Časopis Pomorskog fakulteta Kotor – Journal of Maritime Sciences (JMS)
god. 23, br. 2/2022. Vol. 23, No. 2/2022; November 2022

DOI: https://doi.org/10.56080/jms221104 UDC: 656.61:378.1
Original scientific paper

Student Advancement During Simulator Training*

Ladislav Stazić, Karlo Bratić, Tatjana Stanivuk, Frane Vidović

Abstract: This paper presents the organization and results of a test that attempted to evaluate the success of training students of Marine Engineering on the simulator during the regular course in the third year of the Faculty of Maritime Studies in Split. Sixteen students were assessed at the beginning of the course, then after completing the first part of the training, and finally at the end. The progress of the students was measured using a questionnaire and by performing actual tasks on the simulator. Measuring the success of the simulator training showed a very high success rate that 93.75% of the students met all requirements and passed all tests.

Keywords: Maritime Training, Simulators, STCW & Familiarization.

1. Introduction

Maritime educational institutions in Croatia must follow all rules set by the state [1], as well as meet all requirements regulated by the Convention on Seafarers Training, Certification, and Watchkeeping (STCW) [2]. The convention regulates the use of simulators for training and certification in Maritime Education and Training processes. In accordance with the above rules and regulations, the Faculty of Maritime Studies in Split conducts training for its students on simulators. The Faculty has a large number of simulators, which are used by different departments and different studies and different courses of study. The Department of Marine Engineering has three real-time engine room simulators capable of simulating numerous different engine room configurations (for example steam propulsion, slow-speed diesel engine, medium-speed diesel engine, diesel-electric...). These simulators are Kongsberg Neptune K-Sim Full Mission Engine Room Simulator, Wartsila (Transas) ERS 5000W simulator (2D - ER simulator on the PC), and Wartsila (Transas) ERS 5000W 3D Full Mission Engine Room Simulator. Described simulators are used in the training of marine

* An earlier version of this paper was presented at the 1st Kotor International Maritime Conference – KIMC 2021, Kotor, Montenegro.

engineering students as part of the curriculum. The courses are structured in such a way that the students are learning to demonstrate the theoretical knowledge in the "real" environment (simulator), i.e., to put the theory into virtual practice [3], which is the best solution when people are not on the ship. The course instructors are experienced Marine Engineering Officers and Chief Engineers (some of them are authors of this article) trying to pass on their knowledge and experience to the students and trying to achieve the goal set by Malik and Zafar: "*When properly used, supported by well trained and experienced instructors, simulator training, through its risk-free environment, can contribute to a reduction in accidents and improve capability and efficiency, by providing trainees with the necessary experience and self-confidence to carry out their roles, functions and tasks*" [4]. Despite the high-quality equipment and the effort of the instructors, there is always a question that Sellberg [5] formulated during his research on the use of simulators in training: "*Although the practice of using simulators is well regulated and widespread in Maritime Education and Training, it seems few studies address the pedagogical use and benefits of simulator-based training in this domain*".

The real-time simulator training process is very useful for marine engineers working on real vessels and can provide various types of training that are in accordance with industry needs as it is described by Shen et al. [6]: "*to fit different training purposes, the system provides three training mode: standalone and multi-user collaborative training and evaluation*". The real-time simulator has modeled effects in the VMS and can provide special training for crisis management, e.g. fire or flooding that cannot be performed on real vessels: "*the most severe accidents in the maritime sector involve fire or a loss of stability due to flooding*" [7].

To determine the effects and benefits of simulator-based training, an internal evaluation has been conducted in the 2020/2021 academic year. Details on the simulators and the evaluation are presented in the article.

2. Engine Room Simulators and the training concept

The engine room simulator training is conducted in two courses during the third year of undergraduate studies. The condition that trainees should have theoretical knowledge of ship and ship systems [3] is thus fulfilled. The training is organized in such a way that the engine room itself and its systems are first studied on the Wartsila (Transas) ERS 5000W simulator – 2D Simulator presented in Figure 1.

The simulator consists of the Instructor Station, the Engine Control Room (connected to the Bridge Simulator), and the classroom with 10

independent student stations (Figure 2). Each student station consists of a PC with two monitors where students explore systems and a virtual environment.

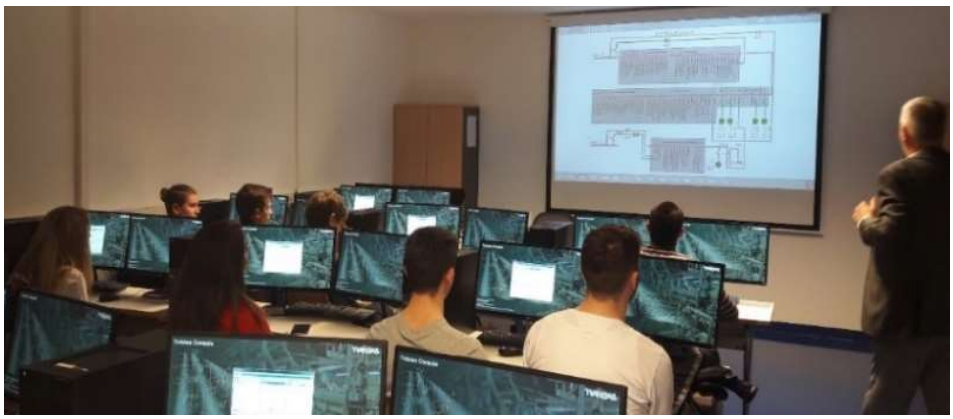

Fig. 1 – *Wartsila (Transas) Simulator Classroom* (2D Simulator).

Models and analyzed systems are the same as in the 3D simulator. Student stations are controlled from the instructor's station i.e., "*each workstation is connected with the trainer independently of the other stations and performs individual tasks, the results of which are not related with the work of other stations*" [8].

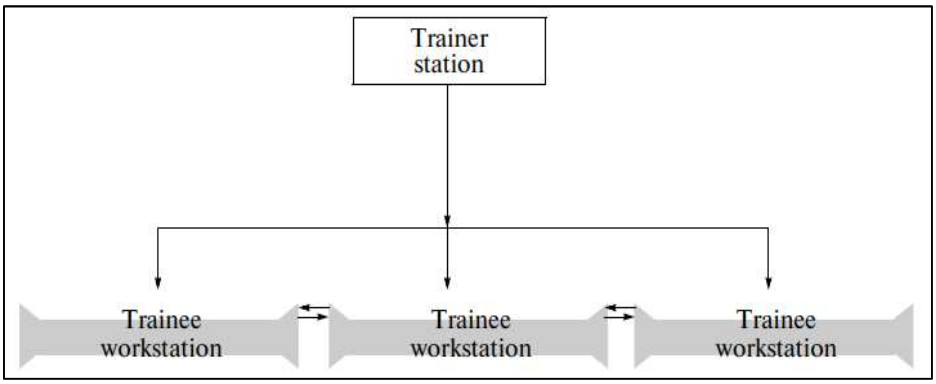

Fig. 2 – *Simulator network configuration [8].*

After learning the characteristics of ER systems and ER equipment layout, students are transferred to the Wartsila (Transas) ERS 5000W 3D Full Mission Engine Room Simulator (Figure 3).

This simulator consists of twenty-two interconnected computers and more than thirty touch screen monitors. The simulator is divided into five separated locations trying to resemble ER layout. Those locations are the instructor station (Figure 3, bottom right), the Engine Control Room with the Main Switchboard (Figure 3, top), the engine room (Figure 3, bottom left), the machinery spaces outside ER, and Emergency Generator Room. Students perform various tasks on this simulator, in an environment simulating the real ER.

Fig. 3 – *Wartsila (Transas) Full mission Simulator (3D Simulator).*

3. Assessment of the benefits of Simulator-based training

A very simple test was conducted to assess how practicing on the simulator affected the students' performance in the engine room and the execution of actual tasks. The idea behind the test was to assess the students' skills and abilities at various stages of the training, starting at the beginning. Sixteen students participated in the test, divided into four groups. The training was conducted separately, and all topics and materials were the same.

At the beginning of the course, the introduction is made and briefly described the layout of ER, followed by the introduction of the ER checklists (lists describing steps required to perform certain tasks). The next step was to abruptly introduce the students to the engine room simulator and give them real tasks, along with the questionnaire [9] about necessary steps and

related machinery. Tasks include starting the various machinery systems and/or performing various real-time tasks. Students' skills are assessed in two different modes:

- Monitoring all actions performed (sequence of actions, student's confidence in the correctness of the procedure, use of checklists, errors in the work...,
- Answering a prepared questionnaire which consists of thirty questions (with multiple answers offered) related to the design of analysed ER systems, machinery working principles, machinery starting sequences, possible malfunctions, prevention, maintenance,…

After the first test, students began training on the Wartsila (Transas) ERS 5000W simulator (Figure 1) in the classroom. The training is based on outcome-based education [10], students learn through practice on the simulator by modifying the provided checklists and creating their own. After they have completed classroom training, the same test is given to the same students. Finally, students are given additional instruction in the Wartsila (Transas) ERS 5000W 3D Full Mission Engine Room Simulator environment, giving them additional self-confidence. During this familiarization, students who did not pass the questionnaire had the opportunity to answer questions. Most students took advantage of this and successfully completed that part of the test. At the end of this phase, an assessment of the actions was conducted. The results of all three assessments are shown in Table 1.

Table 1 – *Student assessment.*

	The number of students who passed the test							
	Group 1		Group 2		Group 3		Group 4	
	Skills	Quest.	Skills	Quest.	Skills	Quest.	Skills	Quest.
Initial	0	1	0	1	0	0	0	1
After Classroom	3	3	2	4	2	3	3	4
At the end	4	4	4	4	3	3	4	4

Results of the benefits of simulator-based training are summarized in Figure 4. Only one of all students failed to finish the course without the need for additional instructions and explanations.

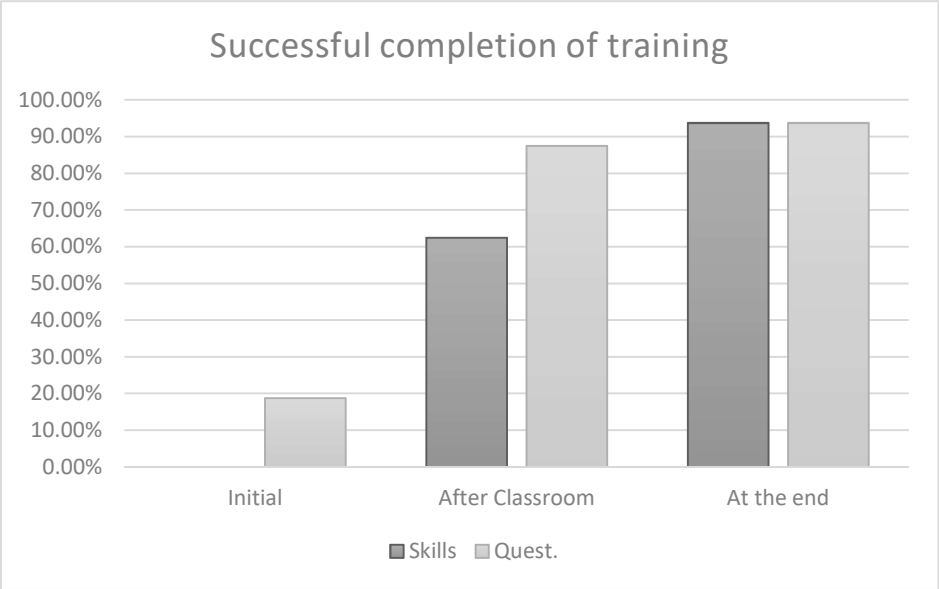

Fig. 4 – *Successful completion of training.*

4. Conclusion

From the results of the tests administered, it is evident that a significant increase in student learning outcomes and awareness was achieved through simulator training. At the beginning of the course, the evaluation of the students was very poor despite their previous knowledge, only 18.75% of the students passed the questionnaire and no one passed the skill test. The situation changed drastically after the training, which was conducted in the classroom on the 2D simulator. The students showed much better results, 62.5% of them passed the skill test and 87.5% passed the theoretical questionnaire. The additional familiarization on the 3D simulator was also beneficial, at the end of the training 93.75% of the students fulfilled all the requirements, i.e., only one student did not fulfill all the required tasks.

This assessment shows that although the students had all the required knowledge for the test before the simulator training, they did not pass the test with success. Simulator training helps them to recall their previous lessons, they manage to combine materials from several different subjects and direct them to solve simulated problems. For 2/3 of the students, this kind of training is sufficient to pass all tests successfully, although the training was not completed.

The total number of students who passed the test after training on the simulator is quite high, which confirms quoted sentence that the simulator can *"improve capability and efficiency, by providing trainees with the necessary experience and self-confidence to carry out their roles, functions and tasks*".

5. Acknowledgments

Part of the research for this article was performed using the equipment obtained through the Project named ''Functional integration of the University of Split, PMFST, PFST and KTF-ST through the development of scientific and research infrastructure in three faculties building'', contract number KK.01.1.1.02.0018.

References

[1] The Ministry of Science and Education of Croatia, available at: https://mzo.gov.hr/, accessed on 18th February 2021.

[2] International Maritime Organization, "International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW)", (2020), available at: https://www.imo.org/en/OurWork/HumanElement/Pages/STCW-Conv-LINK.aspx, accessed on 18th February 2021.

[3] L. Clarke and C. Winch, "Apprenticeship and Applied Theoretical Knowledge", Educational Philosophy and Theory, vol. 36(5), pp. 509–521, 2004, doi:10.1111/j.1469-5812.2004.087_1.x.

[4] A. Malik and N. Zafar, "Applications of simulation technology-pitfalls and challenges", TransNav, International Journal on Marine Navigation and Safety of Sea Transportation, vol. 9, 2015, doi: 10.12716/1001.09.03.12.

[5] C. Sellberg, "Simulators in bridge operations training and assessment: a systematic review and qualitative synthesis", WMU Journal of Maritime Affairs, vol. 16(2), pp. 247–263, 2016, doi: 10.1007/s13437-016-0114-8.

[6] H. Shen, J. Zhang, B. Yang and B. Jia, "Development of an educational virtual reality training system for marine engineers", Computer Applications in Engineering Education, vol. 27(3), pp. 580-602, 2019.

[7] D. Lee, S. Kim, K. Lee, S. C. Shin, J. Choi, B. J. Park and H. J. Kang, "Performance-based on-board damage control system for ships", Ocean Engineering, vol. 223, pp. 108636, 2021.

[8] S. D. Aizinov. and A. V. Orekhov, "Simulator training for the high technology ship crews, Gyroscopy and Navigation", vol. 1(4), pp. 258–262, 2010, doi: 10.1134/s2075108710040048.

[9] S. Nazir and K. Hjelmervik, "Advance Use of Training Simulator in Maritime Education and Training: A Questionnaire Study", Advances in Human Factors in Training, Education and Learning Sciences, pp. 361–371, 2017, doi:10.1007/978-3-319-60018-5_35.

[10] J. Elliott, "Making evidence-based practice educational", British educational research journal, vol. 27(5), pp. 555-574, 2001.

Submitted: 12/03/2022
Accepted: 05/05/2022

Stazić, Ladislav
The University of Split, Faculty of Maritime Studies
Ruđera Boškovića 37, 21000 Split, Croatia,
Email: lstazic@pfst.hr

Bratić, Karlo
The University of Split, Faculty of Maritime Studies
Ruđera Boškovića 37, 21000 Split, Croatia,
Email: kbratic@pfst.hr

Stanivuk, Tatjana
The University of Split, Faculty of Maritime Studies
Ruđera Boškovića 37, 21000 Split, Croatia,
Email: tstanivu@pfst.hr

Vidović, Frane
The University of Split, Faculty of Maritime Studies
Ruđera Boškovića 37, 21000 Split, Croatia,
Email: fvidovic@pfst.hr