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OCEAN LITERACY OF PRIMARY STUDENTS OF INTERNATIONAL SCHOOLS IN RIYADH, SAUDI ARABIA

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ABSTRACT

Background and Purpose: Recently, human impacts on marine ecosystems have intensified as the population and pressures increase. Human-originated pollutants of all kinds have impacted the oceans and the marine ecosystems. Oil spills, sewage, plastics, chemicals, garbage, carbon dioxide, and overfishing are the most challenging issues. It is known that school students are the future generation; they receive their information at school. Therefore, it is essential to assess students' knowledge and awareness regarding ocean related issues.

Methodology: This study investigated ocean literacy (OL) of primary school students at international schools in Riyadh, Saudi Arabia, based on the seven principles of ocean literacy. Resources from which children get information about the oceans was also investigated. Finally, the study investigated the attitudes of primary school students towards learning oceanography, protecting the oceans, and the relationship between humans and the environment. A questionnaire had been adapted from the Survey of Ocean Literacy and Experience (SOLE) and the Survey of Ocean Stewardship (SOS). The SOLE and SOS surveys had been developed originally by Greely (2008). However, due to the grade level of students and time issues, the number of questionnaire items were reduced and simplified. The questionnaire was distributed in two separate sessions. Students from three international schools, boys' sections, received the survey. 120 students answered the SOLE, and 102 students answered the SOS.

Findings: Results indicated a rather moderate level of ocean literacy of participants with a mean score of 12.56 (SD= 5.18) concerning the SOLE, and a mean score of 3.30 (SD= 1.12) concerning the SOS.

As for the resource of information, results indicated the education program to be the students' main source of education, television channels came second.

Contributions: Students of Riyadh international primary schools showed a positive attitude toward ocean stewardship. The study can help policy makers, curriculum developers and textbook authors to better understand the level of ocean literacy among students and take decisions to develop school curricula especially in the efforts to align with UN Decade of Ocean Science for Sustainable Development (2021-2030). It also corresponds to the 2020-2030 vision in Saudi Arabia.

Keywords: Ocean Literacy level, ocean Sciences materials, Saudi Arabia learners' attitudes

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1.0 INTRODUCTION

Oceans make up 70% of Earth's surface and contain 97% of all water on the planet. Just 13% of the world's oceans remained untouched by the damaging impacts of humanity, and 5% of the remaining ocean wilderness is within existing marine protection areas (Carrington, 2018). The year 2018 marked the oceans' hottest year on record, and warmer waters lead to a range of consequences, from changing colors to rising sea levels to more frequent powerful storm surges (Nunez, 2019). Human impacts on marine ecosystems intensify as the population and pressures increase. Pollutants of the marine environment include oil spills, sewage, garbage, plastics, pesticides, toxic chemicals, industry garbage, carbon dioxide, overfishing and illegal fishing, lost and abandoned fishing gear (ghost gear), and plastics.

The Arabian Gulf is an enclosed body of water with a coastline that stretches about 560 kilometers (350 miles). It includes a diversity of marine ecosystems. It is also an important source of food, energy, and transportation. However, human activities increased and affected marine life. For example, fishing has intensified recently due to the increased demand of growing population and development in fishing technologies. In addition, it is estimated that 40% of the Gulf's coastline has been modified through extensive housing, tourism, and industrial development required to sustain the increasing population, and considerable degradation of coastal ecosystems through dredging and land reclamation has occurred as a result (Naser, 2014). Examples of mixed-use developments created by dredging and/or reclamation include the Pearl in Qatar, the Half Moon Bay in Saudi Arabia, and the Palm

Islands in Dubai (Vaughan, Al-Mansoori, & Burt, 2019). Desalination also impacts the gulf marine ecosystems as most of the gulf countries depend on desalination of seawater to get drink water. Over 1000 m3 of waste brine is released into the Gulf every second (Vaughan et al., 2019) impacting coastal ecosystems and affecting regional marine water quality. Brine production in Saudi Arabia, UAE, Kuwait and Qatar accounts for 55% of the total global share (Jones, Qadir, Vliet, Smakhtin, & Kang, 2019). Moreover, 20% of oil traded worldwide moves by tankers through the Strait of Hormuz. Ships may discharge wastewater, oil and grease, fuel spills, anti-fouling chemicals and ballast water into the marine water. Such discharges are not only a source of pollution that affect marine water quality, but also of exotic species carried in ballast tanks that may become invasive, out-competing native species that can disappear. Excavations can reduce water clarity by moving sediments from the bottom. If the lack of clarity persists for several months, it can kill seagrass beds and corals, which need sunlight to thrive (Al-Mubarak, 2018).

Nevertheless, oil spills have dangerous effects on marine ecosystems which depend on the fate of the spilled oil. If the oil is not dispersed, it remains on the surface. In this case, currents bring the oil towards coastal areas which harms coastal organisms like invertebrates, mammals and birds. However, if the oil is dispersed, organisms such as fish, plankton, and larvae, are immediately subjected to oil toxicity (Saadoun, 2015). Last, global climate change affects the marine system in the gulf which experiences already high temperatures in summer. Increasing temperature causes sea-level rise and affects the coral reefs in the gulf that have become widely degraded in the past three decades (Sheppard et al., 2010).

The Red Sea is another enclosed sea with a coastline that stretches about 1,760 kilometers (1,100 miles). The Red Sea's location is very important as it connects Asia with Europe culturally and economically. It provides people with food resources through fishing. Diversity of marine ecosystems in the Red Sea has also been impacted by human activities such as desalination, illegal fishing or overfishing, marine litter, the deposition of untreated sewage, heavy shipping traffic carrying chemicals and crude oil as well as global warming. In Saudi Arabia, the coral reefs that stretch along the coasts of Jeddah and the industrial city of Yanbu are becoming affected by human activities and development. Fish abundance was around 62 percent higher in Sudan and biomass was 20 percent higher. There was also slightly greater diversity on the Sudanese reefs. However, Berumen assures that these species have not completely disappeared. So, there is an opportunity to restore the condition of coral reefs and the species that live around (KAUST, 2017). In addition, the heavy shipping traffic threatens the Red Sea. 20,000 ships sail each year, an average of 55 per day including huge oil tankers

passing through the Red Sea from the Middle East to Europe through Bab Al-Mandab Strait (Wood, 2018). In addition, the untreated sewage dumped in the Red Sea produces toxic algae that could kill fish (Dawood, 2017). Most of the wastewater that is accumulated through pipes is dumped directly into the sea without being treated at all (Zafar, 2018). Researchers collected 178 fish belonging to 26 species from four different marine habitats to find that one in every six fish had ingested small pieces of plastic (KAUST, 2018).

The above-mentioned information urged humanity to take initiatives to protect and conserve the marine environments. Many international and regional organizations, foundations, and research centers have been established to protect and conserve the ocean environments such as Intergovernmental Oceanographic Commission of UNESCO (UNESCO, 1960), World Wildlife Fund (WWF, 1961), Australian Marine Conservation Society (AMCS, 1965), Antarctic and Southern Ocean Coalition (ASOC,1978), Oceana (Washington D.C, 2001) with many other branches in other countries, Global Coral Reef Alliance (GCRA, 1990), International Coral Reef Initiative (ICRI, 1994), Ocean Project (OP, 1997), Sea Shepherd Conservation Society (SSCS, 1977), the Kyoto Protocol (KP, 1997), United Nation's International Maritime Organization (UNIMO, 1982), United Nations Convention on the Law of the Sea (UNCLS, 1982), and dozens of other organizations.

Regionally, neighboring countries of the Red Sea and Arabian Gulf made many initiatives to protect and conserve marine environments. These initiatives include the Regional Convention for the Conservation of the Red Sea and Gulf of Aden (RCRSGA, 1982), Red Sea Environmental Centre (RSEC, 2007), Azraq (2018), Saudi Wildlife Authority (SWA, 1986), Saudi Geological Survey (SGS, 1999), Khaled Bin Sultan Living Oceans Foundation (KBSLOF, 2000), Red Sea Research Center (RSRC, 2009) and many other regional organizations.

2.0 LITERATURE REVIEW

2.1 Overview of International Efforts on Ocean Literacy

In 2002, key individuals and organizations made considerable efforts to develop a consensus position on ocean education. Later, their efforts resulted in "Ocean Literacy" that was used as a term for the first time in October, 2004. Then, a two-week online process involving over 100 people stated the Seven Essential Principles of Ocean Sciences K-12 formally and 44 fundamental concepts. Later, efforts of OL continued; many initiatives appeared worldwide. Finally, UNESCO engaged in ocean literacy both through its Intergovernmental Oceanographic Commission (IOC) and its Education Sector. In 2017, at United Nations

Headquarters in New York, a conference was held to support the implementation of the sustainable development goal "Conserve and Sustainably Use the Oceans, Seas and Marine Resources for Sustainable Development". The conference provided the platform to further promote the ocean literacy concept and framework internationally. A voluntary commitment, Ocean Literacy for All: A Global Strategy to Raise the Awareness for the Conservation, Restoration, and Sustainable Use of Our Ocean, was submitted by UNESCO in partnership with all the institutions mentioned above as well as with other relevant partners. Furthermore, the UN Ocean Conference adopted by consensus the intergovern-mentally agreed declaration in the form of a "Call for Action", which declares that member states agree to support plans to foster ocean-related education as part of education curricula, to promote ocean literacy and a culture of conservation, restoration and sustainable use of our ocean. Last, in May 2019, in Lisbon, Portugal, the UN proclaimed a Decade of Ocean Science for Sustainable Development (2021-2030) to support efforts sustaining ocean worldwide.

2.2 Overview of Related Previous Studies

In the past, people used traditional resources for knowledge such as books, television, newspapers, and magazines. However, the new technology provides more accessible and free resources of information through social media such as Facebook, YouTube, Twitter, and other applications and websites. It is worth mentioning that most of the school education programs nowadays are provided with other online resources for information. Students at schools may use all of these resources to get information related to oceanography. In addition, events such as marine aquariums, parks, trips, school campaigns may raise the students' level of oceanography that is not included in their education programs. All of these resources may contribute to create an ocean-literate generation.

Many researchers studied the impacts of information resources on creating an ocean-literate generation. One study investigated OL of private high school students in Turkey (see Kurtay, 2018). Part of Kurtay's study investigated the resources that students used to get information about the oceans. The results showed that the internet was the students' main preference of information source regarding ocean topics.

Another earlier study conducted investigated the contribution of Facebook to create an ocean literate society (see Fauville, 2013). Fauville (2013) found that Facebook seemed to have a potential to increase the public's ocean literacy. He also found that Facebook could reach a wide range of people with a more or less developed interest in marine sciences. However, the main challenge was to try to foster social interaction on Facebook page, an arena with very few

of the features requested to trigger participation. For practices such as regular posting of stories with videos or photos, Fauville (2013) found that such practices helped to reach more people. Last, he suggested that posting call-to actions could have a positive impact on the visibility of the story.

Fielding, Copley, and Mills (2019) used the global classroom to develop ocean literacy of individuals of all ages, from all countries, cultures, and economic backgrounds. It is found that Massive Open Online Courses (MOOCs) offer a possible tool to achieve the goal as they might potentially reach large numbers of people including those from lower and middle income regions. They shared a 4-week-MOOC entitled "Exploring the Ocean" which was run ten times in the past four years with around 40,000 participants worldwide. The course showed positive impacts on increasing the awareness of ocean issues.

To assess the ocean literacy of students who attended schools in Turkey, Kurtay (2018) measured ocean literacy among 328 students of six private high schools located in four inland (Ankara and Erzurum) and coastal (Istanbul and Izmir) cities. The study was conducted in three schools in Ankara, and only one school participated for each of the other cities. Samples included students from grades 9 to 12, including 165 female students, 134 male students, but 29 students did not state their gender. All of the schools were foundation schools and apply either additional program with MoNE (101 students), or solitary MoNE program (160 students), but 67 students did not provide an answer. The Turkish Survey of Ocean Literacy and Experience (T-SOLE) instrument was used to assess ocean literacy of students based on the content knowledge. The Turkish Survey of Ocean Stewardship (T-SOS) instrument was used to assess the students' attitudes towards ocean sciences. The instrument was first developed by Greely (2008). The quantitative data that measures the level of students' ocean content knowledge and attitude were compared according to students' location, educational program and gender. Finally, data was collected and analyzed. Students' scored approximately 50% of T-SOLE, and almost “agreed” with the T-SOS statements concerning the 7th Essential Principles of ocean literacy. Furthermore factors like habitat, gender and educational program found to have an impact on students' T-SOLE scores. The score of students who lived in coastal regions for more than six months was higher than the score of those who lived inland. Gender and educational program also impacted on students' T-SOS scores. Internet found to be students' main preference of information source regarding ocean topics. There was also a moderate positive relationship between students' T- SOLE and T-SOS scores.

Another study was conducted in three European countries that overlook the Mediterranean Sea (Italy, Croatia, and Greece) by Mogias et al. (2019). The study examined

the issue of ocean literacy of elementary school students (grades 3-6) at 20 schools in 17 cities. The researchers used a survey that was first developed in English then translated to Italian, Croatian, and Greek languages. To ensure the content clarity, the questionnaire was examined by a panel of marine scientists and marine educators. The questionnaire was conducted in February, June, September, and October 2018. Regarding the level of oceanography, the results of the study indicated a rather moderate level of knowledge in the total sample, while slight differences were recorded among the three countries revealing common knowledge gains and misconceptions. Although the proximity of the Italian students' residence to the sea seemed to have affected their knowledge level, that was not the case for the Greeks where in some cases "inland" students appeared to be more knowledgeable regarding marine issues than "coastal" ones. Moreover, students' participation in any kind of nature related activities within their schools revealed higher knowledge scores in the three countries compared to their counterparts with no such experience.

Mogias et al. (2019) found that, in one of the Greek sub-samples, students who lived near or have easy access to non-formal educational settings such as an aquarium and a marine research institute, appeared to possess significantly higher level of marine content knowledge. It revealed that visits to aquaria and zoos impacted students' knowledge and attitudes. Last, gender differences in marine content knowledge seemed to have emerged to some extent since in both Italian and Greek sub-samples male students tended to be more knowledgeable than their female classmates, while this was not the case for Croatia.

Mcpherson, Tyedmers, and Wright (2018) investigated the inclusion of Ocean Literacy Principles in the science curriculum of Nova Scotia high schools which was part of the Atlantic Canada Science Curriculum. Documents of Nova Scotia high school science curriculum were analyzed thoroughly. The study showed that the science curriculum was structured on the basis of General curriculum outcomes (GCO's) that was divided into four basic categories: Science, Technology, Society and the Environment (STSE), Skills, Knowledge, and Attitudes. McPherson et al. (2018) investigated only the curriculum outcomes for each of the 11 curriculum documents. All eleven science documents were analyzed including; Science 10, Biology 11 and 12, Chemistry 11 and 12, Physics 11 and 12, Human Biology 11, Oceans 11, Food Science 12 and Geology 12. Prior to analysis, curriculum documents were imported into NVivo 10, a qualitative data analysis program created by QSR International that allowed the researcher to organize and find insights and connections within qualitative data (QSR International, 2017).

McPherson et al. (2018) found that the Ocean Literacy Principles are represented in some capacity within the cadre of courses, with the exception of Principle 7, which was not included within the science curriculum. However, the results showed that eight of the 11 courses did not include information related to the 7th Principles of Ocean Literacy within their curriculum. The results revealed limited inclusion of ocean concepts throughout the high school science curriculum. That meant students would not be able to make informed decisions regarding the health of the ocean and the future of Nova Scotia. While six of the seventh Ocean Literacy Principles are represented with the science curriculum, it was found that the majority of the supporting Fundamental Concepts are absent. In addition, the study illustrated the degree to which the Fundamental Concepts for each Ocean Literacy Principle were included within the three science curriculum documents.

2.3 Overview of Ocean Literacy Efforts in Saudi Arabia

Saudi Arabia pays respectful efforts to protect and conserve the environment and marine life through formal and informal projects. Many organizations care about the marine life and environmental issues.

2.3.1 Khaled Bin Sultan Living Oceans Foundation

Khaled Bin Sultan Living Oceans Foundation is a non-profit marine science and ocean conservancy foundation. It was established in 2000 by His Royal Highness Prince Khaled bin Sultan in the Kingdom of Saudi Arabia. The foundation aims to preserve, protect, and restore the world's oceans and aquatic resources through research, education, and outreach. For nearly twenty years, it has conducted many coral reef ecosystem research studies in remote locations around the world. In addition, the Foundation has an educational department on ocean literacy and the conservation and restoration of living oceans that aims to educate students about the natural world of coral reefs by conducting workshops and presentations, providing education materials for students and teachers, sponsoring fellowship programs, and preparing annual student art contests to promote the preservation of the world's oceans. Moreover, the foundation commenced a four-year fieldwork campaign in Saudi Arabian Red Sea coastal waters from 2006 through 2009 to assess the Saudi coral reefs in Farasan Islands, Ras Al-Qasabah, Al-Wajh and Yanbu and the Farasan Bank. Furthermore, the Foundation implemented four research missions in the Saudi Arabian Red Sea from 2006 through 2009 to improve the understanding of the spatial distribution, size and condition of shallow marine

habitats, and to identify options to enhance the conservation and management of the Saudi Arabian coral reef ecosystems.

2.3.2 King Abdul-Aziz University - Faculty of Marine Sciences

In 1975 (1395 H), King Abdul-Aziz University established a section of Oceanography related to the Faculty of Science. The course study was initially limited to marine biology as a major at the undergraduate level. In 1978 (1398 H), the supreme council of the university establish the Institute of Marine Sciences with four specialized sections related to Oceanography: Vital, Physical, Chemical, and Geological Oceanography. Later, the supreme council of the university upgraded the Institute to become the Faculty of Marine Sciences in 1401 AH – 1981 A.D. Then, in 1991, the faculty established the Marine Studies Department with three divisions: the Division of Navigation and Marine Area, the Division of Marine Engineering, and the Division of Sea Ports and Marine Shipping.

2.3.3 King Abdullah University of Science and Technology (KAUST) – Red Sea Research Center (RSRS)

The Red Sea Research Center is an institute which has been established since the opening of KAUST in 2009. It is dedicated to study the Red Sea. The Red Sea represents KAUST's most unique 'laboratory'. It undertakes a wide variety of research to formulate a comprehensive understanding of the Red Sea's rich ecology. The RSRC contributes to the understanding of the role, functioning and responding to the pressures of the global ocean by using the unique opportunities offered by the Red Sea. It also aims to provide critical scientific knowledge underpinning the role of the Red Sea in supporting the growth of a Blue Economy for the Kingdom of Saudi Arabia.

As preceded above, Saudi Arabia respectful efforts are made to protect and conserve the environment and marine life through formal and informal projects, but there is a dire need to raise the level of ocean literacy among people in general and students who attend schools in particular to get education because they are the future generations. Providing school students with education and skills of ocean literacy will not only make them ocean-literate people who understand the essential principles of ocean literacy, but it will also enable them to acquire a set of values and feelings of concern towards the environment and marine life, acquire the skills of solving environmental and marine problems, and help them to make better decisions to protect the marine ecosystems, too.

This study is dedicated to investigate the level of ocean literacy among students of international primary schools in Riyadh, Saudi Arabia, based on the seven principles of ocean literacy. In addition, the study investigates the relationship between the students' level and their background factors in terms of educational program. Resources from which children get information about the oceans will be investigated, as well. Finally, the study investigates the attitudes of international primary school students towards learning oceanography, protecting the oceans, and the relationship between humans and the environment.

3.0 RESEARCH DESIGN

3.1 Participants

As the study investigates the level of ocean literacy and attitude of a predetermined student sample of international primary schools towards ocean literacy and protecting the oceans, the study uses a quantitative method based on a cross-sectional survey. To achieve the purpose of this study, three international schools, boys' sections, had been chosen in Riyadh, Saudi Arabia, an inland city and the capital of Saudi Arabia. In fact, it was difficult to contact other schools in other coastal cities. The three schools were coded in numbers instead of using the schools' names. The participants were only boys of three international primary schools, Grades five and six (10-11 years old). In Saudi Arabia, there is a strict separation of the sexes at all levels of education with the exception of kindergarten, nursery, and some private elementary schools for grades 1-3. Therefore, girls study in schools separated from the boys' ones, and they are administered by the General Presidency of Girls' Education.

3.2 Instrument

The questionnaire has been adapted from the Survey of Ocean Literacy and Experience (SOLE) and the Survey of Ocean Stewardship (SOS). The items in the questionnaire are close-ended to make the instrument easy to use, code, and score for statistical analyses. The SOLE and SOS surveys had been developed originally by Greely (2008). It provides reliable ocean content knowledge measures and can effectively distinguish between individuals with different levels of understanding. However, due to the grade level of students and time issues, the questionnaire was conducted in two separate sessions.

The survey consists of 4 parts. Part 1 includes demographic information. Participants should provide information about their grade level, city and gender. These items are important for data analyses. Part two includes the Survey of Ocean Literacy and Experience (SOLE) that was developed by Greely (2008) based on the seven Principles of Ocean Literacy. This part of

the questionnaire investigates the students' level of ocean literacy. The original questionnaire includes 57 multiple-choice questions. However, only 25 questions had been chosen, and the number of choices had been reduced to 3, 4, or 5 choices, some questions are too advanced for students of primary schools, and some others tackle issues related to the USA. The items in the questionnaire are close-ended to make the instrument easy to use, code, and score for statistical analyses.

Table 1: Alignment of SOLE research instrument with the principles of Ocean Literacy

No	Essential Principle of OL	SOLE Instrument	Number of Questions
1	The Earth has one big ocean with many features.	1-2-3-4	4
2	The ocean and life in the ocean shape the features of Earth.	5-6-7-8	4
3	The ocean is a major influence on weather and climate.	9-10-11-12	4
4	The ocean made the Earth habitable.	13-14	2
5	The ocean supports a great diversity of life and ecosystems.	15-16-17-18	4
6	The ocean and humans are inextricably interconnected.	19-20-21-22	4
7	The ocean is largely unexplored.	23-24-25	3

Part three of the questionnaire is dedicated to investigate the resource of information that students use frequently to get information about the ocean sciences. Last, part 4 is dedicated to assess the perspectives of students towards learning oceanography, protecting the oceans, and the relationship between humans and the environment. Greely (2008) developed the Survey of Ocean Stewardship (SOS) based on previous surveys (Cudaback, 2006). The items in the questionnaire are close-ended to make the instrument easy to use, code, and score for statistical analyses. The questionnaire includes three sub-divisions: Attitudes about Oceanography (14 statements), Attitudes about Ocean Stewardship (15 statements), and Relationships between Humans and the Environment (15 statements). However, only five statements from each part have been chosen evenly to fit the allocated time and students' level of education. This part of the questionnaire is in the form of the Likert scale form (1- strongly disagree, 2- disagree, 3- neutral, 4- agree, 5- strongly agree).

Table 2: Alignment of SOS research instrument with the principles of Ocean Literacy

No	SOS Instrument	Statements	Number of Statements
1	Attitudes about Oceanography	1-2-3-4-5	5
2	Attitudes about Ocean Stewardship	6-7-8-9-10	5
3	Attitudes about the Relationships between Humans and the Environment.	11-12-13-14-15	5

3.3 Data Collection and Analysis

Regarding this study, the researcher contacted the administrations of the above listed schools in Riyadh to permit application of the questionnaire. The data was collected in December, 2020 of the school year 2020/2021. Participants and their parents were informed about the purpose of the questionnaire, as well. Since most countries set restrictions due to Covid-19, participants submitted the questionnaire online through Google Forms in association with the schools' administrations and teachers. The allocated time for participants to complete the questionnaire was 45 minutes or one period for each session.

After collecting the data, the Statistical Package for Social Sciences (SPSS) was used. A descriptive analyses was conducted for the SOLE and SOS questions. The general mean and standard deviation of scores of both the questions and the statements had been calculated. As for the resource information, a descriptive analyses was conducted to investigate the frequency of resources. Regarding the SOS, the questionnaire consisted of 15 questions, the reliability of answers was analyzed using Cronbach alpha. The reliability of the SOS was 0.51.

4.0 ANALYSIS AND DISCUSSION

The data was collected in December 2020. The total number of SOLE participants of the three international schools was 120 students: 74 students from School 1 (61.7%), 22 students from School 2 (18.3%), and 24 students from School 3 (20%) as shown in Table 3 below. All participants studied at international schools that used American education programs. In addition, all students lived in Riyadh which is an inland city and far away from the Arabian Gulf and the Red Sea. Long distances between Riyadh and the other coastal cities made it difficult to include school from cities that overlook the Arabian Gulf and the Red Sea.

Table 3: Demographic data of SOLE participants

School No.	Grade 5	Grade 6	Total Number	Percentage
1	24	50	74	61.7%
2		22	22	18.3%
3	19	5	24	20%
Total	43	75	120	100%

4.1 Ocean Content Knowledge

The Statistical Package for Social Sciences (SPSS) was used to analyze the data. A descriptive analysis was conducted for the SOLE. Each correct answer of the SOLE questionnaire took one point. The mean score, range score, and standard deviation had been calculated. Based on the results, participants showed a moderate level of ocean sciences. The mean score was 12.56 out of 25, the range score was 22, and the standard deviation was 5.18 as explained in Table 64 below.

Table 4: Students' SOLE scores

Number of Students	Valid Scores	Missing Scores	Mean Score	Range Score	SD
120	120	0	12.56	22	5.18

Taking the students' grade into consideration, students of Grade 6 demonstrated more knowledge level than Grade 5. As for Grade 5, the mean score was 11.46 and the standard deviation was 5.25. For Grade 6, the mean score was13.18 and the standard deviation was 5.06 as shown in Table 5 below.

Table 5: Students' SOLE scores per grade

Grade	N	Mean Score	Range Score	SD
Grade 5	43	11.46	22	5.25
Grade 6	77	13.18	21	5.06

The frequency of correct answers and the difficulty of each question for all participants had been also explored as shown in Table 6 below. Questions 5, 10, 14, 15, and 3 represented the most difficult questions with the least frequency of correct answers. On the other hand, questions 1, 8, 6, 24, and 17 represented the easiest questions with the highest frequency of correct answers.

Table 6: SOLE Frequencies and difficulty of correct answers per question for all participants

	Question	Frequency of Correct Answers
Difficult Questions	5	27 (22.5%)
	10	31 (25.8%)
	14	37 (30.8%)
	15	42 (35%)
	3	44 (36.7%)
	12	50 (41.7%)
	22	51 (42%)
	13	51 (42.5%)
	2	53 (44.2%)
	7	59 (49.2%)
	20	59 (49.2%)
	23	59 (49.2%)
	25	59 (49.2%)
	9	60 (50%)
	4	63 (52.5%)
	11	63 (52.5%)
	19	64 (53.3%)
	18	65 (54.2%)
	16	71 (59.2%)
	21	71 (59.2)
	17	74 (61.7%)
	24	76 (63.3%)
	6	77 (64.2%)
	8	90 (75%)
	1	99 (82.5%)
Easy Questions		

4.2 Resource of Information

In order to investigate the students' resource of ocean information, a descriptive analyses was applied. This part of the questionnaire included the possible sources that students might use to get information about the oceans: social networks such as Facebook and Twitter, media networks such as YouTube, internet official websites, T.V channels, newspapers, journals and

encyclopedias, and school education program. Five variables were included as choices (1- not using at all, 2- moderately, 3- in medium level, 4- frequently, 5- all the time). The results indicated that students depend on their education program to get information about the oceans with a mean value of 3.65 and SD= 1.29. Then, students chose T.V Channels (M= 2.99, SD=1.15), YouTube (M= 2.95, SD= 1.18), Internet Official Websites (M= 2.75, SD= 1.47), Newspapers, Journals and Encyclopedias (M= 2.25, SD= 1.19), Facebook and Twitter (M= 1.94, SD= 1.18), respectively as shown in Table 7 below.

Table 7: P Mean values of sources of information

Source of Information	Mean Values	Standard Deviation
Social Networks (Facebook & Twitter)	1.94	1.18
Newspapers, Journals, Encyclopedias	2.2549	1.19
Internet Official Websites	2.75	1.47
Media Networks (YouTube)	2.95	1.18
T.V Channels	2.99	1.15
Education Programs	3.65	1.29

4.3 Survey of Ocean Stewardship (SOS)

To assess students' attitudes towards learning oceanography, protecting the oceans, and the relationship between humans and the environment, a descriptive analyses was applied. Each correct answer of the SOS questionnaire took one point. The mean score, range score, and standard deviation had been calculated.

As preceded earlier, the original questionnaire included three sub-divisions: Students' Attitudes about Oceanography (14 statements), Students' Attitudes about Ocean Stewardship (15 statements), and the Relationships between Humans and the Environment (15 statements). However, only five statements from each part had been chosen evenly to fit the allocated time and students' level of education. Participants indicated their attitudes toward ocean sciences according to Likert scale form (1- strongly disagree, 2- disagree, 3- neutral, 4- agree, 5- strongly agree).

The number of participants who answered the SOS questionnaire was 102 participants. The mean score of the entire SOS was 3.30 out of 5 in Likert scale. The mean scores for students' Attitudes about Oceanography, students' Attitudes about Ocean Stewardship, and students' Attitudes about the Relationships between Humans and the Environment were 3.47, 3.52, and 2.97 respectively.

The standard deviation of the entire SOS was 0.12. The standard deviation for students' Attitudes about Oceanography, students' Attitudes about Ocean Stewardship, and students' Attitudes about the Relationships between Humans and the Environment were 0.21, 0.12, and 0.12 respectively as shown in Table 8 below. Based on the results, students showed positive attitudes toward oceanography, in general. The general mean score of 3.30 out of 5 almost aligns with findings in other countries.

Table 8: Mean values and standard deviation of Survey of Stewardship (SOS)

SOS	Mean Values	SD
Entire SOS	3.30	0.12
Attitudes about Oceanography	3.47	0.21
Attitudes about Ocean Stewardship	3.52	0.12
Attitudes about the Relationships between Humans and the Environment	2.97	0.12

4.4 Discussion

This study aimed to investigate ocean literacy of primary international school students, Grades five and six, (10-11 years old) in Riyadh, Saudi Arabia. The three schools use American education programs except for the Arabic, Islamic Studies, and National Social Studies which are compulsory to use at international schools. Based on the results of this study, students showed rather moderate level of ocean literacy with a mean score 12.56 out of 25, SD=5.18, and a range score of 22 for all participants. The mean score of School 1 was 12.87 (SD= 4.41), School 2 was 14.50 (SD= 6.90), and School 3 was 9.83 (SD= 4.67).

This result aligns with other findings in other countries. For example, Kurtay (2018) reported a mean score of 13.28 out of 26 (SD= 5.04) when he investigated ocean literacy of high school students in Turkey. In addition, Mogias et al. (2019) recorded a rather moderate level of ocean content knowledge among elementary school students (Grades 3-6) in three Mediterranean countries (Italy, Croatia, and Greece). The study recorded a mean score of 8.53 out of 16 in the three countries ranging between 7.78 in Greece, and 9.18 in Italy. Guest, Lotze, and Wallace (2015) assessed the level of ocean valuation, knowledge, interaction and interest of public school students grade 7–12 (ages 12–18) in Nova Scotia, Canada, a region with strong connections with the sea. A survey was used that aligned with the seven Principles of Ocean Literacy. The quiz score was below 50%, as well. In 2018, Nyman (2018) evaluated the need for ocean literacy in South African.

The International Ocean Literacy Survey (IOLS) was used to determine the level of ocean literacy in a South African high school population sample. He recorded an average score of 38.05 out of 84, a median score 40 points, and a range score between 2 and 58 points. Last, Leitão, Maguire, Turner, Guimarães, and Arenas (2018) submitted a conference paper investigating ocean of sciences of pupils in the UK and in Portugal. A sample of 132 pupils in Portugal and 328 pupils in the UK of Grades 7, 8, and 9 (ages 12-14) responded to the survey. Their study revealed the pupils' low levels of knowledge about topics such as eutrophication, the importance of the ocean for the planet's supply of oxygen, the causes of ocean acidification and the extent of human exploration of the ocean. Their findings showed that there was still space for improvement regarding ocean literacy. The findings generally aligned with the other studies which suggested a poor understanding of the ocean. Leitao et al. (2018) suggested that one of the possible reasons could be the lack of ocean science in schools, since the school curriculum presents a terrestrial bias in science, leading to a situation where younger generations are more equipped to comprehend terrestrial than marine environmental issues.

Taking the students' grade into consideration, students of Grade 6 demonstrated more knowledge level than Grade 5 with mean scores 13.18 (SD= 5.06), and 11.46 (SD= 5.25) respectively (Table 4).

As mentioned above, Questions 5, 10, 14, 15, and 3 represented the most difficult questions with the least frequency of correct answers. Question 5 was "Approximately, how much of the earth's water is fresh and unfrozen?" The answer should be 1%, but only 27 students chose the correct answer. On the other hand, questions 1, 8, 6, 24, and 17 represented the easiest questions with the highest frequency of correct answers.

Question 10 was "The ocean controls weather and climate by dominating which of the earth's systems?" the answer should include both water and carbon, but only 31 students chose the correct answer. Question 14 was "What produces most of the earth's oxygen?" The correct answer should be plants (algae) in the ocean, but only 37 students chose the correct answer. Question 15 tackled the issue of pressure in the ocean, and question 3 asked about the sources that supply the salt in oceans.

As for the questions that received the high frequent answers, question 1 was "Approximately how much of the earth is covered by ocean?" The answer was 70%, and 99 students chose the correct answer. Question 8 was in the second place "Water moves from the ocean to the atmosphere to the land and back again to the ocean by a process called". The answer was water cycle, 90 students chose the correct answer. Question 6 was "In nature, which factor redistributes sand along a beach?" The answer was wave motion, 77 students chose the

correct answer. Last, Question 24 "Why is it important to study the ocean?" and Question 17 " Ocean life ranges in size from the smallest virus to the largest animal that has lived on earth, called the" received 76 and 74 correct answers, respectively.

As for the resources of information, the results indicated that students depended on their education program to get information about the oceans with a mean value of 3.65 and SD= 1.29. Then, students chose T.V Channels (M= 2.99, SD=1.15), YouTube (M= 2.95, SD= 1.18), Internet Official Websites (M= 2.75, SD= 1.47), Newspapers, Journals and Encyclopedias (M= 2.25, SD= 1.19), Facebook and Twitter (M= 1.94, SD= 1.18), respectively (Table 7).

Kurtay (2018) found that approximately half participants (45%) chose the internet as their most frequently used source about ocean topics, school education program 24%, and radio was the least source of information. Another study by Leitao et al. (2018) found that the computer was found to be the preferred media by the pupils in this study, while the radio was the least chosen option by pupils in both countries. In Portugal, the second and third preferred sources were the books and, very close, in the fourth option, were the mobile platforms. Magazines and the radio came fifth and sixth, respectively. Respondents in the UK placed the mobile platforms in the second while in the third and fourth options television and in fifth the magazines, as in Portugal. Similarly to the Portuguese findings, magazines were chosen in fifth place as the media source to get information about the ocean.

As preceded regarding the SOS, the mean score of the entire SOS was 3.30 out of 5 in Likert scale. The mean scores for students' Attitudes about Oceanography, students' Attitudes about Ocean Stewardship, and students' Attitudes about the Relationships between Humans and the Environment were 3.47, 3.52, and 2.97 respectively. The standard deviation of the entire SOS was 0.12. The standard deviation for students' Attitudes about Oceanography, students' Attitudes about Ocean Stewardship, and students' Attitudes about the Relationships between Humans and the Environment were 0.21, 0.12, and 0.12 respectively. Based on the results, students showed positive attitudes toward oceanography, in general. The general mean score of 3.30 out of 5 almost aligns with findings in other countries. In Turkey, the mean score of T-SOS was 3.72 out of 5 in the Likert scale (Kurtay, 2018).

5.0 CONCLUSION

Based on the results of this study, students showed rather moderate level of ocean literacy with a mean score 12.56 out of 25, SD=5.18, and a range score of 22 for all participants. The mean score of School 1 was 12.87 (SD= 4.41), School 2 was 14.50 (SD= 6.90), and School 3 was 9.83 (SD= 4.67). Considering the grade level, students of Grade 6 demonstrated more

knowledge level than students of Grade 5 with mean scores 13.18 (SD= 5.06), and 11.46 (SD= 5.25) respectively. As for the resources of information, the results indicated that students depended on their education program to get information about the oceans with a mean value of 3.65 and SD= 1.29. Then, students chose T.V Channels (M= 2.99, SD=1.15), YouTube (M= 2.95, SD= 1.18), Internet Official Websites (M= 2.75, SD= 1.47), Newspapers, Journals and Encyclopedias (M= 2.25, SD= 1.19), Facebook and Twitter (M= 1.94, SD= 1.18), respectively. As preceded regarding the SOS, the mean score of the entire SOS was 3.30 out of 5 in Likert scale with a standard deviation of 0.12. Students showed positive attitudes toward oceanography, in general.

Finally, this study suggests to integrate oceanography in international educational programs in general and science education programs in particular to raise the level of ocean literacy among primary school students. Providing school students with education and skills of ocean sciences does not only make them ocean-literate people who understand the essential principles of ocean literacy, but it also enables them to acquire a set of values and feelings of concern towards the environment and marine life, acquire the skills of solving environmental and marine problems, and help them to make better decisions to protect the marine life, too. Last, the study can help policy makers, curriculum developers and textbook authors to better understand the level of ocean literacy among students and take decisions to develop school curricula especially in the era of the new vision 2030 adopted and launched by the government. Saudi Arabia's efforts align with the international efforts of the UN that proclaimed a Decade of Ocean Science for Sustainable Development (2021-2030) in Lisbon, Portugal (2019), to support efforts of sustaining the oceans worldwide.

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