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RAISING THE RESPONSIBILITY OF CADETS FOR THE EFFICIENCY OF CONVENTIONAL TRAINING

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Abstract

Conventional training at a maritime university is an integral part of professional training, which provides for the formation of a set of professional competencies among cadets to ensure the safety and preservation of human life at sea. One of the most serious tasks of a maritime higher professional school is the high-quality training of cadets for emergency response actions. First of all, this applies to such types of accidents as collision, fire and flooding of a ship. The subject of the study is the conventional training of maritime university cadets. In order to create the interest of forming the responsibility of cadets for the efficiency of conventional training, the paper justifies and reveals the main provisions of the methodology for assessing the knowledge on potential emergency situations, such a collision, fire, flooding. The methodology is intended for use in conventional training, as well as in the final examination of cadets in the academic discipline "Initial Safety Training". The paper provides the results of experimental work – testing of cadets using the test questionnaire of the considered methodology, as well as the mathematical processing of the obtained results proving the efficiency of the methodology. The proposed methodology is efficient and may be successfully applied in the educational practice of maritime educational institutions. It contributes to the development of a high level of personal responsibility of each cadet for the efficiency of conventional training for skillful actions in any emergency situation, including in case of collision, fires and flooding of the ship.

Keywords: Conventional training, cadet, responsibility, test questionnaire, result

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1. Introduction

The International Maritime Organization attaches particular importance to the preservation of human life at sea (IMO Resolution…, 1999; International Code on Life Saving Equipment (KCC/LSA Code), 2020; International Convention for the Safety of Life at Sea (SOLAS-74/78), 2016; International Convention on Standards of Training [STCW-78]…, 2018). The promotion of safety of marine navigation is the main condition for the functioning of maritime transport (International Convention for the Safety of Life at Sea (SOLAS-74/78), 2016; International Convention on Standards of Training [STCW-78]…, 2018). Despite the efforts made, maritime transport continues to be at significant risk. The real risk in maritime navigation lies in the possibility of a ship accident, loss of life, cargo, pollution of marine environment. Hazards may occur at any time throughout the sailing.

The need to ensure the least risk to human life, minimum material and environmental losses is a condition for the highly efficient functioning of maritime transport. The risk to people's lives may be caused by various circumstances: errors made by a shipdriver or any of the vessel personnel, shortcomings in the design and construction of a ship, the influence of adverse external factors, failures of the ship's systems and devices. According to experts, 80 % of all accidents are caused by incorrect actions of ship personnel, which occur due to low conventional training, undeveloped skills for actions both at the initial stage and during the development of emergency situations.

The most important principle of conventional training is that safety must always be guaranteed. This means that any crew member is obliged to take personal care of their safety, and the entire crew ensures safety as a single coordinated team.

Safety of navigation is the provision of such conditions when the danger to human life and the possibility of an accident of ships, as well as damage to the technical means and structures used in this process, are minimal.

A future professional should take an unbiased look and without illusions imagine the conditions in which he will have to work, be able to overcome obstacles, avoid danger, get out of critical circumstances with minimum losses.

In order to prepare cadets for competent actions both in everyday and in emergency situations of any complexity, the conventional discipline "Initial Safety Training" (Tomilin, 2020) is tought at maritime universities.

In general, the course considers the rules of conduct, duties and responsibilities of crew members to observe personal safety on the ship, the safety of other crew members in performing daily work, watchkeeping, as well as in emergency situations, taking into account the preservation of life and health of people, the safety of the ship and cargo, and environmental protection. To this end, crew members must comply with all safety regulations and instructions, strictly and responsibly perform their duties, do their part within the limits of their authority in order not to create conditions and not to cause situations that may be dangerous, and, when they appear, to take all possible measures for their successful and timely elimination.

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2. Problem Statement

The International Maritime Organization requires that each crew member be thoroughly prepared for emergency situations. This requirement is set out in the guiding documents (International Convention for the Safety of Life at Sea (SOLAS-74/78), 2016; International Convention on Standards of Training [STCW-78], 2018). The 1978 STCW Code, as amended, provides for the group of competency issues for different situations (International Convention on Standards of Training [STCW-78]…, 2018).

The study of scientific literature on this problem (Avanesov, 1998; Dudina, 2016; Kondratyev et al., 2019; Kushner, 2011; Levchenko et al., 2003; Mikhailychev, 2001) shows the lack of developed diagnostic methods and tools that characterize the level of knowledge of the cadet maritime school in all kinds of emergencies, including collision, fire, and flooding of the ship. It is these types of accidents that pose the greatest danger to the ship and the life of seafarers.

On the basis of the requirements of the International Conventions, the authors developed a test questionnaire, which includes questions on the following topics: competence, survival at sea in the event of abandonment of a ship (Section A-VI/1, Table A-VI/1-1 of the STCW Code) (International Convention on Standards of Training [STCW-78], 2018).

3. Research Questions

The main objectives of the study include the following: 1) to study the requirements of the IMO and Russian guidelines relating to the conventional training of future maritime transport specialists; 2) to study the experience of developing diagnostic methods, questionnaires and tests; 3) to develop a test questionnaire to assess the knowledge of possible types of emergency situations (ship collision, fire, flooding; 4) to test cadets using the developed test questionnaire; 5) to interpret the obtained results and determine the level of cadets' knowledge of the system of actions in an emergency situation and the degree of their responsibility for the level of safety of the vessel; 6) to check the reliability and validity of the developed test questionnaire, to establish its operability and feasibility in educational practice in maritime educational institutions.

4. Purpose of the Study

The purpose of the study is to design the methodology for determining the effectiveness of conventional training of maritime university cadets, establishing the level of knowledge of maritime university cadets for clear actions in emergency situations related to collision, fire and flooding of ships. The analysis of accidents in the marine transport fleet shows that most accidents are associated with collision, fires and flooding of ships. In the course of studying in a maritime educational institution, the preparation for actions in such accidents is given special attention, instilling in students theoretical and practical knowledge how to act in the event of such accidents, as well as in the event of collision of ships, to combat fire and/or water supply, and to eliminate their consequences. This methodology allows a university teacher who teaches the conventional discipline "Initial Safety Training" diagnosing the level of students' preparation, establishing the existing shortcomings, gaps in mastering new knowledge and taking

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the necessary actions in a timely manner to improve the quality of competence and readiness of cadets for actions in emergency situations.

5. Research Methods

The interests of the study required the use of the following well-known and tested methods that proved their validity and efficiency: theoretical analysis of the authors' publications on the topic of the study; observations; conversations (individual and group); survey; testing; analysis and interpretation of respondents' responses; comparison of the obtained results; ascertaining experiment, method of mathematical statistics. The integrated use of this set of methods made it possible to successfully solve the tasks set and effectively achieve the intended purpose of the study.

6. Findings

The diagnostic test questionnaire contains 20 test questions that fully cover all modules of the course taken by students, determined by the curriculum for training cadets. The results of the test works are evaluated on a nominal scale: 1 point, if the answer to the question is correct, or 0 – if the answer is incorrect. Thus, the maximum possible score for all correctly answered questions of the test questionnaire is equal to the number of questions of the test (in our case, 20 points).

The purpose of the proposed test questionnaire is to determine the level of knowledge and readiness of maritime university cadets for clear actions in emergency situations (collision, fire and flooding of the vessel).

The contents of the test questionnaire are shown in Table 01.

Table 1. Content of the test questionnaire to determine the level of knowledge of possible types of emergency situations (collision, fire, flooding)

n/n	Questions of the test questionnaire with answer options	Answer
1	*The main document defining the classification of accidents (accidents and incidents) with ships at sea is:* a) SOLAS-74; b) PRIME-13; c) CMN-99.	
2	*Accidents with ships at sea are classified as...* a) collision of vessels; docking impact; b) accident, very serious accident, incident; c) fires and explosions on ships.	
3	*An accident with a vessel at sea shall be deemed to be an accident if there has been an event or a number of events that have occurred in direct connection with the operation of the vessel and have resulted in:* a) loss of life in direct connection with the operation of the vessel; b) displacement of the cargo carried by the vessel and/or change of physical and chemical properties of the cargo carried by the vessel, resulting in the loss of seaworthiness of the vessel; c) vessel standing and its grounding for more than 24 hours.	
4	*An accident involving a vessel at sea shall be deemed to be a very serious accident in case of an event or a series of events which have occurred in direct connection with the operation of the vessel and have resulted in...* a) failure of the main engine; b) de-energizing the vessel;	

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c) complete death of the vessel or serious environmental damage caused by the damage to the vessel.

5 *An accident involving a vessel at sea shall be deemed to be an incident in case if an event or a series of events other than a maritime accident occurred in direct connection with the operation of the vessel which has threatened or, without being prevented, could threaten the safety of the vessel, its people or any other person, or the environment, namely:*

a) vessel standing and its grounding for 24 hours or less;
b) fire on the vessel;
c) failure of the steering engine.

6 *An emergency is a dangerous situation that was created as a result of...*

a) illness of one of the crew members;
b) reduced visibility at sea;
c) failure (malfunction) of the main equipment of the vessel.

7 *Collision is one of the types of navigation accidents, which means:*

a) contact or touch between vessels in the course of their movement;
b) touching of subsea objects of natural origin;
c) winding of fishing nets on the screw.

8 *The main causes of the collision are:*

a) vessel is only partially loaded;
b) vessel moves at night;
c) unsatisfactory observation, non-use or misuse of the ship's radar.

9 *A collision may create the following dangerous situation (emergency):*

a) limiting maneuver effectiveness of the vessel;
b) impaired water resistance, loss of buoyancy and stability due to water supply;
c) deterioration of navigation environment.

10. *In the event of an emergency or danger, it is important to correctly assess the priorities:*

a) safety of life, safety of the vessel, safety of the cargo and protection of the environment;
b) prestige of the company;
c) cargo safety and environmental protection.

11 *Fire or burning is:*

a) tragic phenomenon of burning combustible substances resulting in enormous material losses and loss of life;
b) rapid physicochemical oxidation reaction in which the burning substance (solid, liquid, gas) is combined with oxygen at a very high speed, thereby generating energy in the form of heat, light, smoke, toxic and poisonous substances.
c) act ofarson of the vessel.

12 *The main causes of fire on the ship are:*

a) safety violation;
b) negligent handling of open fire;
c) smoking in the wrong places.

13 *Features of fires that determine the emergency situation:*

a) constituting about 5 % of all emergency cases, 20 % of them end in death or complete destruction of the vessel;
b) significant duration of burning, but the critical period of fire control is 15 minutes from the moment of detection, if during this time the fire is not taken under control the ship will die;
c) numerous ways of spreading fire on the ship (radiation, convection, thermal conductivity, reactivity) and many damaging factors that prevent fire extinguishing (smoke, gas content, flame, high temperatures, possibility of explosions).

14 *If a fire is detected on the vessel, any crew member shall:*

a) immediately inform the watch assistant of the captain;
b) switch on the manual fire detector in the fire detection system;
c) having reported the place or area of fire occurrence, the crew member, without waiting for further orders and the arrival of the emergency response team, shall combat the fire with all available fire extinguishing equipment

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in the area and take all possible measures to limit the spread of the fire on the vessel and to prevent explosions.

15 *Knowing the exact location of the fire will help to determine:*
   a) specific place of work of the emergency response team and the class of fire to be prepared to combat;
   b) need to disconnect certain ventilation systems;
   c) make it possible to determine which doors and dampers should be closed to isolate the fire.

16 *Flooding is one type of navigation cases, which means:*
   a) shipwreck (i.e. the death of the vessel or its complete structural destruction, after which restoration repairs are not feasible) due to collision, docking impact, loss of buoyancy and stability, storm, ice and other damage, as well as displacement of the cargo and overturning or breakage of the vessel.
   b) opening of kingston valves;
   c) diversion.

17 *The main reasons for water entering the hull may be:*
   a) holes, fatigue cracks;
   b) rupture of the seams of the skin, honeycomb, violation of the tightness of the outboard closures of ship systems and devices;
   c) line leak.

18 *The basis of control over water entry into the hull are:*
   a) regular measurements of the water level in the bilge holding tanks of compartments;
   b) calculations made by the duty engineer;
   c) reports of eyewitnesses.

19 *Indirect signs of water entering the compartment may be:*
   a) noise of water entering the compartment; noise of water-extruded air exiting through ventilation and measuring pipes, necks and other openings of the main deck;
   b) water filtration through loopholes in places of bulkhead connection with longitudinal elements of the hull, pipelines, in places of cables laying, etc.; heating of flooded compartment surfaces;
   c) flat sound when hit by a metal object on the surface of the flooded compartment.

20 *Each crew member is obliged to:*
   a) inform the watch assistant or watch mechanic immediately. The timely start of the struggle for survivability largely determines the end result. The faster the ship's general alarm is announced, the faster the crew begins the battle for survivability, the more likely it is to minimize damage from the accident;
   b) without waiting for further instructions, clarify the location, dimensions, nature of the damage. If the damage is significant and the compartment is flooded, then this information is important for calculating the rate of flooding and choosing means to restore the waterproofness of the hull.
   c) if it is possible to de-energize the compartment and begin to repair the damage to the hull, and if this is impossible, then leave the flooded compartment, sealing all its closures.

The next stage includes the statistical processing of results. The questionnaire is scored in accordance with the question key shown in Table 02.

Table 2. Answers to the questions of the test questionnaire "Assessment of knowledge of possible types of emergency situations, such as collision, fire, flooding"

ANSWERS to the questions of the test questionnaire									
1	2	3	4	5	6	7	8	9	10
b	b	a, b, c	c	a	C	a	C	b	a
ANSWERS to the questions of the test questionnaire									
11	12	13	14	15	16	17	18	19	20
b	a, b, c	a, b, c	a, c	a, b, c	A	a, b, c	A	a, b, c	a, b, c

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According to the studies on this problem and to assess the level of formation and acquisition of knowledge in the developed course, it is advisable to apply a 3- tier approach: low (reproductive), medium (adaptive), high (professional, competent level).

The obtained results are ranked by the number of points scored and determined by the levels of knowledge acquisition, according to the characteristics described in Table 03.

Table 3. Determination of levels of acquisition of knowledge on possible types of emergencies

Quantitative characteristic of levels	Qualitative characteristics of levels
Low Level – from 1 to 7 points	It characterizes the fragmentation of maritime students' knowledge on the main types of emergencies, poor knowledge of the IMO requirements related to the safety of seafarers at sea.
Medium Level – from 8 to 14 points	It characterizes the mediocre level of knowledge which, in general, satisfactorily meets the requirements of conventional and professional training in the field of safety.
High Level – from 15 to 20 points	It characterizes respondents as serious and responsible students with solid and complete knowledge of the main types of emergencies.

The calculation of indicators and their statistical analysis made it possible to distinguish a high level of knowledge for clear actions in emergency situations in the field of studying the proposed methodology: from 70 to 100 % of the maximum number of points received for the diagnostic test questionnaire, and a low level insufficient to master the new methodology with the number of points less than 35 % of the maximum.

To verify the operability of this methodology, we conducted the ascertaining experiment, which included 30 cadets of the graduation course of Admiral Ushakov State Maritime University. These were young people between 22 and 23 years old, which passed two industrial practices on ships for six months each. The total swimming qualification of respondents is 12 months. This allows them giving correct and complete answers.

The obtained statistical results from the conducted test questionnaire correspond to the normal distribution, which was confirmed during the comparison of mode, median, average arithmetic and ranking of the results between the minimum and maximum number of points.

One of the main criteria for efficiency will be the coefficient of knowledge acquisition on possible types of emergencies in this group of participants (Kp), which we define as the ratio of correct answers of cadets to the total number of questions: Kp=N/K, where N – number of correct answers, K – total number of questions. As a result of the analysis of the obtained results of each respondent, we obtain the following statistical data (Table 4) from the results of the study of the group of participants.

Table 4. Results of the ascertaining experiment on the level of knowledge acquisition on possible types of emergency situations

Level	Number of respondents in a group	Acquisition coefficient
Low Level – from 1 to 7 points	1	0.03
Medium Level – from 8 to 14 points	16	0.53
High Level – from 15 to 20 points	13	0.44

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However, in addition to the main purpose – evaluating cadets by a number of parameters – the obtained test results were studied in particular to compare individual cadets and the group as a whole according to their knowledge in certain categories of the discipline.

The level of knowledge and competencies in this section of the guidelines for clear actions in emergency situations related to collision, fire and flooding of the vessel achieved by cadets in the study of the discipline "Initial Safety Training" may be assessed on the basis of a separate assessment of their levels of knowledge in each section of theoretical foundations of the studied discipline.

The received answers allow giving a general description of the level of knowledge of cadets in the field of possible types of emergency situations (collision, fire, flooding of the vessel). The answers of the respondents indicate that:

- 67 % know which document defines the classification of accidents (accidents and incidents) with ships at sea;
- 80 % correctly classify accidents with ships at sea;
- 30 % give the correct definition of an emergency case with a ship at sea referred to as the "accident";
- 87 % know what is meant by such an emergency case with a ship at sea as a very serious accident;
- 53 % clearly understand such an incident as an emergency case with a ship at sea;
- 100 % correctly understand the essence of the term "emergency";
- 77 % give correct definition to the term "collision";
- 100 % are familiar with the main causes of ship collisions;
- 73 % are aware of the danger of collision;
- 97 % can correctly assess priorities in the event of an emergency, dangerous or emergency situation on the vessel;
- 97 % determine exactly what a fire is on a ship;
- 50 % listed the main causes of ship fires;
- 27 % are aware of the peculiarities of fires that determine the emergency situation;
- 27 % are able to act competently when a fire is detected on a ship;
- 67 % understand why it is necessary to know exactly where the fire occurred;
- 97 % gave a complete answer to the term "flooding";
- 47 % gave the main reasons for water entering the hull;
- 97 % were able to explain the basis of control over the flow of water into the hull;
- 40 % named indirect signs of water entering the compartment;
- 50 % know the main actions of each crew member when detecting signs of water ingress.

The obtained test results show a low level of knowledge of cadets on such issues as the definition of the term "accident" – 70 %; incident – 47 %; main causes of ship fires – 50 %; features of fires, which determine emergency situation – 73 %; actions in case of fire detection – 73 %; main causes of water entering the hull – 53 %; indirect signs of water supply to the compartment – 60 %; main actions of each crew member when detecting signs of water ingress – 50 %, etc.

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These results make (a) the teaching staff focus the attention of cadets on the classification of emergencies, their causes, signs and necessary initial actions; b) cadets – on the expediency of strengthening self-training, self-education, self-improvement in actions in emergency situations.

The differences between cadets in the level of the studied feature – assessment of knowledge on possible types of emergency situations – were identified on the basis of the use of specialized statistical data packages.

The evaluation of significance, reliability, accuracy, consistency and validity of the proposed test questionnaire was carried out on the basis of statistical indicators of coefficients. The coefficients obtained according to the formulas of Spearman-Brown, Cronbach, Rulon varied from 0.93 to 0.96.

The validity of the presented test questionnaire means the suitability of the obtained test results for the intended purpose of the study. This confirms the fact that the test questionnaire is free from subjective factors and impartially measures the level of knowledge of maritime university cadets of clear actions in emergency situations. At the same time, the meaningful validity of the compiled test questionnaire means that all test questions completely cover the studied material, and at the same time, in the right proportion, all the main aspects of the discipline which is evaluated and measured by this test. The design validation test was carried out according to the calculated correlation coefficient based on the comparison of other tests on the scale “level of knowledge and readiness for clear actions in emergency situations”. The obtained high (0.86-0.95) correlation coefficient indicates the effectiveness of using the proposed methodology and that the test questionnaire allows determining the level of knowledge of maritime university cadets for clear actions in an emergency.

7. Conclusion

The main task of the hypothesis put forward within the framework of the methodology under consideration was the design of a test questionnaire aimed at determining the effectiveness of conventional training – the level of knowledge of maritime university cadets in clear actions in emergency situations, and confirming the proposed study hypothesis.

The proposed methodology is workable and may be effectively applied in the educational practice of maritime educational institutions.

The responses received from respondents make it possible to state that the graduates of a maritime university as a whole are trained on personal safety issues on a ship, they firmly know the main types of possible emergency situations on a ship, the logic and sequence of actions in case of collision, fire and flooding. The level of their personal responsibility for the results of mastering the training discipline is high, which is confirmed by the received answers to test tasks.

The results of the study with the help of a compiled test questionnaire may be used to improve the training of maritime university cadets, to conduct a comparative analysis of the level of knowledge on clear actions in emergency situations, to study dynamics and identify factors affecting various levels.

The practical significance of developing this methodology is undeniable, obvious and confirmed by the results of the study.

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