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Addressing Environmental Concerns in Tertiary Education

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Abstract. Marine pollution is a problem that is becoming more and more important for the sustainable use of oceans and blue growth. People who appreciate the significance of this problem are taking steps to raise awareness about the issue and educate all concerned to prevent it. In line with this, higher education institutions have started to educate their students to contribute to these efforts and to create an environmentally conscious generation. The introduction of new regulations to limit emissions and of new technologies to help to remove emissions, imposed development of cutting-edge programs in this context. The purpose of this paper is to determine what such a program addressing the needs of maritime in the future regarding marine environment protection should contain. One of the ways to determine the content of these programs is to ask for the opinions of the stakeholders in the sector. To see what their viewpoints and suggestions are, a 5-point Likert survey with 10 questions about issues related to the marine environment protection is used and outcomes of the survey were reinforced with a follow-up benchmarking study to determine the most suitable answer to the needs of stakeholders. Survey results pointed out the importance of the use of technology to minimize marine pollution, environmentally safe port and shipping operations, ecosystem-based approaches in the whole sector, and the benefits of the development of integrated maritime strategies to protect the marine environment. Taking these topics into consideration while preparing the contents of the courses about the marine pollution prevention and environment protection will help raise a more environmentally conscious generation who can protect and restore nature and provide ecological sustainability.

Keywords: Blue growth, sustainable development, marine pollution, tertiary education, environmental awareness

1. Introduction

One of the biggest concerns of the conscious people in today's world is pollution, which may be in different types. No matter what type, pollution causes harmful changes in the natural environment. Three major forms of environmental pollution are air pollution, water pollution, and land pollution [1]. Pollution can also refer to excessive human activity, such as light and noise pollution, or to specific pollutants such as plastic or radioactive material [2]. Of these, marine pollution, which is described as a combination of chemicals and trash, most of which comes from land sources and is washed or blown into the ocean, badly affects life in and out of sea [1].

Water covers approximately 71% of the surface of the Earth [3]. Although water is vitally important for life, people have damaged marine life in many ways such as habitat destruction, carbon emissions, chemical pollution, oil spills, plastic pollution, and overfishing [4]. Main reasons for marine pollution are lack of effective solid waste management, insufficient waste water treatment, inadequate corporate social responsibility, littering, illegal dumping and natural disasters [5]. Apart

from these, marine life faces threats in many ways, such as overexploitation and harvesting, deposit of waste, contamination, exotic species, soil recovery, dredging and global climate change [6]. Current pollutant concentrations in the marine environment are expected to continue increasing with global population growth and product production [7]. Although there are people who have realized how serious the situation is and how important it is to take urgent measures against this, it seems that it will take time to raise awareness in all stakeholders to make use of the seas without harming them.

2. Literature Review

People who were affected by marine pollution in both direct and indirect ways and who were aware of the irreparable danger it may cause in the future have started to take actions against it in formal and informal ways. They have tried to raise the awareness of others and to reach as many people as possible by holding meetings, organizing campaigns, and demonstrations.

On the other hand, there are conventions signed by governments such as MARPOL (The International Convention for the Prevention of Pollution from Ships), which is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. The MARPOL Convention, which was adopted on 2 November 1973 at IMO, includes regulations aimed at preventing and minimizing pollution from ships - both accidental pollution and that from routine operations [8]. The aim of the convention is the creation of a combined responsibility system and structures for pollution caused by ships for affected parties [9]. Other than those for pollution caused by ships, there are more conventions for pollution caused by other actors, such as sewage, toxic chemicals from industries, littering or ocean mining. Basel Convention, the UN Convention on the Law of the Sea, the Ocean Plastics Charter; the UN Resolution on Marine Litter and Micro Plastics are among these [10].

One of the most effective ways for the protection of not only marine environment but also environment in general is to train and educate all parties concerned. This may be possible through informal ways such as public campaigns, conferences, announcements or through formal ways such as by embedding courses that contain subjects related to this issue in the curriculum of schools or modify the content of existing courses in a way to include these subjects. Today, universities, especially maritime universities, all over the world have courses directly related to this issue. Some universities even offer undergraduate or master's degree programs to their students who want to specialize in this particular issue. According to the websites of universities, undergraduate programs focusing on marine pollution come under different names such as "Coastal and Marine Environmental Science", "Marine Environment and Engineering", "International Maritime Environmental Policy" or "Marine Science, Safety, and Environmental Protection". There are also postgraduate programs which focus on marine environmental issues such as "Specialization Studies Maritime Law & Policy" and "Specialization Studies Ocean Sustainability, Governance & Management" at World Maritime University, "Maritime Safety & Environmental Management" program at Dalian University or the joint program given by the Lloyd's Maritime Academy and the World Maritime University together.

Apart from the universities, there are some institutions which give certificate training and education on the prevention of marine pollution. Among the most significant programs of this kind are *Certificate in Marine Pollution Prevention and Management* program given by Lloyd's Maritime Academy, *Marine Environment Protection Training - MARPOL / OPA 90*, *MARPOL Training Courses*, *Petroknowledge General Awareness Workshop*. The courses offered by these programs change with respect to the particular subject they aim to specialize in pollution prevention, environmental management or marine ecology.

According to the web sites of universities there are 45 different courses at the undergraduate level and 18 different courses at the graduate level which aim to prevent marine pollution or to protect marine environment. The names of these courses are given in Appendix A and Appendix B.

The courses that are given in these programs and their contents are determined in line with the changes and expectations in the maritime world. In this study, we tried to find out underlying concerns of the stakeholders regarding marine environment. In this way, we tried to determine the issues that should be taken into consideration while preparing the contents of these courses.

3. Method and Results

The survey used in this study is a survey which was developed in the frame of MINE-EMI (Maritime Innovative Network of Education for Emerging Maritime Issues) Project. The aim of this project is to determine emerging issues in maritime to shape the maritime education of the future. The survey was sent to stakeholders in the maritime sector such as chambers of commerce, educational institutions, shipyards, tourism and port companies, student organizations, etc. It was responded by 224 people. Approximately 56% of the respondents were academicians and students in higher education institutions. The remaining 44% were stakeholders from the sector. The survey contained 50 questions to be responded in 5-point Likert Scale. 10 questions in the survey were directly related to environmental issues. These questions can be seen in Table 1 with their mean and standard deviation values.

Table 1. Statements on the environmental issues and figures related to them

		N	Mean	Std.Dev.
1	Use of technology to address environmental and emission issues.	189	4,58	,668
2	Sustainable ship recycling	188	4,51	,763
3	Salvage: Dealing with crisis quickly and preventing container ship fires	189	4,49	,689
4	Port's social responsibility: Socially responsible behaviour and concerns for human safety, Environmentally safe operations etc.	189	4,44	,753
5	Decarbonisation of ships and ports operations	188	4,39	,816
6	Marine Eco-Environmental Protection; Ecosystem-based approaches into the planning of marine area management	188	4,37	,738
7	The Circular Economy: reducing waste by closing the loop in the supply chain, sustainable marine fuels from waste.	187	4,36	,794
8	The benefits of Marine Protected Areas	189	4,35	,822
9	Climate change; the effects on marine realm, development of new emission control areas.	188	4,33	,813
10	Bunkering: Operational feedback post implementation of the 2020 Sulphur Cap.	189	4,09	,832

The statements with the highest mean are given before the others in the table. Survey results made it clear that environmental issues were the top concern of the participants. Other issues addressed by the survey were mainly related to management, innovations in education and use of technology.

The statements are intended to prevent harmful effects of environment pollution either by putting some legislative regulations or by raising awareness among people. They cover a number of efforts exerted by stakeholders in the sector or some ideas that were advised to be put into practice to minimize or abolish the harmful effects of various operations. The distribution of the participants' responses for these statements are given in the following figures:

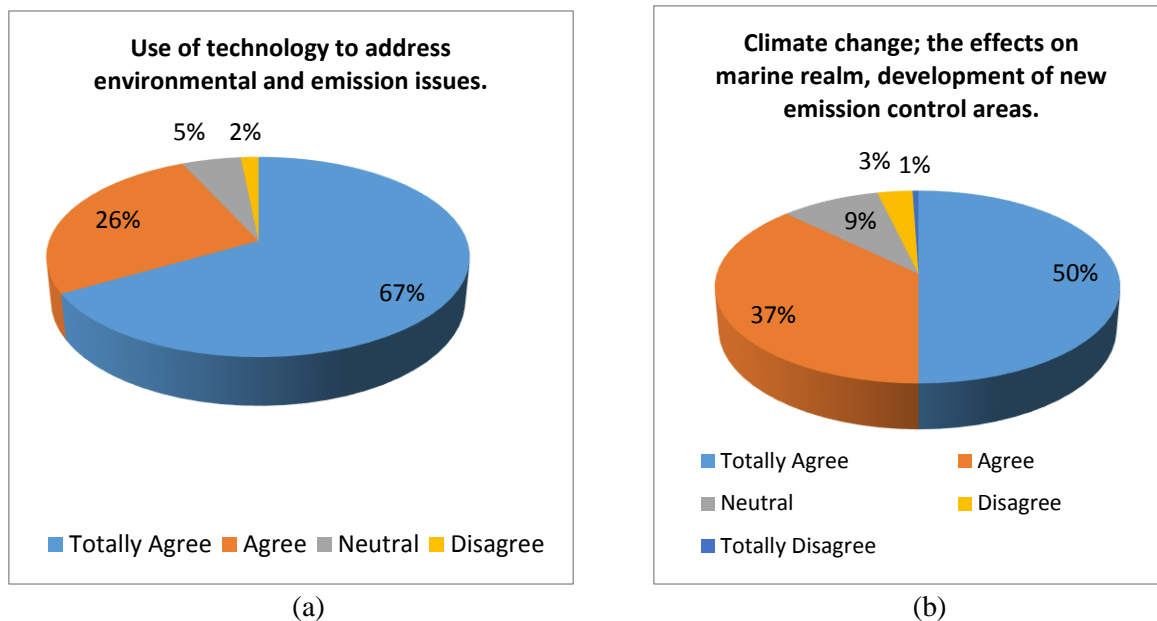


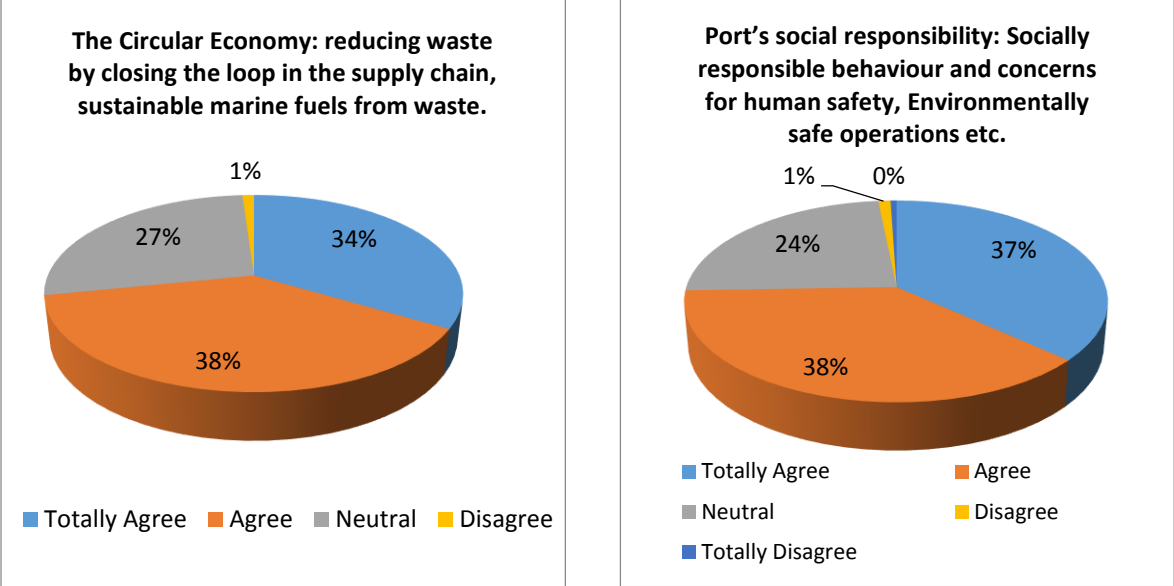
Figure 1. Responses for the statements about the use of technology (a) and climate change (b)

The statement “Use of technology to address environmental and emission issues” had the highest score from the respondents, which means they prefer technology to be used to solve these problems, most probably because it gives better, faster, and more effective results. Figure 1 (a) shows the percentage of the distribution of participants' choices for this statement. 93% of the participants voted in favour of making use of technology while dealing with these problems.

Climate change which is triggered by pollution is another issue the importance of which was emphasised by the participants. They appreciate that it has become a defining issue of today. Winter temperatures in the Arctic have risen by 3 °C since 1990, sea levels are rising, coral reefs are dying, and people are starting to see the life-threatening impacts of climate change on their health, through air pollution, heat waves and risks to food security. These impacts are being felt globally, across regions and across industries. There is a global push to boost ambition and accelerate actions to implement the Paris Agreement on Climate Change [11]. All these factors caused the stakeholders in maritime, like everybody else, raise awareness about the climate change and its effects on marine realm. Figure 1 (b) shows that 87% of the participants accepted that climate change was an important issue and it should be included in the contents of the courses to increase the environmental awareness of the students.

Next item is related to circular economy, which aims the transition to renewable energy sources relies on three words; reduce, reuse, recycle [12]. There is a global transition to circular economy which focuses on eliminating waste and encourages continuous use of resources. Four principles common to the circular economy can be integrated into the port and shipping sectors. They are maintaining, reusing, remanufacturing and recycling [13]. Closed loop supply chain management is not different from the circular economy. It seeks to maximize economic benefits, to decrease the consumption of resources and energy and to reduce the emissions of pollutants – all in an effort to create a socially responsible enterprise, and to balance the economic benefits, social effects and environmental effects [14]. Figure 2 (a) shows that 77% of the participants agreed that employing the principles of circular economy would help reduce pollution. One of the ways to make this possible is by reusing the waste by producing sustainable marine fuels from it. The same idea was also emphasized in the closed supply chain management.

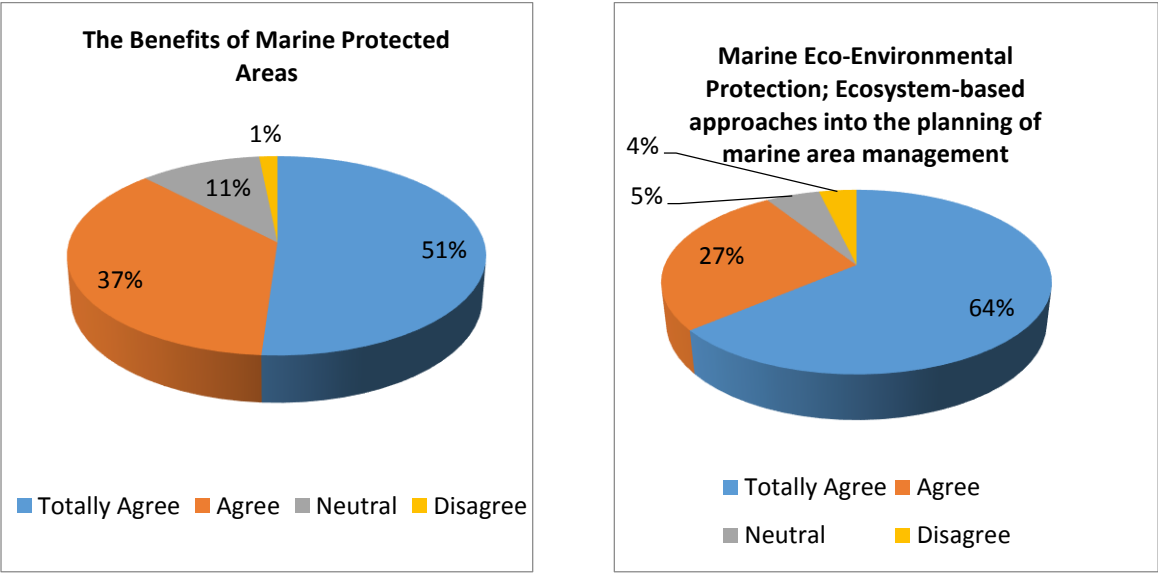
Another point stressed by the participants is the social responsibility of the ports. Socially responsible behaviours from all stakeholders in the sector will increase the awareness of people for the pollution in the seas and will force them to take some measures to prevent it. Figure 2 (b) shows that 75% of the participants believe in the power of socially responsible behaviours.



(a)

(b)

Figure 2. Responses for the statements about the circular economy (a) and ports' social responsibility (b)



(a)

(b)

Figure 3. Responses for the statements about the benefits of marine protected areas (a) and marine eco- environmental protection (b)

Next item in the list is related to marine protected areas (MPA). A marine protected area is basically an area of the ocean where human activities are more strictly managed than in the

surrounding waters, in a similar way protected areas and parks operate on land [15]. MPAs have been established because the ocean and the things that live in it face dangers such as threats to the ocean which include overfishing, litter, water pollution, and global climate change [16]. This requires people to exert extra effort to protect these areas and provide the sustainability of the resources there. The ecosystem approach focuses on understanding the relationship between human society and the ecosystems that support it and how this can inform management decisions. The advantage of this approach is that it offers opportunities for identifying sustainable uses of the sea [17]. As Figure 3 (a) shows, its importance was appreciated by 88% of the participants. That means it was appreciated by the majority of participants that this issue will be significant for the future generations in the maritime sector. On the other hand, 91% of the respondents think that a strategy for an ecosystem based management system which links the theory of environmental policy to the practice of environmental management should be developed. The aim of such strategies is the maintenance of ecosystem integrity while enabling the sustainable use of ecosystem goods and services. It is emphasized by the participants that the course contents should be designed to cover these issues.

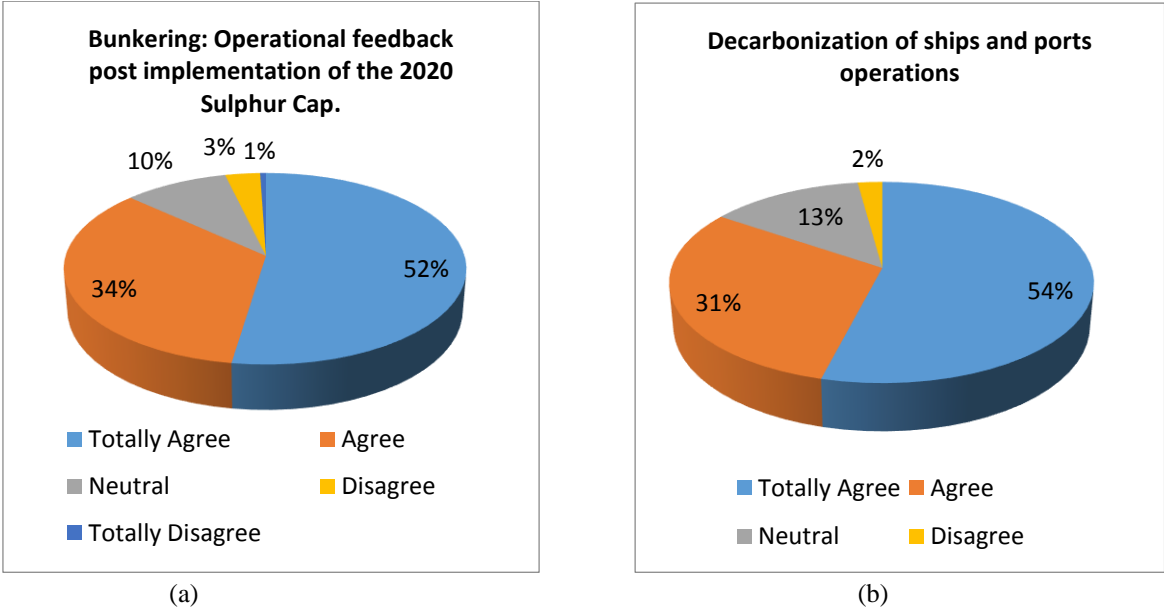


Figure 4. Responses for the statements about implementation of the 2020 Sulphur Cap (a) and the decarbonisation of ships and ports operations (b)

Figure 4 (a) shows that the majority of the participants would like to get operational feedback post implementation of the 2020 Sulphur Cap which aims to reduce atmospheric pollution from ships [18]. It is essential for the ship operators to seek to ensure that appropriate bunkering procedures and sampling practices are followed. In addition to the standard procedures normally followed during bunkering, best practices relevant to the implementation of the Global Sulphur Cap, and the anticipated new grades of fuels to be used, should be followed. The deadline for compliance with the MARPOL Annex VI 0.50% m/m sulphur cap requirements was 1st January 2020 [19]. The experiences and best practices about this issue should be shared among all involved parties so that better measures can be taken against pollution deriving from the sulphur content of fuels. 86% of the participants stated they wanted to get back operational feedback on this issue.

Decarbonization which can be considered as the starting point for greenization is another significant issue that will shape the future activities in the maritime. Figure 4 (b) shows that 85% of

the participants expressed their positive views on the importance of these issues. It is clear that this view will be taken into consideration while preparing the content of the relevant courses.

Next issue evaluated within the frame of environment pollution is the pollution caused by the recycling and salvage processes. Ship recycling industry which dismantles old and decommissioned ships enabling the re-use of valuable materials is a vital part of the circular economy, which purports to minimise waste and recycle some materials infinitely. However, this process has highly concerning environmental and human impacts, releasing materials such as oil, asbestos and toxic paints into the local environment, and disrupting biodiversity. There have been local attestations of significant pollution to the surrounding environment and its resultant impacts on wildlife, farming and communities [20].

The term salvage refers to all services rendered to save property from marine peril. It includes actions undertaken not only to save the vessel or cargo, but also wreck removal, harbour clearance, and deep search and recovery. Among the services it provides is preventing pollution in addition to providing fire fighting assistance or refloating a vessel from stranding [21].

The traditional role of the salvor has been to save a distressed ship, her cargo, and sometimes the lives of the crew. This role has changed with growing public concern for the environment. Nowadays it is more important to prevent environmental damage than salvaging the ship and cargo if the ship is carrying a potentially polluting cargo. International Convention on Salvage adopted by IMO defines damage to environment as "substantial physical damage to human health or to marine life or resources in coastal or inland waters or areas adjacent thereto, caused by pollution, contamination, fire, explosion or similar major incidents" [22]. Such an action requires compensation of various sizes, but what is important is the importance given to the environment by those working in the sector. Environmentally safe operations of the parties related to ship recycling and salvage are appreciated by the stakeholders and they want this issue to be addressed in the programs addressing prevention of marine pollution in the HEIs. Distribution of the responses from the stakeholders to these two statements are given in Figure 5 (a) and (b).

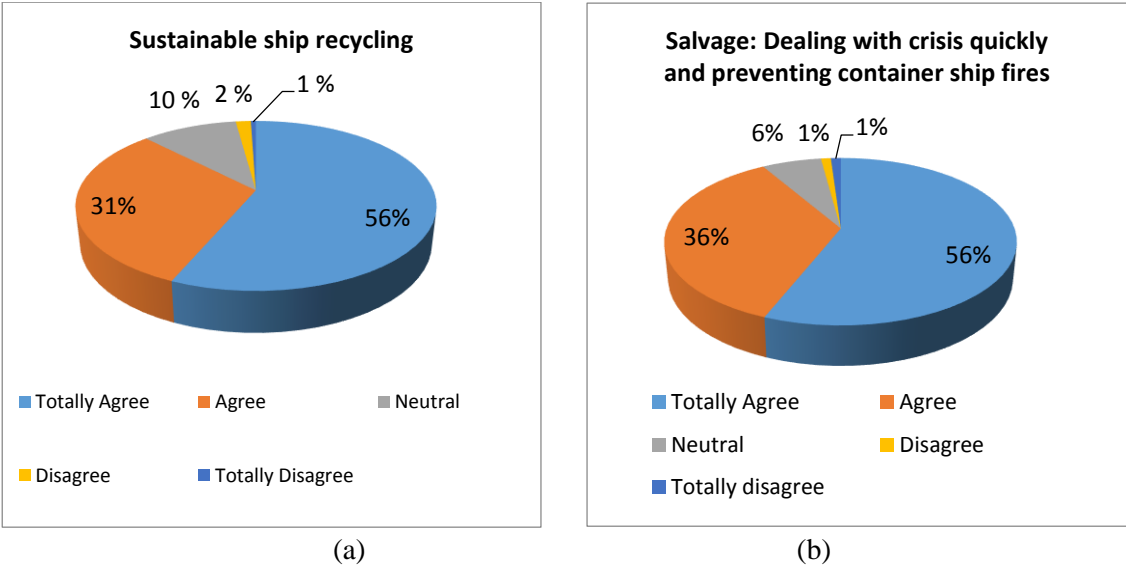


Figure 5. Responses for the statements about sustainable ship recycling (a) and (b)

4. Conclusion

Survey results proved that there was growing concern about environmental issues. The participants think that every effort should be made to protect the environment from the harmful effects of pollution and utmost care should be paid to minimize marine pollution. The research into the academic programs of HEIs showed that the environmental concerns are reflected in the number of programs and courses aimed at educating students who are conscious of marine pollution and raising awareness on marine pollution issues.

A majority of the respondents suggested that students should be educated in a way to be able to use the cutting edge technology for the benefit of environmental issues, since these issues require immediate and precise interventions. People in the sector should have the responsibility of not harming both people and environment in all operations. Learning and teaching detrimental effects of climate change on the oceans and trying to prevent them should be the priority for the socially responsible maritime stakeholders. It must be the goal of the schools to educate the students who are mindful of their actions and who protect the marine ecosystem for next generations.

Educating students in a way to give them a mindset to reduce waste and process waste material in order to reuse it should be the target of all maritime education and training programs. Contents of the courses should be designed with an eye to teach the importance of stopping or minimizing emission of toxic gases into the atmosphere and keeping the interest of environment above everything.

Keeping the sea safe and clean should be number one priority in all operations including salvage and ship recycling. Therefore, the topics like the importance of reducing carbon footprint, avoiding products that harm oceans and benefits of protecting marine ecosystem should be embedded into the curriculum. The effects of every step taken on marine pollution should be considered and clean sea awareness should be imposed on prospective employees in the maritime sector. To achieve this, all the students should be trained to have this mindset.

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Appendix A**The List of Courses at Undergraduate Level**

Air-Sea Interaction	Global Climate Change
Aquaculture Management	Hazardous Material Management
Coastal and Transitional Ecosystems	Human Health and Risk
Coastal Ecology	Indigenous Lifeworlds: Story, History, Country
Coastal Resource MGMT	International Maritime Environmental Policy
Coastal Zone Management	Introduction to Global Environmental Change
Conserving nature and landscapes	Introduction to Environmental Technology
Current environmental problems	Introduction to Marine and Antarctic Science
Earth, Climate, Life	Marine Ecology
Ecology	Marine Pollution
Emergency Management Policy and Governance	Marine Pollution, Prevention and Sustainability
Environmental impact assessment	Oil Spill Management
Environmental Law	Political Ecologies Development
Environmental Management	Prep for Research in Marine Science
Environmental Risk	Risk Communication
Environmental Science and Technology	Social Ecology
Evolution	Space, Place and Nature
Fire, Weeds and Ferals: Conserving Nature in Protected Areas	Sustainable Resource Management
Geoenvironment and Oceanography	The Environmental Dimension (2)
Geographic Information Science	Theory & Practice on Environm. Impact Assessment Studies
Geographies of Economy, Politics and Culture	Understanding Earth Systems
Geographies of Island Places	Waste Management
Geoheritage and geotourism	

Appendix B**The List of Courses at Master's Degree Level**

The Law of the Sea and the Protection of the Marine Environment	Cross-disciplinary Tools for Ocean Sustainability, Governance & Management
International Reaction to Environmental Externalities	Global Ocean Governance, Multilateral Diplomacy & Negotiation
Coastal State Obligations	Area-Based Management of the Ocean and Coasts
Understanding the Ocean and Human Impacts	Marine environment protection standards
Governing Human Activities that Affect the Ocean	Prevention and combating of marine pollution
Cross-disciplinary Tools for Ocean Sustainability, Governance & Management	Human factors in maritime safety and environment protection
Global Ocean Governance, Multilateral Diplomacy & Negotiation	Oil and Chemical Pollution
Area-Based Management of the Ocean and Coasts	Staying Ahead of the Curve - Maritime Environmental Technology, Sustainability and Challenges
Understanding the Ocean and Human Impacts	Governing Human Activities that Affect the Ocean