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Engine Room Simulators
Симулатори на машинното отделение

ONLINE AND REMOTE TRAINING EXPERIENCE IN THE ENGINE ROOM SIMULATOR TRAINING COURSES USING THE IMO MODEL COURSE 2.07 EXERCISES

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Abstract. In the age of technology, changes are experienced in many areas such as globalization, information society, new basic technology, the spread of the Internet, and the realization of competition on a global scale. New methods used in education and training have been developed and kept up with technological developments. With the widespread use of the Internet, online and remote training has become more possible than ever. Technology was ready for online education and training for the past decades, yet the COVID-19 pandemic caused the traditional training to be disrupted and training institutions had to carry out studies for traditional training to be conducted online and remotely. This caused a paradigm change in the training methods. Online or remote education, even in training using the engine room simulator (ERS), has become more popular as an alternative to traditional classroom teachings, even though the pandemic is disappearing. Additionally, the progress in autonomous ships and recent regulatory studies indicates the importance of a better understanding of the engineering data in remote or autonomous ship operations. The authors have been offering Engine Room Simulator (ERS) training courses using online methods since the first semester of 2020, totaling six semesters of online training so far. This paper presents the online training process used in courses including the technological setup and method of teaching and assessment. Experiences and lessons learned by the lecturers in providing operational and management level ERS courses and feedback from students are examined and presented. The use of IMO Model Course 2017 Edition became helpful as it describes exercises for each training objective in accordance with IMO STCW 2010. An Engine Room Simulator (ERS) called Ship ERS or SERS™ was utilized as the remote training tool in the pilot implementation of these courses that were spread over two semesters. The advantages and disadvantages of online ERS training was presented and discussed. A particular and interesting observation has been that the students could have longer duration of exercise opportunities when using SERS™ in the remote training than in traditional ones.

Keywords: engine room simulator; online training; maritime education; remote

1. Introduction

The use of engine room simulators in maritime training has been mandatory since the publication of the Standards of Training, Certification and Watchkeeping for Seafarers (STCW) (International Maritime Organization 1995) in 1995. Since this date, institutions and organizations providing maritime training in the world have started to use engine room simulators in their trainings in order to gain the operational and management competencies specified in IMO STCW, and they continue to be widely used (Al-Sharyoufi 1996; Cicek 2003) with the 2010 version of STCW – IMO (2010).

The main reasons for using the Engine Room Simulator (ERS) in maritime education and training are the real machinery and laboratory setup costs, the very high prices of equipment and systems in the engine room of training ships, the difficulty of operating these systems in a training institution, and the safe conduct of training or research (Stetsenko 2017; Cicek 2003). The main purpose of all simulators is to simulate the machines and systems in the Ship Engine Room as realistically as possible and to use them efficiently in training. The advantages of using simulators over the use of the other training methods, such as training ships, internships or laboratories, are as follows:

- Low operating cost
- Effectiveness of preparation time spent on training
- Flexibility of curriculum planning
- Controlled syllabus and course planning
- Standardization of student training and assessment with scenarios
- Repetitive trainings with scenarios of “high risk” events

With these advantages, the simulator-based training gives students the opportunity to learn, try out, and interact with a variety of realistic situations that can be dangerous or expensive to recreate in real life. This statement is the most important reason why the use of simulators is preferred by educators. Along with the afore-mentioned benefits, the use of simulators made the education standardized in the undergraduate education programs, regardless of the educator. In addition to these advantages, we also have some rapidly changing sector dynamics that increase the interest in training with the engine room simulator in the maritime sector. These are listed below with the main headings and each is explained below with a subheading:

• Interest in education with rapidly changing technology and MDS
• Education obligation with MDS
• Growth in the industry
• Increase in maritime accidents
• High rate of human factor in maritime accidents

There is substantial and increasing academic research on ERS education. Zaini (2020) demonstrated the effectiveness of MDS as a learning tool in maritime education and training; Chybowski et al. (2015) gave examples of using MDS as a tool for explosion and fire protection training; Kojima et al. (2017) developed ERS scenarios for engine room resource management training, and Kluj, S. (2017) presented the concepts of creating environmental awareness training with a simulator in ERS training. Besides the fact that ERS training is mandatory under international agreements, a wide variety of publications attest to the global acceptance of the use of MDS in maritime education and training. The innovations brought by the constantly developing technology are also observed in the maritime sector. The maritime sector, which is an interdisciplinary sector, enables the technological developments in question to be integrated into education more quickly. For this reason, engine room simulators are widely used so that engineers working on ships as well as undergraduate students can experience engine room operations such as routine, emergency and critical ship operations and gain competence in these areas. Companies such as Chevron have supplied simulator systems in which the systems on their ships are fully included[1].

The increasing trend in the demand and supply of ship crew is valid for all port-states of the world. The main reason for this increase is the increase in the role of

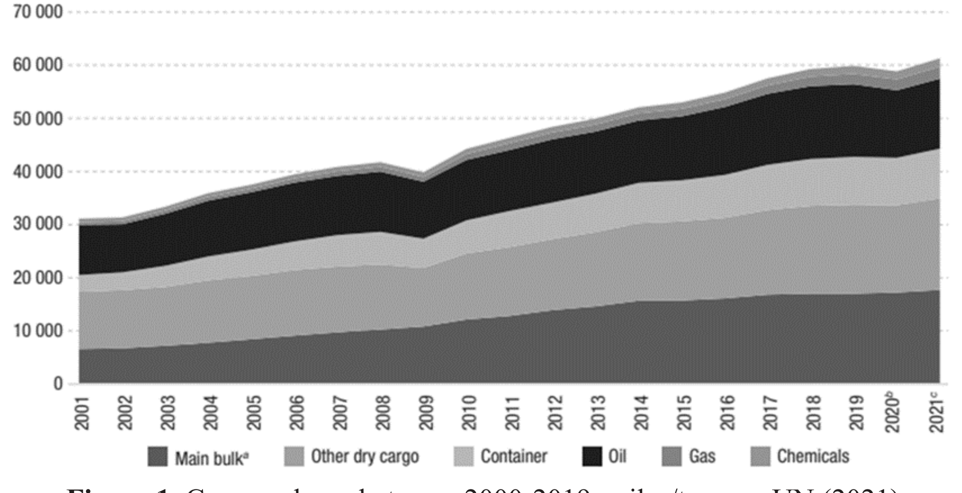


Figure 1. Cargo volume between 2000-2019, miles/tonne – UN (2021)

maritime transport in global trade. According to the data of the United Nations Conference on Trade and Development (UNCTAD), while 30,000 million tons of cargo was transported per mile in 2001, this figure increased to over 60,000 million in 2021 – UN. The amount of cargo and cargo ships transported in tons per mile between 2001 and 2021 are shown in ***Figure 1***.

It has been shown by different studies in the literature that the rate of maritime accidents in the world caused by human error is 80% or more. Uğurlu and Çiçek (Ugurlu & Cicek 2022), in their research and root cause mapping study by examining 513 separate maritime accidents involving conflict since 1977, showed that the root cause of these accidents was human error at a rate of 94.7%. Considering that the increasing number of maritime accidents are caused by human beings, every effort to improve maritime education and new training modules to be developed will contribute significantly to world maritime safety, maritime environmental security and world trade.

Maritime education institutions make it mandatory for students to take "Engine Room Simulator" courses as part of the ship machinery management engineering curriculum. These institutions provide engine room simulators based on their budget and requirements. Data from the International Maritime Organization indicates that most accidents at sea, including loss of life and property damage, are due to unskilled labor. One of the primary reasons for this is the inadequate training standards for ship officers and personnel. To address this issue, the IMO STCW 2010 provides its final form. STCW includes rules that maritime education institutions must follow, including detailed guidelines for training with simulators. These schools prioritize simulators certified by internationally recognized classification societies to comply with international maritime rules. The results of academic studies validate the purpose of these regulations. For example, Mangga at al. (2021) reported that the success rate of students increased significantly, by conducting pre- and post-education performance evaluation studies using the ERS.

2. Training methodology

2.1 Traditional ERS Training

Engine room simulators are used in training given at two different levels, "Operational" and "Management", in accordance with international standards. In the operational level training, the responsibilities of the 4^{th}, 3^{rd}, and 2^{nd} Engineers on board the ship such as the preparation and lining up the systems in the ship's engine room and the observation of the parameters of the systems are handled, and can be practiced on the simulator. In management level training, the responsibilities of the 2^{nd} Engineer and Chief Engineer on board ships, such as the management of the ship's engine room, the efficient operation of the systems, the determination of what needs to be done in case of any malfunction, and the elimination of the malfunction in the shortest and safest way, are handled and practiced on the simulator.

As an example of how operational and management level ERS courses are provided in training curricula, Istanbul Technical University (ITU) Maritime Faculty (ITUMF) curricula are provided in ***Table 1*** at ITUMF, the ERS training courses are provided in two different semesters; one before and another one after the internship. The ERS I is 4 and ERS II is 5 credit hours training courses with the objectives and outcomes described for both ERS I and II are shown in ***Table 1***.

Table 1. ITUMF ERS I and II training courses: Objectives and outcomes

Training Course	Objectives	Outcomes
ERS I	1) To conduct practice on the main engine, auxiliaries, and other systems by using Engine Room Simulator. 2) To get skills on maneuvering, watchkeeping, duties, and operation of engine room systems.	1) Learn preparation of Diesel Generators (DG) and Marine Boiler 2) Learn preparation of Main Engine (ME) and related systems 3) Learn about duties on watchkeeping and navigation 4) Learn about watchkeeping and to remedy malfunction
ERS II	1) To teach detecting and remedying troubles in the engine room 2) To teach efficient operation 3) To teach about the management of engine crew in case of emergencies.	1) Learn about troubleshooting during generator preparation 2) Learn about troubleshooting during main engine preparation 3) Learn about troubleshooting during maneuvers 4) Learn about troubleshooting during navigation 5) Learn about efficient operations 6) Get skills on correct communication and management in case of emergencies

Table 2 shows a typical 4-year marine engineering education and training license program. The authors, in this table, indicated the courses where the ERS could be useful with various purposes. For example, a Class A type ERS is the main [**M**] training method in the ERS I course in the third semester and ERS can be used as a familiarization [**F**] tool, a demonstration [**D**] environment, or a special exercise equipment [**S**], depending on the purpose of the classroom teaching topics. The authors used the engine room simulator as the environment for the design projects [**P**], for investigation and simulator development, and found it a useful method. In some courses, CBT type [**C**] ERS may also be used and it may be a very effective method.

Table 2. The use of ERS types in marine engineering courses

Year	Fall Semester	Spring Semester
1st	Introduction to Marine Engineering and Ethics [**F**]	Maritime English I [**F**]
2nd	Marine Auxiliary Machinery [**C**]	Thermodynamics [**S**] Hydraulic-Pneumatics [**C**] Marine Diesel Engines I [**S**] Marine Electrotechnics [**D**]
3rd	Automatic Control Systems [**D**] Operation & Maintenance of Marine Diesel Engines [**F**] Marine Diesel Engines II [**S**] Marine Boilers and Operations [**S**] Heat Transfer [**S**] Engine Room Simulator (ERS) I **(M)**	Long Term Sea Training
4th	Marine Auxiliary Machinery II [**C,D**] Marine Electrotechnics [**D**] Marine Engineering Design I [**P**] Marine Diesel Engines III [**S**] Operation of Steam & Gas Turbines [**S**] Maritime English II [**F**] Refrigeration and HVAC Systems [**S**]	Marine Engineering Design II [**P**] Engine Room Simulator (ERS) II [**M**] Deck Machinery [**F**] Maritime English III [**F**] Design Project [**P**]

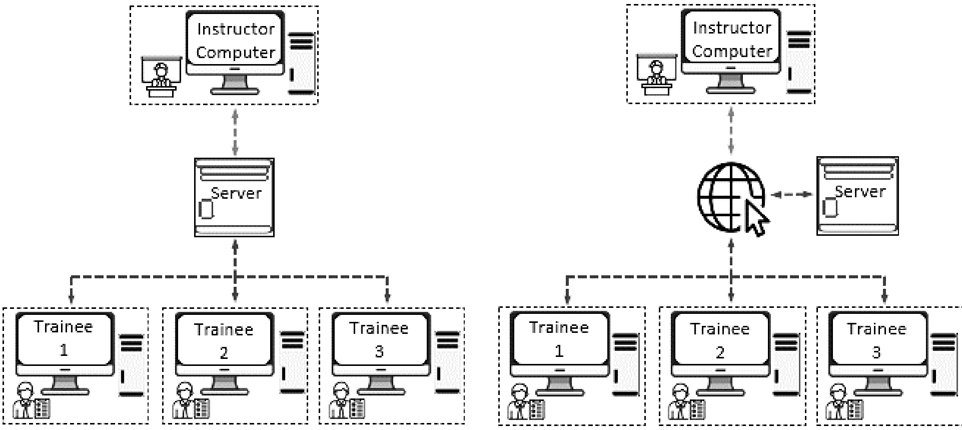
[**M**] Main training method, [**F**] Familiarization, [**C**] Computer-based Training, [**S**] Special Exercise/Training tool, [**D**] Demonstration Purpose, [**P**] Project Application

2.2. Online and Remote ERS Training

To ensure the success of online training, designing the training correctly is crucial. This involves creating a structure that aligns with international standards and pedagogical principles, considering elements such as mode of delivery, individual vs. teamwork, assessment methods, and feedback evaluation.

The SERS™ has been employed alongside training solutions that meet the requirements of the remote training, in line with predetermined objectives. It updates traditional training with modern needs, providing benefits in terms of time and space. The simulator offers two levels of education, ERS-I and ERS-II, at the operational and management levels, respectively.

Figure 2a shows an example of the use of ERS in a classical laboratory configuration with three students and an instructor and ***Figure 2b*** shows an equivalent configuration for conducting a remote ERS training.



(a) (b)

Figure 2. ERS training: a) classical or in-class, and b) online configuration

IMO Model Course 2.07 exercises are essential for effective training and should be integrated into the curriculum. In remote training, conducting these exercises on the simulator is particularly important. Trainers can define simulator exercises and create scenarios in accordance with Model Course 2.07 definitions, providing students with interactive and objective work using pre-prepared forms. The author has developed exercises based on Model Course 2.07, which are listed in ***Table 3***.

Table 3. ERS-I and ERS-II Exercises in accordance with IMO Model Course 2.07

Exercise Topic	Specific Exercise Name
1) Familiarization	1.1) Understanding System Components: Valves
	1.2) Understanding Systems Components: Pipe Lines
	1.3) Familiarity with the Seawater Cooling System
	1.4) Familiarity with Control Equipment and Systems
2) Preparation and Commissioning of Systems: Electrical Systems and Connections	2.1) Shore Power Connection
	2.2) Emergency Generator
	2.3) Power-up Emergency Systems
	2.4) Start the Diesel Generator 1
	2.5) Start the Diesel Generator 2
	2.6) Connecting Diesel Generator 1 to the Main Busbar
	2.7) Synchronization of Diesel Generators 1 and 2

Exercise Topic	Specific Exercise Name
3) Preparation of the Main Engine	3.1) Seawater Cooling System
	3.2) Fresh Water Tanks and Hydrophone System
	3.3) Fresh Water-Cooling System
	3.4) Compressed Air System
	3.5) Boiler and Steam System
	3.6) Main Engine Preheating
	3.7) Main Engine Lubrication System
	3.8) Stern Tube
	3.9) Steering Gear System
	3.10) Main Engine Fuel System
4) Maneuver Preparations	4.1) Start the Diesel Generator-3
	4.2) Line-Up the High Voltage System
	4.3) Main Engine Slow Turn
	4.4) Main Engine Start from Local Control Panel
	4.5) Pump and Compressor Operations
5) Maneuver	5.1) Main Engine Control Room Operations and Maneuvering
	5.2) Bow Thruster Operations
6) Preparation to Navigation-I: Basic Operations	6.1) Start-up the Economizer
	6.2) Start-up the Separators
	6.3) Change Over Procedure
7) Preparation to Navigation-II: Energy Management Operations	7.1) Start up the Fresh Water Generator
	7.2) Start up the Shaft Generator
	7.3) Electricity Consumption and Efficiency
8) Switching to Navigation-III	8.1) Exhaust Gas Emissions Reduction Systems
	8.2) Bilge Separator
	8.3) Ballast Operations
	8.4) Ballast Water Treatment Systems
9) Watchkeeping	9.1) Checking the Journal Records
	9.2) Keeping Journal Records
	9.3) Watchkeeping handover

Operation and management level exercises to be prepared based on the IMO Model Course 2.07 allow students to perform direct operations with the simulator, perform engine room resource management, and thus increase training efficiency and effectiveness, and provide more equipped and competent participation on the ship. In addition to the operation level exercises mentioned above, management level exercises have also been developed and workbooks have been created for both level exercises.

3. Implementation of remote training

The ERS training given to students conventionally had to be adapted to a remote training due to the COVID-19 pandemic in the early part of 2020. During the remote training, synchronous learning was utilized, which is a real-time online learning method that allows for immediate communication and interaction between instructors and students (Renganayagalu 2022). Three ERS-I and three ERS-II semester courses, totaling six, were conducted using ITU Ninova, the electronic learning platform of Istanbul Technical University. The remote training involved online lessons using ZOOM and a remote laboratory was established for students to access outside of class hours, using the engine room simulator provided by GDS Engineering R&D, Inc. Weekly assignments were completed using the simulator with a designated student number and password, and grades were assessed based on various criteria including automatic and application training reports developed by the student.

The diagram of the remote training setup at ITUMF is presented in ***Figure 3**,* which was utilized to deliver remote instruction for ERS-I and ERS-II courses. ERS called Ship Engine Room Simulator (SERS™) developed by GDS Engineering R&D, Inc. was used in the last 3 years of remote ERS training courses of both ERS and II.

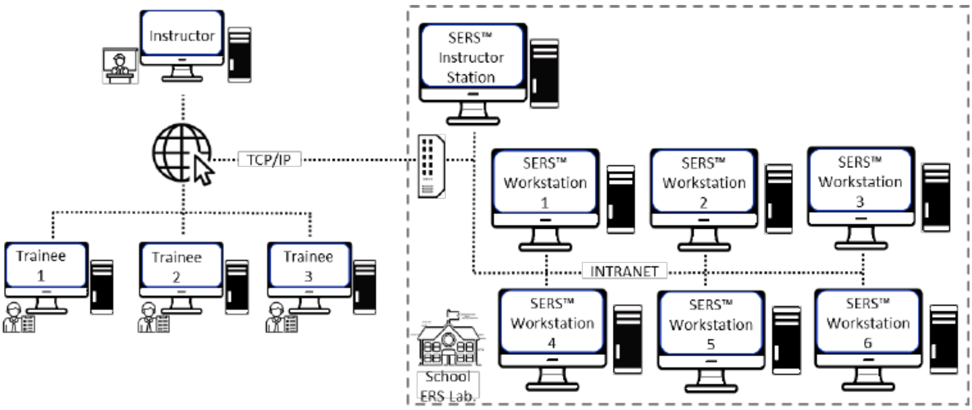


Figure 3. ERS remote training configuration – example shown for three student workstations and 1 instructor, training provided using the GDS SERS™

3.1 Implementation of Remote ERS-I Training Course

In the ERS-I course, which spans 14 weeks, the primary objective is to acquaint students with the engine room systems, allow them to follow the system circuit on the simulator, and line the systems, and monitor the system's parameters. By the end of the semester, students should be capable of lining up and operating all the required systems. The sample video demonstrates lining up operations of the boiler and other systems initiated with the emergency generator[2]. They should also be able to monitor system parameters and identify the root causes of any malfunctions in the systems while taking corrective measures.

To fulfill the requirements of the IMO STCW 2010, a series of exercises have been created based on the sample exercises outlined in the IMO Model Course 2.07. These exercises are designed to meet students with the necessary operational level skills. Students have access to the remote laboratory where they can individually perform these exercises on the simulator and submit reports. The exercises given in the ERS-I course are described in ***Table 3***.

3.2 Implementation of Remote ERS-II Training Course

In the ERS-II course, which spans over 14 weeks, the main objective is to enable students to manage engine room resources safely and efficiently in groups of 4 – 5 people. The students are grouped into teams and take up roles such as chief engineer, 2nd engineer, 3rd engineer, and electrician to experience the operation of engine room systems using the simulator. Additionally, decision-making skills are enhanced by analyzing engine room system parameters. Students are expected to take appropriate actions based on their decisions. Ultimately, the ERS-II course aims to meet with the capability to manage engine room resources in a safe and efficient manner.

To fulfill the requirements of the IMO STCW 2010, a series of exercises have been created, based on the sample exercises outlined in the IMO Model Course 2.07. These exercises are designed to provide students with the necessary management level skills. An example exercise with the effects of weather changes on main engine parameters is demonstrated in an example online video provided by a student lecturer[3]. The designated group has access to the remote laboratory where they can perform these exercises on the simulator and submit reports. The exercises given in the ERS-II course are described in ***Table 3***. In addition to or to support the IMO Model Course exercises, the authors developed ten different scenario exercises that students can work on as homework projects remotely using the online SERS™, i.e., examples are summarized in a list as following:

- Operation and Management of Main Engine (ME) Systems with Scenarios
- Electrical Load Control with DG Control Operations
- Effect of Draft Changes on ME Performance Parameters
- Effect of Different Weather Conditions on ME Performance Parameters[3]
- Various Malfunction Scenarios associated with ME, DGs, and other Machinery
- Event Scenarios in Engine Room Systems (Oil Mist, Fire in Economizer, Pump Wear)
- Event Scenarios in Electrical Systems (Electrical Circuitry Shorts or Current Leakages)
- Energy (Heat-Balance) Equation and Efficiency.

4. Survey on the Remote ERS Training Experience

The authors prepared an online survey questionnaire using the Istanbul Technical University (ITU) survey forms system called VETI, which stands for Data Collection and Statistical System. Table 4 shows the information about the conducted surveys during the last three years of training.

Table 4. The information of the conducted surveys

Semester & Year	Course Name	Course Dates	Date of Survey	Number of Students
Fall – 2020	ERS I	Sep – Dec 2020	18 January 2021	32
Fall – 2021	ERS I	Sep – Dec 2021	3 January 2022	16
Fall – 2022	ERS I	Sep – Dec 2022	25 January 2023	20
Spring – 2020	ERS II	Feb – July 2020	25 July 2020	14
Spring – 2021	ERS II	Feb – June 2021	25 June 2021	42
Spring – 2022	ERS II	Feb – June 2022	20 June 2022	20

In order to use the survey results for statistically combining and analyzing, the same questionnaire was kept in all surveys. The responses provided to the trainees were all kept the same for all survey statements, as the following: 1: Strongly Agree, 2: Agree, 3. Neutral, 4: Disagree, 5. Strongly Disagree.

Table 5. The information of the conducted surveys

Survey Questions of Remote Training	
Q1	The instructor used the lecture times effectively.
Q2	The instructor provided enough information and answered questions satisfactorily.
Q3	The training materials (presentations, videos, applications, etc.) were sufficient to understand the lesson.
Q4	Enough time was given for practicing using the simulator.
Q5	I participated in the online teachings with questions or comments (via chat or microphone).
Q6	I watched the online videos of the lectures after the lesson was remotely held.
Q7	I gained knowledge about ship engine room systems and operations at the end of the course.
Q8	Exercise practices using the online version of the simulator satisfied the objectives of this training course.
Q9	Remote/Online training was more efficient in comparison with classroom training.
Q10	If this course is given again, I would prefer online/remote training, considering the training methodology and efficiency.

Figure 4 shows the results of the conducted remote ERS-I training. In general, student responses were highly positive. The most interesting result of these surveys is probably the fact that the students provided highly positive responses when comparing the effectiveness of the remote training against the in-lab ones. This was especially more obvious in the first semesters of the remote training courses in 2020. Statements 8 and 10 reflect consistent results at all semesters. This could probably be due to the abrupt change of training in March of 2020, the GDS SERS™ was ready for use remotely and students did not waste time[4]. The students could continue the ERS courses while many other courses and methods of remote teaching were not in place. There was a slight decrease in the positive responses to these and similar statements, probably due to the physiological effect of the pandemic stages in time and the effect of students being away from the school environment for such a long time.

Similar results are shown for both ERS-I and -II remote training courses when the results for question number 10 is visited. Responses for Question 5 were less positive when compared to other responses. This shows a relatively smaller number of students participating in the interactions with the instructor. It would be of good interest to compare the results of this against the surveys when the training is provided in the ERS lab in the future.

Another important observation of remote training is that the use of SERS™ gives the opportunity of using of the simulator to students at all times when they are available. The instructors made both group and individual scheduling such that the simulator is utilized at all days and times of the week. This especially made the students find the remote ERS training highly valuable and probably affected the survey results being positive.

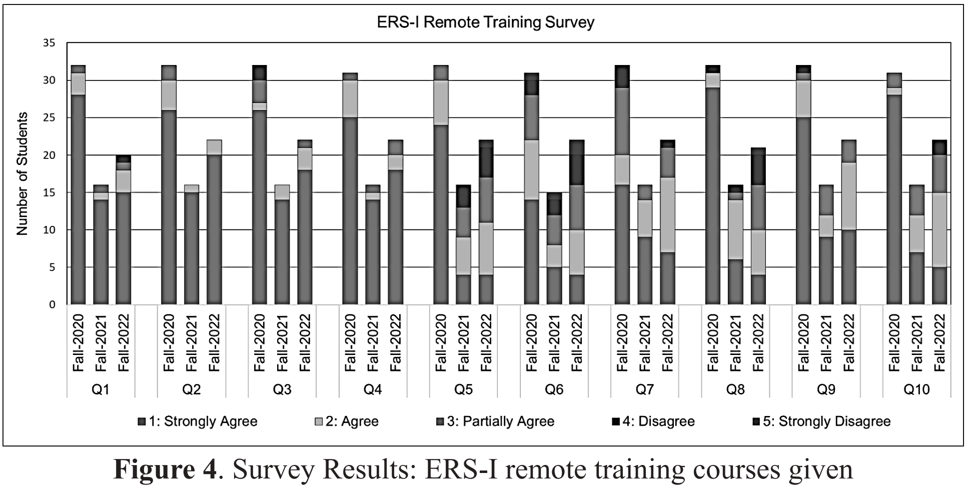


Figure 4. Survey Results: ERS-I remote training courses given in the last three years

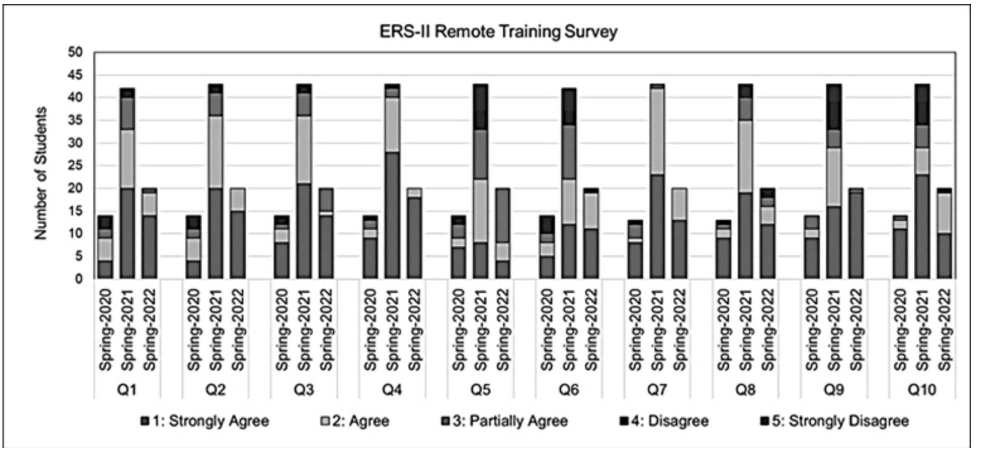


Figure 5. Survey Results: ERS-II remote training courses given in the last three years

5. Assessment

There are many assessment methods traditionally used in ERS training courses. Probably the most important one is the "Objective Assessment" where the trainees are given specific objectives and tasks and the simulator monitors and gives points using the predetermined assessment setup parameters. ***Figure 6a*** depicts the current assessment methods that can be used with the GDS SERS™ and it is demonstrated in a youtube video[1]. The objective assessment, recording and monitoring of the trainee actions, using briefing data, inspecting the electronic training records are other tools for the means of assessment. Assessment is probably the most difficult part of remote training. ***Figure 6b*** shows potential assessment methods that can be used with online training. Because the pandemic arrived abruptly, most institutions had difficulty in providing training to and assessing the trainees. The authors performed the assessment by a) using the workbook exercises, b) inspecting the trainee records, c) conducting online trainee briefings. The workbook exercises were established to make the training productive during the pandemic times; however, then it was found to be very useful during the normal schedules. Cicek (2017) carried out a detailed study on the use of an objective assessment method and demonstrated the application of scoring in practical training, with the application of analytical hierarchy process and simple additive weight methods. By transferring this method, which was numerically formulated by Cicek (2017), to a simulator software with online tools, the assessment would be objective and would record the students' understanding levels numerically. An example demonstration for the objective assessment is provided by GDS (2023)[5].

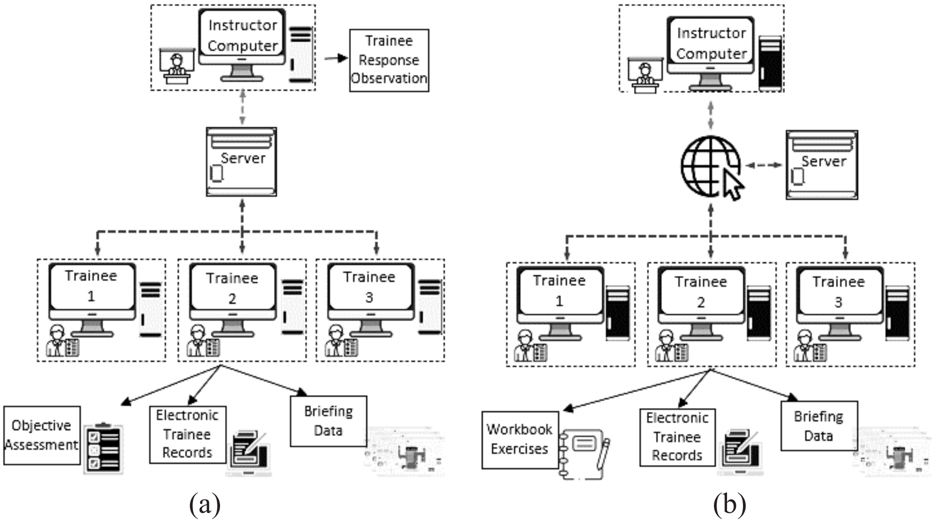


Figure 6. Assessment methodology for a) in-lab, b) online training

Conclusions and Summary

Simulator use is very important in maritime training for both the candidates who will work in the ship's engine room and engineers already working onboard ships. Including the changes in the education and training methodologies, innovative approaches are required in how we design and provide the engine room training using simulators. Having the pandemic and then a big earthquake in the region, the authors of this paper faced the challenge of providing ERS training remotely. Perhaps, this became an obligation for conducting the remote training while the perception of learning is also changing in the new generation. Due to the changes in the education and training perspectives, authors understand that the remote training option will always be considered in future training courses. When the methodology and training setup are correctly lined up, remote training will probably be exercised more often than ever. This study compared the conventional in-lab training of the ERS against the remote version practiced by the authors. However, the authors did not compare the online ERS training courses against the training courses provided in a distributed training configuration in a physical environment, where the reality is increased usually in a training setup with sounds, audio and visual indicators, and physical control knobs and indicators.

A future study by the authors or other academicians is the applicability of the remote training for satisfying the objectives of all STCW competencies. Maybe, this could be realized through another survey between the ERS trainers of IMLA participants.

Objective assessment will probably be the area that the progress is expected the most in the online tools for providing the remote ERS training. The simulators are developed as a formal way of representing the digital twin of ship's engine rooms; however, the new generation is learning much differently than most of us, the academicians, nowadays. For this reason, more elaborated pedagogical studies and surveys are needed for defining the new aspects of ERS and assessment methods.

It would be a good practice to standardize the objective assessment methods between the simulators and training curricula. The authors are working towards a proposal for maritime institutions and simulator developers to provide and use objective assessment tools that can be exchanged between the maritime institutions.

The effectiveness of a remote ERS training highly depends on the availability of the online tools. For example, availability of tools for lecturing, supporting the training exercises accomplished by each trainee and with a group work, and assessment functions and recording. An important observation made by the authors during the first stage of the pandemic is that some of the other laboratory courses could not be provided to students and those had to be repeated. Another important observation of remote training is that the use of SERS™ gives more time usage opportunities to students. In a conventional setting however, a lab could only be designated at certain hours.

NOTES

1. FONSECA, Joseph R. Maritime Logistics Professional Website. 2016-03-14. GTT Training Bags G-Sim Order from L-3 DPA, Chevron. Available from: https://www.maritimeprofessional.com/news/training-bags-gsim-order-from-286535. [Viewed 2022-12-04].
2. GDS ENGINEERING R&D, INC. [GDS YouTube Channel]. Engine Room Operations: From Cold Ship to Boiler Operations. YouTube Video. Available from: https://youtu.be/9y9LroLMKvk. [Viewed 2023-04-28].
3. GDS ENGINEERING R&D, INC. [GDS YouTube Channel]. Exercise with ERS, Weather Change and ME: Marine Engineering Education and Training Using GDS SERS™. YouTube Video. Available from: https://youtu.be/9y9LroLMKvk. [Viewed 2023-04-28].
4. GDS ENGINEERING R&D, INC. [GDS YouTube Channel], *Full Mission Engine Room* Simulator: GDS Ship Engine Room Simulator, SERS™. YouTube Video. Available from: https://www.globaldynamicsystems.com/training-simulators/engineroomsimulator/. [Viewed 2023-04-28].
5. GDS ENGINEERING R&D, INC. [GDS YouTube Channel]. GDS Ship Engine Room Simulator (SERS™) Assessment Module - 1. YouTube Video. Available from: https://youtu.be/OEJAVa_LON4. [Viewed 2023-04-28].
6. INTERNATIONAL MARITIME ORGANIZATION (IMO). International Convention on Standards of Training, Certification and Watchkeeping for

Seafarers (STCW). IMO Publications. Adoption: 7 July 1978; Entry into force: 28 April 1984; Major revisions in 1995 and 2010.
7. INTERNATIONAL MARITIME ORGANIZATION (IMO), 2017. Validation of Model Training Courses. IMO Model Course 2.07 Engine Room Simulator, IMO Publications, 2017 Edition.
8. UNITED NATIONS, 2021. Conference on Trade and Development. Review of Maritime Transport. Geneva.

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REFERENCES

AL-SHARYOUFI, S., 1996. The utilization of engine room simulators for freshmen and career personnel: training and assessment. *World Maritime University Dissertations*, 1047.

CHYBOWSKI, L., et al., 2015. An engine room simulator as an educational tool for marine engineers relating to explosion and fire prevention of marine diesel engines. *Zeszyty Naukowe Akademii Morskiej w Szczecinie*, vol. 43, no. 115, pp. 15 – 21.

CICEK, I., 2003. Integration of Engine Room simulators into marine engineering education. The Chamber of Marine Engineers of Turkey. In: *Proceedings of the 1st National Congress*, Istanbul, Turkey. 22 May 2003, Istanbul. pp. 8 – 27.

CICEK, K., 2017. A Practical Training Assessment Methodology for Engine Room Simulator Training. In: *Proceedings of the 13th International Conference on Engine Room Simulators*, pp. 129 – 135. Istanbul, Turkey.

KLUJ, S., 2017. The Environmental Awareness in the Engine Room Simulator Training. In: *Proceedings of the 13th International Conference on Engine Room Simulators*. Istanbul, Turkey.

KOLMA, M., ET AL., 2017. Concepts of ETM (Engine Room Team Management) for Safety Operation of Ship Engine Power Plant – Suggestion of Scenario Suitable for Competency Evaluation. In: *Proceedings of the 13th International Conference on Engine Room Simulators*. Istanbul, Turkey.

MANGGA, C.; TIBO-OC, P.; MONTAÑO, R., 2021. Impact of engine room simulator as a tool for training and assessing BSMARE students' performance in engine watchkeeping. *Pedagogika-Pedagogy*, vol. 93, no. 6S, pp. 88 – 100. Available from: https://doi.org/10.53656/ped21-6s.07eng.

RENGANAYAGALU, S. K.; MALLAM, S. C.; HERNES, M., 2022. Maritime education and training in the COVID-19 era and beyond. *TransNav: International Journal on Marine Navigation and Safety of Sea Transportation*, 16.1.

STETSENKO, M.; STETSENKO, P., 2017. Enhancing the effectiveness of engine room simulator training with application of augmented reality technology. In: *Proceedings of the 13th International Conference on Engine Room Simulators*. Istanbul, Turkey.

UGURLU, H.; CICEK, I., 2022. Analysis and assessment of ship collision accidents using Fault Tree and Multiple Correspondence Analysis. *Ocean Engineering*, vol. 245, no. 110514.

ZAINI, Z., 2020. The effectiveness of the engine room simulator (ERS) as a learning tool in maritime education and training (MET). *World Maritime University Dissertations,* 1391.

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