward' is the main theme that employs three related subthemes: 'timing of the feedback,' 'how to provide feedback,' and 'perception of the students,' which are rooted in multiple codes. Although most codes are associated with a single theme, some are associated with multiple themes.

NVivo 12 qualitative data analysis software was used to manage the dataset.

Table 3 Table of main themes

Themes	Topics/lenses
Theme 1	Clarifying, sharing and understanding learning intentions and criteria for success
Theme 2	Engineering effective classroom discussions, activities and tasks that elicit evidence of learning
Theme 3	Providing feedback that moves learners forward
Theme 4	Activating learners as the owners of their learning
Theme 5	Activating learners as instructional resources for one another

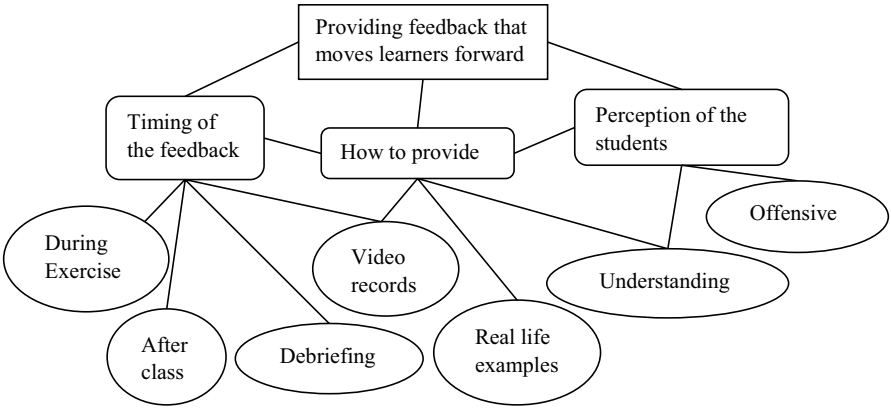

Fig. 1 Thematic map theme 3

5 Results and discussion

The teaching and learning processes in maritime simulator training are highly variable. Within the scope of our study, we are interested in how instructors relate to students in teaching and learning in a simulator environment since maritime simulator instructors usually have a seafaring background. The findings are well aligned with the five key strategies of formative assessment of Wiliam and Thompson (2007).

5.1 Clarifying, sharing and understanding learning intentions and criteria for success

Formative assessment is a planned process in which teachers and students use evidence of students' progress obtained through assessments to modify their ongoing teaching strategies. To develop learning objectives and standards for meeting them, this strategy works in collaboration with students to determine the knowledge gap between what they already know and what they need to know. In addition, finding and addressing misconceptions that can obstruct learning is a crucial part of the learning process in all subject areas. For instance, the process of verifying understanding before moving on to the next part of the course not only clears up misunderstandings but can also enhance learning. To achieve this, it may be a good idea to give students a brief scenario and ask them to predict and explain the outcome.

The student should know where they are going. The learning outcomes that students are expected to achieve are defined before teaching even begins in a constructivist approach to teaching (Biggs and Tang 2015). Therefore, learning intentions should be given at the start of a lesson. This is important because it enables various types of students to incorporate their personal experiences into their learning. Instructors in this study cited the importance of the learning outcomes in helping their students to understand what they need to know. I4 states the following:

> In the description of the scenario, we usually put down the learning outcomes. What they're supposed to learn, or at least what they're supposed to train on? What's the purpose of the whole exercise? So, I think it's important that the student knows what they are going to learn.

The reasoning behind this statement is that providing clear learning outcomes assists students in comprehending the objective of a scenario. By outlining the skills, knowledge, or competencies that students are expected to acquire, attention and effort can be better focused on the task at hand. It also assists them in comprehending how the activity relates to their overall learning objectives and how it fits into the larger curriculum.

The gap between students' current and desired performance can be identified by focusing more on the theory portion of the navigation course and the briefing phase of the simulator training. I8 explains that:

> 'First of all, I have to make sure that all the topics that are supposed to be covered according to the STCW convention… The students have been presented material or a topic in a theoretical way in the classroom by lecturing or videos, or whatever, and they are given the opportunity to discuss a little bit about this back and forth and I ask them questions.'

The STCW convention establishes training and certification requirements for seafarers worldwide. To ensure that seafarers are adequately trained and equipped to carry out their duties safely and effectively, all topics must mandate by the convention be covered. To accomplish this, it is necessary to present the material or topics in a manner that is accessible and interesting to students. This can be accomplished through a variety of teaching techniques, including lectures, videos, and interactive discussions. By encouraging students to discuss the topics and ask questions, instructors can strengthen their understanding of the material and identify areas where additional clarification may be necessary. This approach ensures that they are adequately prepared for the challenges they will face at sea and can carry out their duties in a safe and effective manner.

This requires developing keen skills in observing and interpreting what students say or do. Instructors can teach, but there is no guarantee that students will learn. Moreover, even though we want them to be engaged, not all students are motivated. To help students learn by making connections to the things that interest them, teachers can use connectivism in the classroom (Kop and Hill 2008). Thus, teachers should be more creative to present course content in a more exciting, innovative and engaging manner for students. Therefore, I7 believes that:

> 'I also tried to make the exercise, like, exciting for the students... So, if we trained on a, like, COLREG rule last time, I will also use this in the next exercise. I don't like to split things up in modules so that you only train one thing at a time because that is not real life.'

Most of the instructors say that they are presenting the learning goals of that exercise at the briefing phase of the course. However, instructors did not openly

mention the criteria for success in simulator training in the interviews. Despite this, students should complete the simulator exercise task. This means that students know what is expected and can clarify which steps they need to accomplish to meet the criteria for success.

5.2 Engineering effective classroom discussions, activities and tasks that elicit evidence of learning

This strategy requires the teacher to spend more time planning instruction than grading student work by thinking more carefully about the questions they ask and checking student understanding while in class. Some questions can be designed to reveal what students know at the beginning of the instructional sequence. Since this training period is 3 or 4 years, the instructors observe the students step by step and prepare more complex scenarios at a level where students can use all instruments throughout their training. It is important for teachers to monitor their students' progress every day, minute by minute, to make sure they are continuously getting to where they need to be.

Constructivism calls for a teacher to take on the role of a facilitator, with the main goal of encouraging students to take an active role in their education. According to a constructivist viewpoint, a teacher's principal duty is to establish and sustain a collaborative atmosphere for problem-solving where students are free to build their own knowledge and the teacher serves as a facilitator and guide (Slavich and Zimbardo 2012). Using learning progressions, the teacher can break down a learning objective into more straightforward and achievable sub-objectives. The teacher can also understand the student's position on learning and set a series of smaller goals in collaboration with the learner. To do this, teachers can design questions to check student understanding before continuing the lesson. I1 explains:

> 'Sometimes we show the exercise playback screens, sometimes we take a certain thing and focus on that. But at the same time, we ask students, "Can you tell us about the exercise? What was difficult? What would you do differently?"'

By reviewing exercise playbacks and focusing on specific aspects of the exercise, instructors can provide students with a clear picture of their performance and identify potential improvement areas. Nonetheless, it is equally important to allow students to evaluate their performance and provide feedback on the exercise. By asking questions, instructors can encourage students to evaluate their performance critically and identify potential areas for improvement. This approach ensures that instructors can contribute to a continuous learning and improvement culture and assist students in developing their critical thinking skills and confidence.

The traditional model of classroom questioning presents some problems. One issue is the lack of engagement, where students are required to raise their hands and answer questions. This can result in shyer students disengaging by keeping their hands down, or some students feeling that it is unfair if they know the

correct answer and do not get the chance to show off. Another issue is that the teacher hears only one student's thinking. Social constructivist Lev Vygotsky believes peer engagement helps build skills and tactics. He advises schools to utilise cooperative learning tasks where less competent youngsters progress with aid from more skilled peers (Schreiber and Valle 2013). Instead, the teacher can engineer a whole-class discussion on the concept or match students up for peer teaching. I4 believes that:

> 'When they come to the debriefing area, they start to debrief themselves... I think they learn more if they are able to talk about it rather than me telling them what they did wrong or not. And it's also open for the other students to comment on… then we see the playback ... switch back and forth and allow the students to comment on what they have done.'

This statement is supported by student-led debriefing promoting active learning and facilitating a deeper understanding of the material. By allowing students to reflect on their own performance and discuss it with peers, instructors can foster critical thinking and encourage students to take responsibility for their own learning. By allowing students to conduct their own debriefing, instructors are essentially empowering them to take charge of their own learning and develop their own understanding of the material. As students are encouraged to think critically about their performance and reflect on their own learning process, this strategy can contribute to a more engaging and meaningful educational experience.

Classroom discussions give teachers ideas about how to take students' learning forward. For example, I5 states, 'I run the same simulation exercise twice… and ask "what did you do by the second time compared to the first time and how?"' If no one answers correctly during the discussion, the teacher might choose to reteach the concept.

It is an effective way to promote repetition, reflection, and self-awareness to have students repeat the same simulation exercise twice and evaluate their performance. By giving students multiple opportunities to practice a task and reflect on their performance, instructors can create a more engaging and effective learning environment and help students develop a deeper understanding of the subject matter.

5.3 Providing feedback that moves learners forward

Formative assessment refers to a set of practices that occur continuously during teaching and learning to close the gap between current and desired knowledge. This strategy offers students assessment-based feedback. To improve students' achievement of intended learning outcomes, teachers and students can use feedback to make necessary adjustments. For learners to enhance their learning, teachers should provide them with timely and constructive feedback. The point of feedback is to be effective in engaging students in learning. Thus, instructors must be keen observers

of students to provide effective and appropriate feedback. I3 notes an effective way to provide feedback:

> 'I am very fond of giving feedback on what they've done and relating it to real life… I can give them examples based on my own experience, and I found that important.'

Providing feedback and relating it to real-world scenarios is an effective way to promote learning and assist students in gaining a deeper understanding of the subject matter. By sharing personal experiences and providing concrete examples, instructors can help students see the relevance of what they are learning and become more engaged in learning.

Many instructors found it productive to let students make mistakes in a safe simulator environment. For example, I7 states, "It's allowed to make mistakes in the planning. So we give them more feedback then." Similarly, I9 adds a point about intervention during exercises: "Letting students experience failure without intervening. They are supposed to learn from that. We learn from our mistakes. But sometimes it is good to intervene as well, and not let them do it… if you always intervene, then the students kind of rely on you to intervene." An essential component of the learning process is allowing students to make mistakes and experience failure. Instructors can help students develop critical thinking skills and become more self-reliant learners by providing feedback on their mistakes and allowing them to assume responsibility for their own learning. However, it is also essential to recognize when intervention is required and to strike a balance between providing assistance and allowing students to learn from their mistakes. In addition, if feedback is given too rapidly, it can obstruct the learner's ability to develop their capacity to assess their own performance and limit this type of processing. In addition, providing feedback too frequently can make a student reliant on it and their performance cannot improve without it.

Good feedback helps students perform better work the next time they do something similar. According to cognitivism, feedback is the knowledge that students receive regarding the precision or correctness of their understanding. Feedback is used to fix mistakes and increase comprehension (Butler and Winne 1995). In terms of timely feedback, I8 believes that:

> 'Sometimes I take them out from the bridge and bring them into the instructor's room in the middle of the exercise. I say, okay, you see what happened here now. And they can see it with their own eyes from a different perspective... Because then they have fresh knowledge of what went wrong, and they can use that experience to get out of that situation in a better way. To make them feel that they can handle the situation.'

By providing students with a different perspective on an exercise, they can better comprehend what went wrong and learn how to deal with similar situations in the future. By removing students from the bridge and placing them in a monitoring room, the instructor is able to provide them with a new perspective on the exercise and assist them in seeing things from a different angle. It is an effective way to help

them learn from their mistakes and gain confidence in their ability to deal with challenging situations.

In maritime simulator education, feedback is generally given during the debriefing phase. Video-based debriefing helps address learning objectives by providing stable and accountable records that afford detailed assessments and are open for discussion and reflection. The opportunities for instruction that such technologies offer are significant, especially in debriefings; however, more studies still need to explore and contrast the use of different debriefing technologies. Feedback is also a crucial component of the learning process in constructivism because it enables students to improve their understanding and acquire new knowledge. In constructivism, feedback is frequently given through social interactions with peers and teachers as well as self-reflection and self-evaluation. I8 explains how to appropriately provide feedback:

> 'We use the replay function very actively. So I save the recording of the whole exercise and we can go back and use it as an analysis tool... So, I think maybe that's the most important feature of the assessment—the ability to replay. Because then we can go in afterwards and analyse, and they can see it with their own eyes.'

Overall, the replay function is a valuable tool that can enhance student learning by providing them with detailed feedback and a deeper understanding of the exercise. By actively utilising this tool, instructors can create a more engaging and effective learning environment that encourages reflection and self-evaluation.

Formative assessment is a tool used by educators to refine teaching strategies and offer ongoing feedback to students at every stage of the teaching and learning processes. The simulator environment offers opportunities for instructors to continuously monitor, correct and assess their students' activities and progress toward the learning outcomes. In addition, all activities are undertaken by instructors, while the students provide information to be used as feedback to modify teaching and learning activities.

5.4 Activating learners as the owners of their learning

When we conceptualize formative assessments as assessments for learning, students are as important as teachers in the process. Learners build their knowledge and understanding through their experiences and interactions with their surroundings. Constructivism holds that learning is a process that students actively participate in by establishing goals, tracking their progress, and providing reflections on their learning. In addition, involving students' self-assessments significantly impacts their motivation and self-esteem. Therefore, student involvement is a key practice in formative assessment when teaching and learning are underway.

The constructivist theory of learning emphasizes the necessity for educators to give students a chance to create their own knowledge and emphasizes the significance of students actively participating in their own learning (Carnell 2007). In Norway's maritime institutions, many instructors believe practicing after instructor-led classes effectively improve students' confidence and learning. Teachers give their

students a chance to apply their knowledge right away and gain practical experience by creating environments where they can learn and experience simultaneously. This strategy has also been shown to improve motivation and to promote teamwork. For instance, I9 explains their approach:

> 'The students have always had access to the simulator afterwards, so we record every exercise so that if they want, they can look through it themselves also, like, for a self-study. I think the students can perhaps be better at running and exercising on their own because you learn much more then.'

Similarly, I8 explains that:

> 'If they want to stay here during afternoons and evenings or weekends or holidays, or whatever, they have full and free access to use the facilities as they are. If you want to become good at something, there are no shortcuts. You have to do it many times… We want to give them the opportunity to make themselves as good as possible. It's the university. They need to take care of their own learning as well.'

Providing students access to the simulator and recording their exercises effectively promotes self-directed learning and encourages students to assume responsibility for their own learning. In addition, by creating an environment that encourages practice and repetition, instructors assist students in developing the skills and habits necessary for future professional success.

In addition, experiential learning theory emphasizes that students are urged to learn through experiences that can aid in their ability to remember information and recall facts using this theory (Kolb and Kolb 2009). I5 believes that:

> 'Allowing the students to do more practice, from what I've seen, improves the quality of the students without any objective measurements... I sense that the students that are spending more time in the simulator also have a higher quality once they completed.'

I6 expresses it metaphorically as follows:

> 'If you want to learn to ride a bike, you need to get on the bike.'

I7 expresses an issue related to self-learning activities:

> 'The simulator is available 24/7, which gives them the chance to adapt their training to their time schedule, but it is a little bit problematic for the first-year students because they are not as able to train themselves in the simulator... but also, they may not be able to understand if they perform bad or good. Like, for third-year students, they will know how to train themselves... in the beginning, it's not so easy.'

Giving students access to the simulator encourages them to practice more and allows them to hone their skills and become more adept at handling various

scenarios. As a result, they gain confidence in their abilities and can improve their overall performance through increased practice. The analogy of learning to ride a bicycle highlights the significance of practice when acquiring a new skill. Similar to learning to ride a bicycle, simulation training requires practice to master. However, it is acknowledged that the student's experience level may affect their ability to self-train in the simulator. While third-year students may be better equipped for self-training, first-year students may have difficulty due to their lack of experience. Therefore, it is essential to provide support and guidance to students of varying levels to ensure that they can maximize the benefits of simulation training.

For instance, in one institute, students create mixed teams from years 1, 2, and 3 for these activities, which are called NightSim. In response to requests from the students, these events are scheduled once per week. They communicate with one another through a social media group page. Through weekly announcements, teams are formed in this network, which is run by student volunteers. Anyone can access and use the simulator centre with help from the simulator technician and one or two of the instructors there. However, instructors hardly ever step in during the exercises unless students ask for help. Students make decisions regarding the scenario concepts. Thus, students are motivated to learn. Additionally, these actions lay the foundation for the subsequent strategy.

5.5 Activating learners as instructional resources for one another

According to social constructivism, knowledge is co-constructed through interactions with other people and that learning is a social process. This theory holds that students actively participate in the learning process and build their own knowledge through social interactions with teachers and peers (Palincsar 1998). For effective instruction, peer assessment can be beneficial for both those who get and give feedback. If students assess their peers' work, they are forced to engage in understanding. Also, students often communicate more efficiently among themselves. A key strategy for fostering learning in social constructivism is to engage students as resources for one another's instruction. Activities like peer tutoring, group projects, and collaborative learning can help achieve this. I11 states the following:

> 'I encourage students to kind of collaborate and help each other, which I think is very important. If you're able to teach someone else, you really know this.'

I3 states the following:

> 'We are giving feedback, but the students are also giving feedback to each other, meaning that during the exercises, there are one or two observers writing down on the form.'

Also, I6 states the following:

> 'I also encourage the students to talk to each other. You know, they are two on the bridge and there's only one person that can operate a lot of the time. So I

tell them that they need to look at what their colleague is doing as well. So that they can do the same.'

Collaboration and teamwork are crucial skills required in most professions, including the maritime industry. By encouraging students to collaborate, the instructor promotes the growth of these skills. In addition, teaching is an efficient learning method, and by assisting others, students strengthen their understanding of the subject matter. In addition, they are encouraged to think critically about their own performance and that of others, reinforcing their learning. Observing during exercises provides students with additional perspectives and feedback, thereby enhancing their learning experience. Lastly, by encouraging students to pay attention to their teammates, the instructor is fostering situational awareness and teamwork, which are essential for safe and effective operations in the maritime industry. After graduating from the maritime institution, students generally work on different kinds of vessels and will go through different stages in their maritime careers. Consequently, each student must see and understand the roles (second and third mates, chief mate and master) at all stages. Each student is required to take on each of the roles at the bridge in turn during simulator training. Student teams typically consist of two to four people. Additionally, while the students learn to act as a team, they give feedback to their peers. Consequently, the teacher has the opportunity to watch each student. I3 explains and expresses some concerns about this process:

'We have several exercises and we let the students rotate... you were the master, this one someone else, now you have to rotate... But you have to in the simulator—you have to pay attention from the control room, because if a strong personality tends to whisper or instruct the other master... they shouldn't do that. Because a helmsman certainly shouldn't be the master because the master is unsure. But yes, the helmsman should tell that this vessel coming from the port side, and if nobody is reacting, of course he should tell the master—but he shouldn't take command.'

This strategy of rotating roles in exercises is intended to provide students with a thorough understanding of the responsibilities and duties associated with each role. By rotating roles, students gain a more in-depth understanding of how each role functions by experiencing the challenges and decision-making processes from different perspectives. Additionally, this strategy promotes teamwork and collaboration, which are essential skills in any workplace. It is essential, however, to ensure that the rotation process is conducted fairly and without interference from other students. In this regard, the instructor's role in the control room is crucial. The instructor must oversee the situation and ensure that students do not cross their boundaries or interfere with one another's roles. This allows each student to practice and learn in an environment devoid of outside influence.

Students can aid one another in gaining new knowledge and gaining a deeper understanding of the subject matter by cooperating and sharing their skills and knowledge. However, I7 expresses some additional concerns:

> ‘Sometimes it’s good to have two experienced people who can push each other to the top, and sometimes you can have someone experienced who is very good at learning, like, or teaching the knowledge, but I think this is more dependent on the person than their skills. But some people may be very skilled yet very bad at transferring those skills... After a month, I know the students... if they are good, they are people to put into the bridge with students who struggle, for instance.’

The instructor acknowledges that pairing students with differing experience and skill levels can be advantageous for both parties. Students who are having difficulty can learn from those who are more skilled and experienced, while those who are more skilled and experienced can reinforce their knowledge and skills by teaching and assisting others. In addition, the instructor recognizes that being skilled in a particular area does not necessarily make someone a good teacher or mentor; therefore, it is essential to consider not only a student’s skills, but also their ability to effectively transfer knowledge and skills to others. Therefore, the instructor creates a supportive learning environment in which students can learn from and grow with one another by carefully pairing students with varying levels of experience and skill. Moreover, it has been observed that the NightSim activities mentioned above help students learn from each other. In fact, students can sometimes be more helpful to each other than teacher-led instruction since students are effective at addressing the problems of their peers.

5.6 Discussion summary

This study aimed to examine the research question “What is the current practice of formative assessment in maritime simulator-based education?” The purpose being to fully understand simulator instructors’ teaching methods, how uniform their practice is across the Norwegian teaching institutions, and to explore any scope for improvement. The interviewees’ responses shed light on their approach to instruction and supply fresh insights and current practice into the use of formative assessment as an assessment approach to facilitate learning.

In alignment with the first strategy of formative assessment (Wiliam and Thompson 2007), maritime simulator-based education, practice demonstrates the key roles of collaboration with students and actively addressing misconceptions within the learning process, and clear learning objectives to guide students in focusing their efforts. In seafarer training, covering all required STCW topics and employing various teaching strategies to ensure student engagement and understanding is essential. In this study, instructors emphasized the significance of learning outcomes in aiding their students’ comprehension of what is required. In a constructivist approach to instruction, the expected learning outcomes for students are specified before instruction begins (Biggs and Tang 2015). Most instructors asserted that they present the exercise’s learning objectives during a course’s briefing phase.

Regarding the second strategy, this study's findings highlight the importance of active learning, student-led debriefing, and continuous monitoring of student progress for fostering a deeper understanding of the subject matter. Teachers can spend more time planning instruction and assessing students' comprehension in class to ensure that students' progress continuously. To foster critical thinking and self-awareness, instructors should also allow students to evaluate their performance and provide feedback on the exercise. Instructors can create a more engaging and productive learning environment by encouraging repetition and reflection through multiple opportunities to practice a task and evaluate performance. This approach is based on previous research demonstrating the effectiveness of active learning and student-led debriefing in fostering critical thinking and a deeper understanding. According to a constructivist viewpoint, a teacher's principal duty is to establish and sustain a collaborative atmosphere for problem-solving where students are free to build their own knowledge, and the teacher serves as a facilitator and guide (Palincsar 1998). Instructors design classroom discussions to determine where students are in their learning. The discussion generally occurs during the debriefing. Most instructors believe that students learn more if they are allowed to discuss among themselves rather than being told what they did wrong and right. Meanwhile, students' participation, behaviour and responses need to be evaluated and analysed. Moreover, many instructors found allowing students to make mistakes in a safe simulator environment beneficial.

This study's other key finding is that providing feedback, can be a highly effective way to improve student learning within the maritime simulator context. Instructors employ range of strategies, such as relating feedback to real-world scenarios, allowing students to make mistakes, and providing them with a unique perspective on an exercise. According to cognitivism, feedback can be used to fix mistakes and increase comprehension (Butler and Winne 1995). Also, the constructivist approach, which emphasizes social interactions and self-reflection, includes feedback as an essential element. A replay function is a valuable tool that can improve student learning by providing detailed feedback and encouraging reflection and self-evaluation. Instructors provide ongoing feedback to students throughout learning processes in a simulator environment. They believe that providing students with feedback helps them perform better the next time they complete a similar task. Typically, it is used to identify areas where students require additional support, modify instruction and pacing, and provide students with opportunities to reflect on their learning. Instructors must be keen observers of students in order to provide effective and appropriate feedback.

The forth strategy, as active participants in their own learning, students play a crucial role in the formative assessment. Constructivism emphasizes the significance of student participation in establishing goals, monitoring progress, and providing reflections. Self-evaluation has been shown to have a substantial effect on motivation and self-esteem. Providing students access to simulation tools facilitates self-directed learning, repetition, and practice for developing future success-critical skills. However, different levels of expertise require assistance and direction to maximize benefits. Creating environments where students can simultaneously learn and experience increases motivation and foster teamwork. Overall, the study highlights the significance of student participation in formative assessment and the advantages of simulation-based training for fostering self-directed learning and practical experience. Most instructors create environments that allow students to use their knowledge and gain practical experience

immediately. Additionally, they believe that practice outside of class enhances students' confidence and learning. Thus, students actively engage in learning by setting goals, monitoring their progress, and offering reflections on what they have learned.

This study's final strategy strongly ties to social constructivism, which asserts that activities like peer tutoring, group projects, and collaborative learning are essential learning strategies. Peer assessment is an effective method for fostering student learning and collaboration. By alternating roles and pairing students with varying levels of experience and ability, students can learn from one another and grow. In addition, the role of the instructor in supervising the situation and ensuring a fair rotation process is essential to creating a supportive learning environment. Peer evaluation and collaboration are essential skills for students to develop, as they are essential in various professions in the maritime industry. The activities that were just discussed allow students to learn from one another. Students engage in collaborative, interactive group work even before beginning simulator training due to the inherent nature of the simulator exercises. The instructors guide the students in their work and monitor how well they communicate with one another. As the educational landscape shifts toward learner-centred simulation teaching, the findings from this study present new insights and practices in using formative assessment strategies to facilitate effective learning in MET.

6 Conclusion

The incorporation of cutting-edge simulators has aided the evolution of maritime education. It is a potent tool revolutionizing how we educate and train the next generation of seafarers. Instructors can recreate a realistic working environment, and monitor and assess students' progress in real-time, allowing them to adapt teaching methods to meet student's needs better. Simulators provide various opportunities for instructors to observe students' activities and behaviours, allowing them to guide and assist them in achieving their intended learning goals. Instructors with experience as master mariners are preferred by nautical science institutions. However, there is little pedagogical training available for instructors. The traditional method of assessment, which is based on the subjective experience of the instructor, has long been the norm. Recent research indicates, however, that a more formal and objective approach to assessment can result in better student outcomes. This study's findings have substantial implications for maritime simulator-based education. Incorporating formative assessment strategies into current simulator training practices is one of the most important findings of this study. Observations and interviews with instructors from Norway's four nautical educational institutions show similarities and differences in maritime simulator training. In many cases, it seems that instructors are using variations of formative assessment, as interpreted within the perspective of Wiliam and Thompson's (2007) formative assessment strategies, without explicitly knowing that they are.

Formative assessment helps students understand the goals they are aiming for in a course and assists them in developing the skills required to make judgements about

their knowledge. Notably, one significant factor contributing to successful formative assessments is an instructor's capacity to collect data from formative assessments and provide insights into student progress. Such insights are not merely the sum of scores from a performed test. Each day in the classroom requires instructors to assess students' interactions, observe their actions and analyse their answers to questions. The challenge involves systematically collecting this data and understanding what can be done. In addition, formative assessment strategies can allow instructors to uncover their assumptions about the teaching process, thereby discovering previously unrecognised strengths of their students.

There is no one 'right' method that may be used in the classroom; what may have worked for one instructor may have backfired on another. Nevertheless, we believe that introducing a set of five formative assessment strategies and informing current practice may explicitly enhance maritime education. There is room for advancement. By strengthening formative assessment in maritime simulator-based education through pedagogical training, instructors can increase their efficacy and better support students.

In addition, this study emphasizes the significance of qualitative research methods in education. The researchers were able to develop a thorough understanding of how to meet the educational needs of students by using observations and interviews to gain insight into educators' motivations and perspectives. This type of research can provide educators and policymakers with valuable insights as they work to enhance the quality of education in this field.

Ultimately, the findings of this study provide valuable direction for the development of effective simulator-based maritime education practices. Educators can create a more robust and reliable assessment framework that benefits both educators and students by adopting a more objective and formal assessment methodology. Through ongoing research and pedagogical training, maritime simulator-based education can continue to improve, resulting in better outcomes for students and the industry. Let's set sail toward a better education with stronger assessment strategies.

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Declarations

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