Creation of Scenarios with VSTEP Simulator and Evaluation of Simulators Use in Maritime Education and Training

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Abstract. The aim of this paper is to present created scenarios for training crews on the VSTEP simulator and to analyze the results of a survey conducted on the effectiveness of the education in relation to the future realization of the trainees. Two scenarios developed on the VSTEP simulator are presented in this paper. The first scenario aims at the vessel reaching a certain point of the Bourgas environment and dropping anchor there. The second scenario is about maneuvering two vessels in the Atlantic Ocean under ideal weather conditions. A survey was conducted with cadets and students related to the training of VSTEP navigation simulators at the Nikola Vaptsarov Naval Academy. Conclusions are drawn about the quality of training on the simulators, the level of teaching and the practical skills the trainees acquire at the Nikola Vaptsarov Naval Academy.

Keywords: VSTEP, bridge simulator, scenarios, maritime education, survey.

1. Introduction

The need for the use of simulators in navigation training is indisputable [1-7]. Simulators provide an opportunity for crew to train in very close to real sea conditions without risk to people and damage to the vessel. Students can become familiar with different situations [2] that may arise during navigation and learn how to act in such cases. Working with the simulators allows to increase the skills and experience of the learners, supporting their practical training [1, 2, 8]. Last but not least, the use of simulators saves money and training resources compared to training on real vessels.

For training it is necessary to set up exercises [5, 6] with different ship models in specific sea and river areas. For this purpose, scenarios are created in which the crew is placed in certain situations and appropriate adequate actions have to be taken to successfully execute the scenarios according to the parameters set by the trainer and instructor.

The VSTEP NAUTIS navigation simulator [9] provides features specific to navigation, ECDIS, radar/ARPA, communications and training for search and rescue. This software simulates realistic vessel behavior, in various ports and waterways around the world. The navigation package is used to train cadets and students from Nikola Vaptsarov Naval Academy (NVNA) - Varna on the basics of waterway rules, collision rules, and more.

The aim of this paper is to present scenarios developed for training crews on the VSTEP simulator and to summarize the results of a survey conducted on the effectiveness of the education in relation to the future realization of the trainees.

2. Simulator exercises and scenarios

Exercises and classes are conducted on a certified VSTEP Class A simulator [9].

The simulator has the ability to modify the ship models and to test the changed parameters, the original models are not changed. Scenarios are created based on the exercise creation capabilities of the software.

Table 1 shows the technical parameters of the ship used in the scenarios:

Table 1. Technical parameters of the ship used in the scenarios

SHIP SPECIFICATION CARD

Ships Name	Baynunah	Dead Weight	180t
Call Sign	N/A	Displacement	915t
Build	2009	Draught	3 m
Date	19.01.2015	Draught Aft	3 m

SHIP'S PARTICULARS		ANCHOR CHAIN	
Length Overall	71,5 m	Port	7 shackles
Moulded	12 m	Starboard	7 shackles
Bulbous Bow	No	Stern	N/A

PROPULSION PARTICULARS				
Engine Type	MTU 12V 595 TE90		Max. Power	16 800 KW
Propeller Type	Waterjet			

	Engine Order	RPM/Pitch	Speed (k)		Engine Order	RPM/Pitch
A H E A D	Full Sea	100%	32	**A S T E R N**	Full Sea	21.6
	Full	90%	28,8		Full	19.6
	Half	60%	19.1		Half	13.8
	Slow	30%	7.6		Slow	7.3
	Dead-Slow	10%	1.9		Dead-Slow	1.9

Time Limit Astern	-sec	Full Ahead To Astern	26 sec
Speed At Minimum RPM	0k	Astern Power	75% Ahead

STEERING PARTICULARS			
Rudder Type	Waterjet	Rudder Angle to Neutral Effect	0º
Maximum .Angle	30.5º	Boss Thruster	150 KW
Hard-Over to Hard-Over	6 sec	Stern Thruster	N/A

The 3D visualization of a vessel used in the scenarios, presented in the paper, is shown in Figure 1.
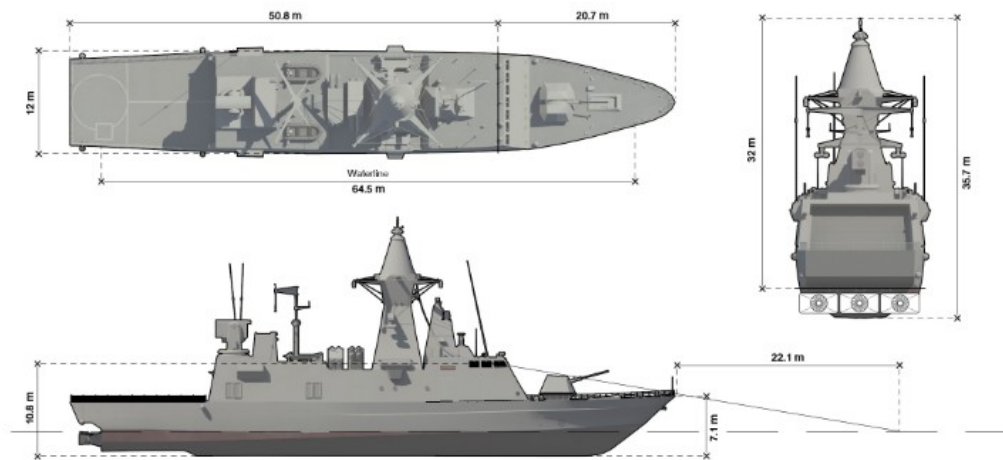
Figure 1. 3D visualization of a vessel used in the scenarios

Scenario 1: Dropping anchor in Bourgas Bay
The idea of the scenario is for the vessel to reach a certain point in the Bourgas environment and drop anchor there. The place of dropping anchor is pre-set in geographic coordinates - Latitude and Longitude. The scenario used aims to teach trainees how to drop an anchor. In advance, students calculate using formulas how many meters of vessel's chain should be slack and accordingly estimate how to maneuver the vessel so that the slack chain and anchor work properly.

Figure 2 to Figure 5 shows part of the process of the exercise. Figure 2 shows the vessel on its way to Bourgas Bay in 3D view (Bird eye view).

Figure 2. The vessel on its way to Bourgas Bay

Figure 3 visualizes a 2D view (On top) of the vessel in Bourgas Bay. Figure 4 shows a chart view of the vessel in Bourgas Bay.
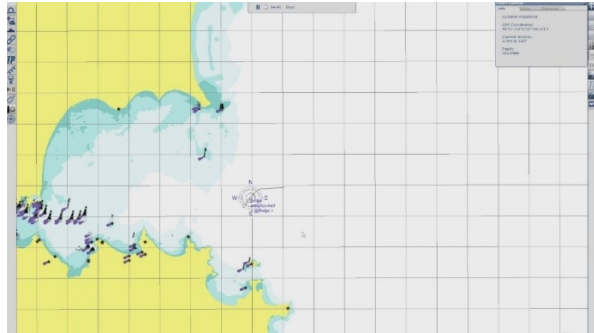
Figure 3. 2D view of Bourgas Bay

Figure 4. Chart view image of Bourgas Bay

Figure 5 shows the correct chain spread and anchor position. The figure presents one of the advantages of the simulator - water removal, which cannot be seen live, as well as in another simulator in NVNA as an option.
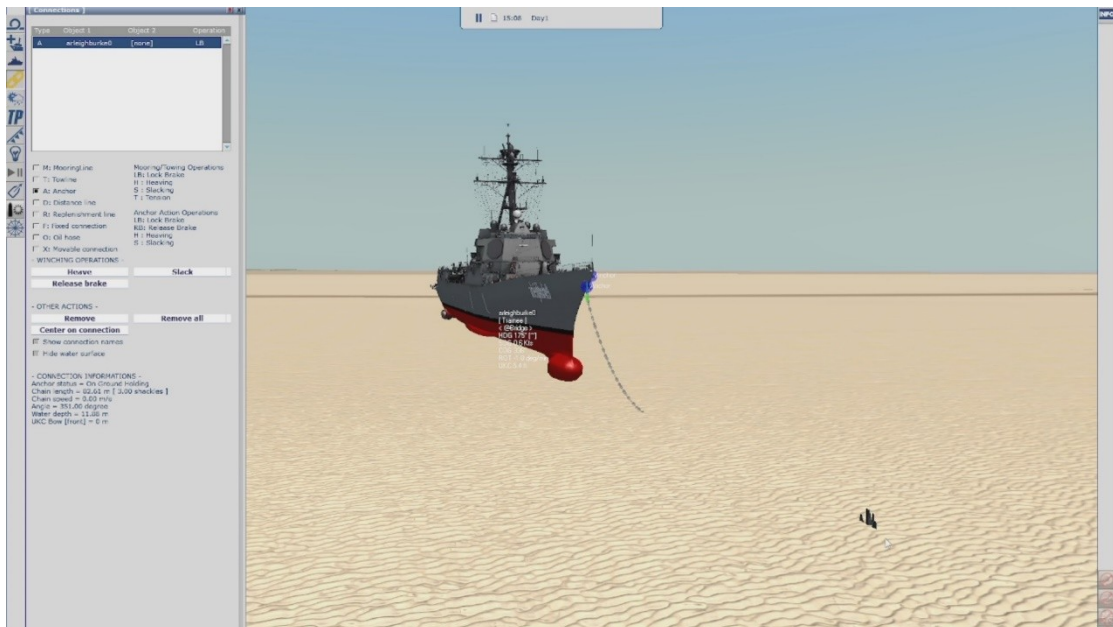

Figure 5. Vessel anchored in Bourgas Bay, water removed

Scenario 2: Sailing in the Atlantic Ocean - two vessels together in one exercise.
The simulator can be used for maneuver training of military vessels. Figure 6 - Figure 8 show elements of a scenario for maneuvering two vessels in the Atlantic Ocean under ideal weather conditions (no wind, rain, fog, current and swell).

Figure 6 shows a Bird's-eye view of the two vessels in the same scenario and operated by two crews.

Figure 6. Bird's eye view of the two vessels, location - Atlantic Ocean

Figure 7 presents a distance line between military vessels, and in Figure 8 the two vessels leave the formation.

Figure 7. Putting a distance line between military vessels

Figure 8. End of exercise, both vessels leave the formation

3. Survey for assessment and analysis of VSTEP training and navigation simulators at NVNA

Thirty students and cadets participated in a survey. They were from the third and fourth year at the Naval Academy and worked with the VSTEP simulator. The survey was conducted online in the period 25.08.2023 - 01.09.2023. A total of 14 questions related to VSTEP training and navigation simulators were asked. The evaluation questions have possible answers: Poor, Fair, Good, Very Good and Excellent.

A high percentage of students -77%, consider that training with VSTEP provides more benefits to them compared to Wartsila [10] - 23%.

Questions were asked to evaluate the navigation simulator training:

- To the question "How do you rate your training on navigational simulators?", 20% of respondents answered Excellent, 43% Very Good, 30% Good and 7% Fair. The training was rated as excellent and very good by 63% of the respondents.
- More than half of the trainees – 57% rate the quality of teaching at the Naval Academy as excellent (20%) and very good (37%). For 30% of them the teaching is good, 13% answer with Fair.
- The same percentage of participants - 57%, consider that the effectiveness level of the current laboratory and simulator training is Excellent and Very Good, 33% - Good, 3% - Fair and 7% - Poor.
- 63% of respondents rate the level of reality of the scenarios used in simulator training as Excellent (17%) and Very Good (46%). 30% of the trainees gave a Good rating, and 7% - Fair. A diagram of the scoring is shown in Figure 9.
- The respondents highly rate the contribution of simulator training to their learning – 63% respond with Excellent (20%) and Very Good (43%). Accordingly, 27% give a good rating and 10% - Fair.
- To the question "Do you think the number of simulator stations should be increased?", the opinion of the trainees is categorically in favor of increasing the number of simulator stations - 77% of them answered "Yes" to the question.
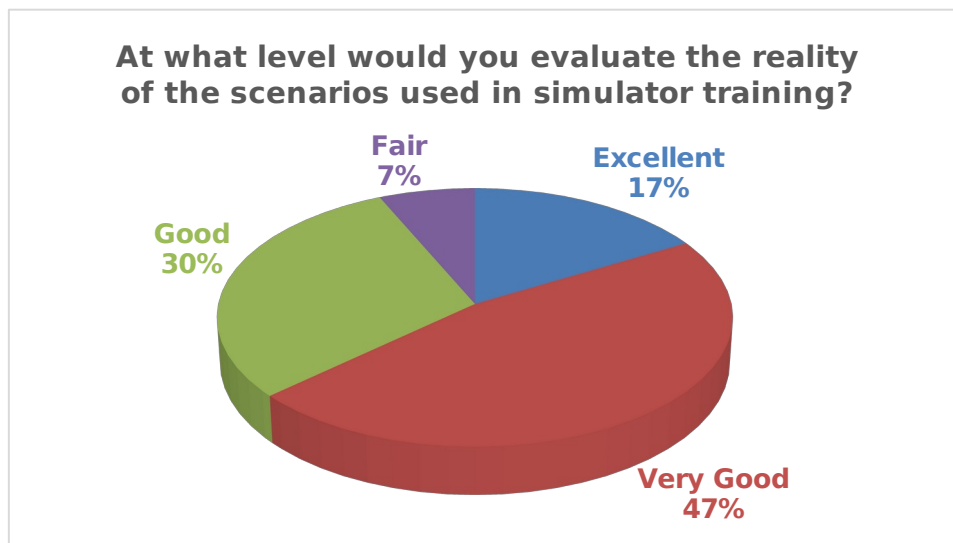
Figure 9. Assessment of the reality of the scenarios used in simulator training

Simulator training requires a good knowledge of maritime English. When asked about the contribution of education in Maritime English to students' professional language knowledge during academic education, 77% of respondents answered Excellent (30%) and Very Good (47%), which is an indicator of the high level of education in Maritime English in NVNA. The remaining ratings are Good - 20% and Fair - 3%.

Training with simulators supports the real work of the students on the vessel. Questions were asked to evaluate the training provided.

- 67% of the respondents evaluate the level at which the simulator training prepares them for sea duties in the future, as Excellent and Very Good, 23% Good, 7% Fair and 3% Poor.
- 74% of students define the benefit of Bridge simulator, as Excellent (30%) and Very Good (44%), 23% - Good and 3% - Fair.
- The ability of the Sea Training on vessels to support the education that students receive at the Naval Academy is evaluated as Excellent by 20% of respondents, Very Good – 37%, Good – 23% and Fair – 20%. More than half of them - 57% rate the ability of the Sea Training on vessels to support the education as Excellent and Very Good.
- The student's assessment of the internship conducted is Excellent for 17% of them, Very Good – 23%, Good – 43%, Fair – 17%. A Good evaluation for conducting the internship prevails. Students undertake internships on various vessels and the grade is dictated by the tasks they perform on the vessel itself.
- When asked about the evaluation of the contribution level of vocational elective courses to professional competence, the respondent's ratings are: Excellent - 20%, Very Good 33%, Good - 30% and Fair - 17%.
- The benefit that students get from the simulator training is evaluated from 63% of them as Excellent (33%) and Very Good (30%). The other ratings are: Good - 27%, Fair - 7% and Poor - 3%. A plot of the distribution of learner responses is given in Figure 10.
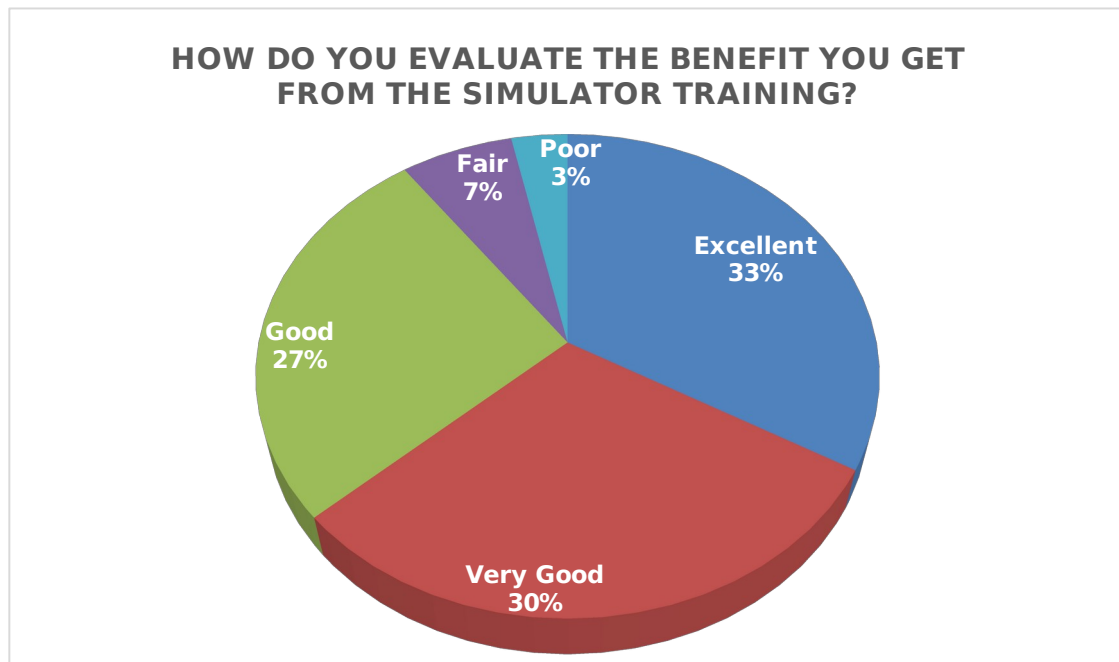
Figure 10. Evaluation the benefit from the simulator training

The following conclusions can be drawn from the survey:
- The level of training using VSTEP and other navigation simulators at the NVNA is highly rated by the respondents - Good, Very Good and Excellent ratings prevail, with the sum of these ratings being given by 90% and over 90% of respondents on the effectiveness level of the current laboratory and simulator training, the reality of the used scenarios and the contribution of simulator training to their learning.
- The quality of teaching was also rated highly, with 87% of trainees considering it to be at a Good, Very Good and Excellent level.
- According to the respondents it is necessary to increase the number of simulator stations. Increasing the number of training stations would also increase the quality of training
- The benefits of simulator training in terms of trainees undertaking internship and performing maritime duties were rated overall Good, Very Good and Excellent by 90% of respondents, with the highest overall rating for the benefits of Bridge simulator training at 97%.
- It is evident from the responses of the respondents that simulator training helps in the performance of the trainees on the vessel and enhances their skills to deal adequately with various situations that may arise in real vessel conditions.

4. Conclusions
The developed scenarios for dropping anchor and sailing in the open sea are used to train students and cadets, and are extremely useful for their future sailing in real conditions and on a real vessel. The advantage of the VSTEP simulator over other simulators is demonstrated in the scenario with the removal of water from the Bourgas virtual environment. Students can practice at VSTEP various scenarios how to adequately deal with various accidents and improve their practical skills for subsequent work on the vessel.

A survey was conducted with students and cadets from NVNA, and based on its results, conclusions are drawn about the usefulness of simulator training. The level of training, the quality of teaching, the benefits of training with simulators in terms of internship and sea practice, and the

increase of the trainees' skills to deal adequately with different situations that may arise on the real vessel were evaluated. The prevailing ratings are excellent, very good, and good. The results of the survey show the need to increase the number of simulator stations, which will also lead to an increase in the quality of training.

In future research, questions will be added to the survey about the simulator exercises and their effectiveness in terms of students' practical skills, as well as surveying the opinions of a larger number of learners.

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