

OCEAN LITERACY AS AN OCEAN GOVERNANCE TOOL

**GLOBAL LESSONS FOR DEVELOPING COUNTRIES
AND AN OCEAN LITERACY SURVEY OF HIGH SCHOOL
STUDENTS IN MOMBASA COUNTY, KENYA**

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of the requirements for the award of the degree of Master of Science in Maritime
Affairs

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Declaration

I certify that all the material in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views and are not necessarily endorsed by the University.

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A tribute to my loving parents; Monica Nthoki Karanja and Eliud Albert Karanja, and a futurology aid for tomorrow's ocean stewards.

Acknowledgements are included at the conclusion of this study.

Abstract

Title of Dissertation: **Ocean Literacy as an Ocean Governance Tool: Global Lessons for Developing Countries and an Ocean Literacy Survey of High School Students in Mombasa County, Kenya.**

Degree: **Master of Science**

The triple planetary crisis of biodiversity loss, pollution and climate crisis have led to global impetus for better management of natural resources, including the ocean. As such, ocean literacy has gained traction as a way of addressing these challenges, thus ensuring better ocean stewardship. Research and preliminary informal interviews were conducted to establish the scope for ocean education in Mombasa County, Kenya. This study involved a mixed-method approach, including semi-structured interviews with two ocean literacy practitioners in Europe, and a survey questionnaire to high school students in Mombasa, guided by a modified version of the International Ocean Literacy Survey (IOLS) model.

Research results showed that although most students displayed adequate knowledge of the ocean, most could not accurately relate to critical ocean species in their local marine habitats, highlighting the need for adoption of global best practice as employed by IOC UNESCO and the Marine Education Centre in Sweden. Additionally, the use of educational material that was learner friendly and in the local language, proved to be an effective learning tool for students.

The study also examines challenges and proposed solutions to delivering these alternative learning techniques. It concludes with recommendations for a wider IOLS study in Kenya, including a collaborative approach between formal and informal approaches, the development of national and international partnerships, effective stakeholder involvement, and the implementation of a new Ocean Literacy Toolkit (OLT) framework designed to enable adoption, tracking and reviewing of OL parameters suitable for flexible applications. The importance of ocean literacy and blue curricula in schools, and the emergence of an ocean-literate society, are

identified as key to make responsible decisions impacting ocean use, sustainability and resources, for the sake of planet, people and progress.

KEYWORDS: Ocean Literacy, Education, Ocean Science, Marine Environment, Sustainability, Futures Literacy, Swahili.

Table of Contents

Declaration.....	ii
Acknowledgements.....	iii
Abstract.....	iv
Table of Contents.....	vi
List of Tables.....	viii
List of Figures.....	ix
List of Abbreviations.....	x
List of Abbreviations.....	xii
CHAPTER 1: INTRODUCTION.....	1
1.1 Definition: What is Ocean Literacy?.....	1
1.1.1 Why is ocean literacy important?.....	4
1.1.2 Global Aspect & Benefits of Ocean Literacy.....	6
1.1.3 OL in Kenya.....	7
1.2 The Education System in Kenya.....	8
1.3 The Competency Based Curriculum.....	10
1.4 Problem Statement.....	14
1.5 Research Aims & Objectives.....	14
CHAPTER 2: ACTORS, METHODOLOGY & FRAMEWORK.....	16
2.1 Role of Stakeholders & Informal Education Approach.....	16
2.2 Ethical Considerations.....	18
2.3 Key Assumptions.....	19
2.4 Choice of Study Location.....	19
2.5 Methods.....	20
2.7 Study Groups.....	23
CHAPTER 3: RESULTS.....	26
3.1 {I} Group 1: Quantitative Results.....	26
3.1.1 Questionnaire Data Highlights.....	28
3.1.2 Opinion Poll: Language and Ocean-Related careers.....	33
3.2 {II} Group 2: Qualitative Results.....	37
3.2.1 Extracts of quotations from interviewees.....	38
CHAPTER 4: DISCUSSION & CONCLUSION.....	42
4.1 Discussion.....	42
4.2 Key Results.....	42

Global Relevance of International Regulation and Shipping	52
Conclusion and Recommendations	55
Closing Remarks	56
Appendices	60
Appendix A	60
I. UN SDG 4 & 14: Sub-Goals (Targets)	60
Appendix B	63
II. Sample semi-structured interviews document.....	63
Appendix C.....	68
III. Sample survey questionnaire document.....	68
Appendix D.....	73
IV. Tukio la kuisimua la IMO: Hadithi ya Visiwa Viwili: eBook	73
CREDIT AUTHORSHIP CONTRIBUTIONS	82
DECLARATION OF COMPETING INTERESTS.....	82
References.....	83

List of Tables

Table 1: Legally Binding Instruments, Government of Kenya	12
Table 2: Voluntary Instruments, Government of Kenya	13
Table 3: Chart for Stakeholder Visualisation Template (Researcher)	17
Table 4: Table - Approach of methodologies (Researcher).....	20
Table 5: Raw Data Tabulation	26
Table 6: Participants of manual OL questionnaire forms, based on survey results (Researcher)	28
Table 7: Number of Ocean-Literacy indicators in the questionnaire inventory (Researcher)	29
Table 8: Extract of key findings of interviews (Researcher)	41

List of Figures

Figure 1: IOLS framework, 2019 global view of countries that have adopted OL principles based on international standards crafted from NOAA & EMSEA research (Fauville, 2020)	3
Figure 2: CBC Education System diagram. (Foundation, The Red Rubber Ball, 2022)	11
Figure 3: Map of Mombasa County (Courtesy of Kenya Bureau of Statistics, 2021)	Error! Bookmark not defined.
Figure 4: Graphical representation of Correct OL responses.....	31
Figure 5: Chart indicating percentage of students with pass or fail mark results	33
Figure 6: Student Opinion Results Graph	34
Figure 7: Cover of Swahili book used by students highlighting ocean, maritime, marine and climate themes (Researcher).....	36
Figure 8: Ocean Literacy Framework (Researcher)	53

List of Abbreviations

Anthropogenic impact / effect	Resultant outcome of activities by human beings, typically on the environment, of a negative or detrimental nature.
Black Swan	A seemingly low probability event with maximum, often devastating impact.
Blue Curriculum	United Nations plan for the adoption of ocean studies by member states in formal education curriculums worldwide - aspiration target intended for 2025.
Blue Planet	Expanse of ocean coverage on planet Earth.
Competency-Based-Curriculum	An educational system designed specifically to combine inherent learning capabilities of students with real-life practical skills and application of theoretical teaching. Able to be flexible to adapt to dynamic needs of evolving requirements.
Futurology / Futures Literacy	A UNESCO-endorsed “teach the future” approach, critical across nations, societies and generations, allowing people to improve their ability to “use the future” and become “futures literate.”
Gen Z	Generation Z, or i-Generation, are young people most closely associated with the 4 th industrial revolution, technological advancement (age of the cell phone). Born between Millennials and Generation Alpha, from the late 1990’s to early 2000’s.
IOLS framework	International Ocean Literacy Surve, one of the first tools to be developed to support efforts of those aiming to educate students and communities about the ocean.
Jumuiya ya Kuantu za Pwani	A Swahili titled local regional collaboration platform consisting of six coastal county members for collective approach to blue economy and ocean related development affairs. Translated as ‘Community of Coastal Counties’.
Mitigation	An anthropogenic intervention to address a particular or several problematic situations, e.g. to reduce the

	source of pollution, minimise underwater noise, or to enhance carbon sequestration.
Modus Operandi	Method of operation, usually referring to pre-set of rules, regulations and activities approved by an organisation to serve a specific work plan
Ocean Literacy	Adequate knowledge of the ocean in relation to anthropogenic activities (behaviour, attitude and actions) on the marine environment, and the effect of the ocean on humanity
Ocean Literacy Framework (OLF)	The OLF (OLGA) mechanism is a new theoretical framework proposed for exploring the essential concepts, interdependencies, legislation and monitoring of ocean literacy standards adoption and growth.
‘Sinema Mtaani’	An ocean literacy program titled in Swahili, translated as ‘Street Films’
Triple-planetary Crisis	Current crises of climate change, marine pollution and biodiversity loss affecting the entire planet, all having significant impact on ocean life.
WIO Symphony Tool	A tool for ecosystem-based marine spatial planning applied in the Western Indian Ocean, covering 80 ecology and human activity maps providing reports showing cumulative impact over large areas and illustrating those that are under specific pressures.

List of Abbreviations

<i>AU</i>	African Union
<i>BBNJ</i>	Biodiversity Beyond Natural Jurisdiction
<i>BMU</i>	Beach Management Unit
<i>BSF</i>	Bibliothèque-sans-frontier
<i>ECOPS</i>	Early Career Professionals
<i>EU</i>	European Union
<i>EUF</i>	The EU Fund
<i>FAO</i>	Food and Agricultural Organization
<i>GBF</i>	Global Biodiversity Framework
<i>GOLI</i>	Global Ocean Literacy Initiative
<i>HESI</i>	Higher Education Sustainability Initiative
<i>ICS</i>	International Chamber of Shipping
<i>ICT</i>	Information Communication Technology
<i>IMO</i>	International Maritime Organization
<i>IOLS</i>	International Ocean Literature Survey
<i>IOTC</i>	Indian Ocean Tuna Commission
<i>JKP</i>	Jumuiya-ya-Kaunti-za-Pwani
<i>KEMFSED</i>	Kenya Marine Fisheries and Socio-economic Development project
<i>KIFWA</i>	Kenya International Freight and Warehouses Association
<i>KNCCI</i>	Kenya National Chamber of Commerce and Industry
<i>LME</i>	Large Marine Ecosystem
<i>MARPOL</i>	International Convention on the prevention of Pollution from Ships
<i>MET</i>	Maritime Education and Training
<i>MDAC</i>	Ministries, departments, agencies and counties
<i>MKC</i>	Marint KunskapCenter (<i>MEC</i> Marine Education Centre)
<i>MO</i>	Modus Operandi
<i>MOEST</i>	Ministry of Education, Science & Technology
<i>MSP</i>	Marine Spatial Plan
<i>NACOSTI</i>	National Commission of Science Technology and Innovation
<i>OECD</i>	Organisation for Economic Cooperation and Development

OL | Ocean Literacy
OLI | Ocean Literacy Inventory
OLWA | Ocean Literacy with All
REC | Research and Ethics Committee
RFMO | Regional Fisheries Management Organization
SCEA | Shippers Council of Eastern Africa
SDG | Sustainable Development Goals
UN | United Nations
UNCLOS | United Nations Convention on the Law of the Sea
UNDIL | United Nations Decade of Indigenous Languages
UNDOS | United Nations Decade of Ocean Science
UNEP | United Nations Environmental Program
UNDOER | United Nations Decade of Ecosystem Restoration
UNESCO | United Nations Educational, Scientific and Cultural Organization
WIO | Western Indian Ocean
WIOMSA | Western Indian Ocean Marine Scientists Association
WMU | World Maritime University

CHAPTER 1: INTRODUCTION

“Bahari ni uhai, matumizi ambayo itatustawi au itatuangamiza.” [The ocean is life, the use of which will either support us or destroy us all.] Eliud A. Karanja 1940-2006

This study explores the application of the level of ocean literacy among Kenyan high school students based in Mombasa County, by applying the international ocean literacy survey as a standard measurement tool. It also examines the use of the local language, Swahili, in the dissemination of ocean education lessons. This introductory chapter explores the meaning, framework, importance, local and global aspects of Ocean Literacy (OL), the problem statement and research aims and objectives.

1.1 Definition: What is Ocean Literacy?

The Ocean Literacy (OL) concept was created in the United States in 2002 as an approach to the measurement of ocean knowledge levels. In 2017, the United Nations conceptualised a comprehensive framework of Sustainable Development Goals (SDGs), which includes Goal 14: Life below Water, focussing on the conservation and sustainable use of the oceans, seas and marine resources. The international approach to the measurement of ocean literacy levels was primarily promoted through education and scientific initiatives e.g., through the United Nations Educational, Scientific and Cultural Organisation and the United Nations Decade of Ocean Science for Sustainable Development. This study is based primarily on United Nations Sustainable Development Goal 14. Fauville et al., defines ocean literacy as the understanding by an individual on the influence have on the ocean, and conversely on the influence of the ocean on people’s lives, which results in the need for individuals to become ocean literate (2018).

In Europe, this concept has also been defined as the cultivation of a meaningful, emotional attachment to the ocean, promoting positive behavioural change (European Commission, 2018 and 2019). Further, OL supports the premise that comprehension of ocean matters forms an essential tool for marine information dissemination, fostering interpersonal relationships and motivating people and

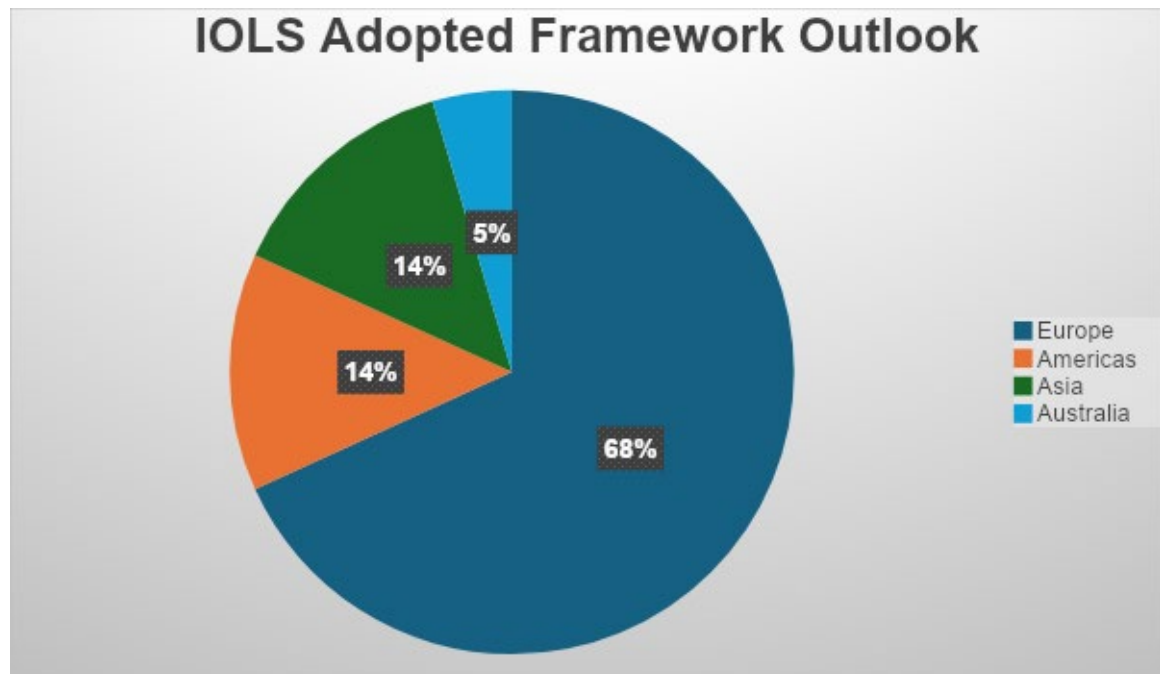
communities towards sustainable actions for the betterment of the marine environment (McKinley et al., 2023).

Ocean literacy has steadily gained momentum as a universal concept that is critical for developing sustainable governance approaches of ocean environments. The concept of OL is implied in UN SDG Goals Numbers 4 and 14 (Ryabinin et al., 2019; Costa & Caldeira, 2018; Gattuso et al., 2018). According to the International Maritime Organization (IMO), “[a] healthy ocean is crucial for the well-being of humans and the planet” (International Maritime Organization, 2024).

The International Ocean Literacy Survey is a standardised measure of ocean science education, developed by a team of researchers under the direction of Geraldine Fauville for the purpose of examining literacy levels among school children and establishing an internationally applicable tool (2018).

Consequently, notable progress has been made in various countries, predominantly in the Global North, through adoption of many ocean education initiatives, as illustrated below. The gap of similar scenarios in the Global South needs addressing as a key tool to improve ocean literacy levels. Conditions in developing and underdeveloped countries have inhibited adequacy of educational services to their populations in general, more so for specialised subjects such as ocean education. This is often a consequence of financial constraints (Palmer, 2006).

Figure 1: IOLS framework, 2019 global view of countries that have adopted OL principles based on international standards crafted from NOAA & EMSEA research (Fauville, 2020)



Further analysing the chart, the distribution per country regarding adoption of OL principle is as follows.

- Americas – USA, Canada, Chile (14%)
- Europe – UK, Italy, Greece, Spain, Sweden, Belgium, Ireland, France, Netherlands, Norway, Portugal, Denmark, Germany, Poland, Portugal (68%)
- Asia – China, Taiwan, Japan (14%)
- Australia – Australia (5%)
- (Africa – 0)

As evidenced above, the IOLS framework has been adapted primarily in developed countries. Even if Africa is not represented in the Chart, a 2018 IOLS-based study was undertaken by E. Nyman, featuring South Africa (Nyman, 2018).

Education plays a vital role in the development of knowledge, attitudes, values, career choices and ultimately behaviour of future generations, towards ocean science,

ecosystems, health and sustainable practices. The relationship between the ocean and human livelihoods has always been interlinked and yet the status of the continuous declining health of ocean ecosystems has persisted, not least dispelling the myth that the ocean is limitless in its ability to absorb without much detriment the activities of humans. Global reports indicate that, continued unabated, these activities pose dire threats for humanity and the planet (UNEP, 2021).

1.1.1 Why is ocean literacy important?

Ocean environmental education helps countries implement sustainable ocean governance through practical ways, such as: protection of ocean environments and species; sustainable management of marine food resources (such as the IOTC agreement); future planning of coastal habitats and cities; new career opportunities for blue economy and ocean-related careers; conservation with consideration of social and economic wellbeing of coastal communities; harnessing emerging sustainable economic opportunities (e.g. seaweed farming); and adopting innovative energy solutions (such as greener fuels and wind energy farms).

The implementation of UN Sustainable Development Goals, specifically Goal 14, and the UN Decade of Ocean Science for Sustainable Development 2021-2030, (UNESCO, 2021, 2020), have generated global interest in OL, albeit without corresponding impetus in formal adoption - as is the case for Kenya. Understanding the level of ocean literacy in schools is key in order to guide policies that can lead to an increase of ocean awareness and stewardship. OL is not only about learning content related to the oceans, but also about having access to educational material that is culturally and locally relevant. Among the most important elements of a learning experience is the right to learn in one's own language. The significance of languages has been recognized by the UN, as we are now in the UN Decade of Indigenous Languages 2022 – 32 (Martin, 2017), which may have been a contributing factor for the publication of the International Ocean Literacy Survey (IOLS) framework in 16 languages (Fauville et al., 2018). The introduction of learner-friendly material, including in story-telling formats, has been proposed as an effective learning tool for young learners (Hapidin et al., 2022).

The connection between OL and addressing SDG 14 is critical, as studies have established that there is a correlation between OL and greater awareness of the importance of the ocean environment, and of ocean-related jobs, ultimately enhancing a country's potential to develop a blue economy (Guest et al., 2015). In Europe, the development of an OL educational network can be traced back to 2011, leading to the establishment of EMSEA (Mokos et al., 2020), (MOKOS et al., 2022) European Marine Science Educators Association. EMSEA is a network of marine science educators based in Europe to promote and deliver Ocean Literacy across society, working with similar organisations elsewhere, such as the National Oceanic and Atmospheric Administration (NOAA) in the United States. The EMSEA hub's activities involve the work and participation of scientists, teachers, policy makers and the public.

The principal literature source for inspiring this study is the International Ocean Literacy Survey framework, developed by Geraldine Fauville and her team (Fauville et al., 2018). The framework was eventually adopted by several countries, translated into sixteen languages, and has since been referenced as an international standard for measuring literacy levels among school students in ocean environment matters. Further, an appreciation of ocean literacy and of ocean literacy programs has been demonstrated to impact attitudes and behaviour, driving positive and responsible actions towards ocean environment management (Fauville et al., 2018; Fauville, 2020).

Devenport et. al. (2021) effectively outline the relationship between young people's understanding, involvement, and overall public participation in marine conservation efforts. Conducted through a survey in Scotland, the study employs quantitative methods that effectively pinpoint obstacles and opportunities for amplifying young voices in public policy development, as well as specific strategies to empower them in managing marine resources.

Another article by Ashley et al. (2019) focuses on enhancing scientific literacy in marine biology and coastal monitoring. It employs before-and-after surveys for two distinct groups: professionals entering the shipping industry and school students. Utilizing the Theory of Change (ToC) framework, the research incorporates

assessments, questionnaires, and statistical analyses (such as t-tests). Findings emphasize the significance of customized ocean literacy resources for both groups, highlighting their potential to positively influence environmental, economic, and social perspectives.

The literature cited serve as examples of studies that test and explore the understanding and integration of ocean environment literacy, and ocean environment concerns among modern youths. They further delve into the impact of the correlation between ocean environments and human activity, and how this relationship is understood.

1.1.2 Global Aspect & Benefits of Ocean Literacy

In terms of worldwide impact, one must consider that 3.2 billion people worldwide depend on the ocean in some way for their livelihood. These diverse, complex and dynamic ecosystems provide numerous functions and services to life both below and above water (Chuenpagdee, 2019). In Europe, several platforms have been created, funded, resourced and legitimised to enable maximum coverage of the ocean literacy agenda for European students and communities in general. Through regional, national and corporate entities' involvement, through partnership with United Nations, OECD, EUF and other philanthropic funding mechanisms, the advancement of ocean-literate students and communities grows steadily in many developed countries such as the US, Canada, and New Zealand. These developments include programs such as the USA Blue Schools Network, the Canada Ocean Literacy Coalition and New Zealand's Ōtākou Whakaihu Waka secondary marine education initiative at Otago University. In Europe, OL programs include the EU for Ocean Coalition program, IOC-UNESCO Baltic Sea and North Seas programs, Blue Schools programs and accreditation processes and the Bauhaus Lighthouse project, among others. On the Corporate scene, fashion powerhouse "Prada", also plays a role towards the OL agenda partially supporting initiatives like *Bibliothèque sans frontier* (BSF Charity, 2023).

The need to develop a standard approach for ocean literacy gave rise to the IOLS tool, currently used as a yardstick for measuring OL internationally and propelling the OL movement that is growing around the world (Santoro et al., 2017). In 2018, the IOLS tool was used to evaluate the need for ocean literacy in South Africa (Nyman, 2018). In China, the COLS framework – a Chinese version of the ocean literacy scale – was adopted to survey high school students using psychometric properties of the OL scale (Tsai & Chang, 2018). The framework was credited as the beginning of a marine sustainability initiative using preliminary results of measuring students' marine knowledge and OL levels in Taiwan (Lin et al., 2020). Earlier research in the US and Portugal showed that ocean literate individuals are more willing to adopt more sustainable knowledge and technology (Fernández Otero et al., 2019). That study also indicated that “OL will embrace all subjects, not only science, but also art, music, archaeology, culture, geography” (Ibid). The framework aided the adoption of climate initiatives by farmers (Ashley et al., 2019). In the UK, OL research outcomes led to furthering of IOLS adoption due to increased literacy levels, climate-change, and ocean-related behaviour change (Whiteman et al., 2013).

With the traction of OL across the world, this paper is conceived as a pilot study, as a first attempt in determining how the IOLS framework can be used to assess students' literacy levels of ocean knowledge in Mombasa County, Kenya. As an acceptable model of standardized literacy measurement of ocean knowledge levels, this process may assist education policy makers to plan around provision of educational enhancement measures such as financial, technical and other necessary resources, and provide impetus for international shipping in maritime-marine issues.

1.1.3 OL in Kenya

Ocean education can be seen as a powerful tool of critical relevance to the country to help Kenya develop the opportunities of the country's blue economy strategy. The hosting of the first Sustainable Blue Economy Conference (SBEC) in Nairobi, Kenya, in November 2018, helped to elevate the country's global positioning in terms of ocean environment, conservation and socio-economic matters. The country has also taken a lead in the Blue Economy Action Group under the Commonwealth Blue Charter, identifying with blue planet issues, encouraging better stewardship of 'blue'

resources and playing an active role in regional management and conservation efforts in the marine environment (Long, 2018).

Empowering Kenya's learners to take informed decisions, responsible actions for environmental integrity, economic viability, and a just society will help the country achieve the Ocean Decade societal goal of an inspiring and engaging ocean, understood and valued by all Kenyans, for all the benefits we derive from our marine resources. As at the 2019 census, 4.3 million coastal residents are ocean-dependent in Kenya. Ocean-facing counties (under the management of a coalition for the economic, social and environmental advancement of coastal communities, referred to in Kiswahili as Jumuiya ya County za Pwani (JKP)) include Mombasa, Kwale, Kilifi, Tana River, Lamu and ocean-dependent Taita Taveta (JKP Kenya, 2023).

In Kenya, ocean literacy has not been given prominence with respect to other educational priorities in the schooling system. Outside of formal curricula, several ocean-related social based programs within Mombasa County focus on differentiated aspects of the ocean - mainly pollution prevention, mangrove restoration and beach cleaning activities by WOMESA¹, KWS² among other organisations. None of these programs utilise the ocean literacy framework, as per IOLS standards, which makes it difficult to assess their effectiveness.

1.2 The Education System in Kenya

There are a total of 23,659 primary and 9,383 secondary schools in Kenya (Ministry of Education, Kenya, 2023). According to an independent survey, Mombasa County hosts 540 schools, consisting of 462 primary, and 78 secondary schools (Shule Zote, 2023).

¹ <https://www.standardmedia.co.ke/health/coast/article/2001443283/women-volunteers-join-hands-to-clean-up-plastic-litter-in-beaches>

² <https://www.kws.go.ke/content/kws-commemorates-world-sea-turtle-day-multisectoral-approach-save-%E2%80%98guardians-oceans%E2%80%99>

A preliminary informal assessment based on the researcher's own experience in the educational system and on informal conversations with educators in Mombasa, reveals that the curriculum does not address OL specifically, but that some aspects of ocean literacy are covered in different courses and subjects, including in environmental sciences, environment studies, Science and Technology, social studies, etc., depending on the school level and type. At present, only when learners get to university, tertiary and other higher education levels, they are presented with opportunities to engage with more focussed or specialised subject content related to ocean studies.

In Kenya, marine environment education is catered for under approved subject content by the KICD (Kenya Institute of Curriculum Development), guided by relevant articles of Kenya's Constitution under Act of Parliament Act No. 4, 2013. The Constitution of Kenya, Chapter Four, Articles 43, 53, 54, 55, 56, 57 and 59, provides for children's rights to free and compulsory basic education, including quality educational services, access to learning institutions and adequate facilities for persons (learners) with disabilities (Source: Constitution of Kenya³).

The inadequacy of Ocean Literacy was witnessed through the rejection of a motion to the County Assembly by MCA Mwavula, Bamburi Ward, to include blue economy lessons into schools' curriculum for Mombasa County (Aura, 2023). This lack of support highlights the deficiency of the system, but it also shows potential areas of developing educational interventions, both in the formal curricula, and through public-private partnership collaborations.

Kenya's Ministry of Education (MoE), first established in 1964, evolved into the Ministry of Education, Science and Technology (MOEST) at the last review of government agencies. The ministry's commitment is to attain world-class benchmarking standards of global competitiveness, innovation, and creativity to improve service delivery in education through delivery of continuously creative and efficient methods. The functions between national and county governments are distributed in accordance with the Fourth Schedule of the Constitution of Kenya,

³ <https://www.klrc.go.ke/index.php/constitution-of-kenya>

Articles 185 (2), 186 (1) and 187 (2), where it is established that the National Government is in charge of education policy, standards, curriculum, examinations, universities, granting of university charters, institutions of research, higher learning, secondary schools, tertiary education institutions, primary schools, special education institutions, sports education, and the promotion of sports. It is also established that County Governments undertake the management of pre-primary education village polytechnics, farmers training centres, home-craft centres, and childcare facilities (Ministry of Education, Government of Kenya, 2023).

1.3 The Competency Based Curriculum

In 2017, the Competency Based Curriculum (CBC) was mooted in Kenya, replacing the previous one which had served the country for 32 years. This new curriculum aimed at regularising the schooling system by enhancing transparency, allowing for accurate assessment results, thereby restoring credibility to the education sector and creating a system designed to promote entire classes to the next grade/s - until university level, with entry hinged on performance-based selection (Amutabi, 2019). Amutabi observed that the CBC mode of education was in consonance with the National Qualification Framework (NQF), which supports life-long learning in formal, non-formal and informal sectors, and early learning (Ibid; Tuck, 2007), mirroring UN SDG's 4 objectives.

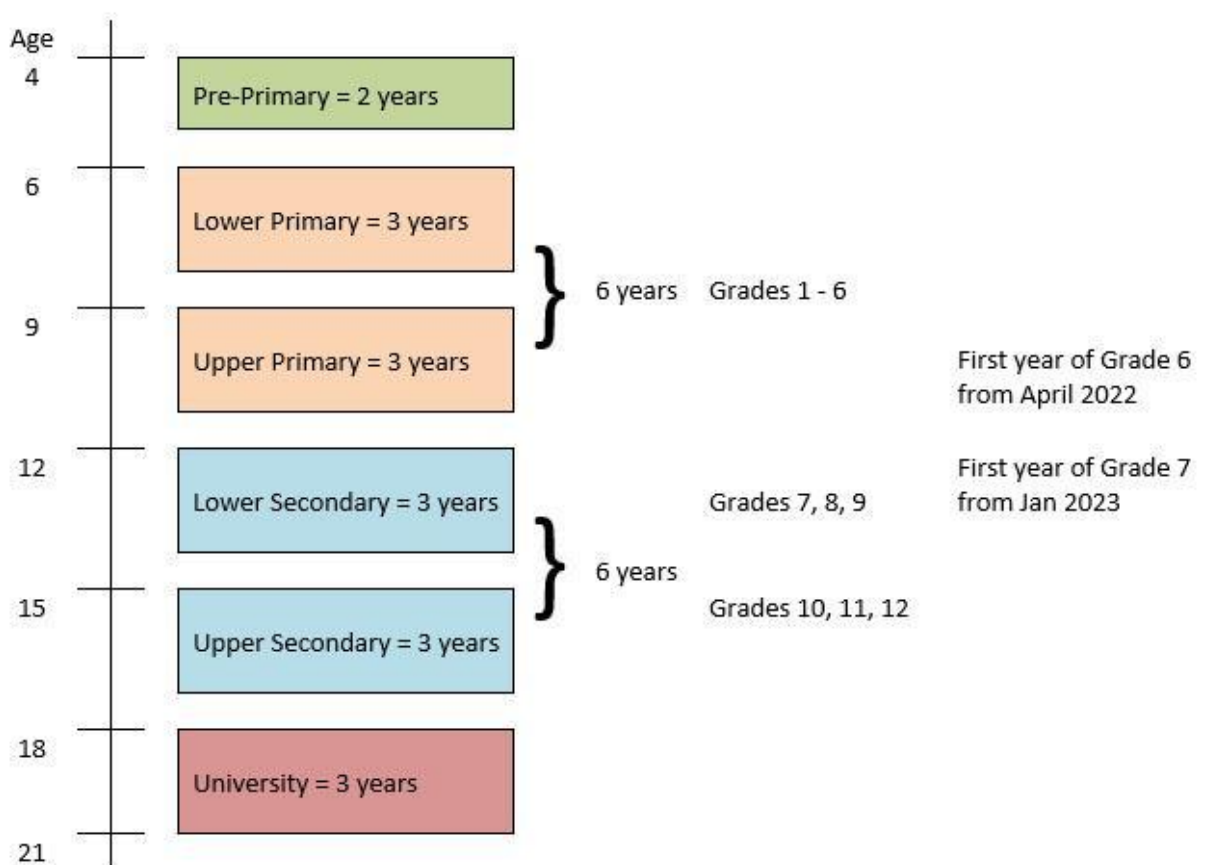
According to a study by NEPAD, the AU's last review on UN SDG 4 indicates that Kenya recorded 44.52% student transition to secondary schools in 2013, which increased to 53.3% in 2019. Improvement in secondary school education is mainly attributed to the Free Day Secondary Education Programmes, supported by strategic activities in basic education like government policy on 100% transition from primary-to-secondary education cycles, school feeding programs and funding to cushion children from vulnerable communities (African Union Development Agency - NEPAD, 2022).

As will be shown later in this study, and in reference to NQF's non-formal and informal learning objectives, the establishment of an OL Centre of Excellence in Mombasa County, on pilot-basis for a national agenda strategy, may help to advance OL for

wider student audiences and local communities. This could be done, for instance, through regional 'OL summer courses, similar to the ones implemented in the Marint Kunskapscenter (Marine Education Centre, or MEC), in Malmö, Sweden (for a development of this idea, see the Chapter on Discussion and Recommendations).

The following figure shows the diagrammatic CBC model, currently used in Kenya (Neil, 2022).

Figure 2: CBC Education System diagram. (Source: Foundation, The Red Rubber Ball, 2022)



As far as the curriculum is concerned, aspects of ocean literacy under environmental sciences are expected to be covered at various levels of primary and secondary schooling. Under Environment Studies in Lower Primary, Science and Technology in Upper Primary, Social Studies in Lower Secondary School, and under Science and Technology, Engineering and Mathematics Pure Sciences in Upper Secondary school.

As elaborated in the Recommendations section of this study, the government could consider the incorporation of a “blue curriculum” into primary and secondary school learning programs by 2025, in line with IOC-UNESCO guidelines (Ryabinin, 2023).

According to the Kenyan government, empowering learners with ocean-relevant knowledge can enhance decision making, responsible actions for environmental integrity, economic viability, and social justice, in line with the societal goals of *the Ocean Decade* (Government of Kenya, 2012). Sumalia (2012) has demonstrated the importance of ocean literacy levels as a key factor to positively impact future stewardship and good governance of the oceans. The lack of adoption of a blue curriculum in Kenyan schools is discussed further in the next section of this chapter.

Salawu showed that the promotion of OL is critical, not only in terms of relevant ocean science content, but also in terms of creating and promoting the use of locally and culturally relevant material, such as Indigenous content that can enhance learners’ affinity and relationship to the subject, and in keeping with UN Decade of Indigenous Languages aspirations (2006).

Kenya has committed to improving ocean awareness and education, for instance, as a signatory to several international treaties and conventions related to ocean affairs and education, as well as in implementing voluntary instruments such as HESI, which was launched at the 2012 UN conference on Sustainable Development, A.K.A⁴ Rio +20 Conference. The following two tables show the relevant treaties and agreements of relevance to ocean literacy ratified by Kenya.

Table 1: Legally Binding Instruments, Government of Kenya

TREATY	SIGNED	RATIFIED ON
United Nations	Yes	16.Dec.1963

⁴ A.K.A: also known as

African Convention on the Conservation of Natural Resources	Yes	12.May.1969
Convention for the Protection, Management and Development of the Marine and Coastal Environment of the East African Regions	Yes	21.June.1985
United Nations Convention of Law of the Sea (UNCLOS)	Yes	2.March.1989
United Nations Educational, Scientific and Cultural Organization (UNESCO)	Yes	5.June.1991
Convention on Biological Diversity (CBD)	Yes	26.July.1994
Amended Nairobi Convention and Protocol for the Protection of Marine and Coastal Environment of the Western Indian Ocean from land-based sources and activities (14.07.2015)	Yes	12.May.2022

As illustrated above, Kenya has ratified a host of critical environmental, educational, legal and conservational international agreements in accordance with relevant protocols and conventions including the United Nations “Constitution of the Sea,” and other legal instruments, geared in-part towards the sustainable management, conservation and use of marine resources.

Table 2: Voluntary Instruments, Government of Kenya

AGREEMENT	SIGNED	ADOPTED ON:
United Nations Sustainable Development Goals	Yes	14.Sep .2016

Higher Education Sustainability Initiative (HESI) – under UNESCO	Yes	5.Feb.2016
International Ocean Literacy Survey	No	N/A

In keeping with international good practice, Kenya is also a signatory to the voluntary international instruments listed above. At present, the country has not yet formally implemented the IOLS framework.

1.4 Problem Statement

Kenya has not yet formally adopted International Ocean Literacy Survey principles as a tool to measure Ocean Literacy levels and is yet to adopt ‘blue curricula’ into the formal educational system. There is a need to bridge the gap between a substantive educational curriculum on ocean literacy and international guidelines on the principles and fundamental concepts of ocean science (UNESCO, 2020). In Mombasa County, last year, a better informed and ocean-literate County Assembly would have been adequately prepared to galvanise support to forward to the National Assembly, the bill advocating for the inclusion of blue curriculum for local county schools (Aura, 2023). New knowledge on the status of OL in Kenyan secondary schools is needed if recommendations are to be provided for future adoption of OL across Kenya.

1.5 Research Aims & Objectives

The main goal of this research is to measure the level of ocean knowledge of secondary school learners through a pilot study in Mombasa County, using the IOLS model (that has been successfully tested worldwide) and assess the students’ perspective of learning material in Swahili using a IMO-themed cartoon book, which focuses on ocean sustainability in the context of a maritime journey, based on the UNODS ethos, ‘the science we need for the ocean we want’, from the UN General Assembly Resolution A/RES/72/73. The research was carried out through pre-set survey questionnaires distributed to students and aligned to the IOLS principles. This

study also analyses (using semi-structured interviews) a successful global OL partnership between the Marint Kunskapcenter and IOC-UNESCO. This part of the research examines their different approaches to OL, exploring challenges, opportunities and other outcomes of this partnership approach and its potential use in Mombasa.

Aims: This research analyses ocean literacy levels of high school students from schools within Mombasa County, drawing lessons from international best practice in Ocean Literacy, and inquiring about the impact of educational material in Swahili.

Objectives:

1. Examine Ocean literacy knowledge levels of randomly selected students in secondary schools in Mombasa County, using IOLS principles framework.
2. Compare successful examples of OL applications of a global organisation and an active in-country learning centre to investigate similarities, differences and notable lessons from both.
3. Assess the usefulness and potential impact of localised learning material in local language.
4. Assess the potential impact of international OL program experiences in the development of OL in Kenya.

Research Questions

- *What are the levels of ocean literacy among secondary school students in Mombasa County?*
- *Which international OL approach could be beneficial to Kenya?*
- *How useful is local language educational material to OL objectives to students?*
- *What kind of lessons from global OL experiences may be relevant to Kenya?*

CHAPTER 2: ACTORS, METHODOLOGY & FRAMEWORK

2.1 Role of Stakeholders & Informal Education Approach

The Actors: Stakeholders' Analysis

As part of the methodology, stakeholder analysis was undertaken to have a better understanding of the main actors involved in the development of an OL initiative in Mombasa. This stakeholders' analysis was based on an interpretation of the outcome of the proposed blue curriculum bill in Mombasa County, the reaction of Assembly members, the reaction of women and fisherfolk communities (many of whom are parents of school-going children), and the interest expressed by a youth group present in the discussions. This section will examine the importance of understanding why and how different groups with interest and influence in the OL discourse may contribute, positively or negatively to ocean education in the context of blue economy education for schools in Mombasa County.

For this exercise, a mixed-method approach was used to gather information from the stakeholders present at the County Assembly, illustrated in Table 2 (Approaches to Methodology). The process involved observation of the blue curriculum debate and informal discussions on the sidelines of the chamber, immediately following conclusion of the session. What resulted from this approach led to the Stake Holder Analysis below.

This is an attempt to map all relevant stakeholders who can contribute to a healthier ocean environment, more pleasant living conditions, better economic circumstances, and a more resilient life-sustaining planet (Egede, 2023; Hammar et al., 2020). Each stakeholder group was aligned to their specific interests and influence according to expected benefits from investing in OL programs, indicated by the colour coding H (blue) for high, or L (lime) in the above chart.

The visualisation and mapping of stakeholders is illustrated in the template below.

Table 3: Chart for Stakeholder Visualisation Template (Researcher)

No.	Group	INFLUENCE		INTEREST	
		High	Low	High	Low
1	Local Community & Schools				
	Residents		L		L
	Beach Management Units		L	H	
	Secondary School Students		L	H	
2	Non-governmental Organisations				
	UNESCO	H		H	
	UNEP	H		H	
	SIDA	H			L
	Social Groups - Jukwaa Arts, Bahari Hai, Bahari Huru, LTC		L	H	
	Marine Science Educators & Others		L	H	
3	Business Community				
	KNCCA - Mombasa Chapter	H			L
	KIFWA - All clearing, forwarding and warehousing companies (many in Mombasa)	H			L
	SCEA ⁵ - Shipping Co.'s; MSC, MAERSK, CGCM, etc	H			L
	Shipping Agents	H			L
	Hotels	H			L
	The 4 th Estate & Social Media Houses	H			L

⁵Website: <https://www.shipperscouncilea.org/>

4	Local Government - Country Government of Mombasa			
	Department of Education & Digital Learning	H		H
	Department of Natural Resources & Climate Change Resilience	H		H
	Department of Blue Economy, Agriculture & Livestock	H		H

The analysis of the different actors helps understand who the various interest groups are, and what kind of interest they had in the OL discussion. Furthermore, the influence of these stakeholders bears a direct and significant impact on the realisation of blue curriculum, informal educational activities and possible opportunities of future careers for the students in the represented ocean industry groups.

A key message of the Stake Holder Analysis (SHA) shows the interplay between those who are most in need (beneficiaries), and those who wield economic and/or political power (benefactors). The management of this inter-relationship is important in order to successfully navigate, implement and produce a well-balanced outcome of the intended objectives: the enhancement of ocean literacy, and the sustainable management of marine resources. The stakeholder analysis was critical to identify the roles and positions of students (the main focus of this research) in the context of OL initiatives.

2.2 Ethical Considerations

Research approvals were granted by the WMU Research and Ethics Board Committee for respondents consent to information provided, copy of transcripts and amendment thereof where applicable under number REC-24-73(M). The project also obtained a licence from the NACOSTI research agency in Kenya (licence NACOSTI-P-24-37487). The information gathered was treated with discretion and will not be

shared without due consent from the participants. The survey respondents were anonymous, and the interviews were anonymised.

2.3 Key Assumptions

A key assumption of this study is that the students will have a basic understanding of the ocean, and that the current formal curricula has adequately prepared them in ocean matters relating to ocean inter-relationships with humanity, climate and ocean ecosystems. It was also assumed that attainment of a 50% pass mark constitutes an acceptable measure of minimum ocean knowledge sufficiency, in accordance with the parameters of the IOLS framework.

2.4 Choice of Study Location

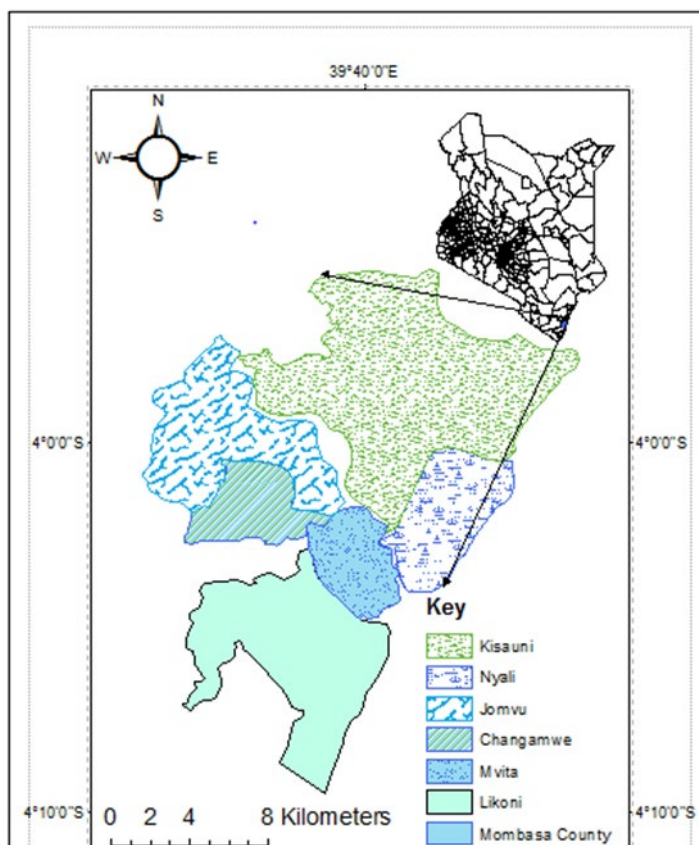


Figure 3: Map of Mombasa County (Courtesy of Kenya Bureau of Statistics, 2021)

Mombasa is an ocean-facing county where people's connections with the ocean date back to about 2000 years ago, originally as a centre of trade and later from the 15th Century onwards, as a transport hub, military station, and headquarters for a host of foreign interests for Persians, Arabs, Indians, and the Portuguese (Bita, 2015).

The city, Kenya's second largest after the capital Nairobi, is home to many people who rely on the

Indian Ocean for many of their nutritional, cultural, economic, medicinal, and aesthetic needs. The opportunity for a deeper understanding and connection with the Ocean through ocean science education and technology, combined with enabling regulatory policy instruments, would greatly enhance the relationship between the focus group of this research (the youth), and the ocean, helping to achieve blue economy aspirations (State Department for Mining, Blue Economy and Fisheries: KEMS FED Project, 2024; Muigua, 2019).

The study was conducted within Mombasa Island, Kenya (for the surveys) and Malmo, Sweden (for the semi structured interviews).

2.5 Methods

The methods applied for this study are illustrated the table below for order, clarity and contextualization purposes. The tabulation of this effort includes the framework or approaches employed, methods, stakeholders, aims and objectives of this study.

Table 4: Table - Approach of methodologies (Researcher)

Approach	Methods	Stakeholders	Aim & Objective
Quantitative	Data Analysis	Secondary school students from 5 schools in Mombasa	Analysis of knowledge levels of ocean matters and usefulness of Swahili in learning materials
Qualitative	Literature Review	- IOLS transferable academic research - Reports of adaptation in various countries	Identification of the extent of IOLS coverage & languages

	Interviews (face-to-face)	• Global stakeholder; IOC-UNESCO • Country stakeholder; MEE, Sweden	• Measure of successes & challenges of OL from comparative approach & MO's (Global vs Country)
	Pre-research: assessment of developments and informal interviews	• Mombasa County Assembly participants in blue curriculum Bill Oct'23 ○ Womesa ○ MCA-Bill Owner ○ Youth Group	

For this study, I used a mixed approach consisting of a quantitative survey for high school students of secondary schools in Mombasa, and a mixed approach (open and closed questions) in interviews with a representative from an ocean science educational facility in Sweden, and a representative from an international global organization in Europe.

Mix-methods approaches have been successfully used in such topics as ocean education, identification of lessons learned, and exploring synergies in supporting a sustainable blue economy (Fernández Otero et al., 2019; Begoña Vendrell-Simón et al., 2024; Lin et al., 2020).

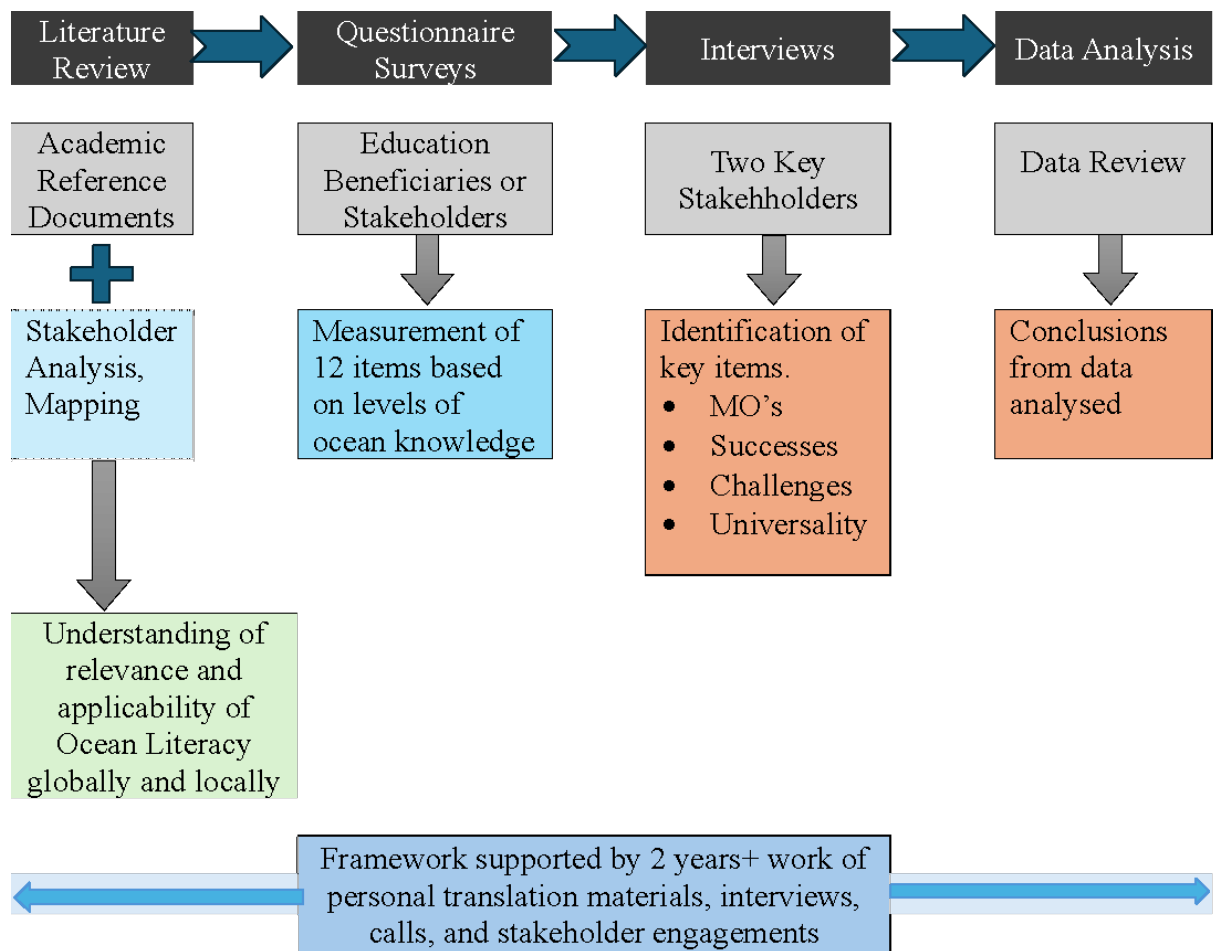
The research methods applied were two-fold, in terms of a pre-set survey questionnaire targeting high school students between ages 14 to 18 years, and a semi-structured interview for participants from global initiatives in Sweden and the IOC-UNESCO. The primary objective was to assess literacy levels of ocean knowledge in Kenya. Other objectives included to assess the relevance and preference of the use of localised learning materials, and to draw data-driven

conclusions based on the results of the data analysis undertaken. The combination of methods provided valuable insights into potential improvements to ocean learning based on the IOLS framework, the use of local language in OL, and the role of partnership and international organizations in supporting OL initiatives in Kenya.

1. **The Quantitative survey** included a random study group comprising of secondary school students converging at an examination centre, from various schools in Mombasa County. The respondents were asked to read an ocean-themed book translated to Swahili. Participants undertook a questionnaire listing 15 questions (3 general questions and 12 IOLS-based questions). The schools involved included students from a 'boys-only' institution, a 'girls-only' institution, and a mixed secondary school. Reviews of youth's preference for literature in the local language was also assessed.
2. **Qualitative interviews** were used to study two approaches to OL in Europe. The interviewees included a representative of the Marint Kunskapcenter, and a project manager for IOC-UNESCO.

The qualitative and quantitative approaches are shown in the figure below.

Fig. 3: Diagram - Data Collection & Theory Framework (Researcher)



2.7 Study Groups

Group 1: This group consisted of secondary school students based in the County of Mombasa, Kenya. Due to limited access and inability to authenticate online profiles for the study group (using computers or cell phones), questionnaires were administered in physical format. The IOLS standard was applied in this study as it is a tried-and-tested tool applied across 24 countries and is considered (by global replication and multiple language translations), a comprehensive yardstick of ocean knowledge internationally (Fauville et al., 2018).

The rationale of the sample populations was to determine whether the formal education syllabus for secondary schools adequately equips students with requisite levels of ocean understanding.

A total of 15 questions was listed in the student questionnaires: Questions 1 to 12 addressed ocean knowledge skill levels of students with 3 biodata background questions at the start of the survey, and 3 opinion questions at the end of the survey. Included as part of the questionnaire was a copy of a Swahili e-book which students were asked to read before undertaking the survey. This book was the researcher's translation of an ocean science themed sea voyage detailing the adventures of a group of seafarers and the lessons they learned on their journey regarding the ocean, climate, shipping, the marine environment, sustainability, energy and other vital lessons. This topic is examined in detail in Chapter 4.

E-book copies of the Swahili text were distributed to students to read through, prior to their undertaking of the survey. Due to restricted access to a limited number of shared computer resources, timing of on-going end-of-semester examinations, and unverifiable usage and access to cell phones, physical copies of the questionnaire (including the book) were emailed to Mombasa, printed out and physically distributed to- and promptly collected from- the students at the end of their exam sessions for all 5 schools' respondents, courtesy of the Head Master of Allidina Visram School. Scanned copies of responses were returned to the researcher.

Samples of the questionnaires, including the Swahili cartoon e-book, can be found in Appendixes 1 and 2.

Group 2: The interviews with OL practitioners using mixed method was undertaken to determine informal educational similarities and differences between literacy approaches and any unique characteristics thereof. The 9 semi-structured questions provided insight into basis, teaching format & materials, global indicator impacts (based on SDG's 4 & 14), challenges, opportunities and recommendations on ways forward.

Two individuals who have championed successful OL initiatives, one in Sweden, and the other in UNESCO, were interviewed. The participants' input was essential in providing tried-and-tested attributes applied to positive, sustainable outcomes of OL programs. The semi-structured interview was conducted face-to-face in Malmö. Soft copy forms were filled out and video recordings were obtained during the interview

process. This process was carried out before and during the MEC & IOC-UNESCO Summer School project week, between June 27th and July 5th in Malmo.

The decision to interview representatives from both initiatives was based on opportunistic sampling, which has been described as “the researcher taking advantage of circumstances that occur as the study progresses, exploiting emerging opportunities for data collection along the way” (Farrugia, 2023). In this sense, the summer school event presented a great opportunity to obtain additional information on proven OL initiatives.

CHAPTER 3: RESULTS

This chapter presents raw data from the research methods applied (see Table 5). Data collected from student participants from the questionnaire exercise is presented, including outcomes of knowledge measurement, trends from students' performance, opinions and preferences as per test parameters.

The second part of this chapter will present results from the mixed-method approach with representatives from OL initiatives in Europe.

3.1 | Group 1: Quantitative Results

The following table presents an overview of the data collected through the survey.

Table 5: Raw Data Tabulation

Bio-data		Respondent	OLQs												Opinion Qs		
Gender	Class		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	13	14	15
M	F3	1	A	A	ACF	A	A	D	C	D	B	C	A	B	3	3	5
M	F3	2	A	A	ACF	A	B	D	B	D	C	C	A	B	5	4	5
M	F3	3	A	A	ABC	B	B	D	B	D	C	C	A	B	5	4	5
M	F3	4	B	A	ACF	A	A	D	C	D	B	C	A	B	5	3	5
M	F3	5	A	A	ACF	D	C	D	C	D	A	C	B	B	5	5	5
NA	F2	6	B	A	ACF	B	ABC	D	A	BCD	B	C	A	B	4	4	5
NA	F2	7	B	A	ACF	B	ABC	D	A	BCD	B	C	A	B	4	4	5
M	F2	8	B	A	ACF	B	ABC	D	A	BCD	B	C	A	B	4	4	5
NA	F3	9	B	A	ACF	B	ABC	D	A	BCD	B	C	A	B	4	4	5
M	F3	10	B	A	ACF	B	ABC	B	C	A	B	C	A	B	4	4	5
M	F4	11	B	A	ACF	C	A	D	C	ODE	B	C	A	B	3	3	5
M	F4	12	B	A	ACF	A	AC	D	C	AE	D	A	A	B	3	3	5
F	F4	13	A	A	ABCF	A	A	D	C	D	B	D	A	B	5	3	5
F	F4	14	A	A	ABCF	A	A	D	C	D	B	D	A	B	5	3	5
F	F4	15	A	A	ABCF	A	AC	D	C	D	B	D	A	O	5	3	5
F	F4	16	D	A	ACF	A	AC	D	B	ACD	C	C	A	B	3	2	5
Key		School Name															
		AVHS															
		Khamis															
		Makande															
		AlFarsy															
		Sacred Heart															

Out of the original 30 scripts sent out, a total of 16 scripts were filled, in 5 schools. Timing, technology and cost restrictions limited sample size, which in turn sets limits to broad generalisation of the study results. The number of questions in the student survey considered the time allocation for participants to read the e-book (total of 35

pages, see Appendix V). The e-book was linked to question number 15 in the questionnaire. The estimated survey time for completion was between 40 and 50 minutes.

Each respondent had a total of 15 questions to answer, applying English as the medium of the survey (Q 1-12) and Swahili as the medium of reading the e-book (Q 13). The participants were also required to provide their biodata, as shown below.

Background Questions

1. What school do you attend?
2. What grade are you in?
3. What is your gender? (Please circle your answer): Male / Female / Prefer not to say

The biographical data indicated that more male than female identified participants responded to the study. From the total 16 questionnaire submissions, the male to female to non-identified ratio was 9:4:3, with 3 participants preferring not to state their gender. Of the 9 male-identified respondents, 7 came from Allidina Visram High School, and 2 from Khamis High School. Of the 4 female-identified respondents, 2 came from Makande, 1 from Al-Farsy and 1 from Sacred Heart schools respectively. Five secondary schools were represented in the sample. The survey group consisted of 56.25% male, 25% female respondents and 18.75% non-identified respondents.

The OL survey primarily employed the use of twelve questions relating to knowledge of the ocean and ecosystems, with the last three questions asking for personal opinions of respondents. The study was conducted between the 22 and the 23 of July 2024 under the direct supervision of the principal of the Allidina Visram School, a secondary school educational centre in Mombasa County.

Modelled on the initial and latest versions of the IOLS framework in question content and format, the survey also incorporated one unique country-specific question (Question 5), testing student's knowledge of their own coastline habitat and resident species.

Question 5

Sea turtles are found in Kenya's coastline habitats. Select the most accurate statement.

Check all that apply.

- ☐ The Hawksbill Turtle is endangered and nesting sites in Lamu and Kilifi Counties need protection.
- ☐ Sea turtles are dangerous ocean creatures and can be poisonous.
- ☐ Ocean turtles help to maintain the health of coral reefs
- ☐ Sea turtles can dive up to a depth of 1,500 metres below sea level.

Other:

Results on this question showed that only 3 students out of the total number provided the correct answer with complete choices of answers selection (i.e. accurate selection of multiple answer choices 'a' and 'c' from the statements provided).

3.1.1 Questionnaire Data Highlights

This section shows responses to the ocean literacy measurement method, based on the IOLS format.

Table 6: Participants of manual OL questionnaire forms, based on survey results (Researcher)

SCHOOL	Participant No.	Class	Av. Performance (%)	Gender	
AVHS (Allidina Visram High School)	10	F2-F3	65.7	60%	Male
Khamis	2	F4	66		
Makande	2	F4	50		
Al-Farsy	1	F4	56	62.5%	Female
Sacred Heart	1	F4	69		

A general observation is that younger students in Grades 10 and 11 (Form 2s and 3s) on average outperformed or tied in score against older counterparts per classroom levels, scoring an estimated 66% (65.7%). The exception being one student from the girls' school, Sacred Heart Grade 12 (Form 4), which produced a top performance with 69% of correct answers. The lowest average score was from a boy's school (Form 4s) with 50% of correct answers (Makande). A limitation of random selection is noted, in that the average scoring may not be representative given the participation of only one student each from Al-Farsy and Sacred Heart schools, respectively. However, the results are based on random selection, and they will be further analysed in the next chapter.

In the weighting of the questions exercise during data analysis, common themes of the questions were identified in relation to the IOLS principles. For example, Principle 1 on ocean features is related to Question 1 which tests respondents' knowledge on number of oceans. Similarly, Principle 2 is represented by Questions 4, 7, 8 and 12, relating to the ocean and ocean life as well as influences of the ocean on the earth, and so it follows for other IOLS principles and corresponding questions. This principle-to-questions correlation, referred to as indicators, is represented in the table below.

Table 7: Number of Ocean-Literacy indicators in the questionnaire inventory (Researcher)

Principle	Indicator No.	Instrument
P1. Ocean features	1	1
P2. Ocean & Life shapes earth	4	4, 7, 8, 12
P3. Weather & Climate	2	4, 6
P4. Ocean makes earth habitable	1	9
P5. Life and ecosystems	4	2, 3, 5, 10
P6. Oceans & Humans inter-connection	1	11
P7. Unexplored Ocean	1	15

According to the data collected, Table 5 provides evidence of the number of OL indicators (OLI) for each of the IOLS principles, as per survey questions, referred to

in the table as indicators. This exercise serves to validate the relevance of research data from the method and questions employed from the IOLS framework.

Another measure, the Rausch model of Indicator Response Theory Modelling framework equation is presented below.

$$P(x/\Theta_j) = \exp(\Theta_j - \beta_i) / 1 + \exp(\Theta_j - \beta_i)$$

Key: P = probability of a correct response to Item 'i', by respondent 'j' with ability 'Θ'. Beta 'i' is the difficulty parameter for item 'i', & theta 'j' is the ability parameter for respondent 'j'.

This formula measures the mathematical probability of a correct response i.e. the respondent's ability, ocean knowledge, and the difficulty of the item (fixed difficulty relative to the other items, not relative to the ability of the respondent), as the only factors influencing whether the respondent answers the item correctly. It remains impractical for application to the current research, but this is included as it may be useful in the future for wider populations with in-depth questionnaires that incorporate sub-strata of principle questions (for sub-indicator/items).

Scoring Guidelines

Test scores for questions numbering 1-12 were measured against the guidelines below following IOLS development research by Fauville et al (2018), where the pass mark of correct answers was indicated as 50%.

Below 50%: Inadequate

50%-80%: Adequate

80%-100%: Well informed

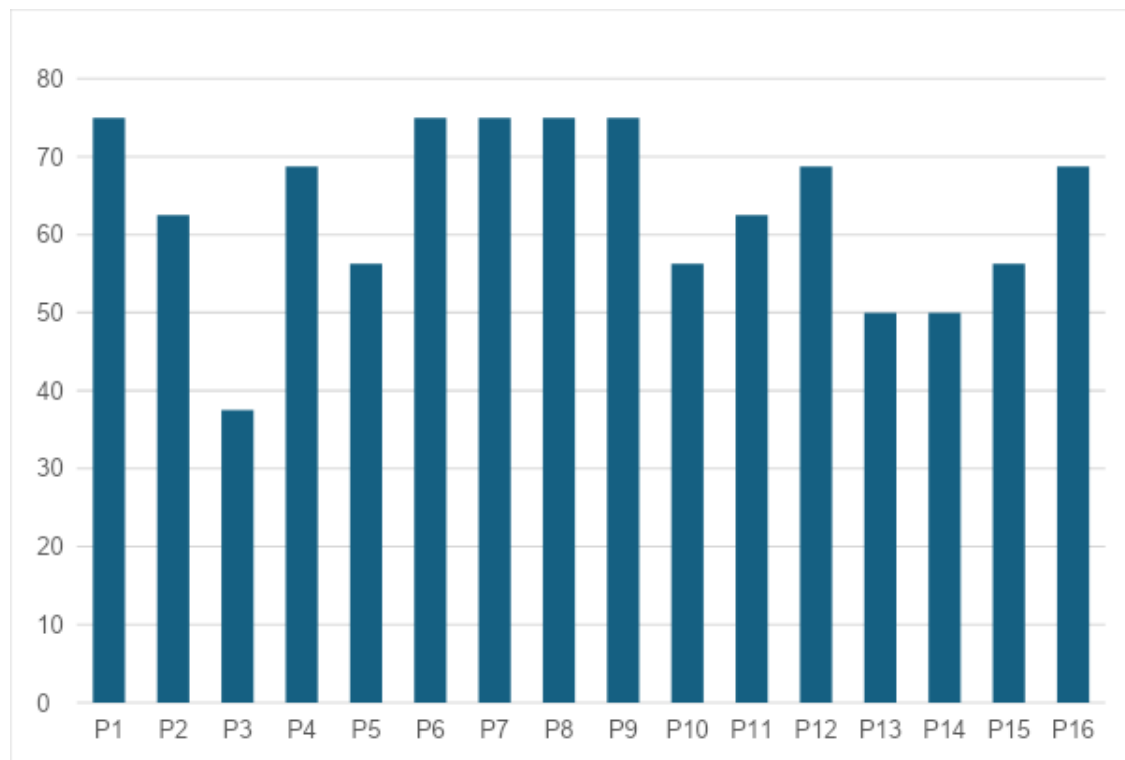
A score above the 80-percentile mark would indicate that the respondent was well informed in ocean knowledge. According to the data collected, none of the students reached the 80th percentile mark. Detailed findings are documented in the bar graph and explanations below.

Besides the questions related to OL, some questions were connected to gauge the respondents' attitudes regarding learning material in Swahili. The inclusion of a

language component to research in OL plays a vital role in the learning experience (Carpenter & Tsykarev, 2021). The Swahili translation of the English e-book version⁶, is included in the appendix.

For the results below, a simplified version of Rasch methodology is applied. (Chen et al., 2020), where precise mathematical relationships between an item (student scores) and a latent trait (knowledge levels) are measured. This table shows the degree of correct responses concerning questions related to ocean literacy, where resultant responses are displayed in the graph below.

Figure 4: Graphical representation of Correct OL responses



From the above findings, we observe the following results.

- Average score: 63%
- Median score: 66%
- Range of score: Between 38% - 75%

⁶ Source: <https://seas-at-risk.org/team/anais-rios/>

On a correlational basis (based on 12 questions specifically related to OL), from a survey population consisting mainly of male students compared to female participants, the highest mark of 75% was scored by 5 students from AVHS, although the lowest score of 38% also came from the same school.

The following table shows the scores of the test regarding OL questions among the participants.

50% and below	Inadequate	3
51%-79%	Adequate	9
80%-100%	Well informed	0

For some of the questions, participants had perfect or near perfect scores. These questions are the ones that included the following topical areas.

- Marine mammals: 16/16 score
- Duty of care: 15/16 score
- Largest variety of living things: 15/16 score
- Form of water (cycle): 15/16 score

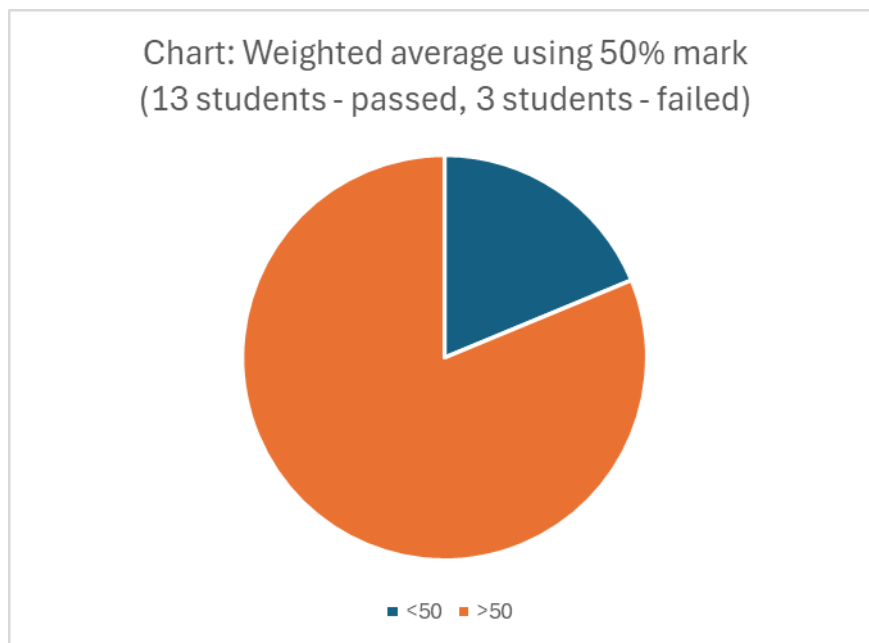
The worst performed question was the one related to the local environment identifying main issues connected to endangered sea turtles in which only 3 out of 16 participants responded correctly.

The questions that the student scored the highest were related to identifying whales as marine mammals, the duty of care by human beings for the ocean and ocean ecosystems, the ocean as host to the largest variety of living organisms, and the form water takes in various cycles or stages of being.

The worst performed question stood out as a surprising result. Most students could not select the most accurate statements relating to sea turtle, which was the only one referencing their own marine habitat. This was the question on IUCN classified, endangered sea turtles, resident in Kenya's coastal ocean habitat.

The chart below shows the percentage of students who attained a pass mark of 50% correct answers and those who fell below this mark.

Figure 5: Chart indicating percentage of students with pass or fail mark results



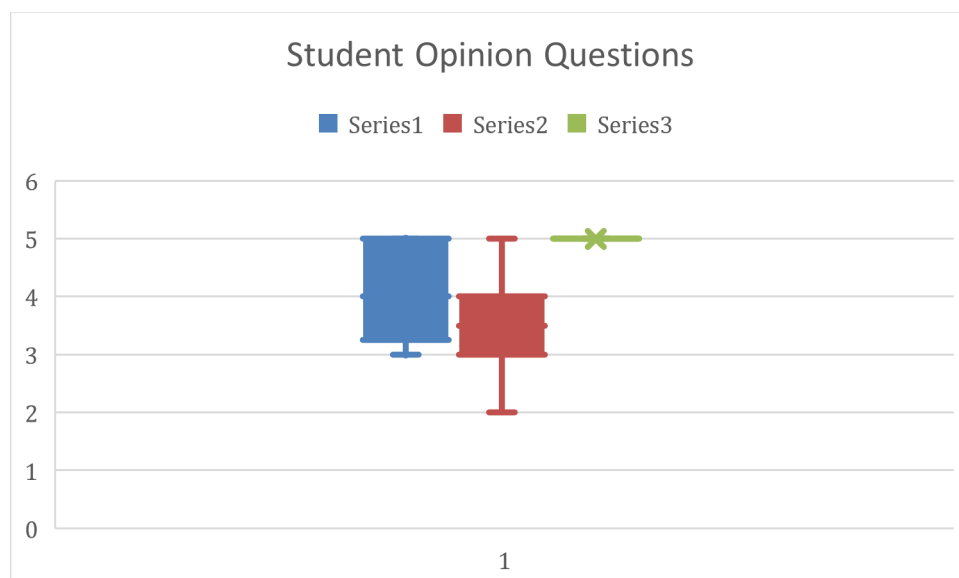
From the above chart, 13 students (in orange) out of 16 achieved the pass mark of 50% and above, and 3 students (in blue) scored below the pass mark, indicating adequate knowledge of the ocean for more than 80% (81.25%) of the student population.

3.1.2 Opinion Poll: Language and Ocean-Related careers

Based on the responses provided on opinion poll questions from the students, the following was derived.

The opinion questions at the end of the survey, Questions 13, 14 & 15 provided responses on the usefulness of use of local language, the helpfulness of the cartoon e-book as an aid to ocean learning and affinity of students to pursue ocean-related careers. The results can be viewed in the diagram below.

Figure 6: Student Opinion Results Graph



Series 1 refers to Question 13: Series 2, Question 14, and Series 3, Question 15.

The above graph represents results for Questions 13 (How useful is the "Visiwa Viwili" story book and the use of Swahili in language in your ocean learning? - in blue), Question 14 (How likely are you to pursue a career in ocean related studies or blue economy job opportunities? - in orange) and Question 15 (Is the cartoon book, Hadithi ya kusisimua ya IMO: Hadithi ya Visiwa Viwili, helpful in your learning about ocean matters? - in green), referring to use of Swahili language (Q13), preference for blue careers (Q14), and usefulness of the cartoon book (Q15), respectively.

Question 13 (Series 1)	Number of students with Score of 3	4
	Number of students with Score of 4	5
	Number of students with Score of 5	7
Ref: Use of Swahili language		Total: 16 students

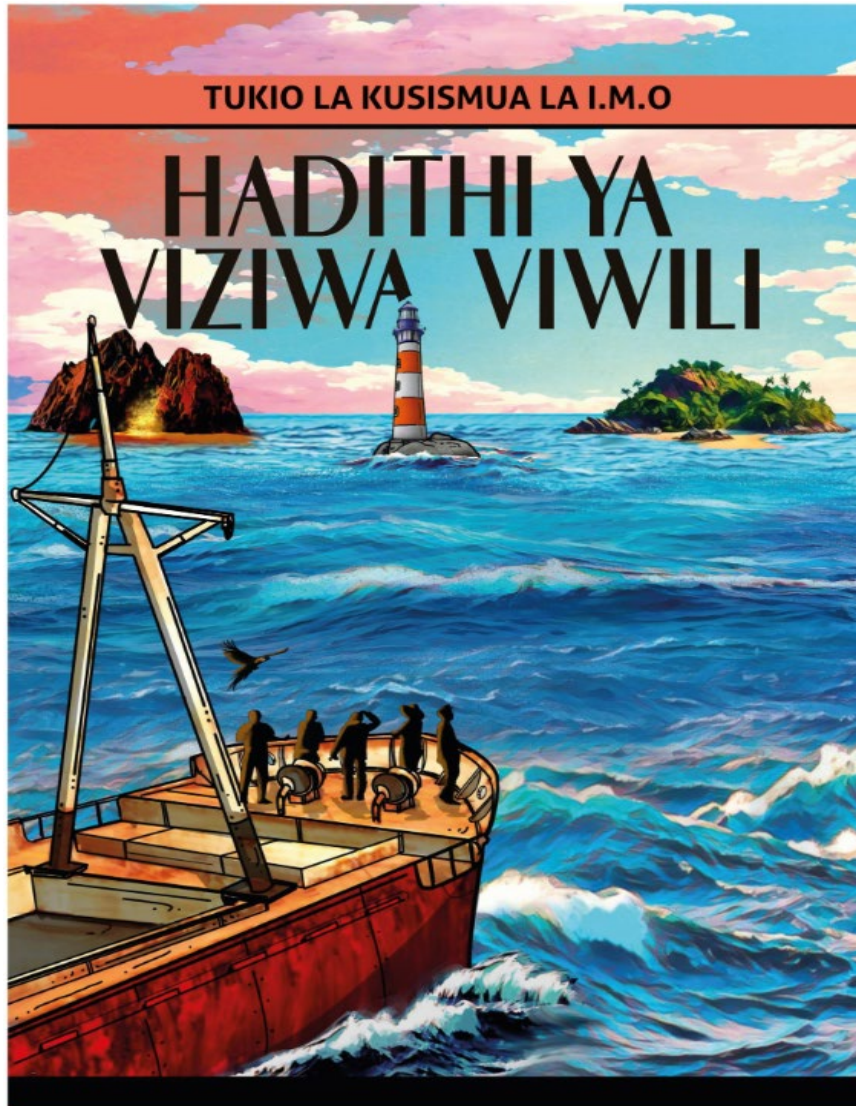
The content of the Swahili e-book includes ocean-related lessons on maritime-marine inter-relationship, climate, nature of the ocean environment, pollution, energy sources and application, and sustainable and responsible practices. The question regarding

the usefulness of the Swahili e-book shows that 100% of the participants responded as 'Yes' (giving the answer a score of "5").

Question 15 (Series 3)	Number of students with Score of 5	16
Ref: Swahili book helpfulness		Total: 16 students

The students unequivocally returned a unanimous affirmative response to the book's helpfulness as an ocean learning tool. Interestingly, these results contrast to the students' answer to the more general questions about the usefulness of Swahili educational material (Question 13).

Figure 7: Cover of Swahili book used by students highlighting ocean, maritime, marine and climate themes (Researcher)



Question 14 (represented by **Series 2**, on the probability of the respondents pursuing a career related to ocean studies or the blue economy) showed a wide range of opinions from Score of 2 'unlikely', 3 'neutral', 4 'possible' to 5 'definitely,' with no particularly strong majority weighting. This result will be elaborated further in the discussion chapter.

The data collected provided answers to the research questions posed, as discussed in the next chapter.

3.2 | {II} Group 2: Qualitative Results

This section will describe some highlights of two mixed-method interviews that were conducted face-to-face in Malmö. The first participant was the Founder of the Marine Education Centre (MEC), referred to as Respondent 1, following the researcher's interview template (Appendix C, III Sample Survey Questionnaire document). The second participant was the Summer School Project Manager from UNESCO, referred to as Respondent 2, following the researcher's interview template (Appendix B, II Sample Semi-structured Interview document).

The interviews had a mixed method approach with some questions being open-ended, others organised around Linkert Scale parameters, and others providing a selection of options and/or opinions. Both interviews followed the same research script, with certain sections drawing different responses according to the two respondents' OL programs, implementation mechanisms, funding, scope of coverage (local vs. global) and other protocols.

The interviews were analysed through identifying the main subjects that emerged from the nature of the questions and the responses from interviewees. Similarities and differences in their responses were identified. The following points provide a summary of the data analysis.

- Although both entities advanced the teaching of ocean science primarily to students, the Marine Education Centre was already established in this effort decades before the advent of IOLS framework; whereas IOC-UNESCO programs and implementation is a more recent UN-based established initiative based on Sustainable Development Goals targets under the UN Decade of Ocean Science which has been adopted into EMSEA strategic agenda for Europe.
- Both MEC and IOC-UNESCO educational approaches favour informal methods equipped with modern aids, as well as practical interactive sessions with the ocean as discussed further in the following chapter. Ensuring the development of learners' five senses (touch, taste, sight, smell and sound)⁷,

⁷ <https://en.smkc.se/a-piece-of-oresund>

activities follow a colourful, eventful, artistic and outdoor engagement approach based on or informed by marine and environmental science.

- Both interviewers mentioned a wide range of technological aids and ocean equipment including microscopes and telescopes, audio-visual gadgets, nets, diving equipment, pontoons, well-equipped sea labs, and ocean science hubs.
- Ocean literacy beneficiaries largely included students from across Sweden (in the case of MEC) and the wider European continent (for IOC-UNESCO summer school and other short-term workshops). In the case of MEC, the programs also involve the general community living around the Oresund in conjunction with the local authority and in line with European Union guidelines. (European Commission, 2019; European Union, 2023).
- The programs are funded in collaboration with EU and UN agencies. Regarding MEC, a portion of the activities is financed by the City of Malmo, particularly for programs that involve local communities. More than 150 students are served at the MEC every year.
- SDG 14 (Life Bellow Water) was identified as being of key importance to MEC, whereas SDG 4 (Quality Education) was identified as being of key importance to IOC-UNESCO.
- The location of MEC (on the shore near the city), the socio-economic environment, the support of the local government and of international partnerships, and the consistent availability of financial resources seem to contribute greatly to the success of the centre. This in turn has a positive effect on the ways learners interact with, develop and carry ocean education lessons into their future behaviour and lifestyle choices.

3.2.1 Extracts of quotations from interviewees

The following are some important excerpts from interviewees. They provide indication of the need for concerted efforts by multiple sectoral stakeholders, governments and international players to deliver on the vision for literacy for all, and for effective adoption of positive behaviour- change towards ocean sustainable and conservation practises.

3.2.1.1 Semi-structured Interview – Respondent 1 (SSI-R1, Marint Kunskapscenter)

SSI-R1⁸: According to the respondent, OL implementation was well ahead of legislation for the MEC, whose operations commenced before the advent of global calls for OL initiatives. This early and unique approach formed out of necessity, and it was backed by ocean science ‘transect studies’ in the 1980’s and has since served effectively as a model for ocean studies in the region (see also Hultman, 2019; Hellström, Åsa; Palmgren, Michael, 2017).

When asked about their main target audience, the respondent said that their primary area of focus has been students of all ages, from kindergarten to high school, *“...catering for a total of 175 schools plus beneficiaries from other European countries every year.”*

On projects financing, *“... funding from the local government, backed by European Union project budgets allowed continuous, numerous training programs”* for the centre. (European Union, 2023)

Additionally, the respondent advised that ocean science education programs need well-intentioned collaboration with multiple stakeholders including universities, international organisations, research institutions, the Skane municipality, philanthropists, among others. An MoU renewed in 2023, between Marint Kunskapscenter and the World Maritime University, designed to facilitate cooperation in areas of mutual interest in the field of maritime and ocean education and research, was brought up as an example of cooperation. The agreement is described on statements by both parties as follows:

Founder, MEC: *“...together we can strengthen our ties and raise awareness of Ocean Literacy and the importance of the ocean for all of us living on this planet,”* and,

President, WMU: *“...to expand the knowledge of our students regarding sea life and ocean issues in the Öresund region - knowledge that is informative and adaptable for addressing ocean issues... (applicable in students’ respective countries) and supports “mutual commitments to achievement of the United Nations 2030 Agenda*

⁸ SSI-RI & SSI-R2: Refers to Semi-structured interview – respondents 1 & 2, titled per anonymity guidelines.

for Sustainable Development, and Goal 14 in particular focused on Life Below Water.”
(World Maritime University, 2023)

3.2.1.2 Semi-structured Interview - Respondent 2 (SSI-R2, IOC-UNESCO)

The respondent from IOC UNESCO identified critical OL legislation & global examples: *“We all know that education is the basic (catalyst) to change people’s behaviour...” There isn’t really a proper legislation or framework for OL in Europe, but using European Commission money, we have the EU-for-Ocean-coalition, Youth-for-Ocean-forum, and others”*. In Europe, the “Ocean Literacy World Conference in Venice - just now in June 2024... is a where the Venice Declaration was born.” Brazil is really one of the few countries that introduced ocean literacy from an early age in a city called Santos.

The main audience and stakeholders for the program are quite different from the ones identified by the MEC respondent. For IOC-UNESCO, their representative confirmed that, “our focus... we have policymakers, students and teachers.”

On IOC UNESCO’s standardization mechanism and global reach, the respondent added that: ...the initiatives from IOC UNESCO recognise that there “is need for more global outlook on the Summer School reach, improve the IOC website more user-friendly, and create a formula to enable users to implement a standardized key measure based on science data.”

On the best approach for OL (*bottom-up and top-down*), Respondent 2 said that “both approaches combined [but] we need focus on the bottom-up.”

The respondent also mentioned that member states did not contribute to the funding of ocean decade programs – with one exception. Sweden is the only country that provides IOC UNESCO with funding, since the beginning of the Oceans initiative and decade activities (Intergovernmental Oceanographic Commission, 2021).

IOC-UNESCO is interested in expanding ocean literacy advocacy by partnering with a wider range of stakeholders, including the fisheries, shipping sectors, universities, and research institutions, with innovative approaches such as the GOLI initiative to coordinate and manage Ocean Literacy programmes.

From both respondents, the reach for global achievement of ocean literacy is far from achieved. Both parties alluded to a current WMU student-led initiative under the acronym “GOLI” (Global Ocean Literacy Initiative), that cuts across geographies, countries, maritime specialisations and languages, whose aim is to drive ocean literacy worldwide and aspires to help catalyse a global bottom-up approach to enhancing literacy rates, starting with student populations (GOLI, 2024).

The following figure shows a synthesis of key findings from the interviews, which in essence illustrates commonalities and differentiation between variables applied by or attributed to the two interview subjects. These are explicitly indicated in reference to importance of SDG’s Goals 4 and 14 in relation to global application and impact, influence of stakeholders (politics and policy), learning and building capacity in ocean science knowledge, use of standardized measure and emerging trends.

Table 8: Extract of key findings of interviews (Researcher)

	Respondent 1	Respondent 2
Global Indicators - SDG4 & 14 Impacts	SDG 14 - Highest impact SDG 4 - High to Moderate	SDG 14 - Low impact/Don't know SDG 4 - High to Moderate
Key Findings	The world must become Ocean Literate , illiteracy levels are still high. Mis-aligned politics and government policy in relation to SDG 14... Recognise emerging anthropogenic threats – Deep-sea mining... Future preparation is important.	More global outlook (partnerships & collaborations), more ‘summer’ OL schools & capacity building needed... leadership to adopt bottom-up approach... standardized measure of behaviour change needed.

CHAPTER 4: DISCUSSION & CONCLUSION

4.1 Discussion

General Outcomes

For the first time in Kenya, a study on ocean literacy levels among high school students was carried out using an internationally applied measurement framework - the IOLS, adopted broadly in Europe and applied in China, Canada, Brazil and other countries.

Even with limited time and scale for this study, interesting results and new information was able to be extracted from the applied methodologies.

In the following section, I will examine what the outcomes of these results entail and how they apply to the research questions.

4.2 Key Results

Discussion Points on Local Study

This section offers some insights regarding how the data collected through the questionnaires help address the research questions that were the focus of this study.

RQ⁹ 1: What are the levels of ocean literacy among secondary school students in Mombasa County?

Ocean literacy levels measurement for the randomly selected secondary school students in Mombasa County revealed that in general terms, the students were adequately informed or knowledgeable about the ocean environment, from data results indicating average pass marks around the 60th percentile.

Nevertheless, none of the students scored a mark higher than 80%, meaning that none of them was exceedingly knowledgeable in ocean matters, which highlights a gap in the current curriculum and standard of ocean studies. This outcome supports the recommendation for the inclusion of ocean science into the school educational

⁹ RQ: Abbreviated format of the words 'Research Question.'

curriculum in Kenya. This would benefit students to acquire higher levels of ocean knowledge and performance in ocean science qualifications for the country, boosting local performance to match international standards, as adopted in other regions globally and as recommended by the United Nations (European Commission, 2018; Ocean Literacy Research Community, 2024). Additionally, it would help in providing better management and protection of Kenya's marine habitat.

Additionally, and quite surprisingly, a large majority of the students could not pick the correct combination of answers in relation to endangered sea turtles, endemic to Kenya's coastal habitat (IUCN Red List Regional Assessment, 2021). This could indicate that, although on average the students' general marine knowledge was acceptable, they were not properly informed of ocean life in their own environment. It should be noted that the International Union for Conservation of Nature (IUCN) is not required knowledge for secondary school students. While this may not be entirely relevant as an indicator of ocean knowledge measurement (given the short sample size and the use of only one question in the survey), it is important to highlight that knowledge of the local environment is crucial for the development of OL and that an extended study of students' knowledge of their local marine environments would shed light on this important issue.

The lack of adequate knowledge of local ocean species by the students may be interpreted to mean that there may be an inadequacy in ocean environment lessons, especially those designed to impart practical, hands-on experiential learning. The experience in Sweden with the Marine Education Centre provides an excellent example of how initiatives involving students and communities can enhance ocean knowledge and ocean awareness. This points to the need of ocean education policy reviews directed to address the inclusion of more on-site marine environment field lessons and excursions, as well as collaboration with other stakeholders, such as marine researchers. The creation of a Marine Education Centre in Mombasa could also be very effective in amplifying ocean literacy in schools and with other stakeholders.

From the student population it was clearly documented that more boys than girls participated in the research study. Given the small sample size and consequent difficulty to draw meaningful conclusions regarding gender, it would be important to

conduct a wider, more inclusive study including a large variety of the student population in future studies.

RQ 2: Which international OL approach could be beneficial to Kenya?

Key lessons from semi-structured interview participants clearly demonstrated that despite the application of different OL frameworks, the respective methods of operations still resulted in ocean science knowledge being enhanced and the beneficiary audiences becoming more conscience of their relationship and actions to the ocean. Evidentiary replication of these methodologies - both the global and local home-grown literacy approaches - presented notable emergent perspectives, useful for future research prospects. A combined approach between formal and informal, international collaboration, and local CBC grown educational programs could be beneficial as a two-pronged approach for Kenya.

Additionally, Kenya could learn from the successful example of the marine education centre in Sweden by emulating this centre of excellence in ocean science learning through the establishment of a similar centre in Mombasa County. The incorporation of a suitable National Development Strategic Plan from a national agenda perspective to achieve this may help the country in reaching wider student audiences and other stakeholders, and it would likely have a positive impact on the recently adopted Marine Spatial Planning Bill, in keeping with obligations ratified under the Nairobi Convention (MSP Vision 2030 Kenya, 2024; Nairobi Convention Secretariat, 2024).

Local application of global best practice may further aid the country in preparing a well-informed future workforce in the marine environment and ecosystem services to effectively accomplish new initiatives such as the Kenya-Tanzania marine transboundary project (WIOMSA, 2024).

Learning from Canada using the example of the Canadian Ocean Literacy Coalition may also encourage the Kenya Government through the existing East African Community framework to establish a similar regional block for the advancement of literacy levels, create a platform to address ocean related emerging challenges and more efficiently address the triple planetary crises of biodiversity loss, pollution and

climate change, as identified in the Kunming-Montreal Convention on Biodiversity framework (Canadian Ocean Literacy Coalition, 2024; Convention on Biological Diversity, 2023).

Conclusions drawn point to the fact that secondary school students of Mombasa County in Kenya are generally interested and adequately knowledgeable about the ocean, a trend that could be encouraged per global studies (Begoña Vendrell-Simón et al., 2024; Associated Press, 2024; Devenport et al., 2021). There is however room for improvement to higher scores.

RQ 3: How useful is local language educational material to OL objectives to students?

According to research and global examples, the use of local language has been identified as a learning advantage (Ciencia Viva, 2023) in the context of education. Preference of learning materials in the local language was concisely interpreted using questions 13 and 15 to give clarity to two separate issues.

While many students indicated preference for use of Swahili in the storybook, quite a few students were non-committal in responding to the same question. However, general responses were in favour of both the use of Swahili, and the usefulness of the cartoon story book as 80% and 100% respectively. This confirms that publications like the IMO-themed Swahili are useful resources for ocean learning (Lin et al., 2020; Tsai & Chang, 2018).

This is interesting because it shows a clear preference perhaps for the type of learning material (cartoon book), versus use of the local language (ocean learning application), on its own merit; meaning that students do not necessarily find it important to be schooled or tested formally on their lingua franca which they use informally daily, outside of the classroom environment.

The result on the use of Swahili perceived less favourably than English in the classroom may suggest that students are habituated to a learning environment in English rather than their own home-based language (Kabellow et al., 2019). Additionally, the popularity of colloquial 'Sheng' over Swahili, has been propelled by

youth-driven peer preferences, as is the case for other similar colloquial continental favourites, such as 'Camfranglais' in Cameroun and 'Tsotsitaal' in South Africa (Erastus & Kebeya, 2018).

While the students were indifferent to the generic question, they became fully engaged when reading the cartoon book. This could be a result of them not having such educational learning material in Swahili and in cartoon format, which is topic that could be explored further by researchers and educators. Research has shown the importance of the use of local languages and of local-based learning (including environmental knowledge) to improve science education approaches and strategies (Irma et al., 2021; Barab & Luehmann, 2003). A study of 'Sheng' indicates that Kenya's youth are inadvertently likely to favour the use of this melange of English, Swahili and other languages which is spoken widely, originally often in cities, but which has since spread as a peer favourite throughout the country (Githiora, 2002).

This outcome may be used by educators in the country's education system to incorporate a non-formal learning mechanism for students, going forward.

RQ 4: What kind of lessons from global OL experiences may be relevant to Kenya?

There are several key lessons from global success stories that may be relevant to Kenya. Firstly, the adoption of OL and OL-based activities for students has been credited as a primary benefit of positive behavioural change in the anthropogenic influence on the blue planet. Such a paradigm shift from previous non-desirable actions and behaviours bears a direct impact on the management of today's climate crisis (Begoña Vendrell-Simón et al., 2024).

Secondly, the research revealed that while a bottom-up approach is much favoured by both participants through the semi-structured interviews, a mix of both top-down (including support for governments and international organisations) and bottom-up (centred around youth and communities), is needed to effectively implement OL for Kenyan students. The relevance of this result is particularly useful to Kenya's

curriculum developers in preparation for the blue curriculum agenda endorsed for adoption globally by the United Nations, beginning in 2025.

As evidenced in the cases of Sweden and regional European Union member states through the UNESCO program, Kenya might be in a position to propose a regional approach amongst East African Community member states, with the objective to develop and expand OL formal and informal approaches for ocean science education advancement. Several OL programs, even when implemented in individual European countries, follow guidelines that can be replicated in or adapted to other regional contexts. Furthermore, a common pool of resources, including financial aid and availability and training of educators, makes the regional approach effective, efficient, auditable and likely to be sustainable with the support of a centralized economic union (European Commission, 2018). Kenya and the East African Community block may well benefit from a similar approach.

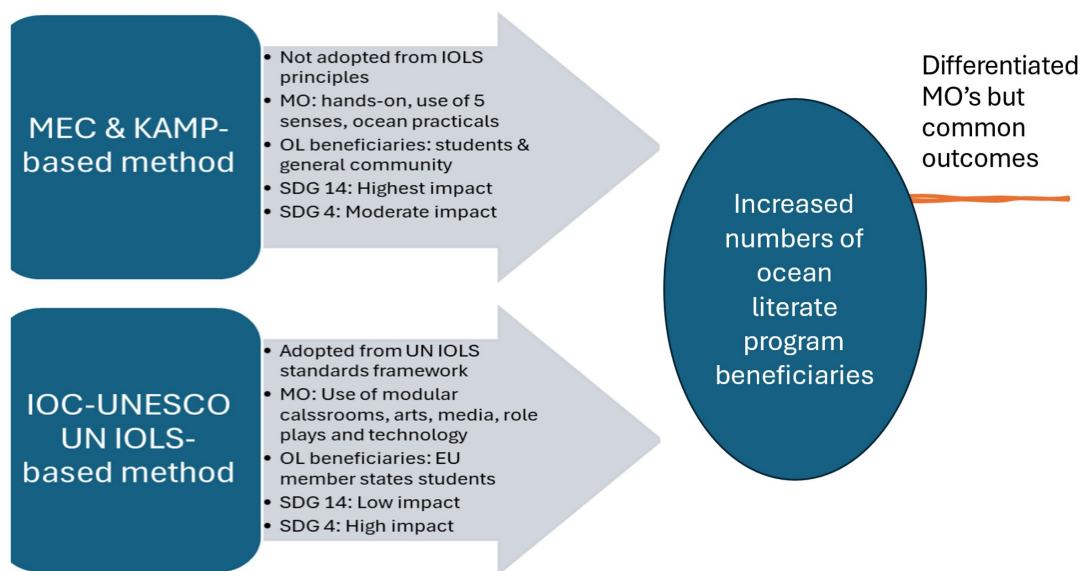
The importance of partnerships and collaborations with key stakeholders also needs to be well considered and implemented in the advocacy for OL (BSF Charity, 2023). Furthermore, the inclusion of actors from the shipping industry and fisheries was identified as an important consideration in the future by global respondents during the interview sessions. In this case, OL would provide a sound base for students considering blue careers.

Lastly, the relevance of OL to improve the handling of the current challenges of climate change, biodiversity loss and pollution cannot be understated, especially in the context of the inter-connectivity of one large, shared ocean, where local, regional and global problems overlap and influence one another. A disaster or event in one location eventually affects or influences marine biological life (and the livelihoods that are connected) elsewhere. This realization is gaining traction among the youth today, who are becoming increasingly vocal about environmental issues, the blue planet and their educational rights (Associated Press, 2024).

Global Lessons and their application to Kenya

Both international practitioners provided a clear overview of OL methodology, materials and management styles, which did not necessarily match item-for-item, but that reflected similar paths leading to a similar outcome - the advancement of ocean knowledge. This is represented graphically below.

Fig. 9: Chart showing differentiated methods of operation (MO) to OL approaches – global & country participants, yielding a common outcome (Researcher).



The chart above illustrates the different approaches used by the two participants. MEC's ocean literacy approach is underpinned by the Kjell-Andersson-Michael-Palmgren (KAMP) methodology, a research and education approach developed by Kjell Andersson and Michael Palmgren that uses photos, videos and biological samples collected through marine transect studies in the Öresund to document changes in marine ecosystems (Palmgren, 2004; Carlson, 2008; Perry et al., 2017). By engaging learners in evidence-based field observations, KAMP provides the methodological foundation for MEC's ocean literacy activities. Findings from these long-term studies demonstrated changes in water quality and marine biodiversity, contributing to policy changes that included the removal of subsidies for fishing fleets to reduce overexploitation and the introduction of measures to reduce land-based

pollution entering marine environments. In contrast, the UNESCO participant's approach is guided by the UNESCO Ocean Literacy Framework (IOLS), which is implemented through initiatives such as the EU Blue Schools programme and is broadly aligned with the NOAA Ocean Literacy Principles.

Both methods key characteristics are captured as detailed in the light blue arrows in the diagram above. Whilst the MEC Kamp-based method focussed on student and community ocean education, the UNESCO IOLS-based method was created primarily for students. The former approach places highest relevance to SDG 14 compared to SDG 4, whilst the latter placed highest impact on SDG 4 compared to SDG 14. Nevertheless, both respondents' key outcomes resulted in a singular similar result, indicated in the blue oval, showing "increased numbers of ocean literate program beneficiaries."

Both interviewees identified some challenges in the operational aspects of their ocean literacy program implementation, including funding challenges, reduced OL coverage beyond Europe due to policy and political bottlenecks, among others.

According to several studies, the benefit of longevity for the MEC has enabled the organisation to establish itself as a centre of excellence for ocean science education in Sweden and Europe. The centre's sterling 30-year reputation is affirmed by IOC UNESCO's partnership with MEC (European Union, 2023), (Hellström, Åsa; Palmgren, Michael, 2017).

Both interviewees highlighted the impact of MEC's OL initiatives in enhancing ocean education levels and promoting sustainable conservation practices in reviving the natural status of the Oresund. They also highlighted connections between OL levels and the drastic reduction in pollution and negative practices by the communities living around the ocean habitat. Other positive impacts of MEC include the increase in protection of wetlands and sensitive areas of ecological importance to Sweden, emergence of new climate-related job opportunities for city planners, environmentalists, hydrographers, scientists, program-managers, and a host of second-tier benefits thereto.

The MEC played a pivotal role in many achievements of the ocean's restoration exercise for Skåne County and Sweden at large. As a result, the centre founder and

director has been at the forefront of the city's planning and development committees for more than 20 years now (Palmgren, 2023)

According to global OL leadership at the IOC UNESCO, the MEC's approach to OL and effectiveness of their programs have led to a thriving partnership between the two organisations. Of note, Sweden has been documented as the only country that has steadfastly continued to be a financier to UNESCO's OL initiatives for several years. An example worthy of emulating by other member states who are also signatories to the UN and related environmental mandates.

In terms of challenges, feedback relating to inadequacies around financing and comprehensive cover of populations needing literacy skills was documented.

Secondly, both interviewees commented on political influence of nationalistic and commercially driven considerations being heavily favoured over requirements for stricter measures towards regulations, more financing, and better conservation of marine resources.

Thirdly, from the comparative analysis of respondents both methods of operation achieved the desired outcome of enhancing ocean knowledge among their select target groups, both students and communities in general (European Union, 2023). Similarly, both respondent representatives confirmed the importance of using ocean-based educational materials, dedicated and custom-fit equipment such as laboratories, waterproof cameras, ramps, buckets, waders, scuba gear, nets and others as being available. They expressed the equipment and material need to be well maintained in order to carry out their literacy programs.

Although some differences between the interviewees were identified, these related mainly to general issues impacting their deliverables such as political inertia of the countries, inadequate finances and in some cases shortage of reach and personnel to effectively carry out assignments and projects. A key differentiator, though not impediment, was the obvious use of IOLS-based framework for the OL global participant and the use of the earlier referenced KAMP-based, home-grown framework, developed in Sweden for MEC.

The lessons from IOC UNESCO indicated a recognition of a *need for more global outlook* on the Summer School reach, improvement to make the IOC website more user-friendly and the creation of a method to enable users to implement a standardized key measure based on proven scientific studies. The interviewee from IOC UNESCO also noted the importance of these outside-classrooms-modelled lessons, and the need to increase opportunities for leadership, like the GOLI model described above.

The interviews also showed that there could be need to restructure the heavy-at-the-top IOC structure and stimulate more leadership modelling on grassroots, working upwards (rather than top-down approach). The application of collaborative educators-students/community-partners model is a key factor that can promote maximum effectiveness, impact and sustainability of literacy initiatives (BSF Charity, 2023).

Both interviewees expressed dissatisfaction with the level of political lethargy in matters of ocean science education. They felt that not enough funding, time nor understanding of the critical nature of OL for current and future solutions was prioritised by governments or international institutions concerned. Furthermore, the ongoing industry-over-environment focus was compounding an already problematic situation, possibly leading up to a 'black swan' event in ocean ecosystems. An example of such people-over-planet decisions is the subsidies extended by European governments to large scale fishing companies (Villasante et al., 2022).

The respondents also observed the need for their approaches and activities in OL to be expanded to other countries and regions, especially in largely overlooked areas, predominantly in the Global South.

It was also recorded that a standardized measurement formula or tool could be adopted. Lack of sufficient funding in developing countries is a key constraint to establishment and sustaining ocean science educational activities. This is compounded by an inadequate infrastructure necessary for practical ocean-based lessons and limited institutional partnerships to sustain long term educational programs. This context is in large contrast with the situations illustrated by the examples provided by both the interviewees regarding Europe. Such a disparity in

situations requires international action, in response to UN SDG 10, which addresses the need to reduce inequalities.

Global Relevance of International Regulation and Shipping

The need to re-examine OL within the maritime industry is an important consideration. Research related to operations and governance (with reference to slow steaming/speed optimization, pollution/waste management), area-based management (PSSAs, MPAs, green corridors), technology (alternative fuels, anti-biofouling) in collaboration with direct impact assessments on ocean habitats is necessary, from specific ship-features such as anti-URN propellers, navigation systems, port management and infrastructure, and may collectively address both sustainable shipping and just transitions more effectively.

According to the International Oceanographic Commission, the IOC-UNESCO 2nd Ocean Decade Report, sustainability education, climate education, global citizenship, and reconciliation education are becoming important areas of pedagogical focus (UNESCO, 2021).

In accordance with IMO's MEPC 82/inf.35 report on the Kunming-Montreal Biodiversity Framework, the maritime industry regulator makes reference to Article 5.4, Goal D, which states in part '..means of implementation, including financial resources, capacity building, technical and scientific cooperation... equitably accessed by all Parties, especially developing countries and small island states..', in addressing the protection, conservation and sustainable use of the ocean by the international shipping community. However, in all the subsequent Articles 6.1 to 6.10, there is no mention of ocean knowledge acquisition in the recommended actions for the international shipping community (International Maritime Organization, 2024).

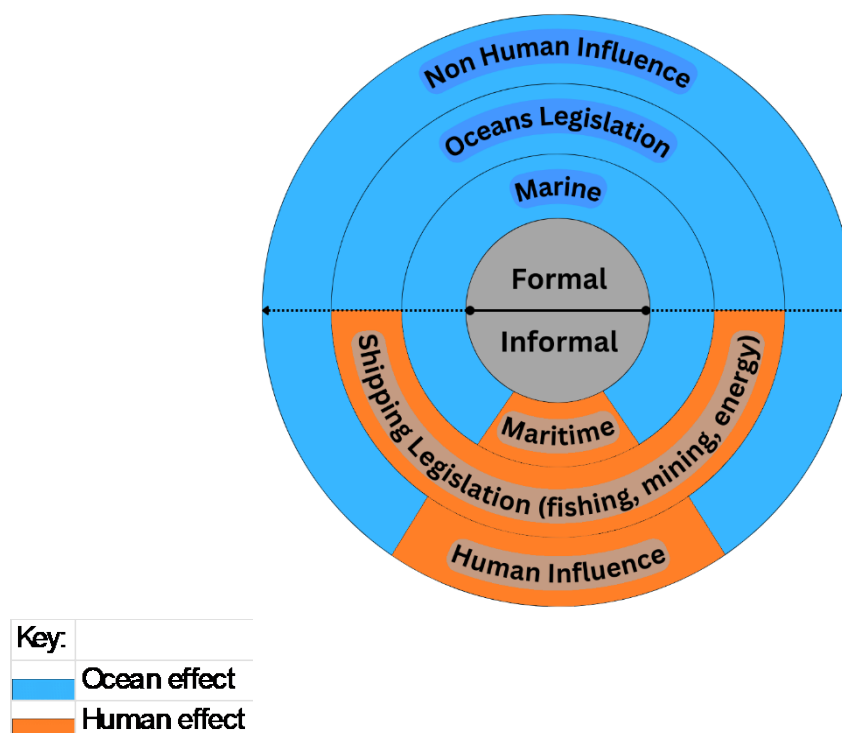
Kenya's Future

This research proposes a simplified plan (Figure 8), which may provide impetus for local OL programs, increasing beneficiaries at different scales, from local to regional level.

Pragmatic and manageable targets would be set, defined and assessed on a quarterly basis, based on collective school calendars and synchronized measurements of

effectiveness. If well-funded, standardized and monitored, the model may be useful in addressing the current gap in effective monitoring of existing partial OL based programs.

Figure 8: Ocean Literacy Framework (Researcher)



The Ocean Literacy Framework (OLF, alternatively OLGA¹⁰ mechanism) is a tool designed to provide users with an overview of various parameters using a 'barometer' or measure of OL adjustors/indicators (i.e. type, sector, legislation and influence). As an example, the current research indicates that both formal and informal methods were used to teach OL in Europe, illustrated at the centre of the framework. In tier two, although both marine and maritime sectors undertake sector-aligned OL initiatives, it is not a core activity of the latter. Tier three illustrates that legislation exists for both human-based and ocean-based spheres, predominantly as protection mechanism for the ocean (e.g. CBD, GBF, UNESCO) and as regulation mechanism for shipping and other activities (e.g. MARPOL, IOTC, UNCLOS). The outer layer shows human influence in the context of OL, in this case illustrating coverage at about

¹⁰ OLGA: Ocean Literacy Global Application (Adjustor) mechanism may also be applied as an Ocean Literacy Governance Application.

30%, in comparison to corresponding 70% oceans influence - for demonstration purposes. Application of this tool is recommended to suit, not just Kenya but also other countries' parameters in their measurement of OL adoption levels, allow flexibility of subsequent reviews, and encourage collaborative sphere (tier) partnerships. This OLF could be further developed for application on literacy initiatives. For illustrative purposes this framework can be applied in different spheres/tiers to research locations and is recommended for adoption on a country-by-country basis.

Pertinent lessons from both government-based and community-based collaborative engagement approaches were learnt. The semi-structured interviews followed conventions/guidelines and local protocols in line with existing internationally recognised principles of universal education, environment and social aspirations of the UN and related instruments.

The application of governance structures that recognise dynamism of authoritarian versus inclusive methods was applied, with the former generally favoured by governments/authorities, whilst the latter, by other stakeholders (Aradhya, 2019). This research also shows the importance of synergy between governance, strategy and policy applications particularly in establishing connections between national government obligations (curriculum owners) to local or county government duties (curriculum administrators), both players being key OL stakeholders for the student related research. Additionally, it also identified the concept of futures literacy and the involvement of key global organisations, such as IOC-UNESCO, and the important role they play in the advancement of OL programs.

Collaboration amongst all stakeholders can yield effective results through, for instance, the creation of "Adopt-a-School" program for local businesses, and "Adopt-a-BMU" program for schools, where businesses sponsor schools in ocean-based activities as part of their CSR (Corporate Social Responsibility), and schools pair up with BMUs for ocean-based learning e.g. beach cleaning, turtle nest conservation, seaweed harvesting and other activities.

Purposeful education of ocean users in the maritime sector in ocean knowledge, impacts and relevance may be able to drive positive change in a fairer, more

sustainable, better understood and implemented pathway to realisation of the targets related to IMO's MEPC 82/INF.35 agenda recommendations.

Conclusion and Recommendations

The aspirations of sustainable marine education development require dedicated efforts to address current common global problems and to implement essential actions and plans for an ocean-positive sustainable roadmap for new, better management of the marine environment for the benefit and equity of future generations. The importance of futures knowledge is an important enabler for intergenerational fairness (Jennische & Sörbom, 2022). Additionally, ocean education can be useful in implementation of national marine spatial planning plans, regional marine transboundary conservation initiatives, and the application of tools such as Symphony for the effective management of Kenya's marine environment.

While the limitations of the study have been discussed (particularly in connection to the limited sample population size), the study was able to elicit adequate information and data to facilitate testing, analysis and draw conclusions that are relevant for this investigation on the state of OL among secondary students in Mombasa. It also sheds light onto potential policy strategies to develop and integrate OL in the school curricula.

While the International Ocean Literacy Survey framework may have its limitations (particularly the focus on quantitative information), it is currently the most applicable tool in the measurement of literacy levels for ocean knowledge, particularly among student populations (Begoña Vendrell-Simón et al., 2024; Fauville et al., 2018; Guest et al., 2015).

This study showed that the student population in general was positive about the need for local language learning materials to enhance their education (specifically when asked about a concrete example of Swahili material), while it also establish the need to conduct further research regarding the use of English, Swahili and Sheng.

The study also showed that the levels of OL in the target population were adequate, but the research revealed the need to provide specifically focused blue curriculum,

practical ocean-based courses, equipment and materials for literacy capacity building. Community involvement, corporate business, government support and partnerships with key stakeholders were identified under stakeholder analysis and in the interviews as vital to a multi-pronged approach towards successful implementation of OL education initiatives.

Lastly, a key finding showed that although students were generally adequately knowledgeable about the ocean, they were not so well informed about their local ocean environment, as exemplified in their low level of knowledge regarding the resident marine species, Hawksbill Turtle, *Eretmochelys imbricata*, which happens to be a critically endangered species under criteria A2bd according to the IUCN Red List (Mortimer & Donnelly, 2008).

In Kenya and the WIO, acknowledgement of the ocean's vital importance for earth's wellbeing and recognition of the triple-planetary crises triggered by climate change have been evidenced (Cowburn et al., 2018). This study's results reinforce the need for the introduction of OL in Kenya. Not to be overlooked, the collaboration between educational institutions is key, with benefits accruing directly to students and their respective organizations, countries and regions.

The role of the private sector and international agencies is critical in helping to reinforce constrained government interventions and to place pressure on industry to accommodate pro-environmental changes that are congruent with OL principles, towards sustainable use of the oceans.

To be adequately prepared for the "Ocean we want," through the World Ocean Assessment III scheduled for 2025 and the on-going global IOLS review according to the States of the Ocean 2024 report (Ocean Literacy Research Community, 2024), OL (blue) curricula inclusion is a key objective in the UN Education for Sustainable Development.

Closing Remarks

It is imperative for the current IOLS applicability that IOC UNESCO blue school funding, projects and programs are extended to Global South countries in line with

UN SDG, UNESCO and GBF universality objectives on equity, inclusivity, conservation and education for all, especially in the spirit of OLWA - “Ocean Literacy with All” (Ocean Decade, 2021).

Additionally, it is recommended from research analysis and international best practice, that Kenya prepares adequately and in a timely manner to participate in a wider in-country IOLS-based study, applying appropriate global standards to ocean literacy, and actively participating in the development of global OL review studies (Ocean Literacy Research Community, 2024), and develop to implement a well-articulated blue curriculum blueprint for national adoption in line with UN 2025 target date.

Including indigenous communities, fisherfolk and other stakeholders represented herein, may benefit the country in the future, particularly in developing an appropriate blue agenda. Noting also the limitations of this study, a broader population study-size, and across more schools, counties and regions may provide more concise, in-depth and better detailed outcomes of study objectives. Indigenous knowledge may contribute to sustainable restoration efforts of damaged or depleted ocean resources. In reference to the marine environment, the circularity concept is likely to be beneficial in baseline assessments, close-loop blue economy models, ecosystem impacts, land-to-sea dependencies, and tracking progress, adoption of best practice and maritime sector transitions (Okumus et al., 2024).

The learning gained from both OL program implementors at country level and at international level has provided useful information on the viability of applying different methods of operation and strategy, while maintaining similar outcomes in terms of OL propagation to different program beneficiaries.

The potential impact of international OL program experiences could aid in a better equipped, sustainable and standardized facilitation of OL learning programs for students in Kenya and other developing countries. A collaboration with the IOC-UNESCO Summer Program team would go a long way in achieving global reach, equitable participation, promulgation of standardized materials, access to well-trained OL personnel, introduction of innovative and modern tools and equipment, and a host of numerous positives for OL beneficiaries in these countries. Furthermore, UNESCO

recommends the inclusion of futures knowledge or futures literacy, especially for the youth because this allows them to have greater agency over their future (Jennische & Sörbom, 2022).

In addition to improving ocean science education levels for student and local communities, both the Marine Education Centre and IOC-UNESCO confirmed the importance of involving key stakeholders in their activities and project partnerships. This key lesson for the Mombasa County's OL stakeholders needs to be carefully coordinated and optimized. This would benefit both environmental conservation and support macro-economic policy for human resource development, nationally and regionally.

Training for OL program teachers is also essential. Research in support of this critical component is growing.

In conclusion, ocean environment sustainability requires a united approach, well trained educators, adequately informed citizenry, well-intentioned stakeholders and global impetus to address common problems facing us all today, particularly the triple planetary crises of biodiversity loss, pollution and climate change. Ocean education is one way in which these challenges can be addressed considering a mix of approaches including ocean science, traditional or indigenous knowledge, standardized ocean science curricula, field studies, adoptive localized content, gamification, and new technologies of learning.

Data collection, analysis and testing methods to authenticate findings of this research have not been exhausted, and the following is a list of recommendations for future research topics.

- I. A study of the partnerships developed in the context of MEC as an example of multi-stakeholders' cooperation and advancements of OL initiatives, and how this could be applied in developing countries.
- II. Research on IOLS-based studies in the context of SIDs and developing countries for blue planet, and blue curricula including trends, challenges and opportunities.

- III. A study of the relevance of Ocean Literacy in the shipping industry in the context of the global triple planetary crises,' and the influence of industry stakeholders.

To conclude, an open, flexible, agile, fun, thought-evoking, content-appropriate, hands-on-outdoorsy relatable learning experience for the youth, is likely to leave a positive, long-lasting, lifetime commitment towards better ocean stewardship.

Social responsibility starts with the individual, and today's youth are tomorrow's leaders. Youth in Kenya have the right to receive fundamental ocean education that would result in developing an environmental personal and collective duty to protect the ocean through good governance, planning and decision-making.

Appendices

Appendix A

I. UN SDG 4 & 14: Sub-Goals (Targets)

Goal 4	Goal 14
4.1 By 2030, ensure that all girls and boys complete free, equitable and quality primary and secondary education leading to relevant and effective learning outcomes.	14.1 By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution
4.2 By 2030, ensure that all girls and boys have access to quality early childhood development, care and pre-primary education so that they are ready for primary education	14.2 By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans
4.3 By 2030, ensure equal access for all women and men to affordable and quality technical, vocational and tertiary education, including university	14.3 Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels

4.4 By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship	14.4 By 2020, effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics
4.5 By 2030, eliminate gender disparities in education and ensure equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities, indigenous peoples and children in vulnerable situations	14.5 By 2020, conserve at least 10 percent of coastal and marine areas, consistent with national and international law and based on the best available scientific information
4.6 By 2030, ensure that all youth and a substantial proportion of adults, both men and women, achieve literacy and numeracy	14.6 By 2020, prohibit certain forms of fisheries subsidies which contribute to overcapacity and overfishing, eliminate subsidies that contribute to illegal, unreported and unregulated fishing and refrain from introducing new such subsidies, recognizing that appropriate and effective special and differential treatment for developing and least developed countries should be an integral part of the World Trade Organization fisheries subsidies negotiation

4.7 | By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development

14.7 | By 2030, increase the economic benefits to Small Island developing States and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism

Appendix B

II. Sample semi-structured interviews document

Semi-structured Interview

Sample document

Dear Sir/Madam,

Thank you for taking the time to respond to this interview.

1. Ocean Literacy Studies

With reference to UN SDG's 4 and 14, how has your organization aligned these goals to ocean educational activities? Consequently, how has this affected the target audience or users of the facility/programs?

ANSWER:

2. Framework

Are the ocean literacy programs based on IOLS¹ / NMOA² Ocean Literacy guidelines?

ANSWER:

3. Funding

Other than those activities that are self-funded, how are/can other learning initiatives or programs be financed?

ANSWER:

¹ IOLS - International Ocean Literacy Survey

² NMOA - National Marine Educators Association

4. Learning Impacts - Students

[i] Who are the main target audience of your programs?

- (a) School-going children?
- (b) Tertiary/University level students or early career young adults?
- (c) Under-represented groups: Women? Disadvantaged Groups?

[ii] Teaching Aids

Is there any use of child-friendly literature or aids such as books, games, simulations, e-gaming to aid in understanding ocean matters? Is that material available in your country's language?

ANSWER:

5. International Networks & Collaborations

Are there examples of partnerships/collaborations that have been established on the theme of OL³ by your organization - locally, regionally, internationally?

ANSWER:

³ OL - Ocean Literacy

6. Global Indicator - Impacts

On a scale of 1 – 5 in terms of impact (1 being low impact, and 5 being integral or highest impact), please indicate the relevance of OL and related activities to the following:

a. Relatable to SDG 4 & 14

.....No Impact Low Moderate High Integral (Indispensable)

b. Aligned to 30X30 principals.

.....No Impact Low Moderate High Integral (Indispensable)

c. Is country-specific?

.....No Impact Low Moderate High Integral (Indispensable)

d. Aids in future-proofing the nexus between ocean life & human activities.

.....No Impact Low Moderate High Integral (Indispensable)

7. What are the lessons learned from your program's perspective?

ANSWER:

8. What are the main challenges that you have faced in developing and implementing your program?

ANSWER:

9. Concluding Opinion

What solutions do you see for ocean literacy opportunities going forward?

ANSWER:

Thank you for your participation.

Appendix C

III. Sample survey questionnaire document

Ocean Literacy - An Ocean Governance Tool

OCEAN LITERACY SURVEY - QUESTIONNAIRE FOR STUDENTS

* Indicates required question

1. How many oceans are there in the world? *

Mark only one oval.

- ☐ One, with difference names and features
- ☐ Seven Oceans in different places
- ☐ Ten Oceans
- ☐ I do not know

2. Whales are mammals *

Mark only one oval.

- ☐ Yes
- ☐ No

3. Fish features include *

Check all that apply.

- ☐ Fins
- ☐ Horizontal tail
- ☐ Gills
- ☐ Hooves
- ☐ Horns
- ☐ Scales

4. Because the ocean covers most of the earth (select the best answer) *

Mark only one oval.

- ☐ It controls our weather, climate and oxygen production
- ☐ Most living things are concentrated on the continents
- ☐ A large part of the earth is not very useful for humans
- ☐ It generates most of the Earth's Greenhouse Gases
- ☐ Other: _____

5. Sea turtles are found in Kenya's coastline habitats. Select the most accurate statement. *

Check all that apply.

- ☐ The Hawksbill Turtle is endangered and nesting sites in Lamu and Kilifi Counties need protection.
- ☐ Sea turtles are dangerous ocean creatures and can be poisonous.
- ☐ Ocean turtles help to maintain the health of coral reefs
- ☐ Sea turtles can dive up to a depth of 1,500 meters below sea level.
- ☐ Other: _____

6. Water changes in form, and can move from the ocean to the atmosphere to land, and back again. This process is called; *

Mark only one oval.

- ☐ Hurricane
- ☐ Rainfall
- ☐ Tsunami
- ☐ Water Cycle
- ☐ Other: _____

7. Where is most of the water on Earth? *

Mark only one oval.

- ☐ Circulating in the atmosphere
- ☐ Frozen in the North and South Polar Ice Caps
- ☐ In the Ocean
- ☐ In rivers and lakes
- ☐ Other: _____

8. Which of these processes can cause changes to sea level? (Select all that apply) *

Check all that apply.

- ☐ Coastal Erosion
- ☐ Seawater when it expands and contracts as it warms and cools
- ☐ Movement of the Earth's crust
- ☐ Ice caps melting
- ☐ Forces of the waves, like in a Tsunami
- ☐ Other: _____

9. Select the best statement *

Mark only one oval.

- ☐ The Earth makes the Ocean habitable
- ☐ The Ocean makes the Earth habitable
- ☐ The Earth and Ocean are independent of each other
- ☐ Other: _____

10. The largest animal ever to live on Earth is: *

Mark only one oval.

- ☐ Elephant
- ☐ Giant Squid
- ☐ Blue Whale
- ☐ Tyrannasaurus Rex

11. Choose the most accurate statement. *

Mark only one oval.

- ☐ Human beings have a duty to take care of the ocean because they use and depend on it.
- ☐ The Ocean is huge and does not need 'human help' for its management, conservation or survival.
- ☐ Land and the sea are clearly seperate terrains, so one does not depend on the other.
- ☐ Other: _____

12. Where can you find the largest variety of living things? *

Mark only one oval.

- ☐ In the forest
- ☐ In the ocean
- ☐ In the desert
- ☐ In space
- ☐ Other: _____

13. How useful is the "Visiwa Viwili" story book and the use of Swahili in language in your ocean learning? *

Mark only one oval.

	1	2	3	4	5	
Not	☐	☐	☐	☐	☐	Very useful

14. How likely are you to pursue a career in ocean related studies or blue economy job opportunities? *

Mark only one oval.

	1	2	3	4	5	
Not	☐	☐	☐	☐	☐	Definitely

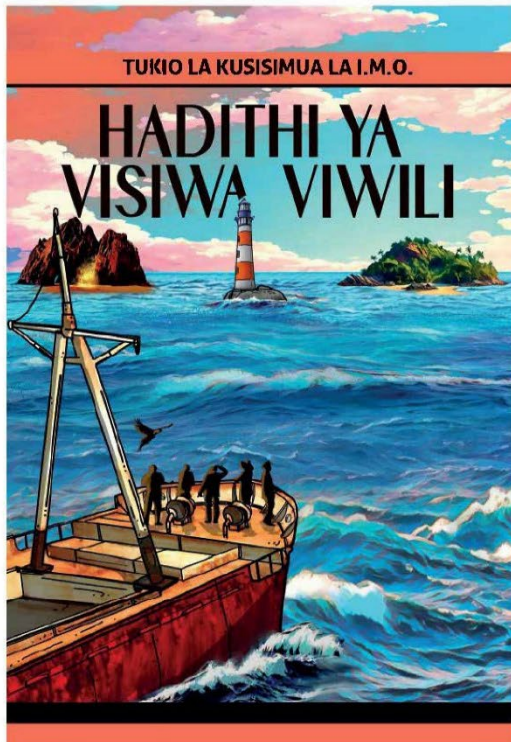
15. Is the cartoon book, Hadithi ya kuisimua ya IMO: Hadithi ya Visiwa Viwili, helpful in your learning about ocean matters?

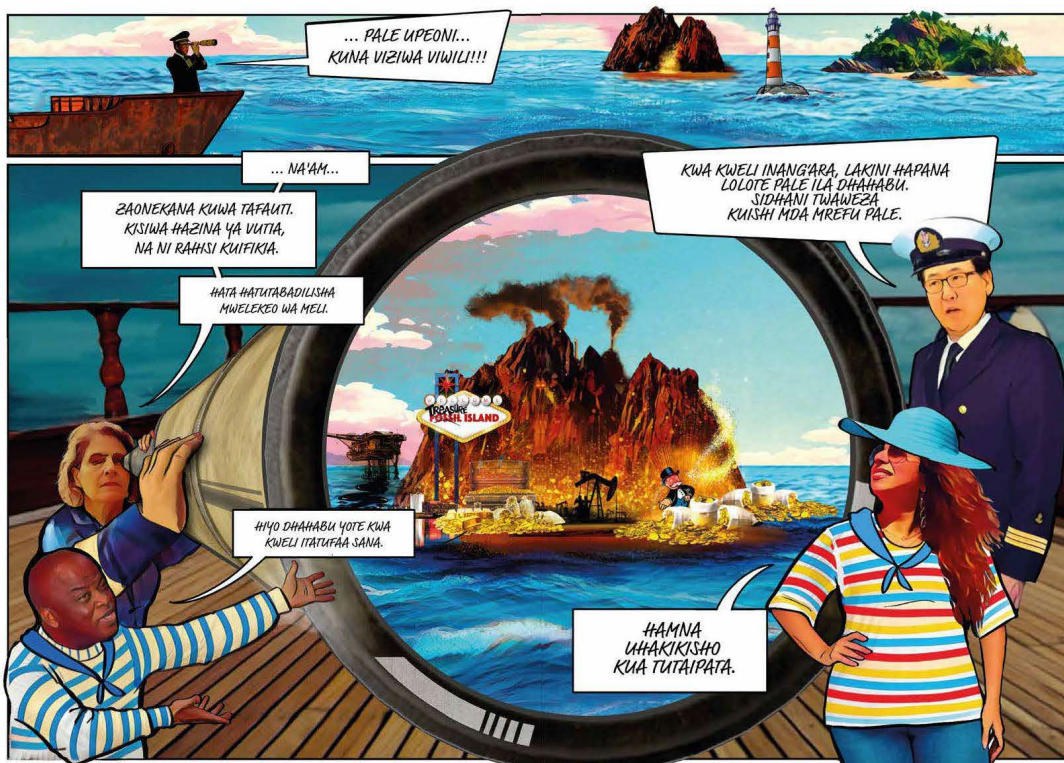
Yes.....

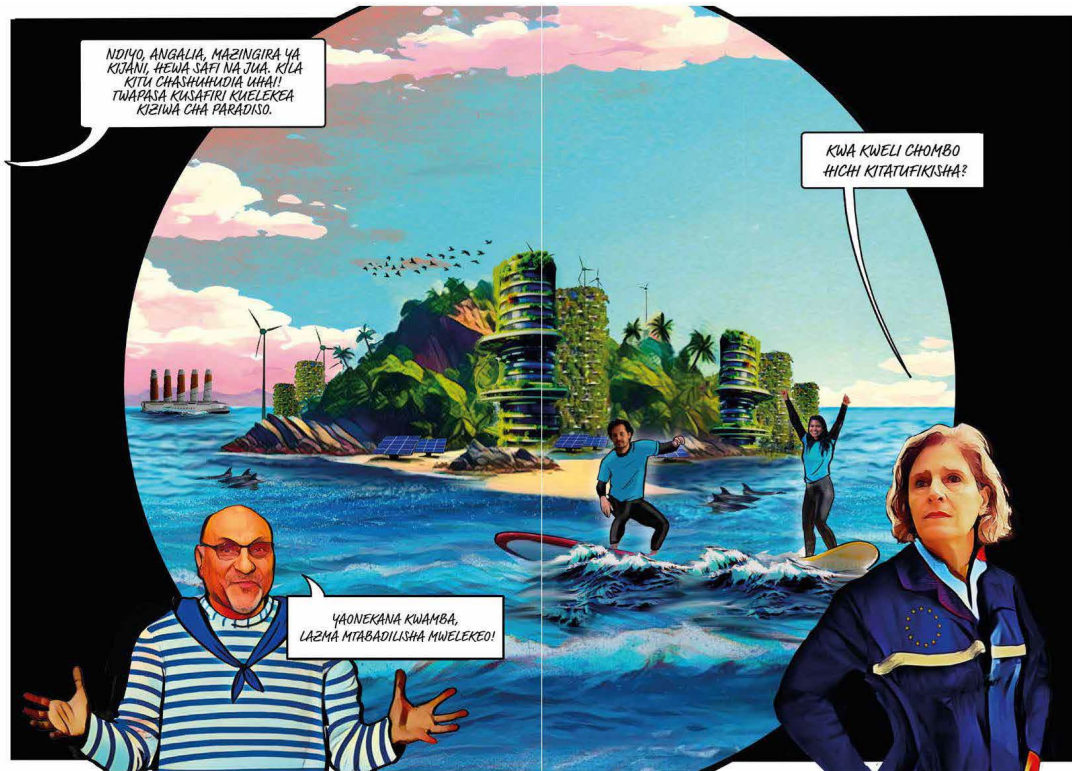
No.....

Appendix D

IV. Tukio la kulisimua la IMO: Hadithi ya Visiwa Viwili: eBook



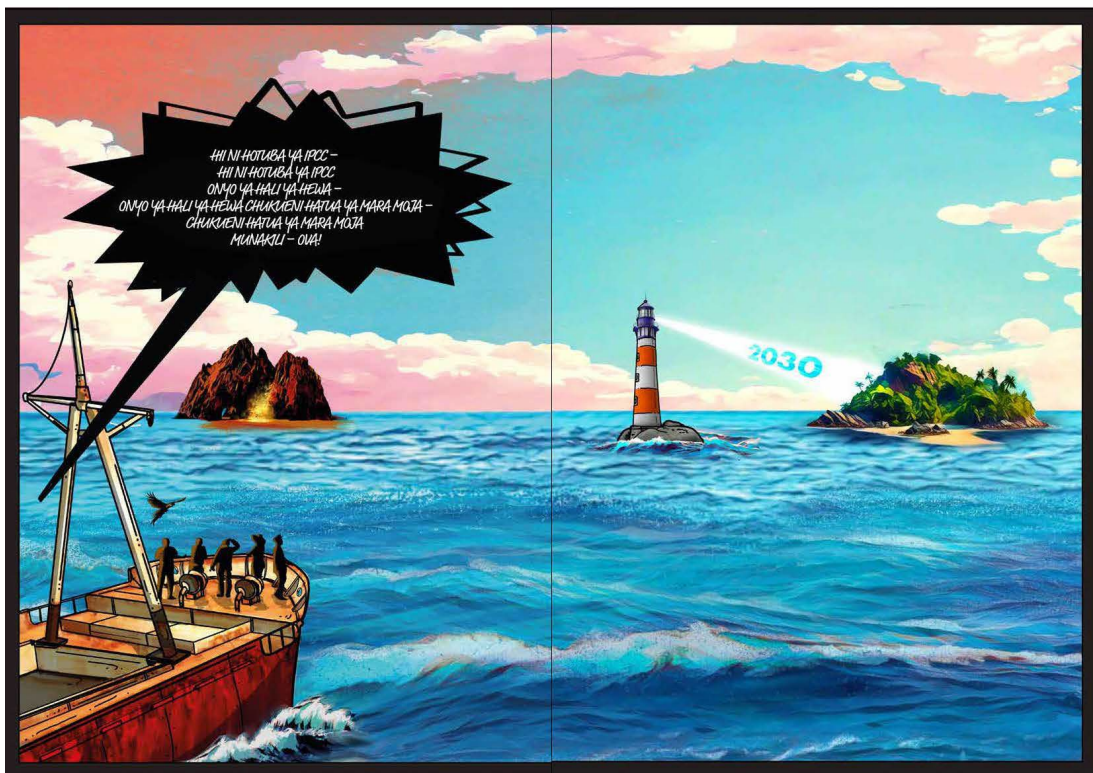




WASAFIRI WETU WATAAMUA KUFANYA LIPI?
JE, WATAONA MWANGAZA NA KUIPATA
MWELEKEO KUFIKA PANGONI PARADISO?



...ONYO YA DHORUBA KUTOKA IPCC YASIKIKA KWA RADIO...



HII NI HOTUBA YA IPCC -
HII NI HOTUBA YA IPCC -
ONYO YA HALI YA HEWA -
ONYO YA HALI YA HEWA CHUKUENI HATUA YA MARA MOJA -
CHUKUENI HATUA YA MARA MOJA
MUNAKILI - OWA!

WASAFIRI WETU WALIONA MWANGAZA, ZIWA LA PARADISO LAWANGOJA....

UAMUZI WA KUBADILISHA MWELEKEO WA SAFARI HII
HAUKUA MWEPESE, WALAKIN TULITEGEMEA MWANGAZA
WA JUMBA LA TAA BAHARINI ULITOLEKEZA UFUONI
MAHALI PEMA NA PA BUSARA KWETU - HATA
MPAKA NYAKATI ZA VIZAZI VIJAO."

ASUMALI ZA PAMOJA!
RASUMALI ZA PAMOJA!

ULIMWENGU
ULIMWENGU
WA AJABU...

**ILI URAMBAZAJI WA MELI YA IMO
KUFIKA PARADISO NA MAFANIKIO,
USALAMA, NA HAKI YA KUDUMU KATIKA
SIKU ZIJAZO, NI LAZIMA:
TUPANGE MALENGO AMBAYO HAINA UTATA
KULINGANA NA TARATIBU ZA I.P.C.C**

IPCC YASEMA KWAMBA UZALISHAJI WA HEWA CHAFU
DUNIANI LAZIMA UPUNGUZE KWA NUSU IFIKAPO MWAKA
2030 NA USHUKU HADI SUFURI IFIKAPO 2040.

MALENGO YA KISAYANSI NA USAFIRISHAJI YAMEKOKOTOA KWAMBA
UZALISHAJI WA (HEWA TAKA ZA) MELI
UNAPASWA KUSHUKA KWA 36% IFIKAPO 2030 NA 96% IFIKAPO 2040.



**ILI URAMBAZAJI WA MELI YA IMO
KUFIKA PARADISO NA MAFANIKIO,
USALAMA, NA HAKI YA KUDUMU KATIKA
SIKU ZIJAZO, NI LAZIMA:**

**TUSAIDIE NCHI AMBAZO ZINAZOENDELEA
KIMAPATO, ILI PASIWE NA YEYOTE AMBAYE
ATAACHWA NYUMA**

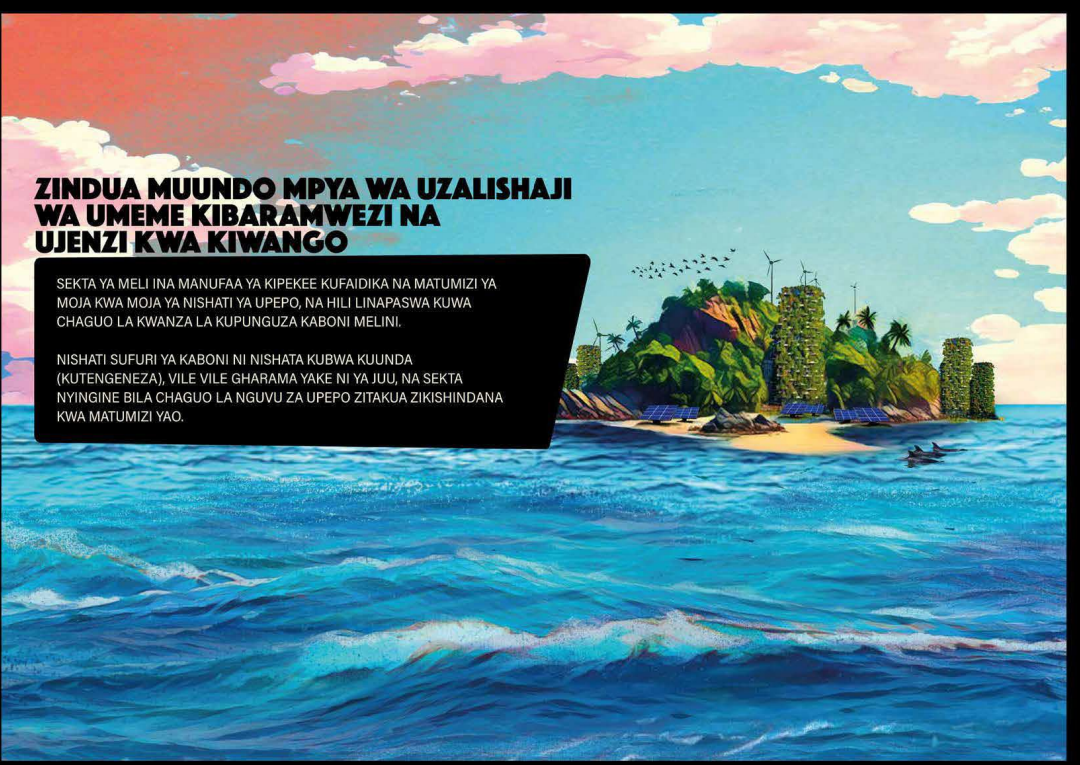
KADIRI SEKTA YA USFIRISHAJI WA MELI KUPUNGUZA UTOAJI WA CABONI, NA HALI YA UCHUMI
KUBADILIKA, HAKUNA ANAYEFAA KUACHWA NYUMA.

USHURU WA MAFUTA YA BAHARINI YA ANGALAU \$ 100 KWA TANI, LAZIMA ITUMIKE, ILI
KUHAJIKISHA NCHI ZINAZOENDELEA NA ZENYE KIPATO CHA KATI, ZINAWENZA KUTUMIA
KIKAMILIFU FURSA ZINAZOTOLEWA NA LENGU YA KUPUNGUZA KABONI KATIKA SEKTA YA
USAFIRISHAJI BAHARINI (YA MELI).

**ILI URAMBAZAJI WA MELI YA IMO
KUFIKA PARADISO NA MAFANIKIO,
USALAMA, NA HAKI YA KUDUMU KATIKA
SIKU ZIJAZO, NI LAZIMA:**

**KUREKEBISHA (HATUA YA) C.I.I ILI KUONGEZA
UFANISI WA MELI IFIKAPO MWAKA 2030,
KUFUNGUA UOKOAJI MPYA WA UTUMIZI WA MAFUTA**

UTOAJI WA HEWA CHAFU KWENYWA MELI LAZIMA USHUKE KWA KASI
KABLA YA MWAKA 2030.
MAREKEBISHO YA MARA MOJA YA MAHITAJI CHINI YA KIPIMO CHA
MDA-MFUPI CHA IMO (CII) INAHITAJIKA ILI KUHAJIKISHA KWAMBA
MANUFAA YA JUU ZAIDI YANAPATIKANA KUTOKANA NA KUPUNGUZWA KWA
KASI NA (MATUMIZI YA) TEKNOLOJIA MPYA YA NISHATI.



ZINDUA MUUNDO MPYA WA UZALISHAJI WA UMEME KIBARAMWEZI NA UJENZI KWA KIWANGO

SEKTA YA MELI INA MANUFAA YA KIPEKEE KUFIDIKA NA MATUMIZI YA MOJA KWA MOJA YA NISHATI YA UPEPO, NA HILI LINAPASWA KUWA CHAGUO LA KWANZA LA KUPUNGUZA KABONI MELINI.

NISHATI SUFURI YA KABONI NI NISHATA KUBWA KUUNDA (KUTENGENEZA), VILE VILE GHARAMA YAKE NI YA JUU, NA SEKTA NYINGINE BILA CHAGUO LA NGUVU ZA UPEPO ZITAKUA ZIKISHINDANA KWA MATUMIZI YAO.



ILI URAMBAZAJI WA MELI YA IMO KUFIKA PARADISO NA MAFANIKIO, USALAMA, NA HAKI YA KUDUMU KATIKA SIKU ZIJAZO, NI LAZIMA:

TOA MOTISHA KWA WATUMIAJI WA KWANZA (WA MAPEMA) WA MAFUTA SALAMA YA KABONI-SUFURI

WALAKIN, HATA KWA MATUMIZI MAKUBWA YA NGUVU ZA UPEPO KUTAKUA NA HITAJ KUBWA LA MAFUTA SALAMA YA KABONI-SUFURI NA MOTISHA, KWA MFANO, KIWANGO CHA KIMATAIFA CHA MAFUTA ZINAHITAJIKA ILI KUHAJIKISHA YAKUA MAFUTA HAYA YANAPATIKANA KWA WAKATI ILI KUCHANGIA PAKUBWA PAMBANO (MAPAMBANO) YA UPUNGUZAJI WA HEWA CHAFU, AMBAO LAZIMA UFANYIKE KABLA 2030.

**ILI URAMBAZAJI WA MELI YA IMO
KUFIKA PARADISO NA MAFANIKIO,
USALAMA, NA HAKI YA KUDUMU KATIKA
SIKU ZIJAZO, NI LAZIMA:**

**DHIBITI MSINGI MZURI
WA KISIMA-HADI-WIMBI**

SI VYEMA MELI SIZITO TOA HEWA CHAFU IKIWA MAFUTA
WANAYOCHOMA YANA ATHARI KUBWA YA HALI YA HEWA
YA JUU YA MKONDO (ATHARI KUBWA JUU YA MKONDO DHIDI YA HALI
YA HEWA).

SHIRIKA LA IMO LAZIMA LIHAKIKISHE KWAMBA ATHARI KAMILI ZA
HALI YA HEWA YA SERA ZINAZINGATIWA WAKATI WA KUWEKA
MALENGO NA KUBUNI KANUNI MPYA.



**LAZIMA TUBADILISHE NJIA:
USAFIRI HAI MSAFI KWA BINADAMU NA SAYARI**

TUNA KILA KITU TUNACHOHITAJI KUENDESHA MELI ZA KIMATAIFA NA ULIMWENGU
KWENYE MUSTAKABALI ULIO SALAMA, ANGAVU
SAYANSI HAINA SHAKA NA HATUA TUNAZOHITAJI KUCHUKUA ZIKO WAZI.

KWA UJASIRI NA NIDHAMU YENU (UAMUZI WENU), USAFIRISHAJI WA KIMATAIFA
UNWEZA KUWA KIONGOZI HALISI WA HALI YA HEWA. BADILISHENI MWELEKEO HIVI
SASA! (BADILISHA MKONDO SASA!)





CREDIT AUTHORSHIP CONTRIBUTIONS

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YS. Karanja & OC. Noutuo: Graphics, formatting and data curation.

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The principal author declares that there is no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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