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To improve training methods in an engine room simulator-based training

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Abstract

The simulator based training are used widely in both industry and school education to reduce the accidents nowadays. This study aims to suggest the improved training methods to increase the effectiveness of engine room simulator training. The effectiveness of training in engine room will be performance indicators and the self-evaluation by participants.

In the first phase of observation, the aim is to find out the possible shortcomings of current training methods based on training theories, to evaluate students' performance and knowledge level by their self-evaluation, and to observe performance indicators. After the observations, three changes were proposed and implemented. The new training methods will be tested in the second phase of observations, effectiveness of training and the factors which influence training outcome will also be found out.

The Result shows participants have more improvement in the second phase, but it is difficult to identify which factor leads to the result. The possible factors could be the commitment with the instructor, the changes in e-coach messages (training method), repetition of training, and the aware of being observed.

Key Words: Engine Room Simulator (ERS), Training Methods, e-coach system

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1. Introduction

On August 13th, 2014, US Coast Guard had assisted a 485 ft Bahamian-flagged chemical tanker after its main engine room fire aboard (USCG, 2014). This fire not only disabled the vessel but killed a crew member out of the 22. The vessel remained without propulsion 700 miles of west Cape Blanco. The fire was extinguished using installed firefighting systems, however, the ship sustained damage to its generators, leaving the crew with minimal battery power.

The engine room of a ship is just like the home of variety machines, systems, and the control panels. With the single purpose of keeping the ship moving and floating, it contains propulsion systems; to provide power for the ship, it relates to fuel substances. As the heavy duty of the engine room, there had been a chance of either combustion or any other dangerous consequence of under maintenance or careless operation (Taylor, 2005). The engine failure will cause schedule delayed, wasted repairing time and money, or even worst to have the loss of life or damage to the environment.

The use of simulators in maritime education had become popular in late 1970's, and the operator standard of simulator had been established by International Marine Simulator Forum in 1978 (IMSF, 2016). One of the earliest produced engine room simulator (ERS) was made by Kongsberg Group (Flatla, Lunde, Remes, Lysdahl, & Alfsvåg, 2009), they unveiled its first navigational simulator in 1974 while the first engine room simulator arrived in 1978. The simulator-based training is used widely in both industry and school education to deduce the above accidents nowadays.

1.1 Research Background

This research focuses on "Cold ship" preparation process training. The object for students is to start the main engine from cold conditions. All of the 20 first year marine engineering students in HSN will have to achieve their goal in this training, with at least three times of practice sections, and each section contains 6 hours exercise in two days. It is the foundation of the marine engine knowledge system, and also the first approach for students studied in ERS.

The ERS exercise was part of the "Marine Engineering at the Operational Level" subject. This is a whole year subject with 20 credits, including lectures, desktop simulator practice, and the ERS exercise. Different students' group will take turns to perform the ERS training each week, and the group was formed by the instructor. Students will be divided into several groups, each group contains three members, voluntarily choose to be Chief Engineer, First Engineer or the Engine Room Operator. However, due to the restriction on the number of students and the unexpected absent, size of a team could be only two or have to extend to four.

This exercise was not only operating systems by students but with an instructor as the guide and the captain. The instructor will give an introduction, in the beginning, observe and correct students' moves when exercising, provide debriefing at the end of training.

1.2 The Aim of this Research

As mentioned before, the use simulator became a popular training method both in the industry and the education. But there are not much research focus on engine room facilities, nor focus on how to make the simulator training more effective.

"A simulator does not train; it is the way the simulator is used that yields the benefit. (US. National Research Council, 1996)" It is easy to be impressed by those hi-tech the simulators, but the more important element than the technology is how educational methodology is implemented and whether if it increases training effectiveness (Drown & Mercer, 1995).

Thus, this study aims to improve current training methods used in ERS training, to increase the effectiveness. However, the evaluation of the effectiveness of training in the engine room is complicated, it's not proper to count on single test results for judgments. Therefore, the training effect will be evaluated by multi-performance indicators.

In a real world, a system failure in engine room may cause serious problems, the best situation is re-start the engine, and the worst one may lead an accident happened. Therefore, this research attempts to find the better way of engine room simulator training, to help students learned better.

1.3 Research Questions

The main research questions are:

- How to improve the current training methods in an engine room simulator-based training?

- What are the key performance indicators in "Cold ship" preparation process training?

- If the change of training methods is not the reason of improving, what causes the improvement of students' performance?

2. Theoretical Review and the Lack in ERS Training Researches

It is not a new idea when mentioning about learning by doing. Well-known educational psychologists such as John Dewey (1859-1952), Carl Rogers (1902-1987), and David Kolb (b. 1939) have proposed the groundwork of learning theories which focus on learning by doing. Dewey raised the concept of Experiential Education that preferred to solve problems and think critically than cram knowledge into someone's brain. Rogers considered experiential learning “significant” as compared to what he said “meaningless” cognitive learning. Kolb noted that concrete learning experiences are critical to meaningful learning and are famous for his Learning Cycle Theory (Kolb, 1984, 2014) which is widely used in designing of training, and the structure is similar to how students learned in ERS.

2.1 Experiential Learning

The definition of "Learning" was defined by Kolb (2014, p. 49) from the experiential perspective as "the process whereby knowledge is created through the transformation of experience." This definition clearly emphasizes some critical aspects, for instance, learning is through the experience. Also, learning is a process where knowledge was created and recreate, not an independent subject to be gained or passed (Kolb, 2014).

Broadly, experiential learning is any learning that supports students in applying their knowledge and conceptual understanding to real-world problems or situations where the instructor directs and facilitates learning. The classroom, laboratory, or studio can serve as a setting for experiential learning through embedded activities such as case and problem-based studies, guided inquiry, simulations, experiments, or art projects (Wurdinger & Carlson, 2009).

Wurdinger and Carlson (2009) also proposed there would be a different culture in class when applying the experiential training. For example, they suggested the key concepts when being students or teachers:

Students' Role.

- Students will be allowed freedom in the classroom with the learning progress.

- Students may need to experience errors when they try to complete their task.

- Students should realize that problem solving is an important part of this training.

Teacher's Role.

- Act as a guide, allowing students make mistakes and learn from them along the way.

- Provide student with freedom to experiment to find the solutions to fix the problem they faced.

- Provide student resources and information when they get stuck, make them move forward.

2.2 Learning Cycle

The work of Kolb (1984, 2014) on experiential learning has been very influential in simulation research. Herz and Merz (1998) used Kolb’s model to compare student learning between groups that participated in a simulation experience with those in a traditional seminar and found that ‘‘the simulation/game seminar outperforms a conventional seminar with respect to all aspects of the learning cycle’’ (p. 248). However, they note that ‘‘game complexity and prior knowledge strongly influence the learning process of participants’’ (p. 249). (Håvold, Nistad, Skiri, & Ø degård, 2015)

The learning cycle in Figure 1 contains with four stages (Kolb, 2014), it is possible to enter the cycle in any of the stages, and follow it with the logical sequence:

Concrete Experience. A new experience of the situation is implement or a reinterpretation of an existing experience. For example, the learners have their first time entering ERS with the practical exercise.

Reflective Observation. Stepping back and have a look at the new experience. A discussion in a coffee break or the debriefing will help the learners at this stage.

Abstract Conceptualization. Reflection gives rise to a new idea or a modification of an existing abstract concept. The learner can finalize their understanding through reading, looking back to what they learned in lecture or desktop simulator.

Active Experimentation. The learner applies them to the world around them to see what results. For instance, when the learner gets back to the ERS in the second time, or when they try to deal with the emergency situation.

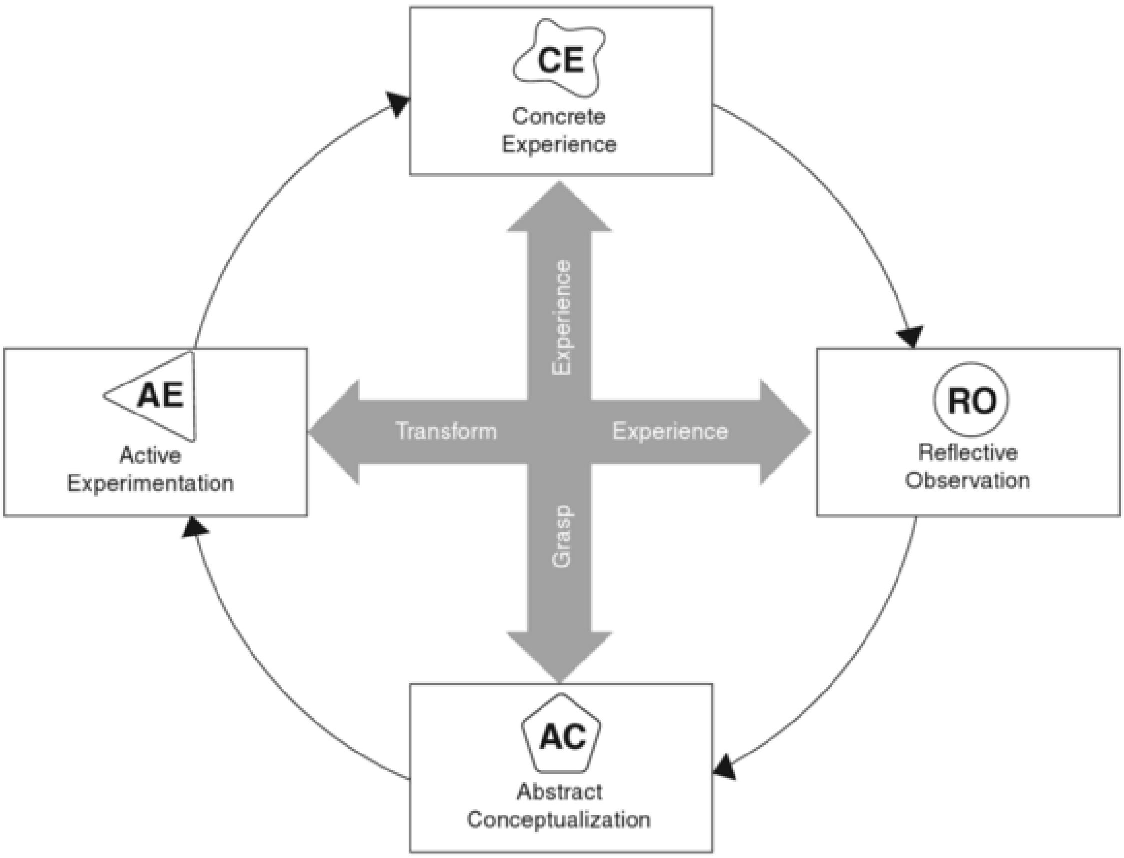

Figure 1. The Learning Cycle (Kolb, 2014, p. 51)

2.3 Other Training Methods Used in Current HSN ERS Training

Lots of training methods can be used in ERS training. Three training methods to improve attention management skills in process control were compared in a simulated process control task experiment (Burkolter, Kluge, Sauer, & Ritzmann, 2010). The researchers divided their participants into three groups: emphasis shift training (EST), EST combined with situation awareness training (EST/SA), and drill and practice (D&P). Meanwhile, some researchers suggested the methods that are proposed as the most promising ones used in the simulator for further empirical research are error training, rule-based training, knowledge-based training, cognitive apprenticeship, drill and practice, overearnings and guided discovery. (Annette, Sauer, Schu¨ ler, & Burkolter, 2009)

In order to be more focus, the following methods which used or might be used in HSN ERS training will be reviewed:

Drill and Practice (D&P). As an instructional strategy, D&P is familiar to all educators. It promotes the acquisition of knowledge or skill through repetitive practice (Adams, 2007). D&P means repetitive work on a task until a certain proficiency level is reached. The skills built through D&P is often used to be the foundation for learning. Merrill (2001) emphasizes that active practice is sometimes most being ignored. A huge amount of educational software, especially at the entry levels, takes drill and practice strategies.

Annette et al. (2009) motioned in their article that Morris and Rouse (1985), Foss et al.

(1989), Mattoon (1994) and Kontogiannis and Shepherd (1999) summarized that practice improves performance best. In general, Hagman and Rose (1983) concluded that the retention of learning outcome can be strengthen by adding training programs through task repetition.

Programmed Instruction. One of the systems about programmed learning was promoted by Skinner (1968). It is a teaching method used when presenting a new material (or knowledge) to students in a pre-programmed of managed steps. Students learn through the programmed material by themselves at their own speed and after each step answering an testing question or take proper moves. They will be shown the correct answer or given additional information right after their answer. Many online learning websites are using this method through electronically delivered Programmed Instruction (Adams, 2007).

Error Training. Salas et al. (2006) define error training as a technique that "promotes learning through trainees experiencing errors, seeing the consequences of such errors, and receiving feedback" (p. 484). According to Salas et al. (2006), error training must includes four fundamentals: error occurrence; error correction; self-correction; supported correction. Instead of trouble shooting, some mutations of error training focus on the emotional learning, trainees will be helped to monitor and in charge of their negative emotions, such as frustration when errors are made (Bell 2002, Annette et al., 2009)

Knowledge-based training. Sometimes it is also called "system-based training" or "guidance in the use of system knowledge", being known as one of the most effective training methods while handling the several tasks of industrial process control (Morris and Rouse, 1985). It is planned to provide the operator a fully understanding of the system knowledge, and to support the trouble shooting or fixing skills. This kind of training involves teaching the learners the mutuality of system components (e.g. something influence the pressure of air compressors may also affects temperature of diesel generator) and providing space for simulation of procedures and maintenance rules. It also includes the understanding of the limitation of the system (e.g. the pressure of emergency generator should be under 25 bars). (Annette et al., 2009)

In particular, knowledge-based training was proved to be rather effective by Patrick and Haines (1988), and Hockey et al. (2007), while they find that when operators are facing unexpected problems or have to deal with some trouble without reference.

2.4 Simulator Training in Maritime Industry

Simulators can be used for training without disrupting normal system operations and can replace on job training in the field because unusual events can be simulated with higher frequency (Flexman and Stark 1987; Annette et al., 2009).

The advantages of using ERS in maritime education are summarized by Cicek et al. (2002) as follows:

- The operations of the machinery are simulated close to the actual conditions
- Training for both normal and abnormal condition repeatedly is possible

- It is cost-effective, after first investment, the facilities can be re-used

- It is time effective

- It offers a flexible and controlled schedule of the training arrangement

- It makes controlled evaluation of the students possible

- It makes standardization of a marine engineering education possible

The biggest advantage of using ERS as a training tool is the possibility of creating malfunctions repeatedly to train students for increasing their trouble shooting skills. However, ERS is still not the real working place. Therefore, it improves the effectiveness when using ERS along with laboratories, workshops, training ships (Cicek & Uchida, 2003).

2.4.1 Advantages of Simulators Training in Detail

Some advantages of using simulators for training is generally mentioned above. The US. National Research Council (1996) had summarized following practical factors which bring benefits in simulator training.

Lesson Repetition. The instructor is able to stop a training situation when the goal or what he/she would like to see had been achieve by using simulator. The instructor can also repeat the training until the students reached the point. Quite the opposite, repetition for tasks is very few in the real world situation; the chance to repeat the practice in an on job training aboard the ship may not take place for weeks or months.

Flexibility. Simulator-based training allows organized arrangement of instructional conditions as the instructor's wish, or as intended for the training guideline. Simulation also allows the innovative use of instructional strategies that may increase the learning speed, improve retention, or develop protection to the generally effects of stress.

Safety. Risks connected with training on operational equipment are a concern in any industry. With the use of simulators in training, the air carrier industry had proved it reduced training accidents.

Multiple Tasks and Prioritization. It fits the deck officers' need best, but can be also applied in engine room situation. Deck officers must continually make decisions at any given time, in any given situation, to decide which of tasks are most important out of a large amount works. A new deck officer’s first training is often made up with a range of skills that were taught, practiced, and examined separately before simulator-based training had been implement. The use of simulation in training programs makes it possible to convert classroom skills and to practice how to prioritize multiple tasks at the same time. Simulation training strengthen the growth of skills and gives the occasion to practice making judgment in prioritizing tasks.

2.4.2 Types of Simulators

The simulator classification system proposed for adoption by the International Maritime Organization (IMO) is used in this report for consistency with current international developments. Under this system, simulators fall into four major categories— full-mission, multi-task, limited-task, and special-task simulators (also referred to as desktop or PC simulators). (US. National Research Council, 1996)

Regarding the classification based on the workstation, the mainly used simulator can be divided into engine room simulators and the bridge simulators. The major difference between a bridge task and an engine room task is the type of interaction. A bridge task involves interaction with the environment while engine room tasks involve interaction with machinery. The interaction with the environment is governed by human rules while the interaction with machinery is governed by physical laws. An engineer has to work in at least two different working environments: the control room environment and the engine room itself compared to one working environment of the bridge tasks. A significant number of the engine room tasks are knowledge-based actions (Kuilenbur, Stapersma, & Wieringa, 2001). Therefore, the goal and object of training will be vary by the difference of working station.

2.4.3 STCW and Other Regulation about Simulators

The International Marine Simulator Forum, an organization of simulator facility operators and other interested parties; and the International Maritime Lecturers Association, an international professional organization of marine educators and trainers, are both have been working to develop technical standards for simulators that would complement and support the STCW guidelines in marine industry (IMSF, 2016).

An Intercessional Simulator Working Group (ISWG) in IMO was established in order to organize and structure simulator related subjects for enclosure in the STCW amendment (Cross, 2011). One definition adopted by ISWG (IMO, 1994) reads:

"Simulation is a realistic imitation, in real time, of any ship handling, radar and navigation, propulsion, cargo/ballast or other ship-system incorporating an interface suitable for interactive use by the trainee or candidate either within or outside of the operating environment, and complying with the performance standards prescribed in the relevant parts of this section of the STCW code."

There are several basic differences between the aviation industry and maritime industry (visual flight and ship-bridge simulators) in the certification of simulators. For instance, visual flight simulators for commercial air carriers are linked directly to the development of specific airframes and are not customized to allow training in multiple airframes (NRC, 1992). This practice is possible because of the large numbers of similar airframes owned and operated by commercial airlines. Quite the reverse, bridge simulators or ERS are not only developed separately from the vessels they simulate but also routinely used to train in multiple models. Use a number of models to meet the specific application needs of training sponsors, or adjust their models to simulate a number of different vessel types, these are the main types of some marine simulator amenities.

Different from commercial air carrier simulators, there are no worldwide standards for marine simulators. Marine simulators vary greatly in mathematical hydrodynamic models, scenario databases, and algorithms. The practice by some simulator operators of adjusting simulator models can cause problems.

The STCW made by IMO had been revised and published, which is the Manila Amendment (IMO, 2010). All new regulations had been effected on 1 January 2012 with a transitional period until 1 January 2017. However, there is still no regulation about simulator performance standards to guide the effective and uniform use of simulators for marine professional development. These performance standards are expected to set minimum criteria that must be met: for instance, field-of-view requirements for different types of functions and tasks such as ship handling (IMO News, 1994; Muirhead, 1994).

2.5 Performance Assessment in ERS Training

There are several methods regarding the performance assessment of simulator training. Perhaps the most widely accepted method for evaluating effectiveness is Kirkpatrick's (1976) four-level approach (Alligar & Janak, 1989), which includes:

- Trainees' reactions to a training program and its content,
- Learning, or trainees' acquisition of knowledge or skills,
- Behavior, or changes which trainees can execute desired training-related behaviors,
- Results, or the extent to which trainees' job behaviors change and result in increased organizational effectiveness. (Mathieu, Tannenbaum, & Salas, 1992)

According to the US. National Research Council (1996, p.120), there is a defination of training: *"Training is the systematic development of attitudes, knowledge, and skills required by an individual or a team to perform a given task appropriately."* However, when working as a team, the contribution of each person to be defined and measured is difficult.

The meaning of competence is to contain sufficient knowledge or skills performing work-related actions, establishing employment or licensing authority standards, as defined by performance criteria. And the meaning of proficiency is to demonstrated the level of ability. The difference between competence and proficiency is presented by traditional mariner licensing processes. Marine officers are examined by a written exam when licensing. This method may reveal a level of knowledge, but does not show the continuous ability to perform the task or the job. Simulators may offer a practical method of evaluating or testing levels of competence and proficiency and the ability to continue to prioritize tasks (US. National Research Council, 1996).

After the understanding of what to be evaluated, the choose of factors for the assessment was emphasized. Management experts have fought for decades the most useful way to review the performance. Currently, the wildest used tools are subjective and objective measures as part of a larger performance measurement process (Terstiege, 2013). Each measurement method has its strengths and weaknesses.

Objective evaluation is not focus to the assessor bias or observational limitations. To use objective evaluation or assessment, the performances must be able to be expressed in “yes” or “no” format (e.g. can students start the main engine from cold condition?). These evaluations could use a checklist or a simulator-implanted measurement. In an objective evaluation, the assessor would note whether a particular practice took place. The objective evaluation may also allow the assessor to point out the quality of the practice. The use of the objective method usually needs that the student regonized the assessor is fair to everyone.

Subjective evaluations are release to understanding or bias by any or all involved: the instructor, the assessor, or the student. These methods may be present in the way of evaluate form of checklists, but the assessment also includes the observer’s qualitative conclusion about the efficiency of the student’s performance (Terstiege, 2013).

2.6 Limitation of Current ERS Training and Researches

Although simulators have been widely used as training environments in different industries (e.g. oil, aviation, medical and nuclear power), there is just little amount of works focus on evaluating the effectiveness of the training methods engaged. (Annette et al., 2009)

The existing training methodology in the marine industry has developed, but very slowly as ships have developed. Actually, the method for using simulators in training was as an extra or a supporting to simulated training programs.

Meanwhile, the training programs using simulation often insert simulation into existing courses rather than customizing the course to make sure that the simulation works effectively to the course training goals. The lack of standardization in simulator-based courses was not solving for decades. The US. National Research Council (1996) claims that the instructor can be more important than the simulation in meeting training objectives.

Therefore, the aim of this research is to find out what are the better training methods to be used in ERS, by evaluating the training effectiveness. Moreover, the evaluate of ERS training should be discussed in this process. If the result shows participants' improvement is not caused by the change of training methods, the possible factors of improvement will be suggested.

3. Methodology

The research methods and the research design will be discussed in this section, including the process of research and the participants. As a mixed methods research, the use of observation, performance indicators and the questionnaires will also be mentioned.

3.1 Research Design

The design of this research was based on the Quasi-Experimental Designs. Referring to Campbell and Stanley (2015), a Quasi-Experimental Design is to make an experiment possible, even though the researcher lacks the full control over the scheduling of experimental stimuli (the when and to whom of exposure and the ability to randomize exposures).

Due to the restriction from originally separated groups between students, the researcher is not allowed to make new groups based on random selection. That is because all 20 students were divided into two big groups, consist 9 (group A) and 11 (group B), and they take turns to attend the training each week (3 in engine room simulator, and rest of them in the desktop simulator). Thus, the participants of group 1 will have to be chosen from group A, and group 2 participants came from group B,... etc.

Based on Campbell and Stanley's (2015) definition, this is an Equivalent Time-Samples Design. The research consists of two phases, same participants will join the training in both phases. This design can be seen as a form of the time series experiment with the repeated introduction of the experimental variable. The experiment is most obviously useful where the effect of the experimental variable is anticipated to be of transient or reversible character.

3.2 Research Flow

The research flow was inspiring from the SAT method, which recognizes five sequential steps in the design of a training program (Sugita, Nakazaws, Hu, & Ishida, 2005):

- Analysis of task and training needs
- Design of training program
- Development of training material
- Implementation of Training
- Evaluation of training effectiveness

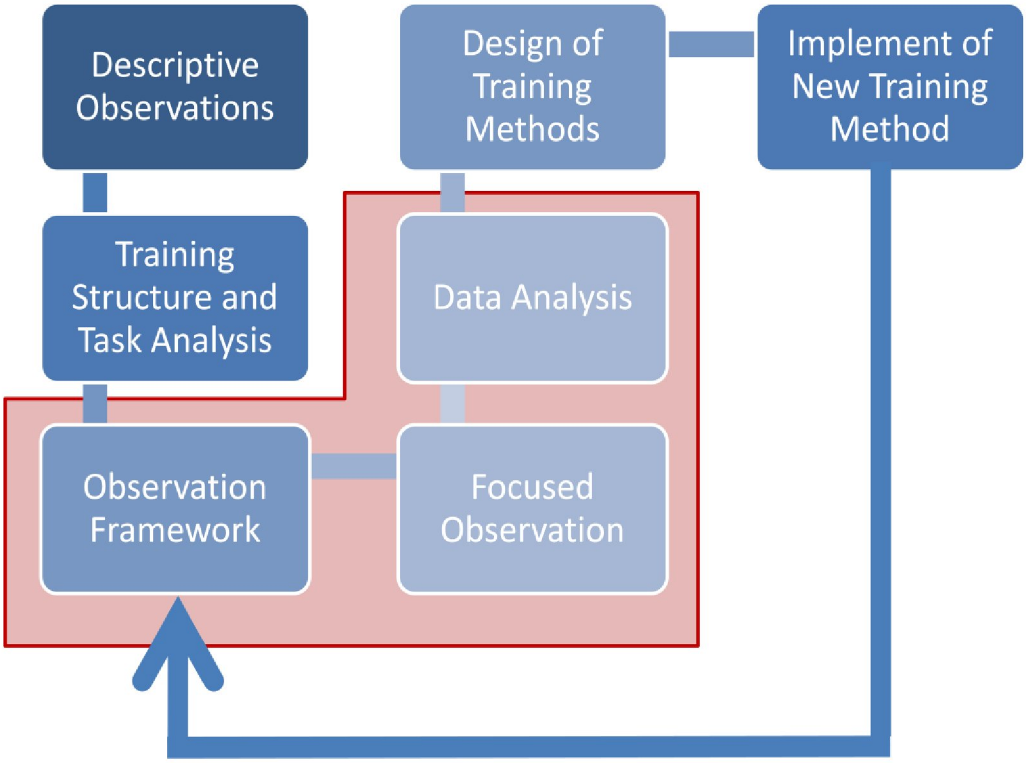

Figure 2. Research Flow Chart

In this research, both observation and quantitative methods will be applied. The process starts with a descriptive observation to understand the field and identify what should be observed. Then the training structure and task will be analysis to help on new training method design. Based on the descriptive observation, a framework for focused observation was designed and used in phase one training. After new training methods were made and implement, phase two training started. Please see Figure 1, the research flow chart; each component will be discussed later in this article.

3.3 Participants

In the beginning, all of 20 first year marine engineering department students were agreed to join this project. However, some of them did not attend the training or couldn't meet the requirement to be in the training. In the end, there are 15 participants, with 3 female and 12 male, average age 22.8, and 80% of them have been to a real engine room before.

3.4 Observation and the Frameworks

There are two objects of observation in this research, the first is to find out what should be improved, and the second one is to record the performance indicators. Therefore, different observation frameworks were used in different stages.

When conducting descriptive observation, the framework was designed base on what Spardley's (1980) mentioned in his book "Participant Observation". There are many things to be recorded in this framework, but this is what to do at this stage: "you will make descriptive observations whenever you look at a social situation and try to record as much as possible." (Spradley, 1980, p. 73). The used framework can be viewed in the APPENDIX.

Descriptive observation is designed to guide the researchers in researches when they are most ignorant of the culture under consideration. Thus, Spradley (1980) suggested following nine dimensions questions, providing an excellent guide for making grand tour observations. These nine dimensions are listed in Table 1:

Table 1

The nine dimension in Descriptive observations (Spradley, 1980, p. 78)

	Dimension	Description
1	Space	The physical place or places
2	Actor	The people involved
3	Activity	A set of related acts people do
4	Object	The physical things that are present
5	Act	Single actions that people do
6	Event	A set of related activities that people carry out
7	Time	The sequencing that takes place over time
8	Goal	The things people are trying to accomplish
9	Feeling	The emotions felt and expressed

After 12 hours of descriptive observations, the researcher decided to focus on selected area by personal and theoretical interests (Spradley, 1980). The observation framework was revised and more focus on the activity, object, event and time dimensions. It can be seen in the APPENDIX.

Two observers were spending the same time and completed their records in this field, one can only speak English and another speaks English and is a native speaker of Norwegian, which is the language used in training. The interobserver agreement (Landis & Gary, 1977) procedure will be executed in the chapter "Result", to enhancing the believability of data.

3.5 Performance Indicators (PIs)

The object of this training is to start the main engine successfully from cold condition before the end of each exercise. Therefore, the performance indicators were defined in two categories: time taken and error made. All six performance indicators are listed in Table 2.

In addition, the performance indicators should be quantitative, akin to both school grade reports and serious-game scoring (Manca, Nazir, & Colombo, 2012). The most natural and consolidated reference to quantitative indicators concerns the category of Key Performance Indexes (KPIs). As KPIs, the performance indicators contains some characters, such as required to be linked to the final goal, be measurable and measured frequently, participants were able to manage them in a certain level (Parmenter, 2010).

Table 2

The performance indicators

	PI	Units	Reason/ Description
1	Time taken to start the emergency air compressor	Time	Easy to identify with sound effect
2	Time taken to have lights on	Time	Easy to identify with lightening
3	Time taken to start the main engine	Time	The goal of the exercise
4	Participants being corrected by instructor	Numbers	How many errors they made
5	Can participants solve tasks given by instructor	Percentage	The successful rate of task solving
6	The lube oil level in DG1 when ME start	Percentage	If participants follow correct procedure

3.5.1 Time taken

Time taken in an exercise can't be the only factor when considering performance evaluation, a rush action may be quick, but also may lead to fail. However, time taken can represent participants' proficiency in operating, the effectiveness of communicating, and the understanding of the system.

The chosen PIs related to time taken were revealed in Table 2, which including time taken to start the emergency air compressor, time taken to have the lights on, and the time taken to start the main engine. The reason for selecting the above PIs are: the start of emergency are compressor will trigger the first sound effect of ERS, which is with a clear sign and easy to be observed. Similar with that, to have the light on brings the light into a dark engine room. Last, the start of main engine is not only a PI, but also the goal of this exercise.

3.5.2 Error made

Following three PIs (fourth to sixth in Table 2) were related to how many errors do the participants made during the training. One of the observers has only limited knowledge of engine room operating system, therefore, it depends on how many times did instructor correct participants. The instructor is not informed this will be recorded to have less effect on instructor's behavior.

The fifth PI, solving the task given by instructor normally happened after the main engine was started. The instructor will set some multifunction challenges such as dirty filters in subsystems, overlord speeds or higher temperature. It will cause the alarms and participants experience the error training.

The sixth PI was chosen because two groups of participants fell into this trap in the descriptive observation. After testing for at least 5 times, the researchers noted that if participants followed the instruction correctly, when main engine was started, the lube oil level in diesel engine number one will be around 60%. However, if they ignore some instruction or lack of some procedures, the lube oil level will not be the same, and it will trigger the alarm when under 30%.

3.6 Questionnaires

Participants will be given three questionnaires, and they have to finish right before and after the exercise, to reduce the probability of confused memory. Most questions are in Likert Scale, rated from 1 to 10, while the last question is in Ordinal style. Participants were requested to fill the pre and post questionnaires in both control period and experiment period. All questionnaires are made in English with Norwegian translation, can be seen in the APPENDIX:

Demographic Questionnaire. Participants received the first questionnaire regarding their background, motivations, and feedbacks of current training. The aim is to understand the satisfaction level of students in current training and to assess if there is a possibility for improving.

Pre-questionnaire before training. Participants need to finish it before the training start, to evaluate their current knowledge and confident level.

Post-questionnaire after the lecture. Intent to evaluate how participants learned and the reason of improvement (if there is any).

4. Proposed Changes

According to the research flow chart, after several weeks of observation, some changes were proposed to the instructor based on literature review and other methods. This chapter is to present the reason and the consideration of changing. To avoid losing focus, the improved suggestions were restricted up to three.

4.1 Current Training Design

To suggest the improvements, it is necessary to understand current training design. According to Cross' (2011) suggestion, there are five division of training, described as follows: team training, operator training, decision-making training, procedure training, and maintenance training. Based on his category, current training contains three types of division: team training, operator training, and procedure training.

Moreover, Cross (2011) provide a guideline of nine steps can be distinguished in the process of designing simulator exercises, out of which following considered steps can fit part of current training structure: Step 1, Introduction; Step 3, Duration of exercise; Step 4, Number of students per instructor; Step 7, Status; Step 8, Debriefing; Step 9, Evaluation.

Current training can be analyzed through descriptive and phase one observation, with following the nine dimensions guidelines (Table 1):

Space. Training was conducted in Engine Room Simulator (ERS), the layout of space was demonstrated in the following sketch:

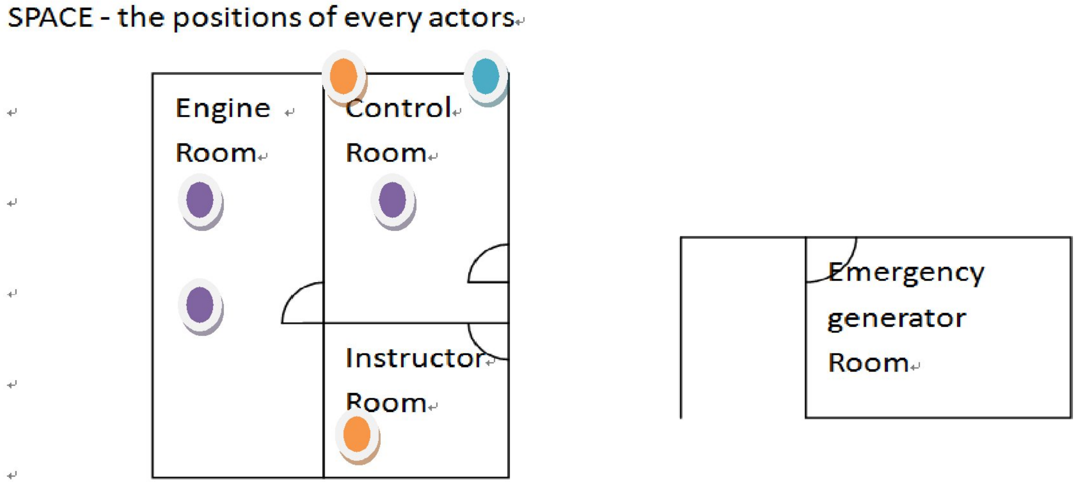

Figure 3. Space arrangement of ERS training

Actor. There are three participants and an instructor in the ERS, plus two observers. Their positions were also displayed in above Figure 2, blue as the instructor, orange as the observers, and the purple as participants. Participants will have their own choice or discuss which role they are going to take. They can choose between Chief Engineer (located in the control room), 1st Engineer or the Operator.

Activity. Operating the ERS by following e-coach instruction or only based on their knowledge learned in the lecture. Thus, participants have to communicate with each other and do their job correctly.

Object. This dimension refers to physical elements, such as furniture and other facilities. The ERS which participant used is a big view simulator, consist with an instructor room, an engine control room, and the engine room. The used engine room simulator is K-Sim engine produced by Kongsberg group. There are various operating models from slow speed diesel engine to Steam turbine propulsion plants. Participants are going to practice on ERS - MAN B&W 5L90MC VLCC model, which is simulating a slow speed diesel engine plant.

Based on the Engine Room Simulator Version MC90-V Operator’s Manual (Kongsberg Maritime, 2009), there are four sequence diagrams was proposed: First start to own supply, Own supply to harbor condition, Harbour condition to ready for departure, and Manoeuvre mode to sea passage mode. The photo of ERS can be seen in Figure 3, 4.

Figure 4. The engine control room, dark engine room, and the instructor room.

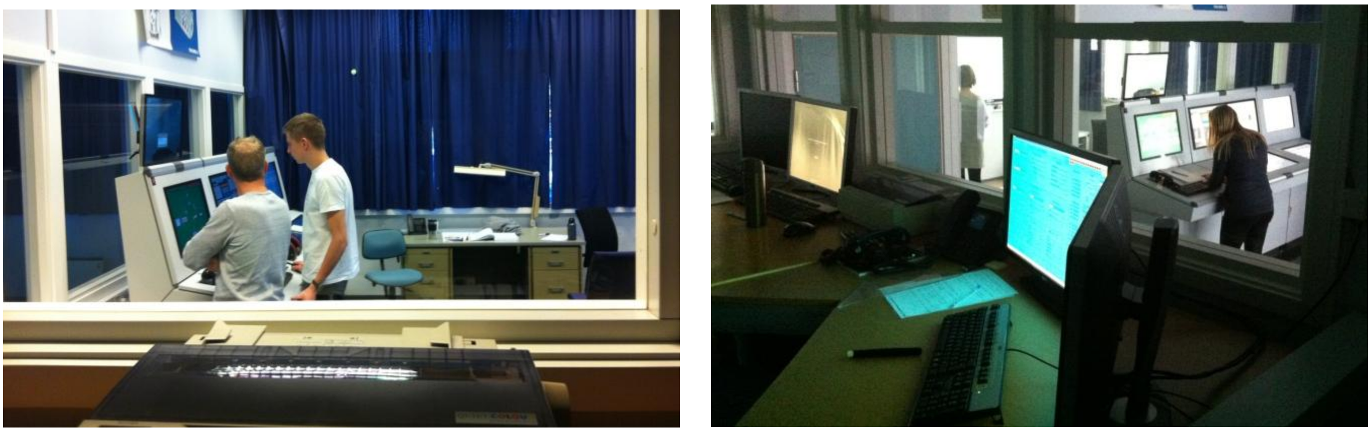

Figure 5. View from the instructor room.

Act. Represents specific individual actions. In this training, all participants are working to start the main engine. Chief engineer plays the leading role to provide instructions, and the operator is the executor to perform the command. The 1st engineer works in between, therefore, he might run between the control room and engine room.

Event and Time. Event means particular occasions, e.g. meetings; and time is the sequence of events. Figure 5 shows the arrangement of current training, which elaborate the events and time. With the restriction of the facility and maximum student numbers, the training was divided into two days. The average used time length was also calculated based on phase 1 observations.

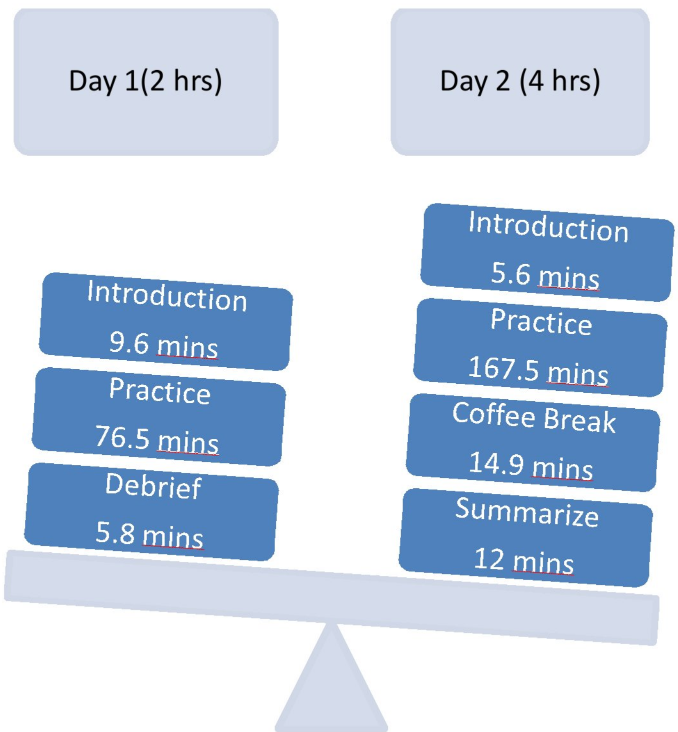

Figure 6: Current training structure

Goal. The final goal of this training is to start the main engine from cold condition. This objective had been announced to students at the beginning of the semester and repeated in every exercise.

4.2 Task Analysis from Cold Ship to Start the Main Engine

Task analysis is defined as: "A systematic examination of a task resulting in a time oriented description of tasks performed by an operator, showing the sequential and simultaneous activities" (Nielsen, 2005, p. 332). The advantage of a task analysis is that it provides the training course designer with information about the training task in a structured manner.

The aim of task analysis in this research is to define what are the systems students have to be familiar with to start the main engine. However, there is no book or guiding which point out the standard procedure of "How to start the main engine", most of the authors elaborate some systems have to start before main engine, without providing a step by step instruction. Thus, the Hierarchical task analysis is based on the user manual provided by Kongsberg Maritime. (Kongsberg Maritime, 2009)

The task analysis is presented as a tabular type in the APPENDIX. The main objection to diagrams is that they do not easily and conveniently permit notes to be made concerning the task (with refer to Figure 6, the first page of the HTA). Without backup notes, the task analysis is extremely limited. Tables provide a solution to this problem.

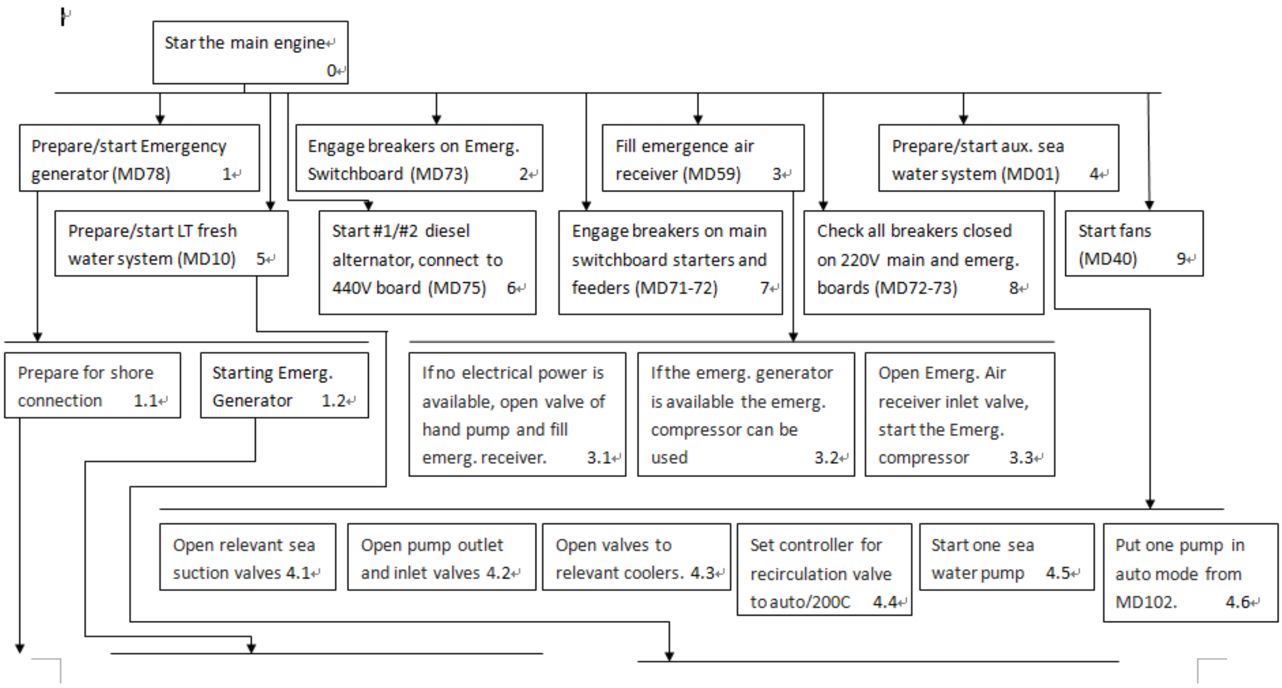

Figure 7. First page of HTA in starting the main engine

4.3 Proposed Change 1: The Use of e-coach

The e-coach system is an electronic instruction system which triggered by different operations, made by Kongsberg Maritime. There will be pop-up messages displayed on the screen to provide a guide to students. Normally the Chief Engineer takes responsibility to read them and release the orders to his or her colleagues.

As mentioned in the literature review, the e-coach can be categorized as a drill and practice method (D&P). Drills are usually repetitive and are used as a reinforcement tool. There is a place for D&P mainly for the beginning learner. Moreover, many researchers suggest that D&P led to a superior diagnostic performance on familiar system faults. D&P facilitates learning through a rehearsal of a task in order to achieve the desired level of proficiency (Cannon-Bowers, Rhodenizer, Salas, & Bowers, 1998; Annette et al., 2009). In

D&P, learners are provided with a clear instruction to complete the task and guided in a step-by-step manner through the steps of the task. Therefore, the participant can focus on task steps instead of having the learner divide attention between finding a strategy and operating. D&P is expected to reduce the learner's mental workload, especially in initial learning (Burkolter et al., 2010).

Thus, the use of e-coach (D&P method) is assuming beneficial for the first year students. However, according to the learning cycle model shown in Figure 1 (Kolb, 2014), D&P only fits the step of Concrete Experience. In order to strengthen the training effectiveness and increasing the reflective observation feedback, the use of e-coach in the second-day training will be removed in phase 2. Figure 8 shows the adopted learning cycle.

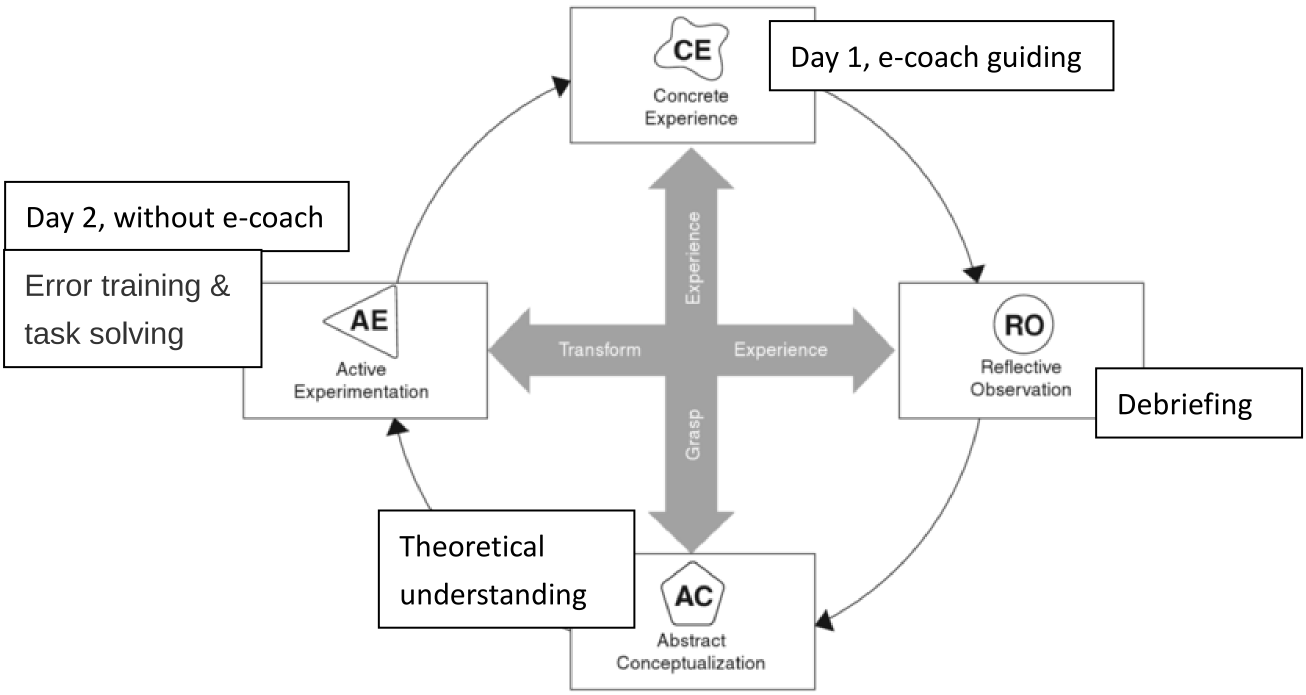

Figure 8. The ERS training projection in learning cycle

A new supporting material implemented in phase 2, it can be a reference in day 2 while participants were without instructions from e-coach system. Checklists and task lists can be useful for measuring performance objectively (US. National Research Council, 1996). Also, checklists reduced the dependency of instructor.

To sum up, the difference between phase one and phase two regarding the use of e-coach is summarized in Figure 9.

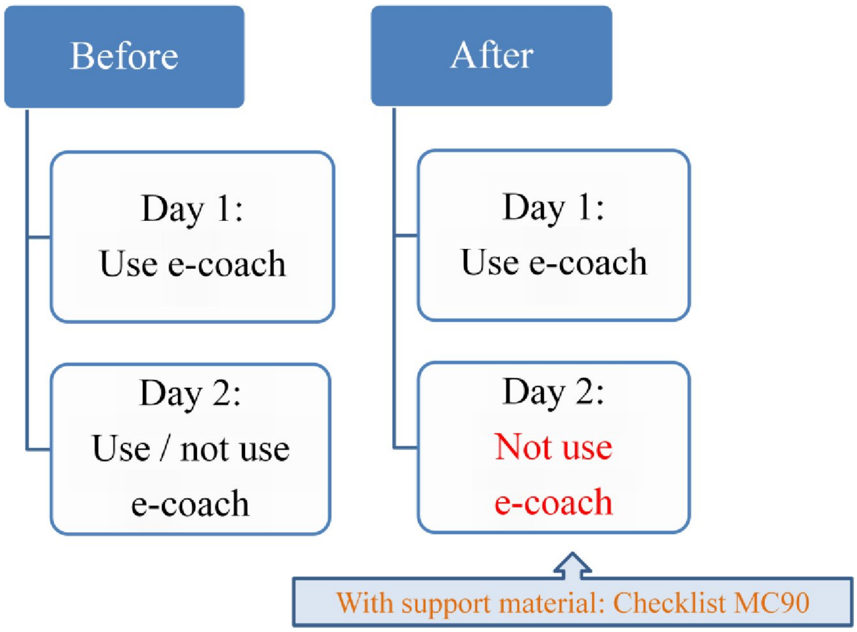

Figure 9. Proposed Change 1: The Use of e-coaches

4.4 Proposed Change 2: e- coach Messages

There are mistakes and improper instructions in current e-coach messages, therefore, the review and revise of e- coach messages is needed. The revision is based on an understanding of task (following task analysis). After modification, it had been tested by the instructor and a senior bachelor student, they both got more than 10 years experience working in engine room.

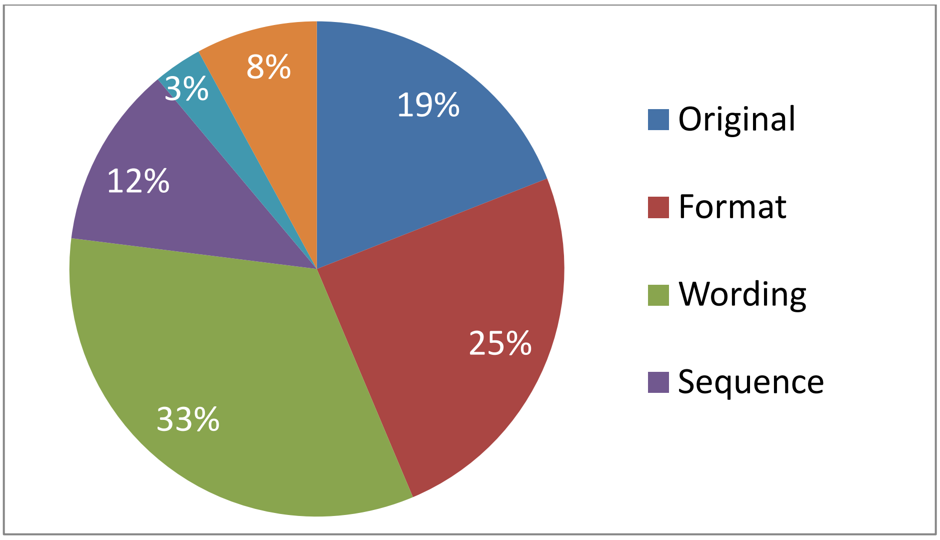

Figure 10. The revised percentage of e-coach messages

As shown in Figure 10, most e-coach messages were revised. There are total 126 messages in the cold ship scenario, only 19% messages kept in their original way. The type of modifying can be defined in several categories, such as change the wording (33%), change of format (25%), reverse the sequence (12%), delete the non-necessary messages (3%), and create a new one (8%). The before and after messages comparison is attached in the APPENDIX.

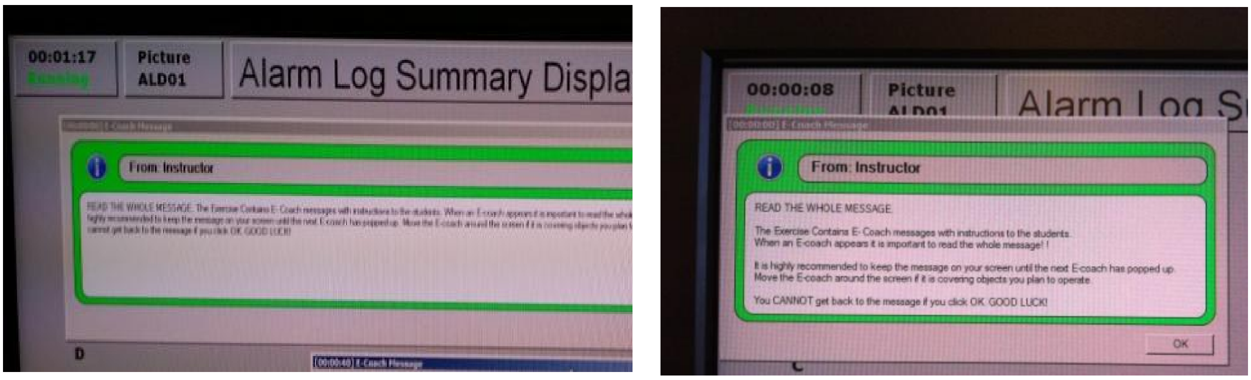

Figure 11. Messages before and after change format.

Change of Format. Figure 11 presents the pre and post messages displayed on the screen. Most of the original messages lack typesetting. A long sentence without line break makes difficult reading and the unpleasant feeling.

Change of Wording. The aim is to make the description of instruction fits the facilities, and more completed. For instance, lots of instructions mentioned only "Go to MD 78", instead of providing the actual system name such as "Go to MD 78, Emergency Diesel Generator." Without giving the system name, students may act just like playing games, and it is not good for creating a theoretical understanding. Some examples of revising were listed in Table 3.

Table 3.

The examples of change wording

Item	Before	After
3.1	Go to MD 01 and open the V00701 High suction inlet valve.	Go to MD 01, sea water system, and open the V00701 High suction inlet valve.
9.2	Go To MD 71. Connect all Pump, Fan and Compressor starters.	Go To MD 71, Main Switchboard - Starters. Connect all Pump, Fan and Compressor starters.
3	Go To MD 40. Start the Fan for Engine Control Room, and the Fan for Cargo Control Room. Start the Engine Room Supply Fan no.1, Engine Room Exhaust Fan no. 1, Accommodation exhaust Fan no 1, Purifier Room Fan and Sewage Room Fan.	Go To MD 40, Air Ventilation System. Start following fans: - Fan for Engine Control Room, - Fan for Cargo Control Room, - The Engine Room Supply Fan no.1, - Engine Room Exhaust Fan no. 1, - Accommodation exhaust Fan no 1, - Purifier Room Fan, - Sewage Room Fan.

Reverse Sequences. This type of modification contains moving some steps to a proper position. For example, the original e-coach ask the participants to remove moored condition while the engine is not started yet, which might cause serious damage. Therefore, this order had been move from 19.6 to 20.1. That means participants should finish the sub-system No. 19 (preparing start of main engine) first, then continue No. 20 (start of main engine) and remove the moored condition after main engine started.

Change Triggers. 24 triggers were changed out of 103, in order to be associated with revised e-coach messages. The setting of triggers can be done by the user itself, with simple system value and logic, when the asked requirements were satisfied, the trigger activates. Figure 12 demonstrates the interface of trigger setting.

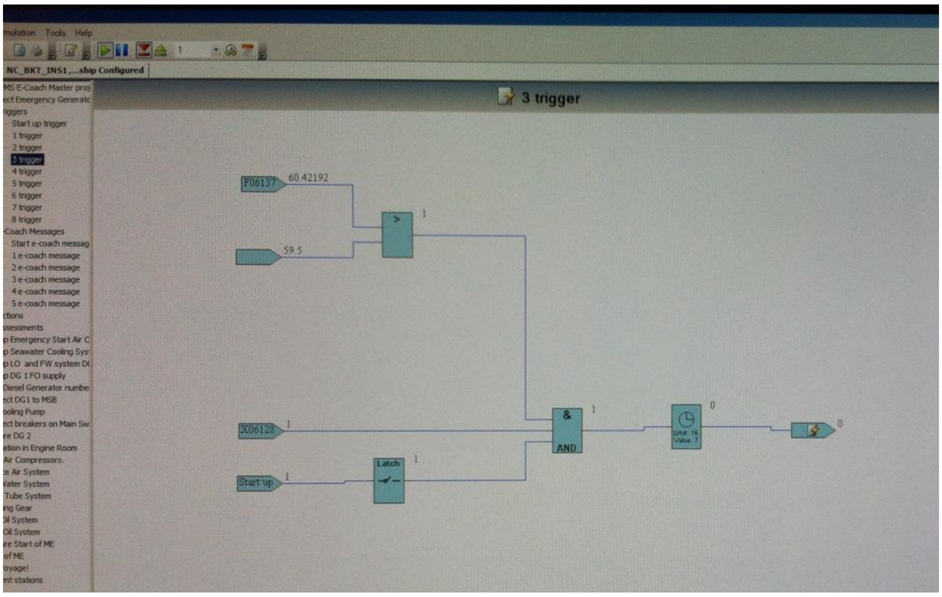

Figure 12. The setting of triggers

4.5 Proposed Change 3: The Time Length of Training

The US. Ship-Bridge Simulation Training Committee found there are no studies of the optimum length of simulator training time or of the optimum balance among lecture, simulator operation, and review of performance in maritime training. Conceptually, the duration of the course needs to be synchronized with the curricula and learning patterns to support overall training objectives (US. National Research Council, 1996). It has been discussed in the previous chapter that current training structure contains two days of exercise, two hours in day one, and four hours in day two.

After finishing the phase one observation, the result shows participants need at average 111.3 minutes to start the main engine. However, they have only average 76.5 minutes to practice in ERS in the first day (see Figure 6 in page 34), which means they do not have sufficient time to start the main engine on day 1.

Besides, although participants can be immersed to training scenarios that might take years to experience during actual operations, a compressed exercise provide little opportunity to contemplate results of individual training sessions. This lack of time to reflect may be especially significant for individuals who have limited nautical experience, such as first-year marine students or are not familiar with ERS training (US. National Research Council, 1996).

Hence, the third proposing change is to extend the training hours in day one, for participants to have more time practicing. Due to the restriction of ERS schedule, the exercise can be from 10 am to 12:10pm, and the instructor will have a debriefing outside the ERS, adding 38.5 minutes practicing time to phase two training in day 1.

5. Results

The result contains two categories based on the type of data. The performance indicators recorded in observations are objective, including "Time taken" and "Error made". Those questionnaires answering by participants will be analyzed by Wilcoxon signed-rank test used when comparing two related samples, matched samples, or repeated measurements on a single sample to assess whether their population mean ranks differ (Wilcoxon, 1945).

5.1 Data from Performance Indicators

Interobserver agreement. The term for the degree of agreement or consistency between or among observers or raters is interobserver reliability or interrater reliability. Suppose you are studying whether an in-service training program for paraprofessionals or volunteers increases the level of empathy they express in videotaped role-play situations. To assess interrater reliability you would train two raters; then you would have them view the same videotapes and independently rate the level of empathy they observed in each. If they agree approximately 80 percent or more of the time in their ratings, then you can assume that the amount of random error in measurement is not excessive. Some researchers would argue that even 70 percent agreement would be acceptable. (Rubin & Babbie, 2011, p. 196)

As mentioned in the chapter methodology, there are two observers in this research. The degree of the interobsever agreement is 92.71%, there are 7 disagreements out of 96 in total.

The high level of agreement shows that the observers are using the same "operational definition" of the behavior they are observing, and brings the reliability.

5.1.1 Time Taken

The average time taken to start the emergency air compressor, to have lights on, and to start the main engine are demonstrated in Table 4. Figure 13 also shows the trends from phase 1 to phase 2. There is a huge deduction on time taken for starting the main engine, some decreasing for having the lights on, but slightly increasing to start the emergency air compressor.

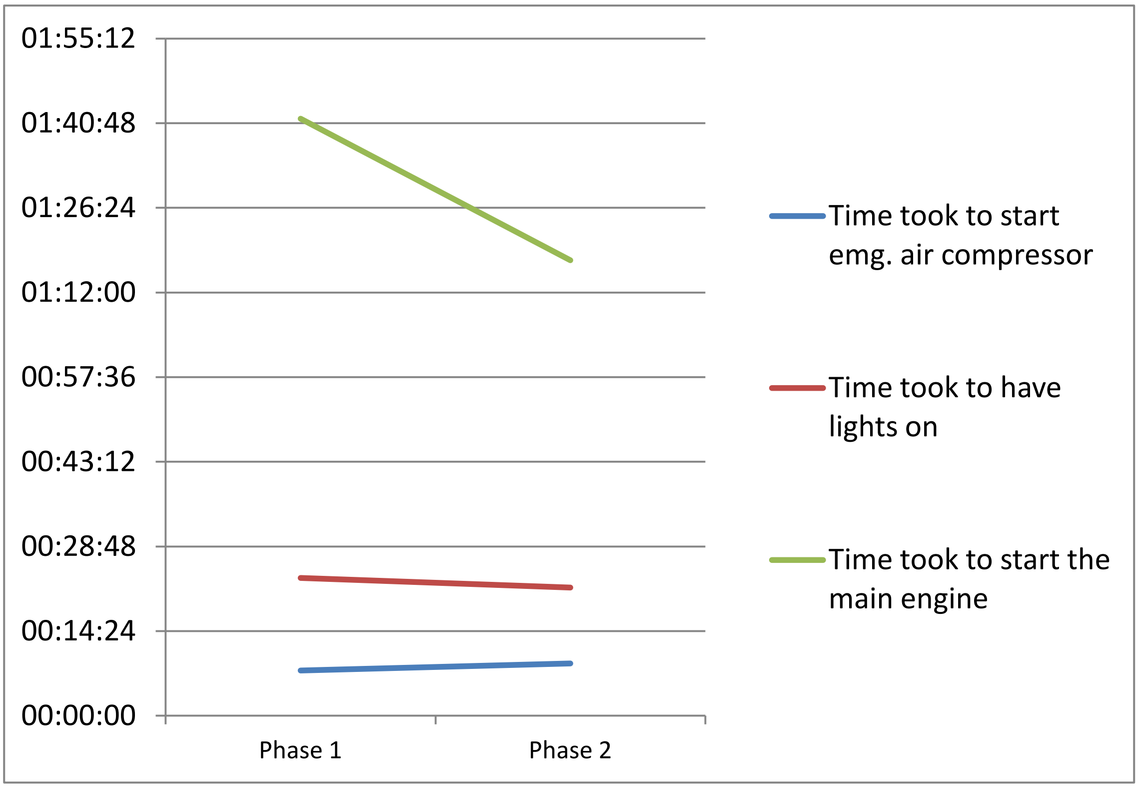

Figure 13. Time taken in different tasks

Table 4

The performance of average time taken in both phases.

	PI	Phase 1	Phase 2
1	Time taken to start the emergency air compressor	00:07:41	00:08:53
2	Time taken to have lights on	00:23:26	00:21:49
3	Time taken to start the main engine	01:41:35	01:17:29

5.1.2 Error Made

The result for PIs related to error made shows participants have some improvements in phase 2, the average performance shows in Table 5. Also, when conducting the Wilcoxon signed-rank test, it shows three tests are all being significant (Asymp. Sig., 2-tailed=.001, .012, .001).

Table 5

The performance of average error made in both phases.

	PI	Phase 1	Phase 2
4	Participants being corrected by instructor	5.47 (times)	2.87 (times)
5	Participants solve tasks given by instructor successfully	70.13%	91.33%
6	The lube oil level in DG1 when ME start	49.27%	63.27%

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
Pre_Corrected	15	5.4667	3.15926	3.00	13.00
Pre_task solve	15	.7013	.27586	.00	1.00
Pre_oil level	15	.4927	.10152	.34	.63
Post_Corrected	15	2.8667	.83381	2.00	4.00
Post_task solve	15	.9133	.11095	.75	1.00
Post_oil level	15	.6327	.03863	.59	.68

Test Statistics[a]

	Post_Corrected - Pre_Corrected	Post_task solve- Pre_task solve	Post_oil level - Pre_oil level
Z	-3.346[b]	-2.523[c]	-3.325[c]
Asymp. Sig. (2-tailed)	.001	.012	.001

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

c. Based on negative ranks.

5.2 Data from Questionnaires

Due to the small sample size, the analysis will be non-parametric statistics, as known as Distribution-free statistics (Corder & Foreman, 2014). Which identified it does not base on parameterized families of probability distributions (Wasserman, 2007). As mentioned before, Wilcoxon signed-rank test will be used in the analysis.

The descriptive statistics of each question can be seen in Table 6, which all shows the result of post tests are greater than which in pre-tests, with significant (Asymp. Sig., 2-tailed=.001). There is also a figure demonstrating the average rating in four stages (pre-tests and post-tests in both phase 1 and 2, see Figure 14).

Table 6

Descriptive Statistics of Data

Subject		Phase 1		Phase 2	
		Mean	SD	Mean	SD
Evaluate current knowledge level from cold ship condition to start main engine	Pre-test	6.40	1.06	6.80	1.74
	Post-test	7.67	1.05	9.27	.59
I feel confident when communicating with colleagues.	Pre test	7.47	1.46	7.33	1.29
	Post test	8.40	1.30	9.53	.74
I know the operating process from cold ship to start the main engine very well.	Pre test	5.53	1.06	6.33	1.80
	Post test	7.33	1.29	8.87	.92
I know the functions and menu of simulator panels very well.	Pre test	5.80	1.21	6.67	1.18
	Post test	7.33	1.18	8.27	1.10
1Evaluate the your overall improvement		8.93	.96	9.60	.83

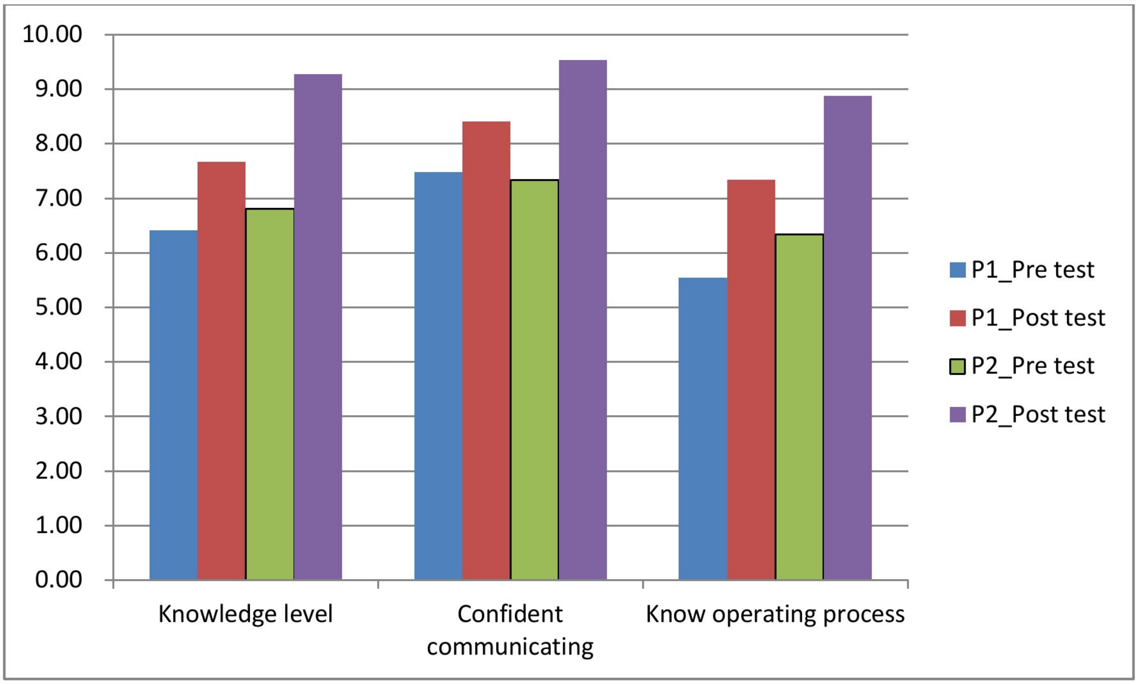

Figure 14. Scores of self-evaluations in each stage.

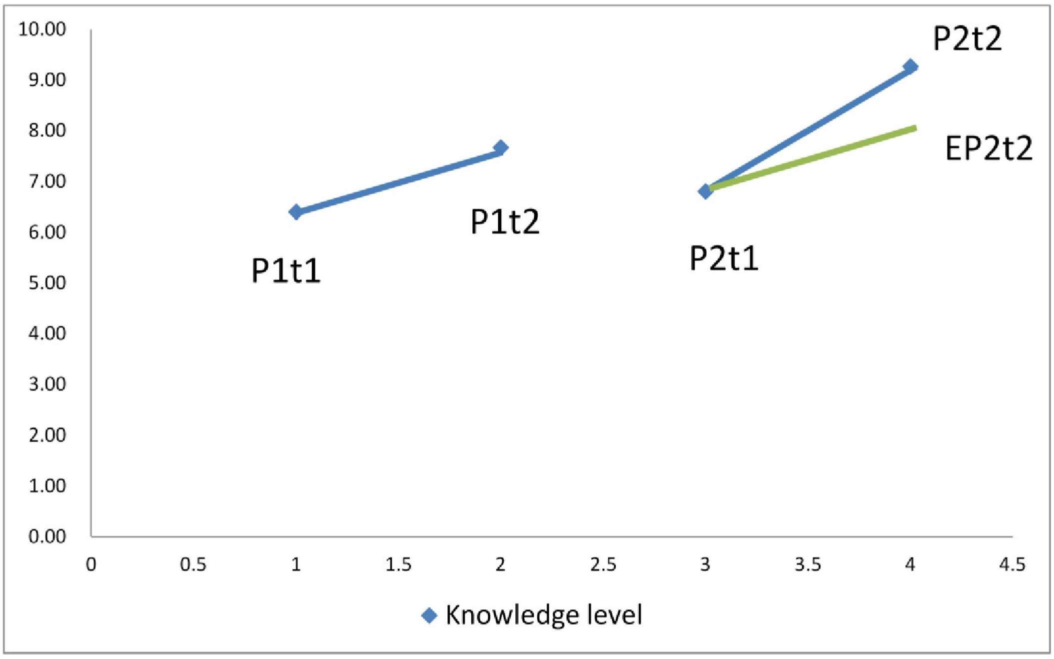

Figure 15. The slopes of knowledge increasing in each phase

The mentioned result shows there are improvements in both phases, but how can it be measured if participants improved more in phase two? The above Figure 15 shows the suggested model. It shows the increasing of knowledge level evaluate by participants, which P1t1 represents pre-test in phase 1, while P1t2 is the post test in phase 1. The gradient of line P1t1 to P1t2 is the margin of knowledge grows in phase 1.

Assuming participants will have same improvements in phase 2, and if their learning ratio keeps the same, and the pre-test score is P2t1. Thus, the score for post-test in phase 2 should be EP2t2 (Expected phase 2 test 2, see the green line in Figure 15). However, the actual P2t2 value is higher than expected, which can be speculated that participants improved more than expected.

The above-suggested model can be summarized by the formula:

$$\frac{\text{P2t1}}{\text{P1t1}} \times \text{P2t1} = \text{EP2t2 (Value of Expected Improvement)}$$

When EP2t2 < P2t2, the improvement is more than expected.

5.3 What causes the improvement?

A rank-order question was asked in both phases. The answer of ranking will be converted into scores in order to see the difference in both stages, for instance, ranked 1st will be given 3 points while ranked 3rd gets 1 point. After that, the Friedman test will be applied (Vogt, Vogt, Gardner, & Haeffele, 2014). This method of analysis might have some limitation which the degree of preference for an item ranked 1 over an item ranked 2 may not necessarily be the same as the degree of preference for the item ranked 2 over the item ranked 3 (Abeyasekera, Lawson-McDowall, & Wilson, n.d.).

Table 7

Descriptive Statistics and Friedman test of Phase 1

	Scores	Mean	Std. Deviation	Mean Rank
The difference of training method	11	.7333	1.22280	3.73
Commitment with the instructor	27	1.8000	1.01419	5.60
Aware of being observed	17	1.1333	1.06010	4.53
Repetition of training	30	2.0000	1.13389	5.80
Change of team members	5	.3333	.48795	3.33
Change of training length	0	.0000	.00000	2.50
Change of e coach messages	0	.0000	.00000	2.50

Test Statistics[a]

N	15
Chi-Square	43.435
df	6
Asymp. Sig.	.000

a. Friedman Test

The above Table 7 shows the result in phase 1, which the factor "Repetition of training" gets the highest score, and followed by "Commitment with instructor". Some participants realized being observed and the difference of training methods (which was not implement in phase 1 yet) help on their learning.

Meanwhile, the following Table 8 brings the result in phase 2. It shows that the choice of factors are more diversified, which the gaps between mean ranks from Friedman test are not so different. This analysis is not statistically significant. The commitment with the instructor is still important (highest score, 20), while some participants noted there are changes in e-coach messages (score 17), and feel positive about that. The difference of training methods, repetition of training, and aware of being observed are just one step behind, gets 16 and 14 scores. Figure 16 shows the comparison of both phases, mentioning both commitments with instructor and repetition of training were considered important factors.

Table 8

Descriptive Statistics and Friedman test of Phase 2

	Scores	Mean	Std. Deviation	Mean Rank
The difference of training method	14	.9333	1.09978	4.23
Commitment with the instructor	20	1.3333	1.23443	4.87
Aware of being observed	16	1.0667	1.22280	4.30
Repetition of training	14	.9333	1.22280	4.10
Change of team members	6	.4000	.82808	3.30
Change of training length	3	.2000	.77460	2.80
Change of e-coach messages	17	1.1333	1.18723	4.40

Test Statistics[a]

N	15
Chi-Square	11.807
df	6
Asymp. Sig.	.066

a. Friedman Test

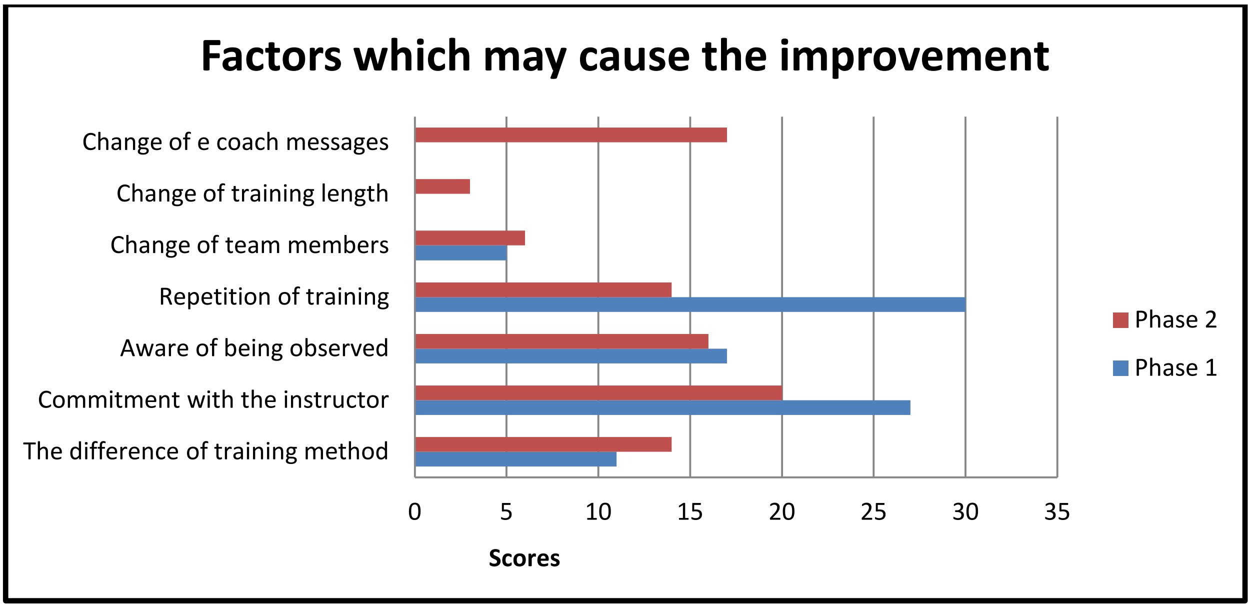

Figure 16. The comparison of phase 1 and phase 2 in factors help on improving

6. Discussions

This study aims to improve current training methods used in ERS training, with a proposed changes implement in the second phase. The result of observations and questionnaires had been displayed in the above chapter. The answer to each research questions will be discussed in this chapter.

6.1 How to improve the current training methods in ERS training?

Current ERS training for first-year students are praised, 60% of participants did not believe it can be improved. However, this is conflicted when participants feel the use of ERS haven't reached the maximum potential intensity (average point 5.6 out of 10).

There are clear improvements on performance indicators from phase 1 to phase 2. Figure 13 and Table 5 had shown the large decrease time taken to start the main engine, and the less error made. Simultaneously, the slope of knowledge increasing model (p. 48) indicates there is an improvement more than expected. Thus, it is possible to define participants had more improvement in phase 2 than phase 1.

13 participants out of 15 (87%) mentioned there are different training methods used in different phases, out of which 11 feel it helps them learned better. The revised e-coach messages get most feedback considering helpful on learning, and it is ranked number two in the analysis of factors cause improvement. Nevertheless, it does not imply other changes of methods is ineffective.

6.2 What are the key performance indicators in this training?

When initiating this study, the performance indicators were defined as what Table 2 demonstrate, and most of indicators indicate participants performance. However, the indicator "Time taken to start the emergency air compressor" shown in Figure 13 did not fits the atcualality and point out the improving. That is because there are different feasible procedure. Participants can choose between prepare for the desail engine number one or start the emergency air compressor first, the reverse of sequence will not make any demage.

Therefore, the performance indicators in this exercise will be following:

Table 9

The confirmed performance indicators

	PI	Units	Reason/ Description
1	Time taken to have lights on	Time	Easy to identify with lightening
2	Time taken to start the main engine	Time	The goal of the exercise
3	Participants being corrected by instructor	Numbers	How many errors they made
4	Can participants solve tasks given by instructor	Percentage	The successful rate of task solving
5	The lube oil level in DG1 when ME start	Percentage	If participants follow correct procedure

6.3 What causes the improvement of students' performance?

It is not proper to identify the exact reason for participants' improvement due to the small sample size and the un-significant test result. However, the commitment with the instructor and the repetition of training can be considered as a further research topic.

6.4 Limitations

This is not a perfect study, but it can be a pilot study for further research. There are some limitations which can be discussed or revised in further research.

The research design. In order to get more participants (increase the sample size), the first year students were test for twice in the quasi experiment. Students might have improvements only due to repetition of training, even there is no change at all.

Moreover, the ERS training is very flexible and dominate by the instructor. The original plan designed by the instructor in phase two is to remove the e-coach system, and students have to start the main engine all by their self. The repeat use of e-coach can be boring for students, but it is necessary for the experiment.

To sum up, it might be more accurate to compare different methods in two groups of students, for example, the first year student of 2016 and 2017 in their first ERS training. Or divided student 2016 into controlled and experimented group.

Restrictions from the environment. It is a very flexible training, which means the instructor treats different students in different ways based on his/her observation. But there are still some restriction from the infrastructure or the existed administration plans.

For instance, the ERS is almost occupied by varies groups in day time, therefore, students are with difficulty to exercise in their leisure time. Also, the proposed change cannot reach its original intension (to extend the exercise in first day to 3 hours), because of the ERS schedule. The allocation of students' groups is also under restriction, which makes too many variables are out of control.

6.6 Suggested Further Studies

Two possible studies appeared after the changes were implemented. It might help on understanding how to make the ERS training more effective.

Work as groups instead of separated rolls. Students are now voluntarily take the positions they want, the choice is between Chief Engineer, First Engineer and the Engine Room Operator. This might be the reason lead to unequal training effectiveness. The feedback of participants shows they feel that the operator get more chance to practice and leaned more. The result of self evaluation matches this description, while the operator assess themselves with higher scores than the other two.

The Importance of Instructor. When asking "what cause the improvement", the unexpected popular answer is "the commitment with the instructor". The instructor controls almost everything in an ERS training, the speed ratio, the timing for debriefing, to correct students or not, and so on. In phase two, the observers accidentally witness what will students act when there is no instructor, and it is totally different than usual.

The repeating of this study to have more sample is also considered, there is always room to improve.

7. Conclusion and Future Works

The use of ERS training had become more and more popular, but there is still no regulation about simulator performance standards to guide the effective and uniform use of simulators for marine professional development set by IMO. Thus, how to use the simulator properly turns to an interesting topic without much research.

This study illustrates that the following improvements help on participants' learning:

- Revised e-coach messages (based on task analysis and user manual)

- Change of time length (create an environment with more chance of drill and practice)

- Not use e-coach in day 2 (strengthen the reflect and experiment stage in learning cycle)

The performance indicators can be categorized into two types, time taken and error made. Five performance indicators were confirmed after the result discussion.

It is still no precise answer to "what causes the improvement", but based on participants reply, the further analysis can be concentrated on the role of instructor, the changes in e-coach messages (training method), repetition of training, and aware of being observed.

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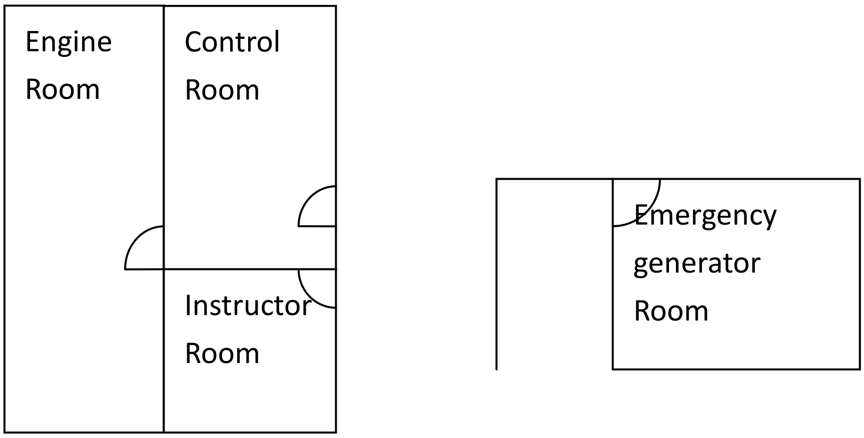
APPENDIX

1. Observation Framework

Date:_______________.

SPACE - the positions of every actor



ACTORS - the names and relevant details of the people involved, how did they rotate roles?

Role	Name (Day 1)/ Notes	Name (Day 2)/ Notes
Chief Engineer		
First Engineer		
Operator		

TIME - the sequence of events

Description	Day 1		Day 2	
Total hours of practice (started /finished)				
Time when simulator freeze (Intro/debrief/breaks)				
*Time took to start the air compressor(real/system)				
*Time took to have lights on (real world/system)				

*Time took to start the main engine (real/system)				
Running ratio of simulator				

* As a performance indicator

EVENTS - particular occasions

Description	Day 1	Day 2
*How many times does the instructor corrected students?		
*How many times did students give up communicating via phone, but choose to talk face to face?		
*Can students deal with tasks given by instructor successfully?	Rate of success (__ /__)	Rate of success (__ /__)
*On what percentage does the oil of DG1 consist when the main engine start?		

* As a performance indicator

Other guidelines:

When the info. was not understandable or students have hesitation, what's the reaction?

☐ User manual ☐ Ask instructor ☐ discuss in group ☐ other:_______________

Did students use any tools to achieve better performance?

☐ Notes ☐ Body language ☐ Eye contacts ☐ other:_______________

How does students react when receiving pop-up instructions?

☐ User manual ☐ Ask instructor ☐ discuss in group ☐ other:_______________

Observer:___________________.

2. Questionnaires

Questionaire for Learning in ERS- demographic

Spørreskjema for læ ring i maskinromssimulatoren1

This is a research study, your data will be kept confidential, and your identity will be disclosure; please feel free leave your comment in English/Norwegian if needed.
Dette er en forskningsstudie, dine svar vil bli holdt konfidensielt og identitet skjult. Kommenter gjerne på Engelsk eller Norsk om nødvendig.

Have you been to the engine room simulator (the big simulator) in this or last semester?
Har du væ rt i maskinromssimulatoren (stor simulatoren) dette eller forrige semester?
□ No; □ Yes, for _______________ hours (approximately)

Do you prefer to have more practice chances in engine room simulator (the big simulator)?
Ville du foretrekke mer trening i maskinromssimulatoren (stor simulatoren)?
□ No; □ Yes, it's better to have_______________________hours more per semester.

Do you know that HBV had advance simulators before you apply for this program?
Viste du at HBV hadde avanserte simulatorer før du søkte studie?

If yes, does it influences your decision on application? □ No; □ Yes.
Om "ja" i forrige spørsmål, hadde dette innvirkning på din avgjørelse om å søke?

Do you think that the current ERS training can be improved? □ No; □ Yes.
Tror du at den nåvæ rende treningen i maskinromssimulator (stor simulatoren) kan forbedres?

If yes, in your opinion, what can be improved?
Om "ja" i forrige spørsmål, hva mener du kan forbedres?

____

____

____.

For the next several questions, please choose a number from 0-10 and write it next to each to indicate how much you agree with the statements.
I de neste spørsmålene; vennligst velg et tall fra 0 til 10 og indiker dette. 0 betyr sterkt uenig og 10 betyr sterkt enig.

1. I am satisfied with my learning outcome in "Cold ship" process till this moment.

Jeg er fornøyd med læringsutbytte i “cold ship” øvelsene frem til nå.

Strongly Disagree					Neutral					**Strongly Agree**
0	1	2	3	4	5	6	7	8	9	10

2. The design of this lecture structure helps me to learn better.

Simulatortreningens utforming hjelper meg til å læ re bedre.

Strongly Disagree					Neutral					**Strongly Agree**
0	1	2	3	4	5	6	7	8	9	10

3. The simulator environment in HBV duplicates the real world engine room well.

Miljøet rundt maskinromssimulatoren ved HBV gjenspeiler et ekte maskinrom veldig bra.

Strongly Disagree					Neutral					**Strongly Agree**
0	1	2	3	4	5	6	7	8	9	10

4. The use of simulator has reached the maximum potential intensity.

Bruken av simulator har nådd sitt maksimale potensiale.

Strongly Disagree					Neutral					**Strongly Agree**
0	1	2	3	4	5	6	7	8	9	10

Student Navn:____

Kjønn: □ Mann □ Kvinne Alder: ______________år_

Do you have sailing experience? □ No; □ Yes, for ______days, or _____years.
Har du seilingserfaring?

Have you been to a real engine room before? □ No; □ Yes, for _________ times.
Har du væ rt i et ekte maskinrom før?

Questionaire for Learning in ERS-2 (Pre-test)

Spørreskjema for læ ring i maskinromssimulatoren-2

This is a research study, your data will be kept confidential, and your identity will be disclosure; feel free leave your comment in English/Norwegian if needed.
Dette er en forskningsstudie, dine svar vil bli holdt konfidensielt og identitet skjult. Kommenter gjerne på Engelsk eller Norsk om nødvendig.

For the next several questions, please choose a number from 0-10 and write it next to each to indicate your evaluation or agreement with the statements.
I de neste spørsmålene; vennligst velg et tall fra 0 til 10 som indikerer din utvikling eller mening. Tallenes betydning indikeres under.

1. Please evaluated your knowledge level of "Cold ship" process. (from cold ship to start the main engine)
   Hvor godt kjent er du med fremgangsmåten i "cold ship" øvelsen (fra kaldt skip til start av hovedmotor)?

Very Poor					Neutral					**Excellent**
0	1	2	3	4	5	6	7	8	9	10

2. I feel confident when communicate with colleagues.
   Jeg føler meg sikker når jeg kommuniserer med medstudenter.

Strongly Disagree					Neutral					**Strongly Agree**
0	1	2	3	4	5	6	7	8	9	10

3. I know the operating process from cold ship to start the main engine very well.
   Jeg kjenner prosessen fra kaldt skip til start av hovedmotor veldig godt.

Strongly Disagree					Neutral					**Strongly Agree**
0	1	2	3	4	5	6	7	8	9	10

4. I know the functions and menu of simulator panels very well.
   Jeg kjenner simulatorens funksjoner og menyer veldig godt.

Strongly Disagree					Neutral					**Strongly Agree**
0	1	2	3	4	5	6	7	8	9	10

5. I have great interesting and enjoy studying in big simulator.
   Jeg har stor interesse og liker studier i maskinromssimulatoren (stor simulator).

Strongly Disagree					Neutral					**Strongly Agree**
0	1	2	3	4	5	6	7	8	9	10

6. It is fun to have training in big simulator.
   Det er gøy å trene i maskinromssimulatoren (stor simulatoren).

Strongly Disagree					Neutral					**Strongly Agree**
0	1	2	3	4	5	6	7	8	9	10

7. It helps me to learn more to have training in big simulator.
   Treninger i Maskinromssimulatoren (stor simulator) hjelper meg til å læ re mer.

Strongly Disagree					Neutral					**Strongly Agree**
0	1	2	3	4	5	6	7	8	9	10

Student Name:____.

Questionaire for Learning in ERS-3 (post test)

Spørreskjema for læ ring i maskinromssimulatoren-3

This is a research study and your data will be kept confidential; feel free leave your comment in English/Norwegian if needed.
Dette er en forskningsstudie, dine svar vil bli holdt konfidensielt og identitet skjult. Kommenter gjerne på Engelsk eller Norsk om nødvendig.

For the next several questions, please choose a number from 0-10 and write it next to each to indicate your evaluation or agreement with the statements.
I de neste spørsmålene; vennligst velg et tall fra 0 til 10 som indikerer din utvikling eller mening. Tallenes betydning indikeres under.

1. Please evaluate your knowledge level from cold ship to start the main engine after this training.
   Hvor godt kjent er du med fremgangsmåten fra kaldt skip til start av hovedmotor etter denne treningen?

Very Poor					Neutral					**Excellent**
0	1	2	3	4	5	6	7	8	9	10

2. I feel confident when communicate with colleagues after this training.
   Jeg følte meg sikker når jeg kommuniserte med medstudenter under denne treningen.

Strongly Disagree					Neutral					**Strongly Agree**
0	1	2	3	4	5	6	7	8	9	10

3. I know the operating process from cold ship to start the main engine very well after this training.
   Jeg kjenner prosessen fra kaldt skip til start av hovedmotor veldig godt etter denne treningen.

Strongly Disagree					Neutral					**Strongly Agree**
0	1	2	3	4	5	6	7	8	9	10

4. I know the functions and menu of simulator panels very well after this training.
   Jeg kjenner simulatorens funksjoner og menyer veldig godt etter denne treningen.

Strongly Disagree					Neutral					**Strongly Agree**
0	1	2	3	4	5	6	7	8	9	10

5. My interesting of learning in big simulator was strengthen after this training.
   Min interesse av å læ re meri maskinromssimulatoren (stor simulator) har styrket seg etter denne treningen.

Strongly Disagree					Neutral					**Strongly Agree**
0	1	2	3	4	5	6	7	8	9	10

6. I have sufficient chances to exercise with all functions of engine room simulator.
   Jeg har tilstrekkelig med sjanser til å øve på alle funksjonene i maskinromssimulatoren.

Strongly Disagree					Neutral					**Strongly Agree**
0	1	2	3	4	5	6	7	8	9	10

7. The instructions or feedbacks from instructor helps me understand more about the procedure.
   Instruksjonene eller tilbakemeldingene fra instruktøren hjelper meg med å forstå prosedyrene.

Strongly Disagree					Neutral					**Strongly Agree**
0	1	2	3	4	5	6	7	8	9	10

8. The timing and length of break is helps me to learn better.
   Tidspunktet og lengden på pausene hjelper meg med å læ re bedre.

Strongly Disagree					Neutral					**Strongly Agree**
0	1	2	3	4	5	6	7	8	9	10

9. It's better be corrected right after making a mistake, rather than receiving feedback in the end.
   Det er bedre å bli korrigert rett etter at man har gjort en feil, i stedet for å motta tilbakemelding på slutten

Strongly Disagree					Neutral					**Strongly Agree**
0	1	2	3	4	5	6	7	8	9	10

10. Please evaluated your improvement in the practice from cold ship to start the main engine.
    Har du forbedret din kunnskap vedrørende praktisering fra “cold ship” til start av hovedmotor.

Worse					Neutral					**Very Much Improved**
0	1	2	3	4	5	6	7	8	9	10

11. There are different training methods used in these two days of training.
    Det er forskjellige treningsmetoder som brukes int og satt mine dager med trening.

Strongly Disagree					Neutral					**Strongly Agree**
0	1	2	3	4	5	6	7	8	9	10

12. The changes of new methods helps me to learn better.
    Endringene av nye metoder hjelper meg å læ re bedre.

Strongly Disagree					Neutral					**Strongly Agree**
0	1	2	3	4	5	6	7	8	9	10

13. The use of simulator has reached the maximum potential intensity.
    Bruken av simulator har nådd sitt maksimale potensiale.

Strongly Disagree					Neutral					**Strongly Agree**
0	1	2	3	4	5	6	7	8	9	10

If you have aware the improvement, please RANK top 3 of following factors in sequence by putting numbers in front of each boxes, to indicate which factors have positive influences to your improvement from major to minor.
(e.g. if you think the difference of training methods helps BEST in your improvement, put 1 in the box; the engagement of instructor also help but less than first one, then put 2 in the box,...etc.)

Hvis du føler klar forbedring, vennligst ranger 3 følgende faktorer i sekvens for å indiker hvilke faktorer som hadde positiv innvirkning på din forbedring, fra størst til minst innvirkning. (ved å sette tall i hver boks.)

(f.eks. treningsmetoden som har gitt deg best forbedring, merkes med 1 i boksen. Metoden som har gitt deg nest best forbedring merkes med 2 i boksen.... osv.)

□ The difference of training methods / Endringen i metoder;

□ Commitment of instructor / Engasjementet til instruktøren;

□ Aware of being observed / vite at man blir observert;

□ Repetition of this training / Mengdetrening;

□ Change of team members / Endring av gruppen;

□ Change of training time length and schedule / Endring av treningstid lengde og tidspunkt;

□ Change of e-coach messages and process / Endring av e-coach meldinger og fremgang;

□ Other factor / Andre faktorer: ______________________________

Student Navn:______________________________.

3. Task Analysis of Starting Main Engine

Task analysis of attending own supply from cold ship scenario

Super-ordinate	Operations and Plans	Further Redescription
0	1. Prepare/start Emergency generator (MD78)	Yes
	2. Engage breakers on Emergency Switchboard (MD73)	No
	3. Fill emergence air receiver (MD59)	Yes
	4. Prepare/start aux. sea water system (MD01)	No
	5. Prepare/start LT fresh water system (MD10)	Yes
	6. Prepare/start #1 or #2 diesel alternator, and connect to 440V board (MD75/76)	No
	7. Engage breakers on main switchboard starters and feeders (MD71/72)	No
	8. Check all breakers closed on 220V main and emergency boards (MD72-73)	No
	9. Start fans (MD40)	No
1	1. Prepare for shore connection	Yes
	2. Starting Emergency Generator	Yes
3	1. If no electrical power is available, open discharge valve of hand pump and fill emergency receiver using the hand pump.	No
	2. If the emergency generator is available the emergency compressor can be used	No
	3. Open Emergency Air receiver inlet valve, start the Emergency compressor	No

4	1. Open relevant sea suction valves	No
	2. Open pump outlet and inlet valves	No
	3. Open valves to relevant coolers. Under normal circumstances only one fresh water cooler need be in use	No
	4. Set controller for recirculation valve to auto and 200C	No
	5. Start one sea water pump locally	No
	6. Put one pump in auto mode from pump/compressor control panel (MD102). Normally one pump running one in standby.	No
5	1. During out of service periods or if stopped for a prolonged period during manoeuvre the main engine must always be preheated. Insufficient pre-heating of the main engine before starting may cause misalignment of the main bearings and fresh water leaking.	No
	2. Once steam is available, open the HTFW inlet valve and close the by-pass valve.	No
	1.3 Correct pre-heating temperature is 60 - 65oC.	No
6	1. Preparation	Yes
	2. Starting	Yes
	3. Setting the operation in Auto mode	Yes
1.1	1. Ensure all generators disconnected, emergency bus bar and bus tie disconnected.	No
	2. Connect incoming cable.	No
	3. Check phase rotation, use phase twist if required.	No
	4. Close shore circuit breaker to supply main bus.	No
	5. Close emergency bus if required or starting from cold and continue start sequence.	No

	6. Shore circuit breaker must be tripped before connecting main generator to bus.	No
1.2	1. Ensure battery voltage is correct. MD73.V72691.	No
	2. Generator in manual operation press start.	No
	3. Turn on voltage control and adjust to 440v.	No
	4. Use governor control to give 60Hz output.	No
	5. Connect emergency generator breaker.	No
	6. Trip main bus breaker connection to emergency bus.	No
6.1	1. Check level in the fresh cooling water expansion tank and refill if necessary.	No
	2. Check that the fresh water temperature controller is working and in AUTO – normal set point is 85℃	No
	3. Ensure sea water valve to cooler is open pump, MD01, and sea water flow is normal.	No
	4. Check level in lubricating oil sump tank, (min 40%) - refill from storage tank if necessary	No
	5. Line up lubrication oil system. Normally one filter is in operation and one filter is cleaned and on stand-by.	No
	6. Ensure that lubrication oil valve to the sludge tank is closed.	No
	7. Start the electrically driven lubricating oil pump (prelubrication oil pump), and check that the oil pressure is increasing.	No
	8. Set the electrical lubricating oil pump in AUTO mode by pressing the AUTO button on the PUMP. CTR. panel.	No
	9. Check water level in the fuel oil service tanks and drain if necessary.	No

	10. Ensure that fuel oil supply valves from diesel oil service tank, MD05, and fuel oil system, MD11, to generator engine are open.	No
	11. Open fuel oil inlet valve to fuel oil pump.	No
	12. Open fuel oil valve before fuel oil filters. Normally one filter is in operation and one filter is cleaned and on stand-by.	No
	13. Check the position of the fuel oil supply 3-way valve.	No
	14. Open start air valves, MD59. Start air must be at least 15 bar (218 psi) on the starting air line.	No
	15. If any of the alarm lamps (red) at the local panel are lit, press the RESET button.	No
	16. Start the engine from the local panel by pressing the START button.	No
6.2	1. When the Engine Control panel is in Remote the engine can only be started from the POWER CHIEF panel or Electric Power Plant, MD70.	No
	2. To start locally select local on the Engine Control Panel.	No
	3. Start the Lubricating oil priming pump manually.	No
	4. Press Start.	No
	5. When engine is running, stop Lubricating oil priming pump and set to AUTO.	No
	6. The generator can now be connected to the main bus using the Synchrchroscope panel, MD142, or Electric Power Plant panel, MD70.	No
	7. To use the POWER CHIEF the generator must be switched to Remote.	No

6.3	1. It is normal to have the generators in AUTO, (MD101), and priorities set on shaft and diesel generators so that load sharing is achieved as the control mode dictates.	No
	2. The Turbo generator will always be priority one when running.	No
	3. With generators not in AUTO mode connection can be made from MD70.	No
	4. Before attempting connection check that the generator is ready to run. (MD75, MD76, MD86).	No
	5. The turbo alternator must be running before connection can be attempted.	No
	6. Ensure that voltage control is on.	No
	7. Start required generator by pressing start/stop button.	No
	8. When engine is running adjust voltage control if necessary to match main bus voltage.	No
	9. The breaker can be made by the semi auto sync – select generator and adjust speed until ready light shows, press conn.	No
	10. Manual synchronising can be carried out from the main switchboard (MD140 – MD144).	No
	11. Once connected the generators must be manually balanced by adjusting the governor controls.	No
	12. To disconnect select generator to be stopped, remove load by lowering the governor control, press disc.	No
	13. After disconnection, the generator can be stopped by pressing the start/stop button.	No
	14. The turbo generator must be stopped from MD86	No

4. The e-coach message comparison

Item	Before	After
0	READ THE WHOLE MESSAGE. The Exercise Contains E- Coach messages with instructions to the students. When an E-coach appears it is important to read the whole message! It is highly recommended to keep the message on your screen until the next E-coach has popped up. Move the E-coach around the screen if it is covering objects you plan to operate. You cannot get back to the message if you click OK. GOOD LUCK!	READ THE WHOLE MESSAGE. The Exercise Contains E-Coach messages with instructions to the students. When an E-coach appears it is important to read the whole message! ! It is highly recommended to keep the message on your screen until the next E-coach has popped up. Move the E-coach around the screen if it is covering objects you plan to operate. You CANNOT get back to the message if you click OK. GOOD LUCK!
	1.(Connect emergency generator)	
1.1	Go to MD 78. Emergency Diesel Generator. Confirm sufficient level in the DO day tank and LO sump Tank. Start Em.DG from the Engine Control panel.	Go to MD 78. Emergency Diesel Generator. Confirm sufficient level in the DO day tank and LO sump Tank. Start Em.DG from the Engine Control panel.

1.2	Go to MD 70. Electric Power Plant. Switch on the Voltage Controller for the emergency generator, and check that the Em. Gen frequency is 60 Hz. The Generator Voltage shall be appx. 440V.	Go to MD 70. Electric Power Plant. Switch on the Voltage Controller for the emergency generator, and check that the Em. Gen frequency is 60 Hz. The Generator Voltage shall be appx. 440V.
1.3	Connect Emergency Generator circuit breaker to the Emergency Bus Bar.	Connect Emergency Generator circuit breaker to the Emergency Bus Bar.
1.4	Go to MD 73. The Emergency Switchboard has power. Connect all of the Circuit Breakers for the ship consumers connected to this switchboard.	Go to MD 73. The Emergency Switchboard has power. Connect all of the Circuit Breakers for the ship consumers connected to this switchboard.
1.5	Good! The Emergency switchboard and the critical consumers supported by this have power!	Good! The Emergency switchboard and the critical consumers supported by this have power!
	2. (Line up Emergency Start air compressor system)	
2.1	Go to MD 59. Start Air System. Open the inlet valve V14460 from Emergency Compressor to the Emerg. Start Air Receiver. Start the Air cooled Emergency Air Compressor from the Local Control Panel.	Go to MD 59. Start Air System. Open the inlet valve V14460 from Emergency Compressor to the Emerg. Start Air Receiver. Start the Air cooled Emergency Air Compressor from the Local Control Panel.
2.2	The compressor is now running and filling up the start air bottle. This will take several minutes. Let the Compressor run and open V14462 Emerg. start air Rec. outlet valve.	Filling of the air bottle will take several minutes. Open V14462 Emerg. start air Rec. outlet valve, let the Compressor run.
2.3	Good! The pressure is increasing. Let the compressor run and leave the system, you will need at least 15 bar in the Receiver.	Good! The pressure is increasing. Let the compressor run and leave the system, you will need at least 15 bar in the Receiver.

2.4	The Emergency Air Bottle has more than 28 bar. The Safety valve will blow at 32 bar. Please stop the compressor, you can leave it in local control until other instructions are given.	The Emergency Air Bottle has more than 25 bar. The Safety valve will blow at 32 bar. Please check if you have set the compressor in remote and auto.
	3. (Line up Seawater cooling system)	
3.1	Go to MD 01 and open the V00701 High suction inlet valve.	Go to MD 01, sea water system, and open the V00701 High suction inlet valve.
3.2	Line up SW side on the FW coolers for diesel generator 1 and 2. Open the necessary valves for circulation of the water set the temperature controller to Auto and start the Aux SW pump..	Line up SW side on the FW coolers for diesel generator 1 and 2. Open the necessary valves for SW circulation of the water, set the temperature controller to Auto and start the Aux SW pump.
3.3	Good! The SW Cooling system is lined up.	Good! The SW Cooling system for the generators is lined up.
	4. (Line up LO system DG 1)	4. (Line up LO and FW system DG 1)
4.1	Go to MD 75 Diesel generator 1. Fill up the LO Sump tank to at least 70 %. Line up LO circulation system and start the LO pump in Manual.	Go to MD 75, Diesel generator 1. Switch the electrical PRE heater ON. Set the Heater to AUTO. Temperature setting shall be 75 degC.
4.2	(None)	Fill up the LO Sump tank to at least 70 %. Line up LO circulation system and start the LO pump in Manual. Make sure the LO Pump Control is set to AUTO.
4.3	Good the DG1 LO System is lined up!	Good, the DG1 LO and FW System is lined up!
	5. (Line up DG 1 FO supply)	

5.1	Line up DG 1 FO supply. Go to MD 05. Open valves from Diesel oil Service tank.	Line up DG 1 FO supply. Go to MD 05 Fuel oil service tanks. Open valves from Diesel oil Service tank.
5.2	Go to MD 75 and open valves for circulation through one FO filter and back to DO service tank	Go to MD 75 DG1, and open valves for circulation through one FO filter and back to DO service tank.
5.3	Good the FO system for DG 1 is lined up.	Good, the FO system for DG 1 is lined up.
	6. (Start Diesel generator number 1)	
6.1	Prepare DG 1 For start up. Switch the electrical PRE heater ON. Set the Heater to AUTO. Temperature setting shall be 75 degC	Go to MD 59, Start Air System. Open DG1 Start air supply valve V04515 to DG 1. Then go to MD 75 and start the DG1 from the Local Control Panel. Observe LO pressure, Exhaust temp, FO pressure and cooling water circulation, acknowledge alarms. Go to MD 70, Electric Power Plant. Turn on the Voltage controller (excitation switch) For DG1.
6.2	Make sure the LO Pump Control is set to AUTO.	(None)
6.3	Go to MD 59 Open DG1 Start air supply valve V04515 to DG 1. Then go to MD 75 and start the DG1 from the Local Control Panel.	(None)
6.4	Engine is now running: Observe, LO pressure, Exhaust temp, FO pressure and cooling water circulation, acknowledge alarms. Go to MD 70 and turn on the Voltage controller (excitation switch) For DG1.	(None)

6.5	DG1 is ready to connect. Observe Voltage (440V and Frequency 60 HZ)	Set Diesel Generator 1 to Remote Position (MD 75), DG1 is ready to connect. Observe Voltage (440V and Frequency 60 HZ)
6.6	Set the Emergency Diesel Generator Engine control to AUTO.	(None)
	7. (Connect DG 1 to MSB)	
7.1	Connect DG 1 to Main BUS BAR 1.	Connect DG 1 to Main BUS BAR 1.
7.2	MSB has Power! Connect the Emergency Switchboard to the Main Switchboard. Breaker: X71520. Observe that the breaker for Emergency Diesel Generator is automatically disconnecting. The emergency generator will stop after som time.	MSB has Power! Connect the Main Switchboard to the Emergency Switchboard. Observe that the breaker for Emergency Diesel Generator is automatically disconnecting. The emergency generator will stop after some time if it was set in AUTO.
7.3	Good! The Emergency Switchboard is now fed by the Main Switchboard. Check the alarm summary, acknowledge the activated alarms. Observe DG1 Confirm that LO pressure, Cooling Water, Exhaust gas temp and FO Pressure is OK.	Good! The Emergency Switchboard is now fed by the Main Switchboard. Check the alarm summary, acknowledge the activated alarms. Observe DG1 Confirm that LO pressure, Cooling Water, Exhaust gas temp and FO Pressure is OK.
	8. (SW cooling pump)	
8.1	The Aux. SW Pump must be started again. The Pump stopped during the transfer from Emergency generator to DG1.	The Aux. SW Pump must be started again. The Pump stopped during the transfer from Emergency generator to DG1.
8.2	Good the SW cooling is OK.	Good, the SW cooling is OK.
	9. (Connect breakers on main switchboard)	

9.1	Go To MD 71. Connect all Pump, Fan and Compressor starters.	Go To MD 71, Main Switchboard - Starters. Connect all Pump, Fan and Compressor starters.
9.2	Good. All necessary starters are connected! Connect the feeders and main transformer MD 72.	Connect the feeders and main transformer MD 72.
9.3	Good. All ship consumers have power! Set Diesel Generator 1 to Remote Position. (MD 75)	Good. All ship consumers have power!
	10. (Prepare DG 2)	
10.1	PREPARE DG 2 FOR OPERATION. (MD76) 1: Line up FO system. Take suction from the DO service tank. 2: Fill up LO Sump Tank. Line up for oil circulation, start LO pump manually and put it to Auto 3: Turn ON the electrical Pre-heater and turn it to Auto. 4: Open Start Air valve V04516. (MD 59)	Prepare DG 2 for operation. (MD76) Turn ON the electrical Pre-heater and turn it to Auto. Fill up LO Sump Tank. Line up for oil circulation, start LO pump manually and put it to Auto. Line up FO system. Take suction from the DO service tank. Open Start Air valve V04516. (MD 59, Start Air System) Set Diesel Generator 2 to Remote control from the Local Engine Control Panel.
10.2	All DG2 sub systems are lined up! Set Diesel Generator 2 to Remote control from the Local Engine Control Panel.	Good, All DG2 sub systems are lined up!
10.3	Line up the system before you start pump!	Line up the system before you start pump!

<table>
<tr><td>10.4</td><td>Go to ECR (MD 101) Power Chief Generator Control.
Set DG1 Auto.
DG 2 shal also be in Auto:
Note:
The HTFW on the diesel generators must be at least 50 Deg C. Before it is READY for Automatic Power Management Operation. Observe temperature on MD 76.
Voltage Controller Must be turned ON. (MD 70)
Lube Oil Pump control must be in Auto (MD76)</td><td>Go to ECR (MD 101) Power Chief Generator Control.
Set DG1 and DG2 in Auto with DG1 as priority 1, DG2 as priority 2.

Note:
- The HTFW on the diesel generators must be at least 50 Deg C. Before it is READY for Automatic Power Management Operation.
- Voltage Controller Must be turned ON. (MD 70)
- Lube Oil Pump control must be in Auto (MD76)</td></tr>
<tr><td>10.5</td><td>Good. Power Management System is taking care of the Generator Load !</td><td>Good. Power Management System is taking care of the Generator Load!</td></tr>
<tr><td colspan="3">11. (Ventilation in engine room)</td></tr>
<tr><td>11.1</td><td>Go To MD 40. Start the Fan for Engine Control Room, and the Fan for Cargo Control Room.
Start the Engine Room Supply Fan no.1, Engine Room Exhaust Fan no. 1, Accommodation exhaust Fan no 1, Purifier Room Fan and Sewage Room Fan.</td><td>Go To MD 40, Air Ventilation System. Start following fans:

- Fan for Engine Control Room,
- Fan for Cargo Control Room,
- The Engine Room Supply Fan no.1,
- Engine Room Exhaust Fan no. 1,
- Accommodation exhaust Fan no 1,
- Purifier Room Fan,
- Sewage Room Fan.</td></tr>
<tr><td>11.2</td><td>Good Ventilation is OK.</td><td>Good, Ventilation is OK.</td></tr>
<tr><td colspan="3">12. (Start air compressors)</td></tr>
</table>

12.1	Go to MD59. Set the Emergency Air Compressor to Remote. Then go to the Compressor Control Panel (MD102) and set the Emergency air compressor to AUTO.	(None)
12.2	Line up cooling water to the Start Air Compressors. Go to MD 01, Seawater System. Open seawater inlet valve to one of the FW Coolers.	Line up cooling water to the Start Air Compressors. Go to MD 01, Seawater System. Open seawater inlet valve to one of the FW Coolers.
12.3	Go to MD 59 an open the cooling water inlet (shut off) valves to the start air compressors.	Go to MD 59, Start Air System. Open the cooling water inlet (shut off) valves to the start air compressors.
12.4	Go to MD10. Fill Up the FW Expansion Tank (Start the transfer Pump). Line up FW Circulation Cooling to the Start Air compressors: Open FW valves to the Air Compressors (V01135). Open outlet valve from the selected FW/SW cooler. Open the LTFW cooler Bypass valve (V01125), Open The HTFW resirc. bypass valve (V01113),Set the LT temperature controller to AUTO. Start The Aux FW Pump.	Go to MD 10, Fresh Water System. Fill Up the FW Expansion Tank (Start the transfer Pump). Line up FW Circulation Cooling to the Start Air compressors: - Open FW valves to the Air Compressors (V01135). - Open outlet valve from the selected FW/SW cooler. - Open the LTFW cooler Bypass valve (V01125), - Open The HTFW resirc. bypass valve (V01113), - Set the LT temperature controller to AUTO. - Start The Aux FW Pump.

		Good, the FW cooling to the two Start Air Compressors is lined up.
12.5	The FW cooling to the two Start Air Compressors is lined up. Go To MD 59 and open Start Air receiver 1 inlet valve. (V04460) and make sure that BOTH of the Compressors is set to REMOTE. After this is done: Go to the Pump Compressor Control Panel (MD 102) and set both start air compressors to Auto. Select compressor No 1 to be the MASTER.	Go To MD 59, Start Air System. and open Start Air receiver 1 inlet valve (V04460), make sure that BOTH of the Compressors is set to REMOTE. After this is done: Go to the Pump Compressor Control Panel (MD 102) and set both start air compressors to Auto. Select compressor No 1 to be the MASTER.
12.6	The FW Exp tank is overflowing ! Stop the filling pump!	The FW Exp tank is overflowing! Stop the filling pump!
12.7	Good the Start air compressor system is ready !	Good, the Start air compressor system is ready!
	13. (service air system)	
13.1	Go to MD 60. Open fresh water cooling shut off valve (V04444) And Air valve (V04465) from compressor to the Receiver. Confirm that the compressor is in Remote.	Go to MD 60, Service Air System. Open fresh water cooling shut off valve (V04444) and Air valve (V04464) from compressor to the Receiver. Confirm that the compressor is in Remote.
13.2	Go to Pump Compressor Control panel and set the Service Air Compressor to Auto.	Go to Pump Compressor Control panel and set the Service Air Compressor to Auto.
13.3	Good The Service Air Compressor is Ready	Good, The Service Air Compressor is Ready.
	14. (sea water system)	

14.1	Go to MD 01 SW system. Set SW pump 1 and 2 to remote. Then go to the Pump/compressor control panel MD 102 and start pump 1. Set pump control to Auto.	Go to MD 01 SW system. Set SW pump 1 and 2 to remote. Then go to the Pump/compressor control panel MD 102 and start pump 1. Set pump control to Auto.
14.2	Good SW pumps are in Auto. Go to MD 01 and stop the AUX SW pump.	Go to MD 01 SW System and stop the AUX SW pump.
14.3	Good. The seawater system is ready.	Good. The seawater system is ready.
	15. (stern tube system)	
15.1	Prepare the sterntube system MD 54: Open Cooling the water valves and ensure flow. Refill lubricating oil sump tank to at least 65% . Fill up both gravity tanks to by using the three way valve and one of the pumps in manual	Prepare the sterntube system MD 54: Open the Cooling water valve. Refill lubricating oil sump tank to at least 65% . Fill up both gravity tanks to by using the three way valve and one of the pumps in manual.
15.2	Open the stern tube Seal ring isolation valve V03568 Monitor the LO SW diff pressure. The Low gravity tank shall be in use. Leave the one pump that is started running, set the other pump in Auto. If the running pump is unable to maintain the level in the gravity tank, the stand by pump starts automatically.	Open the stern tube Seal ring isolation valve V03568. Monitor the LO SW diff pressure. The Low gravity tank shall be in use. Leave the one pump that is started running, set the other pump in Auto. If the running pump is unable to maintain the level in the gravity tank, the stand-by pump starts automatically.
15.3	Good the Stern Tube system is OK.	Good, the Stern Tube system is OK.
15.4	The Lowest gravity tank shall be used. Look at your diff pressure.	The Lowest gravity tank shall be used. Look at your diff pressure.
	16. (steering gear)	

16.1	Go to MD 58. Fill up the steering gear oil expantion tank to more than 50% in both of the chambers.	Go to MD 58, Steering Gear System. Fill up the steering gear oil expantion tank to more than 50% in both of the chambers.
16.2	Line up the steering gear system. Open V15817,V15803,V15804,V15818,V15805 and V15806. Then set both pumps to Remote. Confirm that the Rudder control is set to Remote. A test of the steering gear will be performed before departure, this test is normally done in cooporation with Deck officer.	Line up the steering gear system. Open V15817, V15818 from expansion tank, Open V15803, V15804, V15805, V15806 from control valve block. Set both pumps to Remote and auto. Confirm that the Rudder control is set to Remote.
16.3	Good The steering gear is prepared !	Good, the steering gear is prepared! A test of the steering gear will be performed before departure, this test is normally done in cooporation with Deck officer.
	17. (Fuel oil system)	

17.1	Line Up FO supply System: Go to MD 05 Open valve V00366 DO from service tank. Go to MD11 and open valves for FO heater, FO Back flush filter and the main shut-off valve. Confirm that the V00077 Three way valve is open from DO service tank. Confirm that the V00120 FO Return Three way valve is set to mixing tank. (VENTBOX) Start one FO supply and one FO Crirculation pump.	Line Up FO supply System: Go to MD05, FO Service Tanks. Open valve V00366 DO from service tank. Go to MD11, FO System, and open valves for: - FO heater, - FO Back flush filter - the main shut-off valve. Confirm: - the V00077 Three way valve is open from DO service tank. - the V00120 FO Return Three way valve is set to mixing tank. (VENTBOX)
17.2	Good. Set the FO pumps to remote and auto on MD102.	Start one FO supply and one FO Crirculation pump. Set the FO pumps to remote and auto on MD102 Power Chief Control.
17.3	Good. Fuel Oil System Ready!	Good. Fuel Oil System Ready!
	18. (Lube oil system)	

18.1	Go to MD12 and line up LO system. Open valve for LO cooler number 1 and open lube oil cooler bypass valve. Open valve for backflush filter and main bearing. Open valve for camshaft LO filter.	Go to MD12, ME LO System. Line up LO system. Open following valves for: - LO cooler number 1 and LO cooler bypass. - Backflush filter and main bearing. - Camshaft LO filter.
18.2	Set main LO temp controller to auto. Make up cylinder LO day tank to 0.7 meter. Make up LO sump tank to 0.8 meter. Start the Main LO Pump and observe the flow. Open camshaft LO make up valve and fill the camshaft LO tank to 0.7 meter.	Set main LO temp controller to auto. Make up cylinder LO day tank to 0.7 meter. Make up LO sump tank to 0.8 meter. Start the Main LO Pump and observe the flow. Open camshaft LO make-up valve and fill the camshaft LO tank to 0.7 meter.
18.3	Start camshaft LO pump number 1. Set all pumps to remote and go to MD102 and set to auto.	Start camshaft LO pump number 1. Set all pumps to remote and go to Pump/compressor control panel MD 102 and set them to auto.
18.4	Good. LO system is now ready.	Good. LO system is now ready.
	19. (Prepare start of ME)	

19.1	Go to MD10 fresh water system. Open Valve to ME LO camshaft cooler, ME LO Cooler no. 1, ME air 1, ME air 2, HTFW ME preheater bypass, HTFW inlet ME, HTFW outlet ME and HTFW vent. Open HTFW fresh water generator bypass valve to 100%. Set HTFW temp controller to AUTO. Start LTFW pump 1 and stop LTFW aux pump. Start HTFW pump 1. Set all pumps to remote and go to MD102 and set to auto.	Go to MD10, fresh water system. Open following LTFW valves: - ME LO camshaft cooler - ME LO Cooler no. 1 - ME air 1 - ME air 2 Start LTFW pump 1 and stop LTFW aux pump. Open following HTFW valves: - HTFW ME preheater bypass - HTFW inlet ME - HTFW outlet ME - HTFW vent Set HTFW fresh water generator bypass valve to 100%. Set HTFW temp controller to AUTO. Start HTFW pump 1. Set all LTFW and HTFW pumps to remote and go to MD102 and set to auto.

19.2	Go to MD18 ME manouvering system. Open valve for: Start air distribution block valve. Safety air block valve Start air block valve.	Go to MD18 ME Manouvering System. Open valves for: - Start air distribution block valve. - Safety air block valve - Start air block valve.
19.3	Go to MD59 start air system and open start air receiver 1 outlet valve and ME start air supply valve.	Go to MD59, start air system, and open: - Start air receiver 1 outlet valve - ME start air supply valve
19.4	Go to MD60 service air system. Open service air receiver outlet valve and general control air supply valve.	Go to MD60, service air system, open: - service air receiver outlet valve - general control air supply valve.
	(None)	Go to MD 21-25 ME Cylinders, Open indicator cock for each cylinder.
19.5	Go to MD20 ME local control. Set auxillary blowers to auto. Transfer the control to the control room by pressing local on the responsibility transfer panel.	Go to MD20 ME local control. Transfer the main engine control to the engine control room, by operating main engine control panel.
	(None)	Set ME AUX BLOWERS to auto. Observe the Scav. Air Rec pressure increase. In cooperation with the operator, turn ME with open indicator cocks. Using Slow Turn function, or throttle to 40 briefly; then back to zero. Operator to observe the indicator valves.

	(None)	Go to MD 21-25 ME Cylinders, Close indicator cock for each cylinder.
	(None)	Good, the main engine is now ready to be started! Call the bridge to ask for the approval. Note! The engine is cold; Preheating of engine before start up is normal practice. This is not considered in this exercise.....
19.6	Go to MD97 forward mooring winches and remove ship moored condition by pressing the button.	(None)
19.7	Go to MD102 and set Steering Gear to Auto.	(None)
	20. (Full ahead)	20. (Start of ME)
	(None)	When approval is granted: Set throttle to 40%, ME will start.
20.1	Go to MD110 and select Bridge Control. Acknowledge the transfer from MD104.	Good, the main engine is started! Keep in mind, the vessel is still moored (MD97 FWD Mooring Winches). Maintain Engine Room Pressure by starting air fans. When ME parameters are within acceptable, the control is normally set to bridge.

20.2	The main engine is now ready to be started! Note! The engine is cold; Preheating of engine before start up is normal practice. This is not considered in this exercise..... Set control lever to 100% from bridge. Thermal Load Program and Load Limits will make sure that the ME will run up according to the manufacture's specification.	(None)
20.3	ME are now running and will continue untill it will reach 74 RPM. Observe any alarms. Maintain Engine Room Pressure by starting air fans.	(None)
		21. (Bon Voyage)
		Normally the following tasks will done in cooperation of bridge, before raising up the speed, Go to MD97 forward mooring winches and remove ship moored condition.
		Set control lever to 100%. Note! At this point the vessel is closed to shore or in harbor, full speed ahead might be dangerous. However, this is only for your practice. Thermal Load Program and Load Limits will make sure that the ME will run up according to the manufacture's specification.

21	Bon Voyage! The pre programmed E-Coach guidance stops here. Ask your instructor for further action. If no Instructor is present you may stop the exercise. (Save your assessment)	Bon Voyage! The pre programmed E-Coach guidance stops here. Further the focus would be: to get boiler, separators, evaporators etc. running. Ask your instructor for further action. If no Instructor is present, you may stop the exercise. (Save your assessment)