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**OCEAN LITERACY OF PRIVATE HIGH SCHOOL STUDENTS IN
TURKEY**

A MASTER'S THESIS

BY

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**THE PROGRAM OF CURRICULUM AND INSTRUCTION
İHSAN DOĞRAMACI BILKENT UNIVERSITY
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To my parents

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The Graduate School of Education

of

İhsan Doğramacı Bilkent University

by

Gülce Kurtay

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İHSAN DOĞRAMACI BILKENT UNIVERSITY
GRADUATE SCHOOL OF EDUCATION
Ocean Literacy of Private High School Students in Turkey

Gülce Kurtay

April 2018

I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Arts in Curriculum and Instruction.

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ABSTRACT

OCEAN LITERACY OF PRIVATE HIGH SCHOOL STUDENTS IN TURKEY

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Oceans have an important role in regulating climate, oxygen and carbon dioxide cycles. Therefore ocean literacy carries an imperative role in terms of understanding and communicating one of the major regulators of our daily lives. However, there has not been any study conducted among students in Turkey related specific to ocean literacy. This study investigates the ocean literacy with cross sectional survey method. It explored ocean literacy under two concepts; content knowledge by using Turkish Survey of Ocean Literacy and Experience (T-SOLE) and attitude by Turkish Survey of Ocean Stewardship (T-SOS) instruments. Data collected from high school students ($N= 328$) in 6 different private schools locates in 4 different cities and analyzed with SPSS. Students' scored approximately 50% of T-SOLE and almost "agree" with the T-SOS statements concerning *7 Essential Principles* of ocean literacy. Furthermore factors like habitat, gender and educational program found to have an impact on students' T-SOLE scores. Gender and educational program also had an impact on students' T-SOS scores. Internet found to be students' main preference of information source regarding ocean topics. There is also moderately positive relationship found between students' T- SOLE and T-SOS scores.

Key words: ocean literacy, T-SOS, T-SOLE

ÖZET

TÜRKİYE’ DEKİ ÖZEL LİSE ÖĞRENCİLERİNİN OKYANUS OKURYAZARLIĞI

GÜLCE KURTAY

Yüksek Lisans, Eğitim Programları ve Öğretim

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Okyanuslar iklim, oksijen ve karbondioksit gibi hayati döngüleri kontrol etmektedir. Günlük hayatımızın üstünde bu derece etkileri olan bu sistemi anlamak ve iletişim kurmak açısından okyanus okuryazarlığı konsepti önem taşımaktadır. Fakat, ülkemizde okyanus okuryazarlığını ölçen, ortaöğretime özgü herhangi bir çalışma bulunmamaktadır. Bu çalışma, Türkiye’ deki özel lise öğrencilerinin ($N= 328$) okyanus okuryazarlığını kesitsel çalışma yöntemiyle araştırmıştır. Okyanus okuryazarlığı; içerik bilgisi Türkçe Okyanus Okuryazarlığı ve Deneyimi Anketi (T-SOLE) ve tutumu Türkçe Okyanus Koruyuculuğu Anketi (T-SOS) ile ölçülmüştür. Veriler 4 farklı şehirde ve 6 farklı özel okuldan toplanıp SPSS ile analiz edilmiştir. Öğrenciler, okyanus okuryazarlığının *7 Ana Prensipleriyle* örtüşen T-SOLE testinden yaklaşık %50 puan alırken T-SOS kısmındaki önermelere yaklaşık olarak “katılım” göstermişlerdir. Ayrıca habitat, cinsiyet ve öğretim programlarının öğrencilerin T-SOLE sonuçları üstünde etkileri olduğu bulunmuştur. Öğrencilerin T-SOS sonuçlarında ise cinsiyet ve öğretim programlarının etkisi olduğu tespit edilmiştir. Ek olarak, öğrenciler çeşitli kaynaklardan en fazla interneti kullandıklarını belirtmişlerdir. Son olarak, okyanus içerik bilgisi ve tutumu arasında göreceli pozitif bir ilişki olduğu tespit edilmiştir.

Anahtar kelimeler: okyanus okuryazarlığı, T-SOS, T-SOLE

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TABLE OF CONTENTS

ABSTRACT	iii
ÖZET.....	iv
ACKNOWLEDGEMENTS	v
TABLE OF CONTENTS	vi
LIST OF TABLES	x
LIST OF FIGURES	xii
CHAPTER 1: INTRODUCTION	1
Introduction	1
Background	1
Problem	6
Purpose	7
Research questions	7
Significance	8
Definition of key terms.....	8
CHAPTER 2: REVIEW OF RELATED LITERATURE.....	10
Introduction	10
Assessment of ocean literacy.....	11
Education of oceanography	11

Secondary school educational programs in Turkey.....	12
Secondary school curriculum overview.....	15
Previous studies.....	19
Ocean literacy of students.....	19
Location influence.....	22
Gender influence.....	23
Educational program.....	23
Source of information about oceans.....	24
The content knowledge and attitude relationship.....	24
CHAPTER 3: METHOD.....	26
Introduction.....	26
Research design.....	27
Context.....	27
Participants.....	29
Instrumentation.....	30
Part 1: Demographic.....	31
Part 2: Source of information.....	31
Part 3: Turkish Survey of Ocean Literacy and Experience (T-SOLE).....	31
Part 4: Turkish Survey of Ocean Stewardship (T-SOS).....	32
Method of data collection.....	34
Method of data analysis.....	35

CHAPTER 4: RESULTS	38
Introduction	38
Questionnaire results	38
Demographic results	38
Research question 1: What is the ocean literacy level of high school students in Turkey?	40
Research question 2: Is ocean literacy of students who lives inland different from those in coastal?.....	43
Research question 3: Is there any difference in ocean literacy with respect to gender?.....	44
Research question 4: From which source do students obtain information about oceans?.....	45
Research question 5: Is there any difference in ocean literacy among students who follow only MoNE program and MoNE with additional (IBDP, IGCSE) programs?.....	46
Research question 6: Is there any relationship between ocean content knowledge and attitude of high school students towards ocean?	47
CHAPTER 5: DISCUSSION.....	49
Introduction	49
Overview of the study	49
Major findings	50
The level of ocean literacy regarding 7 <i>Essential Principles</i>	50

Location (habitat) influence on ocean literacy	55
The gender influence on ocean literacy	56
Source of information about ocean	57
Educational program influence on ocean literacy.....	58
Content knowledge and attitude relationship regarding ocean literacy	59
Implications for practice.....	60
Implications for further research	62
Limitations.....	63
Summary	63
REFERENCES.....	65
APPENDICES	73
APPENDIX A: Instrument.....	73
Ocean Literacy Questionnaire	73
APPENDIX B: Permission from the developer of questionnaire	78
APPENDIX C: Permission from Ministry of Education.....	79

LIST OF TABLES

Table	Page
1 School information involved in the study	29
2 Participant number involved in each city.....	30
3 Questions in alignment with <i>7 Essential Principles</i> of ocean literacy.....	33
4 Research questions alignment with questionnaire parts.....	34
5 Data collection periods in schools.....	35
6 Participants according to their grade level and gender	39
7 Participants number according to their habitat and school program.....	40
8 The lowest <i>Principle</i> alignment with items in both test types	42
9 The results of independent sample <i>t</i> –test in T-SOLE scores according to students’ habitat	43
10 The results of independent sample <i>t</i> –test in T-SOS scores according to students’ habitat	44
11 The results of independent sample <i>t</i> –test in T-SOLE scores according to students’ gender	44
12 The results of independent sample <i>t</i> –test in T-SOS scores according to students’ gender	45
13 The mean values of source preferences	46
14 The results of independent sample <i>t</i> -test in T-SOLE scores according to educational programs	46
15 The results of independent sample <i>t</i> –test in T-SOS scores according to educational programs	47

16	The results of correlation analyses between T-SOLE and T-SOS scores of students	48
17	Summary of independent samples <i>t</i> -test results in the study	48

LIST OF FIGURES

Figure		Page
1	The mean scores of SOLE scores among <i>7 Essential Principles</i>	41
2	The mean scores of SOS scores among <i>7 Essential Principles</i>	42

CHAPTER 1: INTRODUCTION

Introduction

This chapter explains the purpose and importance of thesis subject. The background provides relative information about the importance of oceans, ocean literacy and introduces the problem. The purpose and research questions explain how problem is addressed and significance highlights the value of the study.

Background

Oceans cover over 70% of the earth. They also play a significant role in regulating the climate, weather, oxygen and carbon dioxide. In addition, oceans provide important resources for humankind(Centers for Ocean Science Education Excellence (COSEE), 2005) Globally, 60% of the human population lives within 100 km of the coast (Tanzer et al., 2015).

Humans have always been connected to oceans. There are findings that suggest early human usage of marine resources for food (Marean et al., 2007). Viking's performed their famous expansion through their ships and seamanship; Roman's travelled and invaded along the coasts of the Mediterranean. British and Dutch nations relationship to the oceans allowed them to colonize and improve their economy (Perry, 2013). Oceans still play an important roles today. Humans exploit oceans for food, medicine, employment, energy and mining. While terrestrial resources are diminishing with the help of developing technology human consumption of oceanic resources is becoming more frequent and

widespread. Bellingham (2009) predicts that in future we will be more dependent on oceans for renewable energy, deep sea mining, oil and gas, transportation and fish farming.

Turkey is located by the Mediterranean, Marmara and Black Sea. Thus, the sea holds substantial influence in Turkish people's lives in terms of economy, resources and transportation. Turkey catches more than 300 000 tons of fish each year (Turkish Statistical Institute, 2013). In addition to fishing, aquaculture is becoming an important industry in Turkey. After 2012, the country started exporting more aquaculture products than importing (Sariözkan, 2016).

As human use of technology increases, alteration and damage to the marine ecosystem becomes more severe. Some of these alterations are introduction of alien species to ecosystems, radioactive wastes, chemical pollution, plastic and micro-plastic wastes, drilling and mining, nutrient pumping, overharvesting, aquaculture (Halpern, Selkoe, Micheli, & Kappel, 2007). According to Halpern et al. (2008) there are at least 23 different ways human activities affect the oceans. Humans affect heavily 40% of global oceans and there are no areas unaffected.

The Turkish coasts suffer from human impacts as well. According to (United States Energy Information Administration, 2000) report (2000), Turkey is facing a serious threat in Bosphorus because of the heavy ship traffic. Those commercial ships carry oil, gas and other toxic chemicals. Accidents can cause oil spills and other chemical contamination into the Marmara and Black Seas. Between 1960 and 2003 in Turkey 13 crashes and sinks resulted in major oil spill accidents

(Turan, 2009). Other threats caused by nutrient pumping, ballast water and contaminations by territorial resources (e.g. run off).

Furthermore, the Black Sea is in a unique situation with its anoxic zone (no oxygen molecule) located at the sea floor. The countries surrounding the Black Sea are dumping agricultural waste and those nutrients join rivers through underwater or stream that connect with Black Sea. These nutrients cause eutrophication and toxic blooms. Additionally, countries overharvest fish stocks that have given damages to food webs. The biodiversity of food web has been changed because of the impacts (Kideys, 2002).

The Mediterranean Sea also suffers from nutrient input, alien species and eutrophication factors directly or indirectly caused by humans. In addition, through constructions and tourism some landmark species are being depleted like sea turtle (*Caretta caretta*) and the Mediterranean Monk Seals (*Monachus monachus*) (Gucu, 2004).

Human beings cannot protect or conserve systems about which they have no knowledge. There is a strong relationship between knowledge and behavior (Bradley, Waliczek, & Zajicek, 1999). People who are aware that their environment and ecosystem is under risk are most likely willing to do something about it (Hares, Eskonheimo, Myllyntaus, & Luukkanen, 2006). In light of awareness and protection of environment, term “environmental literacy” was revealed by scholars around 45 years ago (McBride, Brewer, Berkowitz, & Borrie, 2013). After a while, additional terms entered the field according to scientists’

interest in human-environment relationships: ecological literacy, eco-literacy and ocean literacy.

Concepts about environmental and ocean literacy create necessity for system thinking. In our contemporary world as systems grows, needs to understand, predict and adjust of its outcomes grows as well. Therefore system thinking turns into an important value for dealing with these complex issues (Arnold & Wade, 2015). According to Arnold and Wade (2015) “Systems thinking is a set of synergistic analytic skills used to improve the capability of identifying and understanding systems, predicting their behaviors, and devising modifications to them in order to produce desired effects. These skills work together as a system” (p. 675). Oceans are huge and complex systems could be understood by ocean literacy that needs to be used systems thinking skills.

Different universities and institutions gathered and formed consortium to define ocean literacy around 2001. Ocean literacy definition, *7 Essential Principles* and Fundamental Concepts published by Consortium for Ocean Exploration Science and Engagement (COSEE) and accepted by scientists. The consortium was composed by National Oceanic Atmospheric and Administration (NOAA), Centres for Ocean Science Education Excellence (COSEE), College of Exploration and the National Marine Educators Association.

According to consensus the ocean literacy is; understanding the ocean influence on you and your influence on ocean. An ocean literate person;

- understands the essential principles and fundamental concepts about the ocean
- can communicate about the ocean in a meaningful way; and
- is able to make informed and responsible decisions regarding the oceans and its resources.(Centers for Ocean Science Education Excellence (COSEE), 2005, p.2)

The same consortium also defined *7 Essential Principles* of ocean literacy that each student should be aware at the end of high school.

The *7 Essential Principles* are:

1. The earth has one big ocean with many features.
2. The ocean and life in the ocean shape the features of earth.
3. The ocean is a major influence on the weather and climate.
4. The ocean made earth habitable.
5. The ocean supports a great diversity of life and ecosystems.
6. The ocean and humans are inextricably interconnected.
7. The ocean is largely unexplored (Centers for Ocean Science Education Excellence (COSEE), 2005, p.5).

It is important to know what public's literacy is regarding oceans in order to support sustainable actions (Rowe, 2002). Thus, various researchers are measuring or suggesting that measures be taken of the ocean literacy among their citizens (Chen & Tsai, 2016; Mogias, Boubonari, Markos, & Kevrekidis, 2015; Steel, Smith, Opsommer, Curiel, & Warner-Steel, 2005). Steel et al. (2005) looked at the United States population's ocean literacy and learned that the public's ocean literacy was inadequate.

Although adult ocean literacy is important today, in order to predict future applications, student level of ocean literacy needs to be investigated as well. Through similar reasoning, in 2010 Plankis and Marrero measured the ocean literacy among American students. The results indicated that like adults' students also demonstrated low level of ocean literacy.

Problem

Turkey exploits marine resources in terms of transportation, resources and energy. This kind of relationship indicates a strong dependency on marine ecosystems. Marine education and increasing awareness has an important role for protection and conservation of marine ecosystems. Investigating ocean literacy level is the first step toward increasing of people's awareness and knowledge about ocean.

Turkey is relatively new to the topic of environmental and ocean literacy. Therefore research about ocean literacy in Turkey is limited. However there are several studies conducted regarding with Turkish students' environmental literacy. Erdogan and Ok (2011) researched fifth grade students' environmental literacy. They found that 61% of students have moderate and 27.3% of them have high level of environmental literacy.

However, we do not know about students' content knowledge and attitude towards oceans. Their source of knowledge regarding ocean literacy also plays an important role to take actions about implementing any concept related with ocean

literacy. The habitat, gender and educational program impact also worth investigating for further implications.

This study is conducted in order to provide insights into ocean literacy of students in Turkey. This knowledge will help to predict future implications about the literacy of today's young generation. In addition, this study will clarify our national curriculum is compatible with the *7 Essential Principle* of ocean literacy.

Purpose

The purpose of this study is to investigate the ocean literacy of selected high school students, in terms of content knowledge and attitude regarding *7 Essential Principles*. Students' level of ocean literacy also was compared according to their gender, location and educational program. In addition, the source of getting information about ocean was determined. The relationship between content knowledge and attitude was investigated. After data was collected and analyzed; suggestions regarding curriculum and extra-curriculum activities were proposed for increasing the level of ocean literacy.

Research questions

Six research questions were investigated in this study. They are:

1. What is the ocean literacy level of high school students in Turkey?
2. Is the ocean literacy of students who lives inland different from those in coastal?
3. Is there any difference in ocean literacy with respect to gender?
4. From which sources do students obtain information about ocean?

5. Is there any difference in ocean literacy among students who follow only MoNE program and MoNE with additional (IBDP, IGCSE) programs?
6. Is there any relationship between ocean content knowledge and attitude of high school students towards ocean?

Significance

The significance of this study is that it is the first to measure ocean literacy among Turkish high school students and determine their source of content about the ocean. As a result of this study, improvement suggestions and integrated program were proposed to improve curricula and fortunately increase the ocean literacy of students in Turkey. Policy makers, teachers and curriculum developers will be able to use this study in order to understand of the Turkish students' level of ocean literacy. From the recommendations generated at the end of this study same audience may benefit from the suggestions of improving ocean literacy.

Definition of key terms

International Baccalaureate Diploma Program (IBDP): The International Baccalaureate (IB) Diploma Program (DP) is for students aged 16-19 (Diploma Programme, 2017).

International General Certificate of Secondary Education (IGCSE): Cambridge IGCSE is the international program qualification for 14 to 16 year olds (Cambridge International Examinations, 2017).

Ministry of National Education Program: The program is prepared by Turkish Ministry of National Education and follows mandatorily by each school in Turkey.

Oceanography: It is a science that deals with the oceans and includes the delimitation of their extent and depth, the physics and chemistry of their waters, marine biology, and the exploitation of their resources (“Oceanography,” 2017).

Ocean literacy: Ocean literacy is an understanding of the ocean’s influence on you and your influence on the ocean (Centers for Ocean Science Education Excellence (COSEE), 2005)

Sea: In terms of geography, a sea is part of the ocean partially enclosed by land (US Department of Commerce, 2017).

CHAPTER 2: REVIEW OF RELATED LITERATURE

Introduction

Oceans cover more than half of Earth's proportion. They control the weather and climate, offer shelter, and provide resources such as food, medicine, energy and other resources to human beings (Bellingham, 2009). Therefore, it is important for people to understand the mechanisms of ocean. The relationship between scientific knowledge and attitude related to oceans is positively correlated (Allum, Sturgis, Tabourazi, & Brunton-Smith, 2008). Public awareness of environmental issues might create difference and demand new applications from government in democratic systems (Steel et al., 2005). In other words, people who have awareness will sustain and conserve more about the environment and oceans.

This chapter aims to share necessary background information regarding ocean literacy concerns and problems in the world. The chapter provides information about common components of ocean literacy by including the definitions, principles and previous studies.

Brief information about educational applications of ocean literacy is given. Additionally, secondary school educational programs in Turkey and their approaches to ocean literacy are discussed with in the conceptual framework regarding *7 Essential Principles*.

Assessment of ocean literacy

The Ocean Project in United States conducted a survey at 1999 and found out that the public generally knows that oceans are essential to human survival and they need to be protected. However, most don't know the specific functions of the oceans, human impact and cost of the damages. Similar results have been found when the survey repeated at 2011. In addition, after major accidents like "BP Deep water Horizon" people are convinced that conservation is needed. However, they did not find evidence that knowledge about ocean threats, climate change and over-pollution increased since the 1999 survey (The Ocean Project, 2011).

Steel et al. (2005) looked at the United States population's ocean literacy more comprehensively. They studied approximately 1233 individuals randomly and investigated their comprehension by looking at familiarity to terminology, answers to quiz questions and participants' self-assessment regarding ocean policy issues. They found the public's ocean knowledge and awareness with general concepts of ocean was inadequate.

Education of oceanography

After releasing the framework about definition of ocean literacy and the 7 *Essential Principles* which mentioned in background, Ocean Literacy Scope and Sequence for Grades K-12 was published. This guideline mentions the principles above and supports them with 45 fundamental concepts. The guideline was prepared by COSEE California with the help of COSEE West. The science education community took part in the process with 150 members and the guideline was published in 2010 by National Marine Educators

Association (NMEA). The guideline presents resource and framework for teachers (National Marine Educators Association, 2010).

In Turkey, there are Non-Governmental Organizations that organizes workshops and give trainings regarding marine issues, conservation and pollution to public and K-12 students. Turkish Marine Environment Protection Association (TURMEPA) is one of the main organizations that educate students at national level. In addition, some universities and Marine Science Institutes organize local level trainings. However, there is no framework or guide produced to implement to *7 Essential Principles* of ocean literacy into Turkish Ministry of National Education (MoNE) program. Thereby, educational programs are the only formal source for students to gain knowledge regarding *7 Essential Principles* of ocean literacy in Turkey.

Secondary school educational programs in Turkey

MoNE offers a mandatory school program to every secondary school registered in Turkey. Further, there are some private international guidelines and programs that are followed by other schools in other countries. Some private schools in Turkey offer those programs in addition to MoNE to be a part of international education community. The most common ones are International Baccalaureate Diploma Program (IBDP) and International General Certificate of Secondary Education (IGCSE).

Ministry of National Education (MoNE) Program

MoNE offers a secondary school program to Turkish students. This is a four year program follow by students at 14 to 17 years old. MoNE provide course

selection to students in secondary school although, there are mandatory classes that students need to take. Some of the courses taken by students are:

- Language and expression
- Turkish literature
- Education of religion and ethics
- History
- Geography
- Foreign language
- Secondary foreign language
- Physical education
- Visual arts/ Music.
- Math
- Science
- Language
- Mathematics (Ministry of National Education, 2016).

International Baccalaureate Diploma Program (IBDP)

IBDP is a high school program which addresses the students between 16 and 19 years old. The main foundation is International Baccalaureate Organization (IBO) which offers other programs to younger students. The students in Diploma Program choose one of the six subjects to focus:

- Studies in language and literature (Group 1)
- Language acquisition (Group 2)
- Individuals and societies (Group 3)
- Sciences (Group 4)

- Mathematics (Group 5)
- The arts (Group 6) (International Baccalaureate Organization, 2014).

They also need to take one course from each group. Students have option to study additional individuals and societies, language and science instead of art. There are high level (HL) and standard level (SL) in courses. Students are obligatory to choose at least three high level and the rest might be standard level (International Baccalaureate Organization, 2014).

Within Science subject; Biology, Computer Science, Chemistry, Design Technology, Physics, Sports, Exercise and Health Science courses are offered. In addition, Environmental Systems and Societies (ESS) course is offered as part of Group 4 (Science) and Group 3 (Individuals and Societies). ESS is an interdisciplinary course which has only standard level (International Baccalaureate Organization, 2014).

Cambridge International General Certificate of Secondary Education (IGCSE)
 Cambridge International General Certificate of Secondary Education (IGCSE) is another international qualification program which addresses 14 to 16 years old students. It has developed by Cambridge International Examination. The program offers 70 subjects within different routes and combinations. The subjects can be grouped under six themes. These are:

- English Language and Literature
- Mathematics
- Sciences
- Languages

- Humanities and Social Sciences
- Business, Technical and Creative.

There are different levels of courses like Additional Mathematics and International Mathematics. Science courses offers separately as Biology, Chemistry, and Physics and combined as Science. There are classes like Environmental Management and Agriculture which are inter-disciplinary (Cambridge International Examination, 2016a).

Secondary school curriculum overview

The following school programs were investigated within conceptual framework regarding *7 Essential Principles* of ocean literacy.

There are different pathways and programs in IGCSE, IBDP and MoNE high school student programs. The subjects and courses that cover most of the content regarding oceanography were:

MoNE; Biology and Geography

IBDP; Environmental Systems and Societies and Biology

IGCSE; Environmental Management and Biology.

The syllabuses and guidelines of these courses were identified and the knowledge they provide are summarized in below subsection.

MoNE curriculum dispenses ocean literacy and *7 Essential Principles* topics under two classes; Geography and Biology.

- Geography distributes the necessary information under different grade levels. At grade nine, “Natural Systems” unit gives importance on

climate and the factors that control it. In addition, tectonic plates and movement of them are discussed, shape of features and formation of earth mentioned as well. At the unit “Environment and Society” discusses the relationship between human and nature, human impact. At grade 10 the unit “Natural Systems”’ shape of physical features and formation of earth is mentioned. In the same unit Turkish water resources and the socio-economic relations with usage of resources are given. At eleventh grade, the unit “Natural System” discusses aquatic ecosystem and importance for human, use of natural resources and sustainability and human impact on water systems also involved in the subject. The unit Environment and Society promotes the environmental awareness and points out the management (Ministry of Education, 2011). This content gives importance on the *Second Principle*; “*The ocean and life on the ocean shape the features of earth.*”

- Biology collects the necessary information under different grades. At grade nine the unit “Environmental Problems and Human” mentions about climate change, human impact and some pollution problems. At grade 10 the unit “Our World” focuses more about ecology topics and give introduction of aquatic ecosystems, water cycle, water pollution and human part on pollutions (Ministry of Education, 2013).

IBDP educational program frequently mentions the *7 Essential Principles* related topics in two classes; Biology and Environmental Systems and Societies (ESS).

- IBDP Biology introduces the necessary information as a part of core ecology unit. In this unit climate change, carbon cycle and marine ecosystems were discussed. In the core optional part “Ecology and Conservation” unit highlights the conservation and marine pollution with climate change and human contributions. Moreover, addresses the importance of autotrophs and influence on carbon and oxygen cycle. In addition, the option part on ecology addresses human impact like over population and sustainable fishery, algal blooms, macro and micro-plastics, invasive and alien species (International Baccalaureate Organization, 2016).
- IBDP ESS guideline has a whole chapter on aquatic systems. This chapter gives importance to both marine and freshwater resources; it also includes more marine content compare to other subjects in IBDP. “Introduction to Water Systems, Aquatic Food Production” and “Water Pollution” chapters provide some information regarding ocean literacy. They mention the mechanism of ocean circulation and its influences on the climate and global distribution of water. Human activities such as; deforestation, agriculture, urbanization have an impact on runoffs and infiltration discussed as well. Freshwater area which covers the surface of earth, climate change effects and it may disrupt rainfall patterns. Aquatic systems provide a source of food production. Unsustainable use of aquatic systems and its dangers on humans, importance of aquaculture. Water pollution in both groundwater and surface water is a major global problem, the effects of human and other biological systems, invasive species (International Baccalaureate Organization,

2017). Like Environmental Management, ESS has a whole chapter on aquatic systems. Other two programs distribute the information regarding oceans literacy under other chapters and subjects. Thus, ESS subject refers most of the *7 Essential Principles* that ocean literacy involves.

IGCSE mentions to the topics related to the *7 Essential Principles* mostly with Biology and Environmental Management courses.

- IGCSE Biology scatters the topics related with oceanography under two topics which are “Organisms and their Environment” and “Human Influences on Ecosystems”. Organisms and their Environment topic; describes water cycle with limitations of evaporation, condensation, precipitation and transpiration. Further, it gives importance to carbon cycle and nitrogen cycle. The guideline of the program also mentions in human being influences on ecosystem about marine pollution, water pollution, increase of CO₂, livestock production fish, chemical fertilizers, agriculture effects to the environment. It also gives specific examples like untreated sewage system, fertilizers, contraceptive hormone, plastics impacts to marine systems. It also informs about eutrophication and climate change effects (Cambridge International Examination, 2016).
- Environmental Management course of IGCSE, gives most content regarding the oceans. Under “Hydrosphere” unit, the water cycle and oceans were discussed. The physical properties and the oceans as resource and environment, human exploitation and intervention to

aquatic systems, under risk oceans and how to manage those systems were introduced to students. (Cambridge International Examination, 2016b). This course discusses oceans under one unit with interdisciplinary subjects. Thereby, the topics and information given matches most of the 7 *Essential Principles* of ocean literacy.

Among programs mentioned above, all biology subjects cover the limited parts of ocean literacy terms and the main themes are relatively same. Still, IGCSE Biology seems to share most detailed examples regarding oceans and most content with Environmental Management. However, IB DP ESS program covers most of the *Principles* by mentioning human relations and policy as well. The main problem in here is the oceans and oceanography interdisciplinary; therefore, it is difficult to investigate and gather ocean literacy principles under one topic or subject. The success of ESS and Environmental Management courses is that they are combination of several disciplines by nature. This characteristic gives a chance to embrace most of the topics by different angles and literacy principles as well.

Previous studies

Ocean literacy of students

After ocean literacy started to draw attention in education community, several studies have been conducted on students. Through mixed methods, Plankis and Marrero (2010) measured the ocean literacy among 434 K-12 American students. In the quantitative part of the research, data collection was conducted through two different instruments; Secondary Science Environmental Literacy

Instrument (SSRLI) and Students Ocean Literacy Viewpoint and Engagement (SOLVE). The SOLVE instrument was prepared according to the *7 Essential Principles* of ocean literacy. The instrument composed of four different parts.

- At the first part, there are multiple choice questions measures the knowledge of five different principles.
- Second part, ask students to list the cause and impacts of oceanic problems
- Third part measures the concerns of students against oceanic problems.
- Fourth part present as post-test and measures student's viewpoints and engagements through open- ended questions.

The results showed that students exhibited a low level of ocean literacy. The researchers indicated most of the students could not define ocean literacy.

In the qualitative part of the study, Plankis and Marrero (2010) conducted a case study among two classrooms. These two classrooms were selected purposefully. The teachers were taught the ocean literacy focused program which NOAA sponsored, Signals of Spring. The researchers used field notes, open ended questionnaires, teacher and student interviews and student produced documents for gathering data in the case study. The results of the case study suggested that students who engaged with ocean literacy focused program might change their behavior towards protecting the ocean.

Another study was conducted with Canadian students by Guest, Lotze and Wallace (2015). According to the results of an ocean literacy quiz administered to students in grades seven to 12, students scored under 50%.

The study included 723 students in Nova Scotia. The survey was composed of three parts.

- First part contains demographic data then second part relates with facts.
- Second part has multiple choices, true-false, fill in the blanks and open-ended questions. The questions in the second part are based on the *7 Essential Principles* that is mentioned above.
- Third part of the survey includes students' relationship with the oceans, marine activities and interests on topics.

Random sampling was used and surveys were presented and collected from schools by the researcher. With using 'R' and 'Statplus' programs ANOVA and *t*- test were applied to the data in order to analyze test results. Regardless of students' low scores on quiz, the researchers found students value the marine environment.

Additionally, a study conducted from participants of Oceanography Camp for Girls to explore teen girls' ocean literacy in United States by Greely (2008). Study investigated the understanding (content knowledge), feeling (attitudes and morality) towards ocean environments and how these understanding and feelings related with reasoning of ocean issues. Study conducted with 30 female students. A mixed method approach applied within quantitative:

- Survey of Ocean Literacy (SOLE) assesses content knowledge
- Survey of Ocean Stewardship (SOS) for identify emotive factors (attitudes, beliefs, personal experiences)

- Survey of Ocean Environmental Morality (SOME) associated with ocean environmental moral reasoning tests.

Qualitative part of the study is Ocean Socioscientific Issues (OSSI) interview questions. Study found out that content knowledge and environmental attitude have an important part in ocean literacy. Also teens are consulting biocentric environmental reasoning to solve oceanic dilemmas. Interviews indicated rationalistic, emotive and intuitive patterns as informal reasoning.

Despite the international educational interests, there have not been any studies related to ocean literacy undertaken in Turkey. However several studies were conducted regarding environmental literacy. Erdogan and Ok (2011) explored the fifth-grade students' environmental literacy by surveying 2412 of them at 26 provinces in Turkey. The results showed that 61% of the students have moderate level of environmental literacy and 27.3% of them have high level of environmental literacy.

Review of the above-mentioned ocean literacy studies indicates that other variables such as location, gender and specific program in which the students were involved might create an impact on literacy level.

Location influence

Location impact considered as an important variable in terms of literacy. It is logical to assume that people who live in certain ecosystems will share more knowledge and positive attitude towards that area. Hares et al. (2006) studied Sudan savannah and Thailand forest ecosystems. They investigated how people explained the impacts on environmental change in two different

ecosystems with case study interviews. The results support that local people are knowledgeable about their environment and might help developing sustainable practices.

Steel et al. (2005) explored the location influence while surveying the United States population's ocean literacy. Study illustrated that people who live in coastal areas knows and heard more about ocean terminology compare to people who live in inland cities.

Gender influence

The second variable that has influence on literacy might be gender. Tuncer, Ertepinar, Tekkaya and Sungur (2005) explored the environmental attitudes among Turkish students from eighth grade to graduate students and gender of these students in Ankara. They applied a questionnaire approximately to 1500 students regarding their awareness of environmental problems and individual responsibilities also solutions to these problems. They detected a significant difference among boys and girls towards environmental attitudes in favour of girls.

On the contrary, Steel et al. (2005) found out males showed more content knowledge than female participants regarding ocean topics. Guest et al. (2015) also support those results with their study as well. They found a significant difference between male and female in favor of males in terms of their ocean literacy quiz scores.

Educational program

Third impact on literacy might come from students' educational program. International Baccalaureate Diploma Program (IBDP), International General Certificate of Secondary Education (IGCSE) and Ministry of Education

(MoNE) program are the main three educational programs that Turkish schools offer. These programs might create a difference among students' environmental and ocean literacy. Ödün (2013) compared the IGCSE, MoNE and IBDP textbooks regarding ecology units. Through content analysis, she found out that MoNE textbooks covers more ecological key concepts than other books and present most friendly language style. However, IGCSE textbooks are the only ones with teachers' resource kit and IBDP provides a lot of additional web links related with topics.

Source of information about oceans

Individuals choice of source (social, TV, radio, journal, textbook) regarding oceans also might create difference. Steel et al (2005) found out that internet and newspapers increase the literacy while TV's and radios have a negative effect. Furthermore, within increasing popularity of social media individuals encounter with different concepts and information. Therefore, some institutions started to be present and use social media to inform public.

Fauville, Dupont, von Thun and Lundin (2015) investigated the impact of social media on scientific literacy through Monterey Bay Aquarium Facebook webpage. They found positive effect on some practices like posting text with picture instead of text only. They also emphasized that Facebook pages have limited offering about appropriate social context to foster participation since they cannot provide where such practices could develop.

The content knowledge and attitude relationship

Guest et al (2015) investigated the relationship between content knowledge and values of ocean literacy and found a positive relationship among the 723 Canadian students mentioned above.

Cummins and Snively (2000) investigated the knowledge about ocean and attitude of fourth grade students in British Columbia, Canada. Study was an experimental study which conducted among 15 male and 11 female grade four students. Researchers assessed students' knowledge and attitude towards seashore and ocean. Then they implemented a constructive instruction including field trip about oceans and assessed the students after the implementation. They found out that students' attitude and knowledge scores increased after implementation and there is weak positive relation exist among them.

Additional to ocean literacy, Allum et al. (2008) tried to illuminate the public understanding of science. Thus, they looked at the relationship between content knowledge and attitude towards different scientific topics among different studies from 40 different countries through meta- analyses. They suggested that most of the studies underline a small positive relationship between attitude and knowledge. They also found the participants in those studies show a small content knowledge regarding the scientific topic of the study. Therefore, their suggestion for the small positive relationship between knowledge and attitude comes from the small scientific knowledge of participants.

To conclude, several studies were conducted among different societies and populations within several aspects and the common problem of all studies was ocean literacy. Since oceans are essential for human beings from every nation, it brings a global and international perspective to the problem. Thereby, this study investigates the ocean literacy of students in Turkey from an international standpoint.

CHAPTER 3: METHOD

Introduction

This chapter starts with an explanation the research design for the study. Then, it comments on the context, participant profile and instrumentation. Data collection and method of data analyses are discussed in the last part of the chapter.

This study investigates the ocean literacy of selected private high school students in Turkey. The level of their ocean content knowledge and attitude were compared according to students' location, educational program and gender. The research questions are indicated below:

1. What is the ocean literacy level of high school students in Turkey?
2. Is ocean literacy of students who lives inland different from those in coastal?
3. Is there any difference in ocean literacy with respect to gender?
4. From which sources do students obtain information about ocean?
5. Is there any difference in ocean literacy among students who follow only MoNE program and MoNE with additional (IBDP, IGCSE) programs?
6. Is there any relationship between ocean content knowledge and attitude of high school students towards ocean?

Research design

In this study, a survey method was used to explore ocean literacy. The reason behind this was to investigate private school students' level of content knowledge about and attitude towards ocean as population (Fraenkel & Wallen, 2008). The quantitative data were compared statistically based on gender, school region and education program. This design method is most suitable for understanding the students' level of ocean literacy in terms of content knowledge and attitude. The research focuses on reaching the students in different cities and schools therefore a questionnaire meets the purpose of this study. Mogias et al. (2015) have used similar research technique in order to measure the ocean literacy among pre-service teachers in Greece.

The questionnaire was applied to a predetermined sample group for a specific time. Therefore, it is cross sectional survey (Wallen & Fraenkel, 2001). The intention of this survey is to provide snapshot about ocean literacy of private high school students in Turkey (Lavrakas, 2008).

Context

The study was conducted in four different cities and in six schools. Cities were chosen both coastal and inland to investigate the habitat impact on ocean literacy. İstanbul and İzmir were chosen as a part of coastal locations while Ankara and Erzurum were the inland locations. The names of the schools coded as School 1, 2, 3 and 4, 5 and 6 (Table 1). All schools are foundation school and apply either additional program (IBDP, IGCSE) with MoNE or solitary MoNE program.

- The School 1 is a foundation and international laboratory high school located in Ankara. It is an English medium school. Main language is

English inside of the school except Turkish subject. The students start this school in two ways; students coming from middle school, inside of School 1 system proceed to high school directly. Secondly, students coming from outside of School 1 system should pass an entrance exam which assesses their knowledge and skills regarding English, Science, Math and Turkish to establish entrance and placement into high school.

- School 2 is a foundation school locates in Ankara. Students who enter this school can have a scholarship according to their National secondary school entrance examination results. It is also an English medium school. National examination applies to eight grades in whole country and has taken account for transition between primary to secondary education. Examination assesses Math, Science, Turkish, History, Religious Studies and English subjects. In addition School 2 organizes another examination which differ high achievement students and grouped them together.
- School 3 is a foundation school in Ankara; it has similar transition system to School 1 regarding middle school students. In addition School 3 also applies its own exam and national exam for entrance and scholarship purposes. In School 3, students follow only MoNE educational program and learn subjects in Turkish. However students who follow an international program next to MoNE learn subjects in English.
- School 4 locates in Erzurum and is a foundation and laboratory school. Like School 1 it is also an English medium school and main language in school is English. Although, compared to the other schools this school offers an enhanced scholarship program which covers at least 70% of its students. It accepts students through examination and interview processes.

- School 5 locates in İstanbul and is a foundation school. It is English medium school. This school also offers a scholarship according to the scholarship examination or national examination results.
- School 6 locates in İzmir and also a foundation school. It belongs to same foundation with school 5 therefore follows the same scholarship and language policy.

Table 1
School information involved in the study

School no	Town	City
1	Çankaya	Ankara
2	Gölbaşı	Ankara
3	Çankaya	Ankara
4	Palandöken	Erzurum
5	Üsküdar	İstanbul
6	Göztepe	İzmir

Participants

The population of the study is composed of foundation high school students in İzmir, İstanbul, Ankara and Erzurum. Purposeful and convenience sampling used in this research due to existing partnership between Graduate School of Education, Bilkent University and sample schools (Etikan, 2016).

Three schools that included in the study were from Ankara and other cities have just one participant school. Samples included students from grades nine to 12. The

total number of participants was 328. The number of participants from each city is stated in Table 2. Three schools from Ankara include 113 participants while Erzurum has 51, İzmir 50 and İstanbul has 114. To prevent any misconceptions that can cause by recent movements of participants “living in coastal more than six months” question added in the demographic part in questionnaire. Students who lived in coastal city more than six months were 150 while not live in coastal were 141, 37 participants did not answer the question (Table 7).

Female students who participated in the study were 165 and 134 participants were male, 29 students did not state their gender (Table 6). Students who follow only MoNE program were 160 while 101 students indicated an additional program with MoNE, 67 participants did not answer (Table 7).

Table 2
Participant number involved in each city

City	n	Percentage (%)
Ankara	113	34.5
Erzurum	51	15.5
İzmir	50	15.2
İstanbul	114	34.8

n: Number of participant

Instrumentation

The questionnaire of the study consisted from four parts:

- Part 1: Demographic information related with students’ city (location), program, grade, age and gender.
- Part 2: The source of information about oceans (frequency table of source usage).

- Part 3: Turkish (T)- SOLE (26 questions, multiple choice questions).
- Part 4: Turkish (T)- SOS (16 questions, Likert scale).

The questions were adapted and translated from the Survey of Ocean Literacy and Experience (SOLE) and the Survey of Ocean Stewardship (SOS) with the permission of developer, Teresa Greely, University of South Florida (Appendix B). The original study applied the 13-14 years of girls and high school students as a part of doctoral dissertation project. In this study SOLE referred as T-SOLE and SOS as T-SOS since the instruments were translated into Turkish. Part 1 and Part 2 were added by the researcher.

Part 1: Demographic

The first part of the questionnaire was asking for the participant's demographic data. It aims to gather the information about the location, grade level, age, gender of the students and educational program that they follow.

Part 2: Source of information

The second part of the questionnaire explores the source of information of participants regarding oceans. The source of information table were developed according to Steel et al. (2005)'s study. This part gives information about which source (internet, school, TV, radio, newspaper) students choose and how frequent they use that source to get information about oceans. Second part addresses the research question number four (Table 4).

Part 3: Turkish Survey of Ocean Literacy and Experience (T-SOLE)

The third part of questionnaire is the T-SOLE. The T-SOLE questions were prepared according to the *7 Essential Principles* and contents of COSEE (2005)

guideline which was mentioned in Chapter 2 and aims to assess content knowledge of students regarding ocean literacy with multiple questions (Table 3). The original 57 questions were reduced to 26 questions in current study in order to adjust to the length in school periods in the Turkish school system which is 40 minutes. Most of the schools agreed to participate in the study with the condition of spending only one period of their class time. Some questions were also removed because they were related to the local issues about oceans in the original study (United States), not relevant to Turkey. T-SOLE part of the questionnaire illustrates the information about the content knowledge about *7 Essential Principles* of ocean literacy which addresses the first research question (Table 4).

Part 4: Turkish Survey of Ocean Stewardship (T-SOS)

T-SOS questions were formed to assess the attitude, beliefs and emotions towards oceans by considering COSEE (2005) *7 Essential Principles* and content (Table 3). The original author Greely was comprised the questions based on the categories from previous surveys (Cudaback, 2006). The original 44 questions were reduced to 16 questions in current study to adjust with the necessary duration for answering to period time frame of school system. The questions are in form of five-point Likert scale type changes from:

- 1- Strongly disagree
- 2- Disagree
- 3- Neutral
- 4- Agree
- 5- Strongly agree.

T-SOS provides information about the attitude, belief and emotion level of students regarding *7 Essential Principles* of ocean literacy and addresses the first research question (Table 4).

Table 3
Questions in alignment with *7 Essential Principles* of ocean literacy

Essential principle	No. of questions	Instrument
1. The Earth has one big ocean with many features.	6	T-SOLE (1,2,3,4), T-SOS (3,4)
2. The ocean and life in the ocean shape the features of Earth	6	T-SOLE (5,6,7,8), T-SOS (1,12)
3. The ocean is a major influence on weather and climate.	4	T-SOLE (8,9,10,11)
4. The ocean made Earth habitable.	3	T-SOLE (12), T-SOS (4,13)
5. The ocean supports a great diversity of life and ecosystems.	9	T-SOLE (13,14,15,16,17,18,19), SOS (11,15)
6. The ocean and humans are inextricably interconnected.	11	T-SOLE (20,21,22), T-SOS (2,5,6,7,8,9,14,16)
7. The ocean is largely unexplored.	4	T-SOLE (23,24,25,26)

The combinations of demographic part, third part and fourth part of questionnaire provide answers regarding the second, third and fifth research questions. The relationship between third and fourth part of questionnaire illuminates the sixth research question (Table 4).

Table 4
Research questions alignment with questionnaire parts

Research questions	Part of questionnaire	Instrument
1. Ocean literacy level	1, 3 and 4	T-SOLE and T-SOS
2. Habitat impact	1, 3 and 4	T-SOLE and T-SOS
3. Gender impact	1, 3 and 4	T-SOLE and T-SOS
4. Source of information	2	Source of information table
5. Student program impact	1, 3 and 4	T-SOLE and T-SOS
6. Content knowledge, attitude relationship	3 and 4	T-SOLE and T-SOS

The SOLE and SOS questions were previously applied in two different studies (Greely, 2008, Mogias et al., 2015). Questionnaires were translated from English to Turkish and back translated (Brislin, 1970). This process was completed by two individuals, an expert in Tropical Biodiversity and Ecosystems and the researcher. Both Turkish and English versions of questionnaires were distributed to students in hard copy.

Method of data collection

Proposal was submitted at February 2017 to Ministry of Education for permission to apply the questionnaires in schools. After the approval from ministry (Appendix C), consents from school administrations and boards were gathered. The researcher brought the questionnaires to Schools 1, 2, 3 and 6 personally. For School 4, questionnaires were sent and received through mail. Another researcher brought the questionnaire to School 5 and followed the process. Students

voluntarily participated in the survey. The necessary permissions from parents were gathered before the sessions through the schools. Guidance and biology teachers informed the students regarding confidentiality and the content of questionnaire, distributed them and monitored students. It took students' 25-30 minutes of time to complete the questionnaire. Students didn't share information with each other and teachers while taking the questionnaire. In three-week time researcher made another appointment to collect the questionnaires. Data was collected from School 5 and 6 at April 2017, School 4 at May 2017. School 2 were collected at March and School 1 and 3 at May 2017 (Table 5).

Table 5
Data collection periods in schools

School	School 2	School 5	School 6	School 4	School 1 and 3
Date	March 2017	April 2017	April 2017	May 2017	May 2017

Method of data analysis

Data were analyzed by using the Statistical Package for the Social Sciences (SPSS) program. The tests were applied to the T- SOLE and T-SOS questions separately. Normality of data were investigated through Skewness and Kurtosis analyses (Ghasemi & Zahediasl, 2012). T-SOLE questions were in normal distribution range with Skewness of -0.58 ($SE=0.14$) and Kurtosis of -0.18 ($SE=0.3$). T-SOS questions also indicated normal distribution with Skewness of -0.73 ($SE= 0.15$) and Kurtosis of 0.74 ($SE= 0.3$). For T-SOS questions reliability were checked through Cronbach's alpha (Tavakol & Dennick, 2011). T-SOS questions

found to be reliable (16 items; $\alpha = .83$). Parametric analyses were conducted after the validation of normal distribution.

To explore the level of ocean literacy of students in Turkey and answer the first research question, descriptive analyses were conducted for the T-SOLE and T-SOS questions. In terms of T-SOLE, each correct answer got one point. The general mean, standard deviation, standard error scores of 26 multiple choice questions were calculated. Secondly, mean, standard deviation and standard error scores of each *Principle* calculated through addressed questions Table 3 indicates the each question alignment with its *Principle*.

T-SOS questions were also analyzed with similar method to T-SOLE. Participants gave scores to each T-SOS item in terms of 1 for “Strongly disagree” to 5 for “Strongly agree”. The general mean, standard deviation and standard error scores of 16 Likert scale questions calculated. Following, mean, standard deviation and standard error scores of each *Principle* calculated through addressed items.

In order to investigate the difference between coastal and inland in second research question, independent *t*-tests were applied to T-SOLE and T-SOS questions separately. “I have lived in coastal more than six months” statement in Demographic part of questionnaire was taken account as grouping variable while T-SOLE and T-SOS scores were assigned as test variable.

To explore the difference between genders stated in research question three, independent *t*-tests were applied to T-SOLE and T-SOS questions separately. Gender statement in Demographic part of the questionnaire was taken account to group participants as grouping variable. T-SOLE and T-SOS scores assigned as test variable.

For answering the research question number four, frequency data of sources were conducted through descriptive analyses. Participants scored 1 “not using at all” to 5 “using all the time” to indicate the use of frequency for each source given in the questionnaire. Mean scores, standard deviation and percentages of sources were calculated to explore the most preferred source type.

In addition, to investigate the educational program type impact on ocean literacy and illuminate fifth research question independent *t*-test were applied. Education program type question in demographic part of questionnaire were used to group program types as grouping variable. T-SOLE and T-SOS scores assigned as test variable.

Correlational analyses were applied to investigate the relationship between mean scores of T-SOLE and T-SOS to illuminate sixth research question and explore content knowledge and attitude relationship. Pearson *r* correlation coefficient were used as a part of linear relationship ($r = .41, p < .05$).

CHAPTER 4: RESULTS

Introduction

The results of the research questions are presented in this chapter. The demographic results are introduced and explained in the first part. Following, results of each research question are presented in order.

Questionnaire results

The results of this study were conducted according to the data from the questionnaire. The results are consisted with four parts in questionnaire; demographic, source of information, T-SOLE and T-SOS. T-SOLE was used to explore content knowledge of students about ocean while T-SOS was used to explore attitudes of students towards ocean. SPSS program was used in order to enlighten the research questions. Therefore SPSS analyze results were given with related table under each research question.

Demographic results

The demographic information was obtained from participants in the first part of the questionnaire. Participants were asked for gender, grade level, the school program that they follow and whether they have lived in the coastal city more than six months or not.

Three hundred and twenty-eight students from ninth to twelfth grade participated in the survey (Table 6). Grade 9 addresses to 14-15 years old while grade 12 consists of 17-18 years old students. Most of the students were in eleventh

grade (49.7%) and in tenth grade (32.6%). Female participants (50.3%) in the study were almost 10 percent more than the male (40.9%) participants, 8.8% of participants did not state their gender ($N= 328$ F=165 M=134).

Table 6
Participants according to their grade level and gender

	<i>n</i>	Percentage	SD
Grade 9 (14-15years)	27	8.2%	0.8
Grade 10 (15-16years)	107	32.6%	0.8
Grade 11 (16-17years)	163	49.7%	0.8
Grade 12 (17-18years)	29	8.8%	0.8
Male	165	50.3%	0.5
Female	134	40.9%	0.5

n: number of participants
SD: Standard deviation

Students were also classified according to the educational programs that they follow. Students who follow only MoNE program (48.7%) were more than students who follow MoNE with additional (30.7%) IBDP or IGCSE educational program, 20.6% of students ($n= 67$) did not mention their program (Table 7).

Students were also classified according to their habitat. Living in coastal city more than six months was taken account for habitat classification. Forty-five point seven percent of the participants lived in coastal more than six months and 43% did not live in coastal areas. Eleven point three percent of participants ($n=37$) did not mention where they have lived (Table 7).

Table 7
Participants number according to their habitat and school program

	<i>n</i>	Percentage	<i>SD</i>
MoNE only	160	48.7%	0.5
MoNE and additional program	101	30.7%	0.5
Coastal	150	45.7%	0.5
Inland	141	43%	0.5

n: number of participants
SD: standard deviation

Research question 1: What is the ocean literacy level of high school students in Turkey?

Questionnaire measures the level of ocean literacy in two aspects: content knowledge (T-SOLE) and attitude (T-SOS) levels. Firstly, the multiple-choice questions aid to assess the T-SOLE scores of students related with 7 *Essential Principles*. For every correct answer, participants got one point. The mean scores of T-SOLE questions for the whole group is 13.28 out of 26 ($N= 328$ $SD= 5.04$). Figure 1 indicates the mean scores distribution among 7 *Essential Principles* in T-SOLE part. According to the results, participants scored highest score from *Principle 1*, “*The earth has one big ocean with many features*” $M= 0.69$ $SD= 0.25$ while *Principle 4*, “*The ocean made earth habitable*” $M= 0.38$ $SD= 0.49$ and 7, “*The ocean is largely unexplored*” shows the lowest mean value of 0.38 $SD= 0.32$. Table 8 indicates the related items with lowest *Principles*.

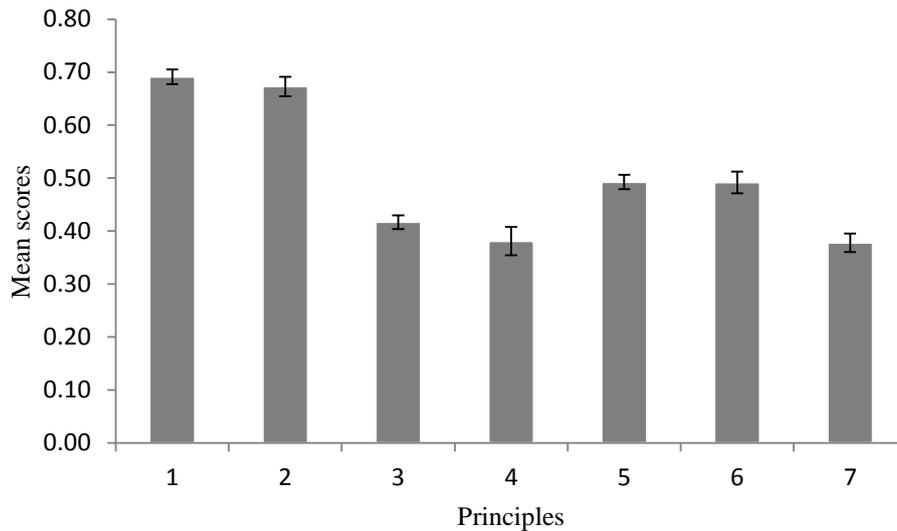


Figure 1. The mean scores of T-SOLE scores among 7 *Essential Principles*

Secondly, attitudes of students towards ocean were measured with T-SOS questions. Participants indicated their attitudes towards ocean according to a Likert scale type of questions (1: indicates strongly disagree, 2: disagree, 3: neutral, 4: agree and 5: strongly agree).

There were 267 participants answered the questions and the mean score of T-SOS is 3.72 $SD= 0.67$ indicates the participants towards “Agree” statement approximately.

Figure 2 illustrates the mean scores of T-SOS questions distribution among 7 *Essential Principles*. *Principle 3* is not addressed in this questionnaire; it also not addressed in original questionnaire and in the study. The highest score belongs to *Principle 4*, “*The ocean made earth habitable*” with the mean of 3.98 $SD= 0.93$ while the lowest is *Principle 2*, “*Ocean and life in the ocean will shape the earth*” with the mean of 3.12 $SD= 0.99$. Table 8 indicates the related items with lowest *Principles*.

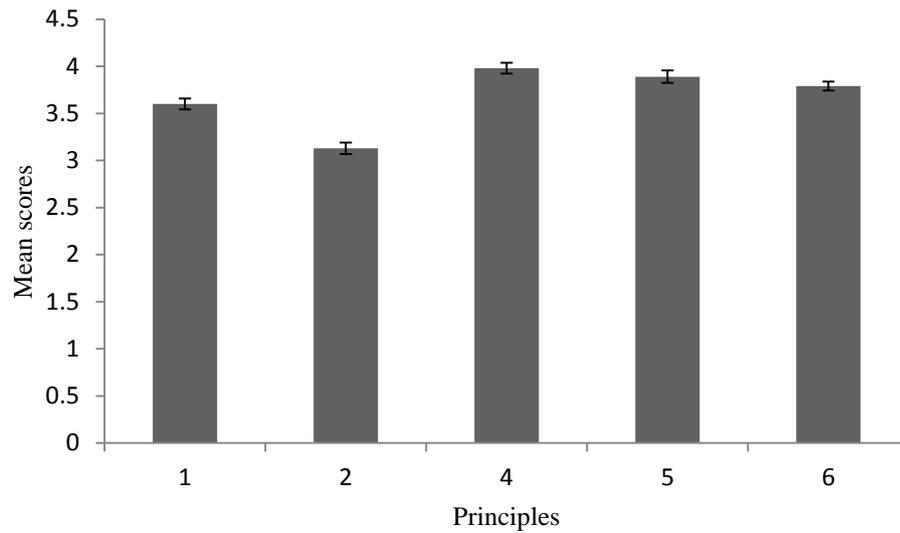


Figure 2. The mean scores of T-SOS scores among 7 *Essential Principles*

Table 8
The lowest *Principle* alignment with items in both test types

Test type	<i>Principle</i>	Item
T-SOLE	4	<ul style="list-style-type: none"> • What produces most of the earth's oxygen
T-SOLE	7	<ul style="list-style-type: none"> • How much of the oceans remains unexplored
T-SOLE	7	<ul style="list-style-type: none"> • Why is it important to study the ocean?
T-SOS	2	<ul style="list-style-type: none"> • Ocean scientists are relying more and more on which of the following technology tools to explore the ocean?
T-SOS	2	<ul style="list-style-type: none"> • Over the last 40 years, use of ocean resources has significantly increased. Why is it important to know this?

Research question 2: Is ocean literacy of students who lives inland different from those in coastal?

This question investigated under two aspects; T-SOLE and T-SOS levels. Table 9 indicates that there is a statistically significant difference between T-SOLE scores of students who live in coastal more than 6 months ($M= 14.31$ $SD= 4.5$) and students who do not ($M= 12.77$, $SD= 5.11$); $t(279.027)=-2.712$, $p= .01$.

Table 9
The results of independent sample t –test in T-SOLE scores according to students’ habitat

Variables		<i>N</i>	<i>M</i>	<i>SD</i>	<i>F</i>	<i>sig</i>	<i>df</i>	<i>t</i>	<i>p</i>
Habitat	Coastal	150	14.31	4.5	5.61	.02	279.07	-2.71	.01
	Inland	125	12.77	5.11					

* $p < .05$

The second part of the questionnaire covers the T-SOS questions. According to independent t test there is no statistically significant difference between students who live in coastal more than 6 months ($M= 3.80$, $SD= 0.73$) and students who do not ($M= 3.68$, $SD= 0.61$); $t(237)=-1.41$, $p= .16$ (Table 10).

Table 10

The results of independent sample *t* –test in T-SOS scores according to students’ habitat

Variables		<i>N</i>	<i>M</i>	<i>SD</i>	<i>F</i>	<i>sig</i>	<i>df</i>	<i>t</i>	<i>p</i>
Habitat	Coastal	114	3.80	0.73	1.47	.23	237	-	.16
	Inland	125	3.68	0.61				1.41	

**p* < .05

Research question 3: Is there any difference in ocean literacy with respect to gender?

According to independent sample *t* test results in Table 11, female participants’ (*M*= 13.85, *SD*= 4.73) scores are significantly higher than male participants (*M*= 12.63, *SD*= 5.12) in terms of T-SOLE scores $t(297)= 2.13, p= .03$

Table 11

The results of independent sample *t* –test in T-SOLE scores according to students’ gender

Variables		<i>N</i>	<i>M</i>	<i>SD</i>	<i>F</i>	<i>sig</i>	<i>df</i>	<i>t</i>	<i>p</i>
Gender	Female	165	13.85	4.73	0.86	.36	297	2.13	.03
	Male	134	12.63	5.12					

**p* < .05

Regarding T-SOS scores of students indicated in Table 12, independent sample *t* test suggested a significant difference between female (*M*= 3.81, *SD*= 0.62) and male students (*M*= 3.62, *SD*= 0.72) with the conditions, $t(244)= 2.3, p= .02$.

Table 12

The results of independent sample *t* –test in T-SOS scores according to students’ gender

Variables		<i>N</i>	<i>M</i>	<i>SD</i>	<i>F</i>	<i>sig</i>	<i>df</i>	<i>t</i>	<i>p</i>
Gender	Female	142	3.81	0.62	0.61	.44	244	2.3	.02
	Male	104	3.62	0.72					

**p*< .05

Research question 4: From which source do students obtain information about ocean?

In order to answer this question participant filled in a table which indicates the frequency of use of internet, television (TV), radio, newspaper (np)/ journal and school sources to obtain information regarding oceans. One to five (1: not using at all, 2: moderately, 3: medium level, 4: frequently, 5: all the time) scale is used to find out the answer for this research question.

Table 13 indicates the mean values of source preferences according to use of frequency scale. Internet has the highest mean with *M*= 3.89 *SD*= 1.29 while radio has the lowest value (*M*= 1.40 *SD*= 0.94). School has preferred to be the second choice with the mean of 3.30 *SD*= 1.36; television and newspaper follows by *M*= 2.46 *SD*= 1.14 and *M*= 2.22 *SD*=0 .94.

Table 13
The mean values of source preferences

The source type	Mean values	Standard deviations
Internet	3.89	1.29
School	3.30	1.36
TV	2.46	1.14
Newspaper/journal	2.22	0.94
Radio	1.40	0.75

Research question 5: Is there any difference in ocean literacy among students who follow only MoNE program and MoNE with additional (IBDP, IGCSE) programs?

In order to answer this question independent sample *t* test was applied both for T-SOLE and T-SOS scores.

As indicated in Table 14, there is a significant difference in T-SOLE scores of the students who follow only MoNE ($N=160$ $M= 14.96$ $SD= 4.20$) and additional program (IBDP or IGCSE) with MoNE ($N=101$ $M=13.42$ $SD= 4.93$) $t(188)= -2.61, p= .01$

Table 14
The results of independent sample *t* -test in T-SOLE scores according to educational programs

Variables		<i>N</i>	<i>M</i>	<i>SD</i>	<i>F</i>	<i>sig</i>	<i>df</i>	<i>t</i>	<i>p</i>
School program	MoNE	160	14.96	4.20	7.12	.01	188	-	2.61
	MoNE + additional	101	13.42	4.93					

* $p < .05$

In terms of ocean T-SOS scores, Table 15 illustrate a significant difference between the students who follow MoNE ($N=160$ $M=3.86$ $SD= 0.61$) and additional program (IBDP or IGCSE) with MoNE ($N= 101$ $M= 3.56$ $SD= 0.65$) $t(259)= -3.71, p= .00$.

Table 15
The results of independent sample t –test in T-SOS scores according to educational programs

Variables		<i>N</i>	<i>M</i>	<i>SD</i>	<i>F</i>	<i>sig</i>	<i>df</i>	<i>t</i>	<i>p</i>
School	MoNE	160	3.86	0.61	2.92	.09	259	-	0
program	MoNE + additional	101	3.56	0.65				3.71	

* $p < .05$

Research question 6: Is there any relationship between ocean content knowledge and attitude of high school students towards ocean?

To investigate the correlational relationship between T-SOLE and T-SOS scores Pearson’s r value was checked through SPSS program (Table 16). According to Ratner (2009) there is a moderately positive correlation between two variables ($r= .41, N= 267, p= .00$).

Table 16
The results of correlation analyses between T-SOLE and T-SOS scores of students

Variables		T-SOS	T-SOLE
T-SOS	Pearson correlation	1	.41**
	Sig.(2- tailed)		.00
	N	267	267
T-SOLE	Pearson correlation	.411**	1
	Sig.(2 -tailed)	.00	
	N	267	267

**Correlation is significant at the 0.01 level (2-tailed).

Table 17
Summary of independent samples *t*-test results in the study

Categories	Variable 1	Variable 2	Difference
Habitat (T-SOLE)	Coastal	Inland	Found
Habitat (T-SOS)	Coastal	Inland	Not- found
Gender(T-SOLE)	Female	Male	Found
Gender(T-SOS)	Female	Male	Found
School program (T-SOLE)	MoNE only	MoNE with additional	Found
School program (T-SOS)	MoNE only	MoNE with additional	Found

Table 17 summarizes independent samples *t*-test results of this study according to the variables. Table also explains the research questions two, three and five.

CHAPTER 5: DISCUSSION

Introduction

This chapter presents discussion with elaborating and interpreting the results.

Chapter started with an overview of the study then continued with deliberating major findings. Implications for practice and further research suggested as well. Limitations of the study also discussed at the end of the chapter.

Overview of the study

This study investigated the ocean literacy level of students in six different private high schools located in Turkey. Schools locate in İstanbul, İzmir, Ankara and Erzurum. As a part of ocean literacy, content knowledge and attitude of students were explored through T-SOLE and T-SOS items. Additionally, most preferable source of information regarding ocean literacy topics was identified. The data were analyzed with Statistical Package for Social Studies program and the results were given in Chapter 4. According to the results, the mean T-SOLE scores of students about ocean *7 Essential Principles*' is 13.28 out of 26 points ($SD= 5.04$). The average score of SOS ($M= 3.72$ $SD= 0.67$) in terms of ocean related issues is close to positive "Agree" statement in 5-point Likert scale. The students who lived in coastal city more than 6 months scored higher in T-SOLE compare to the students from inland cities. However, there is no significant difference found between students' T-SOS scores. Secondly, a statistically significant difference found about both T-SOLE and T-SOS scores of them regarding gender with the favor of female students. The students preferred source of information concerning ocean literacy also had been researched, internet found to be the most frequent use of choice among students.

Furthermore, ocean literacy difference between students only follow MoNE and students follow additional program (IGCSE, IBDP) with MoNE was discovered. In terms of MoNE and additional educational programs a statistically significant difference was found both in T-SOLE and T-SOS scores of students within the favor of students follows only MoNE. Lastly, a relationship between T-SOLE and T-SOS scores were investigated, and moderately positive correlation between T-SOLE and T-SOS scores was discovered in the study.

The following section conducts the discussion under the 5 topics:

1. The level of ocean literacy regarding *7 Essential Principles*.
2. Location (habitat) influence on ocean literacy.
3. The gender influence on ocean literacy.
4. Source of information about ocean.
5. Educational program influence on ocean literacy.
6. Content knowledge and attitude relationship regarding ocean literacy.

Major findings

The level of ocean literacy regarding *7 Essential Principles*

According to consensus of several institutions guideline on COSEE (2005) ocean literate person; “understands the essential principles and fundamental concepts about ocean; can communicate about the ocean in a meaningful way, and, is able to make informed and responsible decisions regarding the ocean and its resources” (p. 2).

An ocean literacy framework for K12 students was constructed to help develop an ocean literate person. *Seven Essential Principles* that every student should know at the end of high school were identified (COSEE, 2005, p.5).

The *7 Essential Principles* are:

1. The earth has one big ocean with many features.
2. Ocean and life in the ocean will shape the earth.
3. The ocean is major influence on weather and climate.
4. The ocean made earth habitable.
5. The ocean supports a great diversity of life and ecosystems.
6. The ocean and humans are inextricably interconnected.
7. The ocean is largely unexplored.

Thereby, in order to understand the level of ocean literacy this study focused on the first part of the definition above and applied a questionnaire which aligns with the *7 Essential Principles* of ocean literacy.(Centers for Ocean Science Education Excellence (COSEE), 2005) One part of the questionnaire explored the content knowledge level of students about ocean through T-SOLE while another part investigated students' attitudes towards oceans by T-SOS.

According to the results of this study, students' mean scores of T-SOLE is 13.28 out of 26 ($SD= 5.04$). The *Principle 1* "*The earth has one big ocean with many features*" received the highest score. This principle consists of how much of Earth is covered by oceans, the ocean basins, source of circulation and transportation of materials. Students' general content knowledge regarding these concepts was the highest. This

finding might be explained by the Geography subject in high school. The first two concepts are covered by Geography curriculum in grade nine; shape of features of Earth, tectonic plates and movement are mentioned in the MoNE program (Ministry of Education, 2011). The IBDP ESS subject mentions the four concepts covered by *Principle 1* as well under the “Aquatic System” chapter (International Baccalaureate Organization, 2017). The IGCSE program Environmental Management subject also comments on *Principle 1* under the topic of “Hydrosphere” (Cambridge International Examination, 2016b).

On the other side, *Principle 4* “*The ocean made earth habitable*” and 7 “*The ocean is largely unexplored*” had the lowest scores. The mean scores of *Principle 4* indicate students might have a problem understanding that ocean on the major producers of oxygen on Earth. The idea of oxygen mainly comes from marine algae needs to be more emphasized in biology classes (Ministry of Education, 2013). This problem might come from emphasizing territorial ecosystems like tropical, savannah etc. more in educational programs compare to marine ecosystems Since marine environments are not natural human habitat, students might have problem with visualizing different ecosystems in marine therefore tend to forget quickly compare to territorial ecosystems (O’day, 2007). This suggestion leads to the lack of content knowledge in *Principle 7* as well. Students find it difficult to make reason why we need to explore oceans, what technology scientists are using, how much of ocean is unexplored. The reason behind that might come from lack of visualizing as well. In addition, marine ecosystems; deep sea, open sea, estuaries needs to be mentioned more in detail as well in MoNE program under “Our World” ecosystems unit at grade ten (Ministry of Education, 2013). Mentioning marine ecosystems in detail might help students to visualize the environment and its features better. Then, they

can relate more and predict why we need to explore oceans and what kind of technology that scientist will use and obstacles they need to overcome according to those features. In addition, those themes also need to be emphasized more in all educational programs.

Guest et al. (2015) also applied a similar questionnaire to the students in Nova Scotia, Canada. According to their results, the content knowledge of students from grade 7 to 12 about ocean literacy is less than 50%. *Principle 5* “*The ocean supports a great diversity of life and ecosystems*” has the highest score while questions related with *Principle 1* “*The earth has one big ocean with many features*” has the lowest score. The general content knowledge level regarding ocean literacy of students show similar results in Turkey and Canada. However, in Turkey the least score was with *Principle 4* and *7* while in Canada it is with *Principle 5*. The reason for that might be differences on educational programs, culture and/or values.

The T-SOS part in the study was applied to explore the attitude of students towards oceans. The mean score of T-SOS was 3.72 out of 5 in Likert scale. The highest score was observed in *Principle 4* “*The ocean made Earth habitable*” while the lowest was *Principle 2* “*Ocean and life in the ocean will shape the Earth*”. The mean scores of related statements indicated that students do not trust their knowledge regarding how ocean works and if the ocean ecosystem will be able to cope with the impact of modern industry. Both of the statements suggest that students might have problem with perceiving oceans as systems. As mentioned in Chapter 2, MoNE is short of mentioning ocean as system. Ocean composes of different aspects from different disciplines. As system, study of oceans is combination of Biology, Chemistry, Physics and Geography. Therefore, it is an interdisciplinary concept. IBDP and IGCSE programs have subjects to offer like Environmental Systems and

Societies and Environmental Management which both are interdisciplinary therefore covers ocean as system (Cambridge International Examination, 2016b,(International Baccalaureate Organization, 2017). Environmental and Societies subject reserves whole unit as “Foundations of environmental systems and societies” which explains systems, equilibrium, sustainability and pollution that helps students to comprehend system thinking. Environmental Management subject from IGCSE also provides system thinking under “Hydrosphere” unit within topics of water cycle and oceans.

MoNE program distributes the ocean content knowledge under Geography and Biology instead of combining them and forming an interdisciplinary course. (Ministry of Education, 2011, Ministry of Education, 2013). This might create problem for students to perceive ocean as system. In addition, under the related topics of these courses the idea of connections among ecosystems and system thinking need more emphasize. For example, in “Natural Systems” topic of Geography subject among with water resources, connections of fresh water, marine ecosystems in Turkey and relationship with surrounding seas (Black Sea, Marmara and Mediterranean) with Atlantic Ocean might be added.

In terms of Biology subject, “Environmental Problems and Human” at grade 9 might emphasize the idea about human implications and outcomes in global perspective.

Also, in unit “Our world” at grade 10 is open to discussions about water cycle connections and explain ocean as global system (Ministry of Education, 2013).

Mogias et al. (2015) applied the same SOS test to pre-service teachers in Greece and found that the statement which participants don’t have any problem with belongs to *Principle 4* as well. Guest et al. (2015) also found similar results in terms of general interest of students. Most of the students in Nova Scotia showed a great value and agreed that oceans are important in their life.

Other researchers also have concluded similar results regarding ocean content knowledge and attitude about ocean. Spruill (1997) found that United States citizens have low knowledge but high concerns relating ocean issues. Cummins and Snively (2000) also highlighted low knowledge and high concern values regarding ocean literacy in Canada among grade 4 students.

Location (habitat) influence on ocean literacy

Hares et al. (2006) suggests that people knows more and shows more attitude towards the ecosystems they are living in. According to their results, people who live in ecosystems like savannah or forest have more content knowledge and positive attitude towards their ecosystem.

This study found similar results with Hares's study. T-SOLE scores of students who live in coastal regions for more than six months was higher ($M=14.32$ $SD=4.5$) than the students who live inland ($M= 12.77$, $SD= 5.11$). These results also align with Steel's et al. (2005) results in the United States. According to their study, citizens who have visited the coastal for leisure, recreation or business purposes have more content knowledge regarding ocean issues and policies compare to citizens who do not visit coastal region. However, they couldn't find difference between participants who live coastal compared to inland states. This might suggest that participants who create a type of experience with marine ecosystems show more content knowledge due to learning through experience. This model fits in the experiential learning theory as well (Kolb, 1984).

Within light of this finding above, it is important for schools locate in inland areas to increase any experience that relates to ocean ecosystem. This experience might be increased through field trips to coastal areas. In Turkey there are non-governmental

organizations which work for protection of marine ecosystems. Inland students might involve those activities as a part of community projects in schools. Also, some marine research institutes voluntarily organize education programs for local students which can be organized for inland schools as well. In addition, inland schools might form “ocean rooms” which relates ocean ecosystems and explain oceanography.

Although current study revealed a difference between students who live in coastal more than six months and the students live inland regarding the T-SOLE, there is no statistically significant result found for the T-SOS scores regarding attitudes toward ocean. This might indicate the fact that students who lived in coastal are showing same concerns and responsibilities with inland students or there are other factors that have impact on attitude more like socioeconomic status (Buttel, 1987).

The gender influence on ocean literacy

This study results indicates that there is statistically significant difference in ocean literacy scores of T-SOLE and T-SOS in terms of gender. Female students presented higher scores within T-SOLE questions ($M=13.85$, $SD= 4.73$) and T-SOS ($M= 3.81$, $SD= .62$) compared to male students ($M= 12.63$, $SD= 5.12$; $M= 3.62$, $SD= 0.72$).

The results of the study contradict with Guest et al. (2014) results. They have discovered that male students are more knowledgeable than female students regarding ocean literacy. In addition, these findings also contradict with Steel et al. (2005)’s study. They found out that male participant content knowledge levels about ocean are higher than female participants.

The reason of this contradiction might come from exploring different participants in researches. This research investigated prestigious foundation high school students’ ocean literacy while Steel et al. (2005) investigated citizens from different age

groups and Guest et al. (2014) studied public schools in Canada. There might be other factors that have more impact on content knowledge level rather than gender like socio-economic status.

Secondly, T-SOS results align with the results of Tuncer et al. (2005) study. They looked at the Turkish students' environmental attitudes and discovered that female students have higher scores in the questionnaire compare to male students. Bord and O'Connor, (1997) explain this difference with risk-related environmental issues. Females tend to show more concern when they relate specific health problem with environment. Therefore, if a main idea or statement triggers any health risk relation they might show more concern and reaction. The statements in the T-SOS questionnaire like "The health of the ocean is important to human survival" or "If things will continue on their present course, we will soon experience a major ecological catastrophe" might emphasize any specific health risk related with environment and create this difference between genders.

Source of information about ocean

According to the results of the study, approximately half of participants (45.4%) chose the internet as their most frequently used source about ocean topics. Students' second preference was school education at 24.4%. Radio is their least preferred source of information with 0.9%.

Cudaback (2006) also have conducted research with undergraduate students and found out that 56% of their students prefer formal education as a source for information about oceans. However all of their participants have taken an Introduction to Oceanography course in college which might affect the results.

Cummins and Snively (2000) found that TVs and movies are the first preference of

students' source about ocean compared to visit aquaria, firsthand experience, read books and school. Cummins and Snively (2000) also had different participant pool than this study; they studied with fourth grade students in Canada and their questionnaire did not include Internet as preference type.

The reason for different preferences for ocean as source of information compared to other studies might be explained by the frequency of internet usage of adolescents in Turkey. During the ten years gap between other studies, internet usage has increased. According to Turkish Statistical Institute press release at 2016, 87.5% of Turkish youth between 16-24 ages use the internet. The amount has increased 5.1% since 2015. Additionally 94.9% of internet users are use it almost every day or at least once a week (Turkish Statistical Institute, 2016).

The importance of knowing the source used for ocean literacy affect the quality of the knowledge. Steel et al. (2005) claimed that internet and newspapers had increased the ocean literacy while radio was decreasing it. Fauville et al. (2015) also looked at the social media effect and specifically Monterey Bay Aquarium Facebook page impact on citizens and they discovered some practices increased the scientific literacy.

Educational program influence on ocean literacy

The study found out that there is a significant difference between students who follow only the MoNE program and students who follow MoNE with an additional program (IBDP or IGCSE). Student group follow only MoNE program showed higher scores regarding T-SOLE ($M= 14.96$ $SD= 4.20$) than the student who follow MoNE and an additional program ($M=13.42$ $SD= 4.93$). Secondly T-SOS results also

suggested a difference in favor of students who follow only the MoNE program ($M=3.86$ $SD=0.61$; $M=3.56$ $SD=0.65$).

Ödün, (2013) has suggested MoNE textbook includes more ecology content compared to IBDP and IGCSE program books and has more user-friendly language. This might explain the higher scores in MoNE group.

Secondly, the foundation schools in this study belong to most prestigious school group in Turkey. Therefore, students need to get higher score from either national exam or specific entrance exam for entering those schools. In addition, some schools participated in the study with only their top students as students follow only MoNE. There is a high chance that these groups of higher achievers will show high scores in T- SOLE regardless with program. Therefore, higher achiever students might affect the results in favor of student which follow only MoNE program. This fact might have created different results from the expected results. Student group which follow additional program next to MoNE are expected to get higher scores in T-SOLE since additional programs offer interdisciplinary classes.

Content knowledge and attitude relationship regarding ocean literacy

The results of the study indicate a moderately positive relationship between T-SOLE and T-SOS questions ($r= .41$). Cummins and Snively (2000) discovered a weak positive relation between content knowledge and attitude regarding ocean literacy of students. Guest et al (2015) also found a positive relationship between ocean knowledge and valuation. The relationship between knowledge and attitudes identified in Bradley et al. (1999). They researched about environmental issues on high school students. They found out that after ten days of environmental course, students' attitudes increased along with their knowledge. Allum et al. (2008)

completed meta- analyses regarding science between content knowledge and attitude of public from 40 different countries. They suggested that most of the study underlined a small positive relationship between attitude and knowledge; this is because of the small level of scientific knowledge of participants. These studies indicate the relationship attitude and knowledge relationship tends to be positive most of the time.

Implications for practice

- Curriculum developers may notice students' ocean literacy level and emphasize the subtopics related with *Principle 4 "The ocean made earth habitable"* and 7 "*The ocean is largely unexplored*" to improve students' level of content knowledge before developing a curriculum. Curriculum developer's consideration regarding the ocean content knowledge about 7 *Essential Principles* might increase the awareness and attitude of students towards oceans.
- Ministry of National Education's program might form an interdisciplinary environmental subject which approaches and explains systems like ocean as whole, instead of distributing the content of the 7 *Essential Principles* under different subjects.
- Ministry of National Education's program also might provide system thinking under its individual subject alignment with existing topics like "Our world and Environment Problems and Human" at Biology subject and "Natural Systems" topic at Geography subject".

- Teachers may define the student's level of ocean literacy and prepare a lesson plan and objectives accordingly to stress *Principles 4* and *7* more than others. They may also consider using reliable social media and internet as source of information while developing lesson plan.
- Material developers may prepare more effective materials to help students visualize marine ecosystems and comprehend its features.
- School and teacher communities may also plan extra-curricular activities to improve students' ocean literacy such as recreation and sports. In addition, they might invite ocean scientists to school environment and introduce their work and the obstacles they need to overcome while exploring oceans.
- School communities in inland areas may prepare an ocean room for students to introduce several marine habitats and ecosystems with visual materials and posters.
- Policy makers might take account of the level of ocean literacy, involve and inform citizens regarding marine policies and legislations.
- The marine institutes and organizations might improve students' content knowledge by using the source of information of their preference (social media, website etc.) and make them involve into their activities.
- Teachers might consider mixing genders in their group activities in order to achieve mixed ability and peer-learning.
- School and teacher communities from inland locations might involve students more in marine ecosystem by organizing field trips to coastal sites.
- The public officials and Non- Governmental Organizations might use the connection between content knowledge and attitude to raise awareness of people.

- 7 Essential Principles might implement to teacher education programs along with Environment and Sustainability. In addition, pre-service teachers might be informed with contemporary problems that ocean ecosystems are facing through seminars.

Implications for further research

- The aim of the research is to investigate the foundation high school students' literacy level in Turkey; public school students' level of ocean literacy also might be investigated.
- Addition to the secondary school; primary, undergraduate students' and trainee teachers' level of ocean literacy might be investigated.
- The general public ocean literacy level might be investigated with nationwide survey and other factors like socio economic status and age may be included in the study.
- This study investigated the attitude of ocean literacy among students; further research can be conducted by involving the reasons of these attitudes.
- This study focused on the *7 Essential Principles* of ocean literacy and mean scores of the questionnaire, further researches might focus on each statement by item analyses.
- This study explored the attitude towards ocean and content knowledge about ocean, further research can be conducted regarding morality.
- This study investigated the content knowledge level of students and attitudes of them towards ocean; actions, recommendations and misconceptions of students regarding ocean literacy also can be investigated.

Limitations

This study used convenience sampling because of time and distance limitations. Therefore, participants belong to highly privileged foundation schools. Such schools require high score from national examinations therefore participants are not representing the general private school or public high school profile in Turkey.

Summary

The followings are the summary of this research;

- Students in general scored approximately 50% the *7 Essential Principles* of ocean literacy in T-SOLE. *Principle 4 “The oceans made earth habitable”* and *Principle 7 “The ocean is largely unexplored”* are the two statements that students have most problem with.
- Students in general illustrated “agree” towards statements in T-SOS. *Principle 2 “Ocean and life in the ocean will shape the earth”* is the principle which they mostly disagree with.
- Students who live more than six months in the coastal have better score in T-SOLE regarding ocean *7 Essential Principle* concepts compare to students who live inland.
- Female students illustrated higher scores in T-SOLE and T-SOS compare to male students in terms of ocean literacy.
- Students’ main preference source regarding ocean literacy is internet follows by school, TV, newspaper and lastly radio.

- Students' who follow only MoNE program showed higher scores in T-SOLE compared to students who follow additional program with MoNE.
- Students who follow only MoNE program illustrated higher scores in T-SOS compare to students who follow MoNE with additional program.
- Students' level of content knowledge and attitude regarding ocean literacy results in the questionnaire shows a moderately positive relationship.

These findings might start a new chapter in education system. After implementing some of the suggestions above, ocean literacy among students might increase. Along with increasing ocean literacy, future adults of Turkey might involve more in marine issues. They might also demand changes with in favor of protecting marine ecosystems against its threats. Within increasing demands from public, government might take steps towards protection of marine environment from human impact. One generation's content, knowledge, attitude and awareness of ocean literacy will pass on next generations through public culture.

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APPENDICES

APPENDIX A: Instrument

Ocean Literacy Questionnaire

Dear Students,

The purpose of this questionnaire is to measure ocean literacy of 9th, 10th, 11th and 12th graders. The questionnaire is formed by three sections. The first part includes demographic knowledge, second part is related with source of your knowledge and third part measures the knowledge and attitude of ocean literacy. The whole questionnaire takes approximately 25-30 minutes. The answers will be kept secret. Please answer the all questions. If you would have any questions, please contact with Gulce Kurtay from Bilkent University.

Contact info:

Telephone: 0531 969 7016

Email: gulce.kurtay@bilkent.edu.tr

P.S.: Seas are the parts of ocean which encounters with land. Thus, please think about this definition while answering the questionnaire.

PART 1: Demography

Gender: Male/
Female

Class:

City:

I have lived Yes/ No
in costal
more than 6
months:

The I am
education following
program: National
Turkish
program

I am
following
other
program

International General Certificate of Secondary
Education (IGCSE)

International Baccalaureate Diploma
Program (IBDP)

Standart
level
Biology
 High
level
Biology
 ESS

PART 2: Source of Information

For each sentence please indicate your agreement by selecting a number from 1 to 5 where the numbers been following:

- 1-Not using at all.
- 2-Moderately
- 3-Using in medium level.
- 4-Using frequently.
- 5-Using all the time.

Information source	Frequency
Internet	
Television	
Radio	
Newspaper/ Journal	
School	

PART 3: SOLE

1. Approximately how much of the land is covered by ocean?

- a) 30
- b) 50
- c) 60
- d) 70
- e) 90
- f) 97

2. There is one big ocean. The continents divide the ocean into basins. Which of the following are major ocean basins?

- a) Arctic,Red Sea,Atlantic,Pacific
- b) Pacific,Gulf of Mexico,Atlantic,Mediterranean
- c)Pacific,Atlantic,Indian,Bering Sea
- d)Arctic,Pacific,Atlantic,Indian
- e)Pacific,Carribbean,Atlantic

3. The ocean circulation is powered by

- a) tides
- b) wind
- c) earth's rotation
- d) a and b
- e) a, b& c

4. Which of the following are transported by rivers from watersheds to estuaries and to the ocean?

- a) nutrient
- b) salts
- c) sediments
- d) pollutants
- e) all of these
- f) b and d

5. In nature, which factors are redistribute sand along a beach?

- a) wave motion
- b) coastal currents
- c) tectonics
- d) birds
- e) plants
- f) a and b

6. Sediments are formed from erosion of land based earth materials. These include

- a) rocks
- b) minerals
- c) soil
- d) plants and animals
- e) all of these
- f) none of these

7. The physical structure and landform of the coast are influenced by

- a) sea level change
- b) force of waves
- c) gopher tortoises
- d) tectonic activity
- e) a, b and d
- f) none of these

8. If our planet were without its ocean but otherwise the same as today, would surface temperatures be more extreme than they are now?

- a) more extreme b) less extreme c) no change in temperatures

9. The ocean dominates the earth's carbon cycle. Approximately how much of all the carbon dioxide in the atmosphere is absorbed by the ocean?

- a) 30 b) 50 c) 60 d) 70 e) 90 f) 97

10. The ocean controls the climate and weather by dominating which of the earth's systems?

- a) energy b) plants c) water d) carbon e) a, c and d f) none of these

11. The ocean dominates the earth carbon cycle. Approximately how much primary production of earth takes place in the sunlit areas of the ocean?

- a) 30 b) 50 c) 60 d) 70 e) 90 f) 97

12. What produces most of the earth's oxygen?

- a) forests b) plants(algae) in the ocean c) both equally d) none of these

13. Pressure in the ocean increases with depth. What happens to the temperature?

- a) increases with depth b) decreases with depth c) stays same d) increase&decrease e) none of these

14. What happens to sunlight in the ocean as depth increases?

- a) increases with depth b) decreases with depth c) stays same d) increase&decrease e) none of these

15. Where is a greater diversity of living organisms found?

- a) on the land b) in the ocean c) both equally

16. Ocean life ranges in size from the smallest virus to largest animal that has lived on earth called the

- a) giant squid b) basking shark c) blue whale d) sperm whale e) Loch Ness monster

17. The most abundant life form in the ocean is

- a) phytoplankton b) fish c) shrimp d) microbes e) zooplankton

18. Deep ocean ecosystems that independent of energy from sunlight and photosynthetic organisms are

- a) hydrothermal vents b) submarine hot springs c) methane cold seeps d) both b and c e) all

19. Which ocean ecosystem provides habitat for one-third of all marine species?

- a) coral b) seagrass c) mangrove d) open sea e) estuary
meadow

20. Which of these following statements are true about ocean?

- a) It provides food and medicine b) It provides mineral and energy resources c) It provides transportation and jobs d) It benefits our economy and national security e) all of these f) both c and d

21. What does the statement, the ocean and humans are inextricably connected mean? Humans need the ocean

- a) for freshwater b) for oxygen c) to regulate the temp d) for new health cures e) all of these

22. Which natural hazards can impact coastal regions?

- a) bird migrations b) hurricanes c) storm surges d) both b and c e) all of these

23. The ocean is the last and largest unexplored place on earth. How much of the oceans remains unexplored?

- a) 30% b) 50% c) more than 90% d) less than 5% e) 65%

24. Why is it important to study the ocean?

- a) better understand ocean systems b) satisfy our curiosity c) understand ocean processes d) not important to study the ocean e) answer a,b&c

25. Over the last 40 years, use of ocean resources has significantly increased. Why is it important to know this? So that we

- a) can do our part to sustain resources b) will discontinue ocean recreational activities c) will better understand ocean resources and limitations d) a, b and c e) both a and c

26. Ocean scientists are relying more and more on which of the following technology tools to explore the ocean?

- a) buoys b) satellites c) sub-observatories d) unmanned submersibles e) all of these f) both c and d

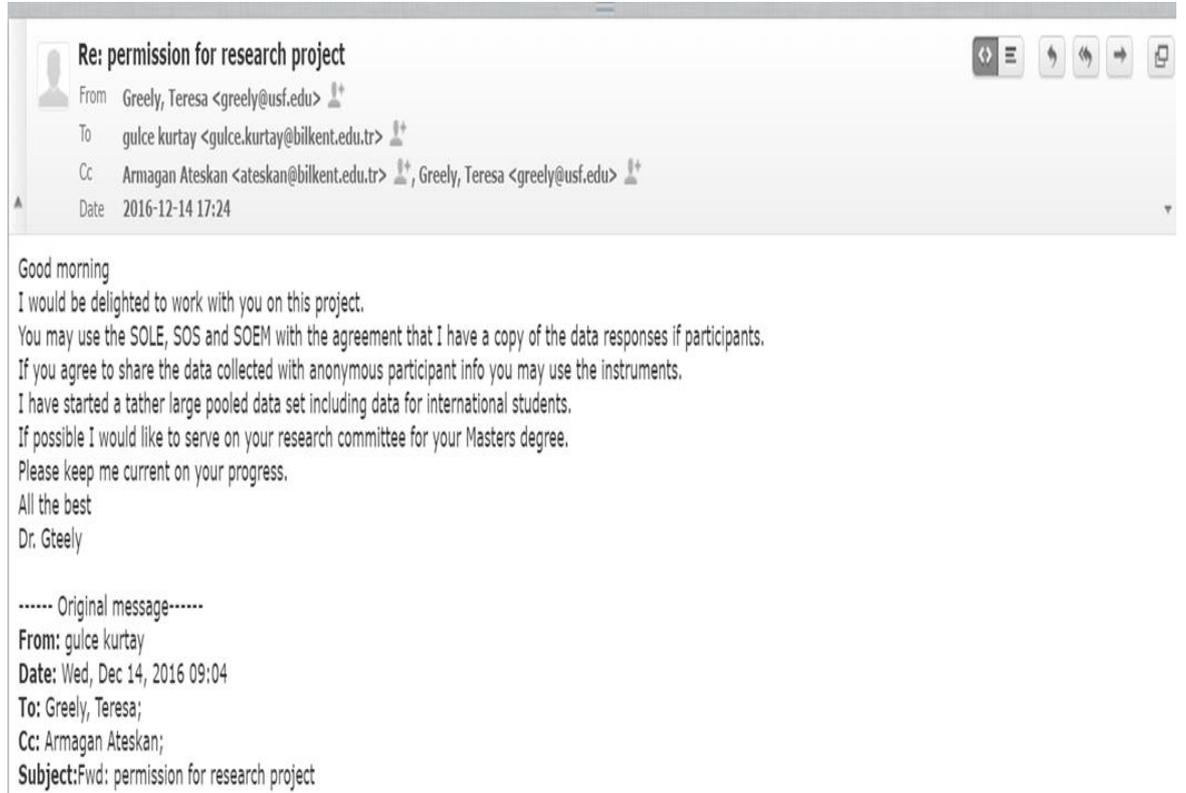
PART 4: SOS

For each sentence please indicate your agreement by selecting a number from 1 to 5 where the numbers been following:

1. Strongly disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly agree

1. ___ I can usually make sense of how ocean works.
2. ___ I know some specific thing I could do to help the ocean.
3. ___ I am familiar with the issues facing global ocean.
4. ___ The health of the ocean is important to human survival.
5. ___ We do not need to worry about the health of the oceans, because we will develop new technologies to clean the ocean.
6. ___ What I do in my life doesn't impact ocean at all.
7. ___ Business and industry should be responsible for protecting oceans.
8. ___ Government should be responsible for protecting marine environments.
9. ___ Humans have the right to modify the natural environment to suit their needs
10. ___ The earth has plenty of natural resources if we just learn how to develop them.
11. ___ Plants and animals have as much right as human to exist.
12. ___ The balance of nature is strong enough to cope with the impact of modern industrial nations.
13. ___ The so -called'' ecological crisis'' facing humankind has been greatly exaggerated
14. ___ Humans were meant to rule over the rest of the nature.
15. ___ The balance of nature is very delicate and easy to upset.
16. ___ If things will continue on their present course, we will soon experience a major ecological catastrophe.

APPENDIX B: Permission from the developer of questionnaire



APPENDIX C: Permission from Ministry of Education

175/004042

**T.C.
MİLLÎ EĞİTİM BAKANLIĞI
Özel Öğretim Kurumları Genel Müdürlüğü**

Sayı : 36077160-405.99-E.2549704
Konu : Araştırma İzni

27.02.2017

DAĞITIM YERLERİNE

İlgi : Bilkent Üniversitesi Eğitim Bilimleri Enstitüsünün 15/02/2017 tarihli ve 2836 sayılı yazısı.

Bilkent Üniversitesi Eğitim Bilimleri Enstitüsü Eğitim Programları ve Öğretim Yüksek Lisans Programı öğrencisi Gülce KURTAY'ın Yrd. Doç. Dr. Armağan ATEŞKAN'ın danışmanlığında yürütmekte olduğu "Lise Öğrencilerinin Okyanus Okuryazarlığı Bilgi Düzeyleri ve Okyanusa Karşı Olan Tutum ve İlgileri" konulu araştırmanın, ilgi yazıda belirtilen özel okullarda uygulanması izni talebine ilişkin ilgi yazı ve ekleri incelenmiştir.

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Bilgilerinizi ve gereğini rica ederim.

Kemal ŞAMLIOĞLU
Bakan a.
Genel Müdür V.

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İlgi yazı ve ekleri

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