USING A POSTERIORI ANALYSIS TO ASSESS SCENARIOS ASSOCIATED WITH THE USE OF TACTICAL NAVY

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Abstract: *In the new millennium, information and communication technology has become a tool that is transforming our time into an age of information. The widespread use of information technology results in significant changes both in weapons of war and the way they are employed in modern warfare. New trends are appearing to reflect the processes of transformation and integration affecting the armed forces worldwide. Evaluating the effectiveness of the use of M & S in the training of servicemembers is a problem related to the lack of uniform criteria and methodology to assess the quality of individual and / or group simulator training. The subject of this study is to apply a posteriori analysis to the training carried out at the "Ship Bridge" navigation simulator as part of the course in "Naval Tactics".*
Key-words: *posteriori analysis, modeling and simulation, naval tactics.*

1. ANALYSIS OF STATE AND USE OF SIMULATORS AND TRAINERS IN THE PROCESS OF TACTICAL PREPARATION OF BULGARIAN NAVAL OFFICERS

Naval tactics is a science whose subject is the organization and management of a sea battle – the most superior form of preparing and conducting combat actions at sea. Its place in the theory of naval art is determined by the relations with naval weapon systems, strategic environment and the way of using of warship's weapons.

The tactics of the Navy is a result from the tactics of naval weapon system [34, c. 252] and the tactics of different classes of naval ships [30, p. 93]. Therefore, if we want to have real combat training, we need real simulation models which are able to ensure with a high probability the solution of the tasks in accordance with the maritime tactical publications.

2. USING A POSTERIORI ANALYSIS AS AN ASSESSMENT TOOL FOR SIMULATION TRAINING

Evaluating the effectiveness of the use of M & S in the training of servicemembers is a problem related to the lack of uniform criteria and methodology to assess the quality of individual and / or group simulator training .

2.1 Characteristics of the conducted research

The term "pedagogical research" has a strongly expressed integrative character because, in the very process of research, different, traditionally separated parts of many academic fields and .areas of focus are united. From the point of view of its content, a given military-pedagogical research, professional, specialized and higher education can be covered to an equal degree [5, p. 36].

Likewise, such research can involve representatives of any academic field and .area of focus whose fundaments are taught. The essential and determinant thing in this case is that the research is pedagogical by content and aims which involves representatives of different sciences and institutions in order to conduct it successfully. It is by pedagogical research that efforts, knowledge and creative abilities of different specialists are integrated by common goals and tasks [5, p. 36].

The methods of pedagogical research are the other important element of terminology and methodology of pedagogical research.

It is known that the scientific method is a means for attaining certain knowledge in theory and practice, a means for the familiarization, study and alteration of the objective reality. In a structural aspect the scientific method is a system of regulating principles which direct the cognitive activity of the researcher to the objective truth. For this reason the scientific methods employed by each science for the familiarization and alteration of its subject have a profoundly heuristic nature, because they serve for gaining new knowledge as well as for the interpretation of this knowledge. [5, p. 36].

The basic principles of pedagogical research are: significance, reduction, minimization, analogy, representation, sameness, confirmation [as quoted in 98 according to 5, p. 40].

The main feature of empirical pedagogical research is that they serve for encompassing the alterations and the development of a personality in result of some kind of influence. The main peculiarity of an item of empirical research is that a purposeful organization established on a case-by-case basis yields empirical data for actually existing pedagogical phenomena and processes. These data are furthermore integrated in the process of describing, explaining or forecasting regarding the events, phenomena or processes of interest for the researcher. To this end, the data collation results in the formulation of hypotheses whose truthfulness is checked by way of experiments. This leads to the formulation of rules, principles, laws, trends, prognoses. [5, p. 44].

The goal of this study is to find the answer to the questions related to the quality of the conducted simulator training by analyzing the results of the conducted training sessions.

Hypothesis: It is possible to enhance the efficiency and the quality of the simulator training by correcting the existing scenarios and changing the pattern used to conduct the training sessions and evaluating the trainees.

The main reason for conducting an *a posteriori* analysis of the practical classes in the subjects of Naval Tactics and Navigational Support of Combat Activities conducted at the Ship's Bridge navigational simulator is the availability of the significant amount of acquired empirical experience - the information related to 166 trainees over the period of time from 2001 to 2011 is available for analysis.

Regarding the preparation of officers at the JCATS and DANGEROUS WATERS simulators, no records of the conducted sessions or the acvieved results were found.

2.2 Characteristics of the system of evaluation tasks

The evaluated tasks cover training content with the following **topics**:

Task 1: Rules for changing course, speed and formation during joint sailing using the document BES-80. This problem was solved until 2010.

As Bulgaria's membership in NATO necessitated changes of the documents for commanding the forces, problem 1 retained its content, but the command of the tactical units now also has to conform to the documents EXTAC 1000 and MTP – 1 (D), apart from BES-80. The use of the new regulatory documents does not lead to changes in the scenarios of the training sessions.

Task 2: Tactical deployment and carrying out a missile strike by a group of fast patrol boats.

Task 3: Arranging a mine barrier by a group of ships.

Task 4: Organizing and conducting mine countermeasures by a minesweeper group with contact sweeps.

2.3 Description of the roles played by the trainees in the course of the training sessions

In the course of the training sessions the trainees play the following roles: commanding officer of a vessel, navigating officer, helmsman, radar operator on duty, and officer of the watch

The trainees are evaluated depending on their expertise, using the criteria presented in Table 2.0. They are graded using a five-grade system with Fail (2,0) the lowest possible grade, and Excellent (6,0) the highest possible one.

Table 2.0
Trainee evaluation criteria by role

Criterion / Role	Assessment according to the curriculum
Commanding Officer	Profound knowledge of the documents regulating the multinational naval tactical instructions, procedures, command and maneuvering signals related to ensuring the defences and protections of the task force; Proper organization of the control of the helm and the machinery, organization of the internal communication among the combat crewmembers - reports and acknowledgments; Proper command language, special orientation and decision-making in a real situation; Reporting the taken actions.
Officer of the watch	Practical use of the documents regulating regulating the multinational naval tactical instructions, procedures, command and maneuvering signals related to ensuring the defences and protections of the task force, exercising the communication rules and documents - reports and acknowledgments; Reporting the taken actions; Keeping the logbook.
Navigating officer	Plotting the combat evolutions of both sides completely and accurately, as well as solving the particular problems related to maneuvering; Reporting the taken actions;
Surface surveillance radar operator	Operating the radar properly and complete utilization and evaluation of the obtained information; Reporting the taken actions.
Helmsman	Knowing the rules and commands used onboard Bulgarian naval ships; Reporting the taken actions.

Note: This table was compiled using the Methodology of preparing and conducting the practical training for cadets and students at the Bridge Simulator

2.4 Statistical analysis of the difficulty of the tasks

In order to examine how adequate the scenarios are in respect to the purposes of the training, it is necessary to check the difficulty of the tasks trhat are played through.

The task difficulty is determined by the percentage of the examinees who have solved it correctly. It is designated with the difficulty index of *P* [6, p. 176]. The higher the index number, the easier the task, whereas a low index indicates that the task is more difficult.

The index *P* is calculated using the formula:

$$P = 100\frac{N_R}{N}$$

Where:

P is the difficulty index;

N_R – the number of persons to have solved the task correctly;

N – total number of the persons to have attempted the task [6, p. 176].

A task is assumed to have been solved correctly if it was graded with a number higher than or equal to the arithmetic mean of the grade received for the respective role.

The task is assumed to be easy if its difficulty level is $60 \le P \le 80$.

An average level of difficulty is assigned to tasks with a difficulty index ion the range of $40 \le P \le 60$.

A difficult task is defined as ones with a difficulty index of $20 \le P \le 40$.

Tasks with a difficulty index $P \le 20$ are defined as very difficult, and tasks with a level of difficulty $80 \le P$ are to be disregarded [18, 28].

The summarized statistical results from the analysis of the four tasks are shown in Table 2.1.

The table shows that the largest number of trainees are the ones graded in the course of Task 1, Rules for Changing Course, Speed and Formation during Joint Sailing– 148 persons, and the smallest number are the ones graded in the course of Task 4, Organizing and Conducting Mine Countermeasures by a Minesweeper Group with Contact Sweeps– 19 persons.

Table 2.1
Summarized statistical results for tasks 1, 2, 3 и 4

		Task 1	Task 2	Task 3	Task 4
№:	Valid	148	75	78	19
	Missing	18	91	88	147
Mean		4,554	4,553	4,564	5,237
Median		4,500	4,500	4,500	5,000
Mode		5,0	5,0	5,0	5,0
Std. deviation		0,6285	0,7692	0,8349	0,5861
Minimum		3,0	2,5	3,0	4,5
Maksimum		6,0	6,0	6,0	6,0

The statistical data for Task 1, Rules for Changing Course, Speed and Formation during Joint Sailing using BES-80 (EXTAC 1000, MTP – 1 (D)" are shown in Table 2.2. The calculation of the difficulty index for task 1 yields *P*=40,54, which shows that the task is on the borderline between high and average difficulty level. As

mentioned above, a task with an average or a high difficulty index is optimal for achieving the goals of the training. In this case, no changes to the scenario used to conduct the training session are required. Because the difficulty index is obtained as the total of the grades for the separate roles, it is unclear whether it is necessary to change the scenario in respect of one of those. In this sense it becomes expedient to analyze the difficulty level for each separate role, and should the analysis results show that its difficulty level is too low or too high, the scenario is to be corrected in order to achieve maximum results in the course of the training session.

The statistical data for Task 2, Tactical deployment and carrying out a missile strike by a group of fast patrol boats are shown in Table 2.3.

The calculation of the difficulty index for task 2 yields *P*=42,7, which shows that the task is average difficulty level.

Table 2.2
Statistics for Task 1: „Rules for Changing Course, Speed and Formation during Joint Sailing using BES -80 (EXTAC 1000, MTP – 1 (D)"

		Frequency	Percent	Valid percent	Cumulative percent
Valid	3,0	3	1,8	2,0	2,0
	3,5	11	6,6	7,4	9,5
	4,0	34	20,5	23,0	32,4
	4,5	40	24,1	27,0	59,5
	5,0	42	25,3	28,4	87,8
	5,5	15	9,0	10,1	98,0
	6,0	3	1,8	2,0	100,0
	Total	148	89,2	100,0	
Missing	system	18	10,8		
Total		166	100,0		

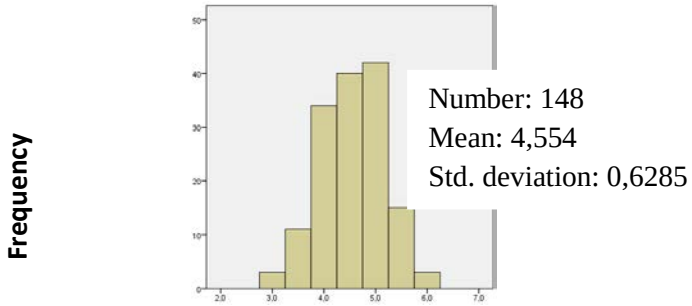

Figure 2.1 Frequency distribution – task 1

Table 2.3
Statistical data for Task 2: Tactical deployment and carrying out a missile strike by a group of fast patrol boats

		Frequency	Percent	Valid percent	Cumulative percent
Valid	2,5	2	1,2	2,7	2,7
	3,0	1	,6	1,3	4,0
	3,5	5	3,0	6,7	10,7
	4,0	19	11,4	25,3	36,0
	4,5	16	9,6	21,3	57,3
	5,0	24	14,5	32,0	89,3
	6,0	8	4,8	10,7	100,0
	Total	75	45,2	100,0	
Missing	system	91	54,8		
Total		166	100,0		

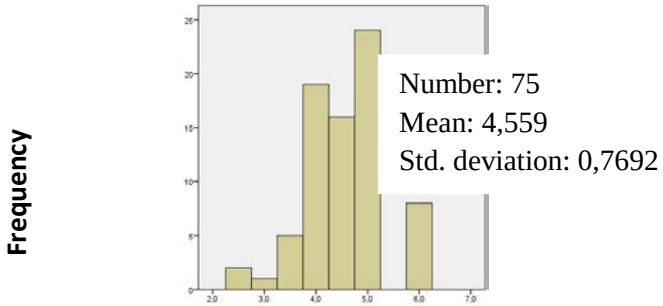

Figure. 2.2 Frequency distribution -task 2

The statistical data for Task 3: Arranging a mine barrier by a group of ships are shown in Table 2.4.

The calculation of the difficulty index for task 3 yields *P*=46,2, which shows that the task is average difficulty level and there is no need of scenario correction.

Table 2.4
Statistical data for Task 3: Arranging a mine barrier by a group of ships

		Frequency	Percent	Valid percent	Cumulative percent
Valid	3,0	6	3,6	7,7	7,7
	3,5	6	3,6	7,7	15,4
	4,0	18	10,8	23,1	38,5
	4,5	12	7,2	15,4	53,8
	5,0	23	13,9	29,5	83,3
	5,5	4	2,4	5,1	88,5
	6,0	9	5,4	11,5	100,0
	Total	78	47,0	100,0	
Missing	system	88	53,0		
Total		166	100,0		

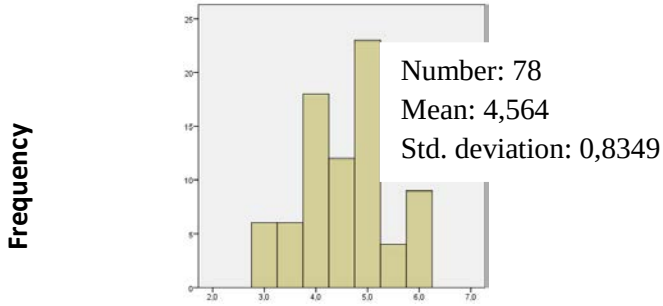

Figure. 2.3 Frequency distribution – task 3

The statistical d ask 4: Organizing and conducting mine countermeasures by a minesweeper group with contact sweeps are shown in table 2.5.

The most likely reason for the low percentage of respondents in the conduct of training - 11.4% of all 166 people who participated in the study is that the scenario exercise was created later than the scenarios that take place in other workouts.

Table 2.5
Statistical data for Task 4: „Organizing and conducting mine countermeasures by a minesweeper group with contact sweep".

		Честота	Процент	Валиден процент	Кумулативен процент
Valid	4,5	4	2,4	21,1	21,1
	5,0	8	4,8	42,1	63,2
	5,5	1	,6	5,3	68,4
	6,0	6	3,6	31,6	100,0
	Total	19	11,4	100,0	
Missing	system	147	88,6		
Total		166	100,0		

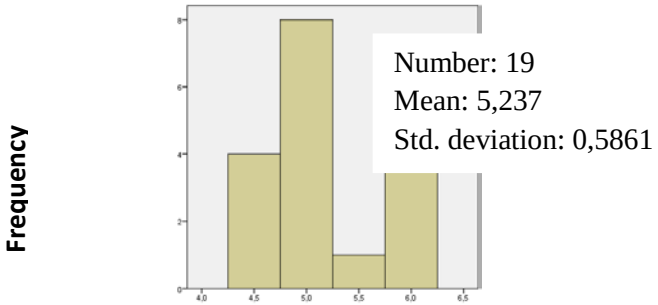

Figure. 2.4 Frequency distribution – task 4

A logical quest whether the sample in terms of task 4 is adequate to formulate reliable conclusions? According to Klaus Ebner to the required sample size can not provide universally applicable guidance [31, pp. 152]. A sample is considered large if it spans more than 30 elements. Most often the number of test persons must be between 30 and 100 [31, p 153]. In the case of the task 4, it is seen that the sample is small.

After the calculation of the index of difficulty of the fourth task is obtained P = 36.84, indicating that the task has a high degree of difficulty, but due to the small sample may not be made firm conclusions.

3. CONCLUSION

Final conclusion, which is required by the statistical analysis of the results obtained in practicing tasks 1, 2, 3 and 4 is that the practical classes included in the program of preparation in the subjects of Naval Tactics and Navigational Support of Combat Activities have a medium to high degree of difficulty, which means that the scenarios that are worked are useful for achieving the purposes of the preparation.

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