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Use of modern technologies at Naval Academy Varna

Ivan Conev [1*], Dimitar Dimitrakiev [2]

[1, 2] *Nikola Vaptsarov Naval Academy, Bulgaria*
[*] *Corresponding author: i.tsonev@nvna.eu; Tel.:* +359-888-435977.

Abstract: One of the most important guiding documents in shipping, which to a huge extent determines the safety of everyone involved is the Convention on the International Regulations for Preventing Collisions at Sea (COLREGS). The COLREGS are binding rules for all navigational officers and the insufficient knowledge, misunderstanding or non-observance of those rules usually leads to accidents. Often the result of such incidents is the loss of ships and, above all, of human life. The Convention sets out different obligations for shipmasters regarding maneuvering for passing, crossing and overtaking at sea, detailing which ships have priority in these cases depending on the circumstances and types of ships involved and what actions must be taken by ships obliged to give way, as well as rules for signals (lights, figures and sound signals) that ships must display or sound in various situations. This research aims to present the new approach to the maritime safety training at the Nikola Vaptsarov Naval Academy in Varna.

Keywords: Maritime safety, COLREGS, training, electronic platforms, simulators

1. Introduction

Shipping is perhaps the most important industry in the world, carrying according to United Nations Conference on Trade and Development (UNCTAD) statistics over 90% of goods in the world trade. In its report on trade developments for 2022, the conference noted that after a rapid but uneven recovery in 2021, the world economy is in the midst of cascading and multiplying crises, the most serious of which is the war in Ukraine and these crises decelerate global growth. For maritime transport, however, the recovery continues throughout 2022with moderate growth of 1,4% and the forecast for the period 2023-2027 is to expand by an average of 2.1% annually (UNCTAD, 2022).

At the same time, shipping is also among the most dangerous industries, with one of the main dangers being the risk of collision. More than 40 years after the entry into force of the COLREGS, despite improvements in navigational aids, sophisticated bridge equipment and attempts to raise training standards, collisions still occur, and unfortunately they happen quite often. Mistakes are usually made not because of insufficient or inadequate regulations, but because those regulations and standards are often ignored or not adequately understood. In the latest analysis that the European Maritime Safety Agency (EMSA) is doing on the investigated 573 incidents that happened in 2021, collisions between ships were 254 out of them, i.e. just over 44%. The cases of contact between the ships' hulls should also be mentioned here, because they are usually a consequence of non-compliance with the COLREGS – they are a total of 89 (15.5%). Or in summary – 343 (almost 60%) out of all investigated incidents were caused by ignorance or not following the Regulations. Although "human action" is about 78% of the total number of incidents, its distribution is different when it comes to an incident caused by non-compliance with the COLREGS: 83.5% of collisions and 70.8% of ship-to-ship contact. The EMSA study analyses also the factors summarized under "human action": wrong perception and interpretation of the situation - in 28 of the cases, lack of knowledge - in 30 and lack of abilities - in 23 (EMSA, 2022).

Safety at sea almost entirely depends on the professionalism and competence of seafarers, but part of overall safety is compliance with the COLREGS, which is the primary duty of officers in charge of a navigational watch. The development of the above-mentioned competence begins during the training of the future deck officers at Nikola Vaptsarov Naval Academy.

The COLREGS was adopted as a convention of the International Maritime Organization (IMO) on October 20, 1972 and entered into force on July 15, 1977 (IMO, 2018). By the end of 2021, the convention had been ratified by 165 countries, representing 99.03% of the world's merchant fleet tonnage. The Convention consists of 41 rules divided into six parts and 4 annexes.

There are three main documents that determine the requirements regarding competence related to COLREGS in Bulgaria:

The first of them, The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978 (STCW) requires every deck officer to possess such competence and defines it as knowledge, understanding and skills. Mandatory Part A of the STCW Code states, among other minimum standards of competence for navigational officers, that it is obligatory for every officer in charge of a navigational watch to possess and demonstrate "thorough knowledge of the content, application and intent of the International Regulations for Preventing Collisions at Sea" (IMO, 2011).

The second international document is the Model Course of the International Maritime Organization (IMO Model Course 7.03). The curriculum of the model course covers the requirements of the STCW Convention, Chapter II, Section A-II/1, which sets out in three functions the minimum compulsory requirements which the knowledge, understanding and skills of officers must meet. In the model course a detailed curriculum is developed and outlined, in particular the topics that relate to COLREGS (IMO, 2014). The undergraduate education at the Nikola Vaptsarov Naval Academy is entirely based on this model course, however naturally the topics and number of their classes are expanded.

The third document is the Ordinance No. 6 on the competence of seafarers in the Republic of Bulgaria (issued by Ministry of Transport and Communications), which introduces the requirements of the STCW Convention into Bulgarian national legislation and essentially sets the same requirements (MTITC, 2021).

Although there are many factors that threaten safety at sea, the general conclusion in all the studies mentioned above is that most accidents are the result of poor training and insufficient qualifications. That is why the necessary attention is paid to the education of students in maritime safety, including in COLREGS, at Nikola Vaptsarov Naval Academy. The importance of the Regulations is emphasized by the fact that the topic is studied twice in the undergraduate curriculum. The first time is at the end of the fourth semester (before the students undertake their initial shipboard practice) and consists of theoretical lectures to learn the COLREGS rules, combined with practical classes and simulator training. The second time is in their last eight semester (immediately before graduation and the final seamanship practice) and the training is only practical - solving tests and again exercises on a simulator. In both semesters students' knowledge is assessed in a semester exam. In addition, the first of the five state exams for graduation is of COLREGS. This is also one of the five exams before the Executive Agency "Maritime Administration" for which all applicants for the qualification "Officer in charge of a navigational watch" take part.

In order to increase the effectiveness of training of COLREGS, innovative means are also actively used - the electronic platform e-COLREGS and navigation simulators.

2. COLREGS revolution

The electronic platform e-COLREGS was created under the project "Avoiding Collisions at Sea" (ACTs) and was financed by the European program "Leonardo da Vinci". Its purpose is to create a new way of teaching COLREGS and has led to the development of a modular course for e-learning and e-assessment, available online on www.ecolregs.com. The platform has been developed for 2 levels of training – initial (the basic level) and advanced training.

2.1 Level for initial training

This part of the platform is used in the initial training of students in their fourth semester and is offered in 6 different languages - English, Bulgarian, Spanish, Turkish, Croatian and Slovenian (Dimitrakiev, Conev, 2020).

There are four sections – COLREGS course, assessment, Convention and information about the project.

All 41 COLREGS rules are presented in the course section, and in some places along with the text of the Regulation itself there are added and clarifying comments as well as links to other related regulations.

Part A ("General") includes only of the text of the first three Rules but Part B ("Steering and sailing rules") consists of more than 280 scenarios that could be met in real-life situations. In each scenario except a description of the situation there is also an explanation of which rule(s) to apply and why. When appropriate, the scenarios are accompanied by a bridge view (video), a radar screen view and an electronic chart view.

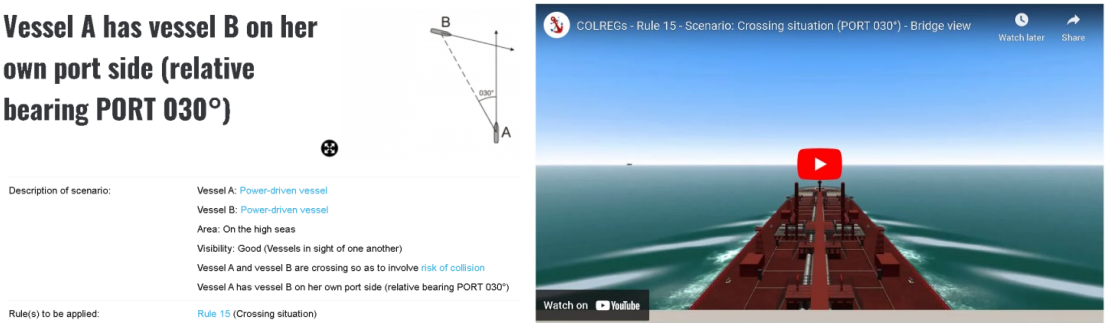

Figure 1. e-COLREGS Rule 15 Crossing situation - one of the scenarios

The rules in the other parts of the platform have been developed in a similar way. For ease of navigation in the platform, if a reference to another rule is indicated, it is made as a link and directly refers to the rule.

In the COLREGS assessment there are tests with 20 randomly generated closed-type questions with four possible answers. After answering each question, a pop-up window informs the participant whether the selected answer is correct or incorrect. The test ends with the final score in percentages and an overview of the participant's answers showing the correct ones.

2.2 Advanced level

This part of the platform is developed in English only and requires registration from participants. At Nikola Vaptsarov Naval Academy it is used to improve students' knowledge after they have already learned the Rules and completed their first internship on board a ship, where they saw their observance in practice.

Here the re are also 4 submenus, with only the first one differing from the beginner level. It is called "COLREGS Advanced Course" and there participants can find 18 additional complex scenarios between more than two ships and with necessity to apply multiple rules. These scenarios are designed to demonstrate training in three main types of situations: crossing, overtaking and head-on situation, which can occur in open seas, narrow channels, traffic separation schemes and coastal waters (Dimitrakiev, Conev, 2020).

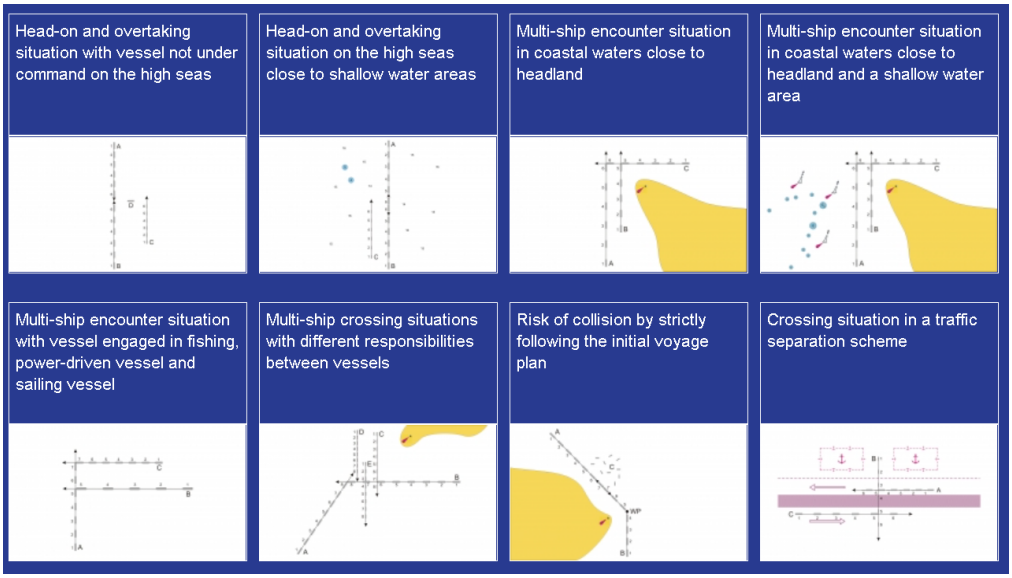

Figure 2. Advanced e-COLREGS – different scenarios

The tests in the "COLREGS Advanced Assessment" sub-menu consist of a closed-type question from four randomly selected scenarios. There are two to six questions for each scenario. After answering each question, a pop-up window informs the participant whether the selected answer is correct or incorrect. The test ends with the user's final score in percentages and an overview of the answers given, showing the correct ones.

3. A digital tide of knowledge

Recently, the importance of simulators in the education of students of technical specialties at Nikola Vaptsarov Naval Academy has been constantly growing, and they have become an indispensable part of the training. In all three regulating documents mentioned in the introduction, the use of simulators is specified, including the possibility of assessing professional competences through simulators. With the development of simulators, the training conditions can be more successfully brought to the actual operation of the ships.

There are a total of 40 navigation simulators at the Nikola Vaptsarov Naval Academy, 8 out of which are full-mission simulators (Class "A" according to the DNV classification (DNVGL 2020) with 360° visualization, and the remaining 32 are equipped with the same software, but with a partial visualization of 120° (Class “C”). They fully replicate the bridge configuration of an actual vessel, with engine and rudder controls and all navigational aids. Virtually all shipping scenarios (even these ones that could hardly happen in real life) can be played out on simulators, practically with any type of ship.

Usually, the simulator exercises are preceded by a session on the e-COLREGS platform (described above) to recall the rules and how they should be applied in complex situations.

The main use of simulators in COLREGS training is maneuvering for safe passing according to the Rules in various areas with certain specifics or with heavy traffic (Bosphorus and Dardanelles, English Channel and Dover, North Sea, Straits of Gibraltar and Singapore, important ports), areas where in practice it is necessary to continuously maneuver for collision avoidance. Students will have to apply the Rules repeatedly: make a correct assessment of the situation and recognize dangerous targets by determining the elements of their movement and the parameters of the passing, then take the right decision and maneuver when necessary - give way, reduce their speed or to stop the vessel if required in order to pass safely.

Figure 3. Maneuvering in a confined area

The exercise can be extremely complicated when such a maneuver has to be planned with several ships (sailing on different courses) at the same time or is carried out in conditions of restricted visibility. The instructor has the option to include other ships as targets to maneuver in the area in a certain set way. They can be ships with a special purpose or in a special condition (restricted in their ability to maneuver or

not-under-command), requiring positive and with due regard to the observance of good seamanship actions from the students. There is a possibility that during the execution of the maneuver (i.e. in real time) the characteristics of the targets' movement can be changed, thus complicating the situation even more.

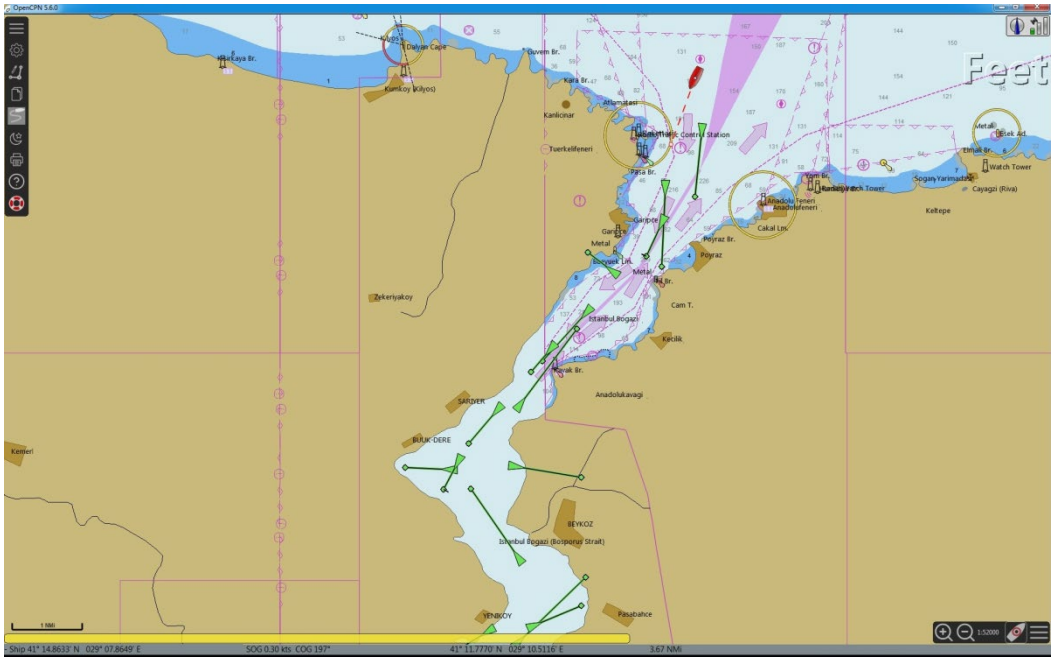

Figure 4. Passing Bosporus Strait with wrongly maneuvering vessels

Depending on the goals and objectives of the exercise, can be developed a scenario in which two training bridges (two ships) maneuver simultaneously in real time in the same area, in sight of each other. One bridge may even be assigned a task to maneuver against the rules in order to check and assess the response of the other bridge in such situation, so the trainees will be required to continuously monitor and evaluate the situation, as well as react timely and in correct manner to avoid collision. An extremely good feature of the simulator is that it can evaluate a large part of the trainees' actions according to pre-set criteria, independently of the instructor.

During the exercise, students have the opportunity to exhibit required lights or sound required signals in accordance with the COLREGS, to use signaling with the flags of the International Signal Code.

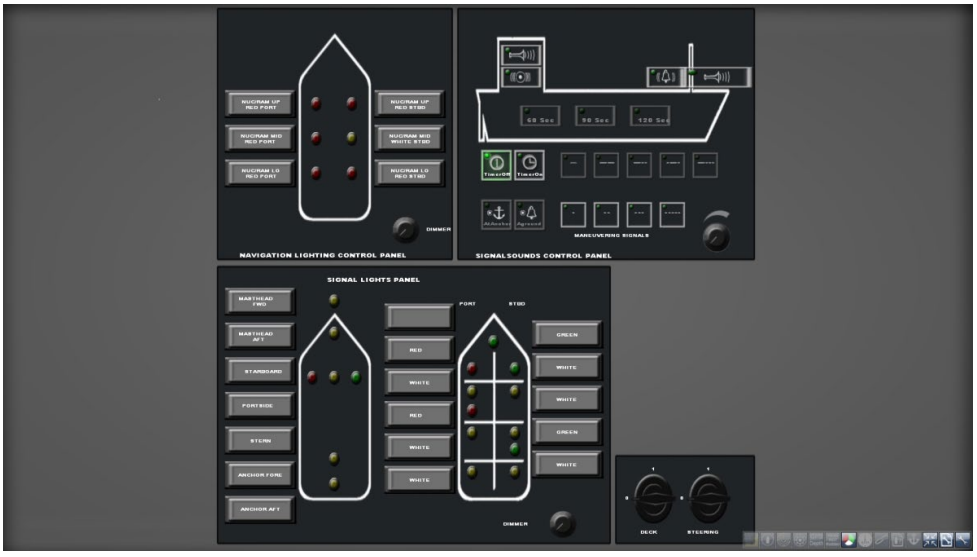

Figure 5. Iterface for exhibiting lights and sounding signals according to COLREGS

The instructor can also include a fault in one of the ship's navigation lights or controllers and assess how the students react. During the exercise they also have the opportunity to communicate through VHF with the target-ship (role performed by the instructor).

4. Anchored in innovation: the educational benefits

The described teaching method involving the use of the electronic platform e-COLREGS and navigation simulators offers several advantages and distinctions compared to traditional methods of teaching COLREGS such as interactive learning, real-time assessment and feedback as well as improved understanding.

Traditional methods, such as textbooks and lectures, often rely on passive learning, where students primarily absorb information through reading or listening, which may be less engaging. Contrary, by using an electronic platform like e-COLREGS, students can engage with the International Regulations for Preventing Collisions at Sea (COLREGS) in an interactive and multimedia-rich environment (Atanasova, 2022, Gramchev et al. 2023). This can lead to a better understanding of the rules and regulations, as students have the opportunity to explore scenarios and view visual representations.

The platform provides immediate feedback on quizzes and assessments, helping students gauge their comprehension and identify areas for improvement (Dimitrakieva et al. 2022, Ivanisevic et al. 2017). This immediate evaluation helps students understand the consequences of their choices and reinforces correct behaviors (Kitada et al. 2018, Suhrab et al. 2023). It also provides instructors with valuable insights into each student's performance. Moreover, the inclusion of navigation simulators allows students to practice applying COLREGS rules in realistic maritime scenarios (Grbic et al. 2021). Simulators help bridge the gap between theory and practical application.

The utilization of contemporary technology and electronic devices is likely to hold greater appeal for today's technologically adept students, thereby rendering the process of learning COLREGS more intellectually stimulating and contextually pertinent. While conventional pedagogical approaches may not fully exploit the expansive capabilities of contemporary technology in facilitating cognitive engagement.

The combination of e-COLREGS and navigation simulators emphasizes the importance of safety at sea (Alop, 2019). Students learn not only the rules but also the practical implications of safe navigation and collision avoidance (Zhao et al. 2019, Wei et al. 2022). This can instill a strong sense of safety awareness, which is crucial in the maritime industry.

In addition, by using an integrated approach with electronic platforms and simulators, training programs can ensure that students meet international and national regulatory standards related to COLREGS knowledge and competence.

5. Conclusions

The integration of electronic platforms like e-COLREGS and navigation simulators into maritime education marks a transformative era in the instruction of the International Regulations for Preventing Collisions at Sea (COLREGS). This innovative approach not only enhances understanding but also bridges the gap between theory and practice, instilling a profound sense of safety awareness among students.

Furthermore, the self-checking features underscore the effectiveness of this combined methodology. This definitely makes the topic more interesting and attractive for the students. Ease of use and convenient interface have turned the platform and simulators into a valuable aid in students' learning. This is also the opinion, which the majority of students expressed during discussions. By utilizing technology and simulations, this approach not only caters to the evolving preferences of technologically proficient learners but also serves as a dynamic catalyst in preparing seafarers for the multifaceted challenges of the maritime industry.

Ultimately, the method provides an engaging, effective, and contemporary educational framework that propels maritime safety training into uncharted waters of excellence.

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