Interactive module "Environment protection" of Maritime English course on LMS Moodle for future ship engineers

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Abstract. As the maritime industry continues to evolve, the imperative to prioritize environmental protection and sustainability becomes increasingly evident. Future ship engineers play a pivotal role in ensuring the maritime sector's compliance with stringent environmental regulations and the reduction of its ecological footprint. This scientific article presents an innovative interactive module designed to educate and engage future ship engineers in the vital area of environmental protection within the context of a Maritime English course. The module integrates cutting-edge pedagogical techniques, multimedia resources, and collaborative learning activities. The module's content is structured to cover crucial topics such as international environmental regulations, emissions control, ballast water management, and sustainable maritime practices. It fosters a comprehensive understanding of environmental challenges facing the maritime industry and equips future ship engineers with the knowledge and skills necessary to address them effectively. The interactive nature of the module encourages active cadet participation through quizzes, case studies, discussions, and games. Additionally, it provides real-time feedback and assessment tools for teachers to gauge cadets' progress and comprehension. By utilizing Moodle's collaborative features, cadets can work together on group projects and exchange ideas with his groupmates. The results of this research demonstrate the module's effectiveness in enhancing cadets' environmental awareness, knowledge, and their ability to apply sustainable practices in their future careers as ship engineers. Furthermore, it highlights the potential for scalability and adaptation of this module to other educational contexts, thereby contributing to a more sustainable and environmentally conscious maritime industry.

Keywords: Environmental awareness, MARPOL, Online courses, Digitalization

1. Introduction

The maritime industry, a cornerstone of global trade and commerce, faces an increasingly pressing challenge nowadays: environmental sustainability. As the international community grapples with climate change, pollution (including those produced by military operations in Ukraine), and the depletion of natural resources, the need for responsible and ecologically conscious practices within the maritime sector has never been more critical. Central to meeting

these challenges are the future ship engineers, who will bear the responsibility of ensuring that the industry not only complies with rigorous environmental regulations but also pioneers innovative solutions for a more sustainable future. Environmental protection in the maritime sector extends beyond the boundaries of technological advancements and regulatory compliance: it demands a fundamental shift in the mindset and education of those who will work on the ships of tomorrow. Recognizing this imperative, this scientific article introduces an interactive module tailored specifically for a Maritime English course, hosted on the Learning Management System (LMS) Moodle [1], to equip future ship engineers with the knowledge, skills, and ethical foundation necessary to address the environmental concerns facing the maritime industry.

The objectives of this article are the following: first, to elucidate the pressing environmental challenges confronting the maritime sector, ranging from emissions reduction to the preservation of marine ecosystems, and second, to present a novel educational approach that bridges the gap between linguistic proficiency, technical expertise, and environmental stewardship. This innovative module harnesses the capabilities of digital learning platforms and incorporates modern pedagogical strategies to cultivate a generation of maritime professionals who are not only fluent in Maritime English but also environmentally conscientious and proactive.

2. Literature Review

Numerous studies emphasize the importance of integrating environmental education into maritime curricula [2, 3, 4, 5]. M. Cieśla and T. Opasiak presented the data of a survey among seafarers to determine the level of understanding of situational awareness as a predominant component of the human factor in most accidents in the maritime industry. They concluded the seafarers have lack of basic knowledge about the phenomenon of situational awareness, as well as a lack of skills due to insufficient training in the training center [2]. P. Chan, R. Norman, K. Pazouki, and D. Golightly in their research proposed various techniques such as being mindful of the environment and staying vigilant which allow individuals to improve their situational and environmental awareness [3]. D. Moroni, G. Pieri, M. Reggiannini and M. Tampucci proposed to use a mobile crowdsensing app to improve maritime security and awareness [4]. Thus, many initiatives seek to empower future ship engineers with the knowledge and skills needed to navigate the complexities of environmental challenges, such as emissions control, ballast water management, and sustainable practices. But the "Environment Protection" module within the Maritime English course on LMS Moodle [5] represents a timely and innovative effort to equip

future ship engineers with the necessary skills and knowledge to address the environmental challenges of the maritime industry.

3. Methods

The experiment was conducted at Structural Unit of "Maritime Applied College" of Kherson State Maritime Academy (KSMA), Ukraine. 81 ship engineering cadets (men, 17-19 years old, pre-intermediate - intermediate level of English, same study conditions and curriculum) took part in the study. Cadets were divided into two groups: control (40) and experimental (41). The two groups are mostly the same. The experimental group included cadets K231 and K232, the control group - K233 and K234. Participants of the experimental group studied English as assigned using the LMS MOODLE e-course of two teachers.

During the research, the following methods were used: observation, study of practical experience, verification of creative works and application of tests. The state of the experiment of future ship mechanics was constantly monitored, the results of the students' activity were recorded. Experimental verification of the effectiveness of the obtained results and statistical analysis were carried out.

4. Results

The modern method of the educational process is a kind of mixed learning, that is, a combination of the traditional form of acquiring knowledge with elements of electronic distance learning (Learning Management System): modern information technologies. The participants of the experiment were offered to use the LMS Moodle platform, where students could find not only learning materials (according to different modules) and training exercises, but also communication in individual rooms, group discussions, creating projects, which is more attractive in the sense that it allowed more differentiation of learning. They were also more satisfied with learning Maritime English, everyone could choose a level to take the test and subsequently improve their score. Also, attendance at online classes has improved, and students have increased their diligence. In the classroom, the cadets demonstrated better individualization than in the traditional classroom. They learn the material more easily, and develop critical and creative thinking.

The module's content is structured to cover crucial topics such as international environmental regulations, emissions control, ballast water management, and sustainable maritime practices. Students get acquainted with the problems and accidents which took place in the past

decades to predict operation of vessels as a factor of marine pollution in future. Oil with numerous products of its processing has become one of the main substances that pollute waterways. There are many sources of water pollution with oil products: coastal industrial enterprises, oil refineries, oil terminals, storage facilities, pipelines, oil production drilling rigs, ports. Future professionals have a unique responsibility to learn how to be good managers of oceans and waterways, minimizing human impact on the environment both at sea and onshore, thereby conserving waters for recreation and livelihoods. In case of improper handling with spilled fuel, toxic detergents and paints, waste tanks, and plastic that has fallen into the water lead to spread of pollution of the marine world.

Students study MARPOL regulation which in total has VI Annexes. Annex I (Rules for the Prevention of Oil Pollution) of MARPOL provides for severe restrictions on the discharge of oil, oil residues, oily waters and a complete ban on discharge in special areas specified in the Annex (the Black, Mediterranean, Baltic, North and Red Seas, areas of the Persian Gulf, northwestern Europe, Antarctica and the Caribbean). For other places, dumping is allowed, but is subject to a number of strict conditions.

Annex II - Rules for the Prevention of Pollution by Noxious Liquid Substances, transported in bulk, provides for the division of bulk chemicals into 4 categories according to their degree of toxicity and potential harm, and their discharge from tank cleaning or ballast discharge may cause harm to marine resources and human health. The Annex establishes maximum concentrations of harmful substances during discharge or completely prohibits such discharge.

Annex III - Rules for the Prevention of Pollution by Harmful Substances Carried by Sea in Packages, provides general rules relating to packaging, labeling, documentation, stowage and limits for hazardous substances carried in packages.

Annex IV - Rules for the Prevention of Pollution by Sewage from Ships, deals with regulations relating to the discharge of sewage from ships, ship equipment for the control of discharge of sewage, and reception facilities for the reception of sewage in ports and terminals.

Annex V - Rules for the Prevention of Pollution by Garbage from Ships, establishes strict limits on the dumping of garbage into the sea in coastal waters and special areas, completely prohibits the dumping of garbage made of plastic, and imposes restrictions on the dumping of garbage made of paper, rags, glass and metal. As plastic waste occupies a leading position in terms of the amount of input and the amount of pollution of the marine environment. Plastic waste forms

entire garbage patches floating in the oceans. They require careful monitoring, as they not only pollute the surrounding marine environment, but also create a serious threat to living organisms and a navigational obstacle for ships. The Annex also provides for the provision by States Parties of garbage reception facilities at ports and terminals. Special areas for the purposes of the Annex are the Black, Mediterranean, Baltic, North and Red Seas, the Antarctic region, the Caribbean Sea basin region.

Annex VI - Rules for the Prevention of Air Pollution from Ships, describes measures to prevent air pollution, including ozone-depleting substances, nitrogen oxides, sulfur oxides and volatile organic compounds.

With more than 70% of water covering our planet, the maritime industry thrives every day, and therefore shipping, which is entirely responsible for sea and cargo transport, is one of the powerful sources of marine pollution. With such rapid industrial growth, the marine ecosystem will inevitably be disrupted by unwanted problems such as marine litter and the effects of marine pollution. Marine litter and associated debris have been declared a major cause of global ocean pollution. In today's conditions, international agreements on the prohibition of dumping polluted waters and garbage into the open seas and oceans are of primary importance.

Water transport is the most economical, as it moves on the surface of the water, which performs a supporting function. Historically, water transport used human muscle power or wind energy, thus being environmentally friendly. Currently, water transport objects move on the basis of the energy of internal combustion engines, which is mainly due to their impact on the environment. All ships built after the entry into force of the international Convention MARPOL 73/78 must meet its requirements in terms of environmental protection; ships built prior to this date must be modernized to comply with the provisions of MARPOL 73/78 and national environmental regulations. The main operational shipborne pollutants can include oily and waste water, garbage and emissions into the atmosphere. The main part the global shipping industry is slowly but surely mastering new standards for the sulfur content in marine fuels, which will solve the problem of air pollution with sulfur dioxide [6, 7]. According to the 2005 annexes to the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78), the sulfur content of fuel on any ship in any water shall not exceed 4.5%. Now this standard looks outdated: the International Maritime Organization (IMO) plans to make 0.5% mandatory by 2025 [8].

While shipping plays a critical role in today's financial world, it should not come at the expense of the environment. With care and proper planning, ship owners can help reduce their environmental impact (slow evaporation, use of efficient ships and clean energy to reduce harmful emissions, proper and timely engine maintenance, use of absorbent materials to collect any spills, installation of oil a tray to collect any grease leaks). Ship owners can also minimize the amount of waste they produce and manage it well. Although this may seem like a daunting task, it is important to remember that even a small change can go a long way in saving the environment

In practice, reducing the sulfur content of the fuel leads to the abandonment of fuel oil and the use of either diesel fuel or low-sulphur fuels such as liquefied natural gas (LNG). The only alternative to the rejection of heavy fuel for the time being is the installation of special gas cleaners on board the ship to filter the exhaust of the main engine. Both options are expensive for shipowners. Since fuel costs account for 30% to 60% of all operating costs in maritime transport, even a partial switch to environmentally friendly fuel significantly increases freight rates - by 25-40%. Ports around the world are now exploring the possibility of switching to liquefied natural gas, which contains virtually no sulfur. An excellent alternative from an environmental point of view. The benefits of using LNG in maritime transport can be significant. Percentage reduction in atmospheric emissions of the container ship, the world's first LNG container ship, was 98% for particulate matter, 97% for sulfur oxides, 72% for carbon dioxide, and 60% for nitrogen oxides. Use of liquefied natural gas as a fuel for the main ship engines, as well as for the production of electricity to meet the needs of ships while they are in ports - it helps to curb the growth of pollution and comply with the increasing environmental restrictions of the International Maritime Organization (IMO), operating under the auspices of the OUN [9, 10].

Sea and river vessels pollute the biosphere with waste from operational activities and emissions in cases of ship accidents with toxic cargoes, mostly oil and oil products. You can prevent sea pollution with garbage by following simple rules. It is necessary to properly collect garbage, process it and burn it.

5. Conclusion

The interactive module "Environment Protection" integrated into the Maritime English course on LMS Moodle represents a significant advancement in the education of future ship engineers. This module was conceived and designed with the dual purpose of equipping maritime cadets with the linguistic and technical proficiency required in their field while instilling a deep

sense of environmental responsibility. Throughout the paper, the critical role of future ship engineers in addressing the pressing environmental challenges facing the maritime industry was outlined. And detailed description of the module's content, design, and assessment methods was provided. This innovative educational approach, which seamlessly integrates language learning (Maritime English) with environmental awareness, has demonstrated its potential to bring about meaningful change in the maritime education landscape.

This module not only enhances cadets' comprehension of environmental issues but also fosters their ability to apply sustainable practices effectively. The incorporation of interactive elements such as quizzes, case studies, discussions, and collaborative projects (e.g. H5P, Assignment) has encouraged active engagement and critical thinking among cadets. The real-time feedback and assessment tools have facilitated continuous improvement, ensuring that learners are well-prepared to meet the complex demands of their future careers. The scalability and adaptability of this module to various educational contexts and institutions underscore its potential to promote environmental protection on a broader scale. By nurturing a new generation of maritime professionals who are not only linguistically adept but also environmentally conscious, we can contribute to the global effort to reduce the ecological footprint of the maritime industry which is so important nowadays.

The prospect of further research can be seen in investigation of the ways in which future ship engineers can engage with local and global communities to promote environmental awareness and sustainable practices beyond their roles on ships.

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