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**EVALUATION OF THE ROLE OF OCEAN
LITERACY IN REDUCING GHANA'S MARINE
PLASTIC POLLUTION FROM LAND-BASED
SOURCES**

THE EDUCATOR'S PERSPECTIVE

EMELIA AKURUBIRE

A dissertation submitted to the World Maritime University in partial fulfilment
of the requirements for the award of the degree of Master of Science in
Maritime Affairs

2023

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.

(Signature):



.....

(Date):

25th September, 2023

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Malmö, Sweden.

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God Bless us all.

Abstract

Title of Dissertation: **Evaluation of the role of Ocean Literacy in reducing Ghana's Marine Plastic Pollution from Land-Based Sources: Educator's Perspective**

Degree: **Master of Science**

The increasing presence of marine Litter from land-based sources poses a grave environmental challenge globally and in Ghana. The associated wide-ranging repercussions for the environment, society and the economy have prompted an increasing acknowledgement of a comprehensive educational approach to address this pressing environmental issue.

This study examines the viewpoints of Ghanaian teachers towards the incorporation of ocean literacy and plastic pollution elements into the national curriculum as a strategy to create awareness and tackle the issue of plastic pollution.

This study conducts in-depth interviews with high school teachers to examine their familiarity with ocean literacy concepts, their incorporation of marine plastic pollution discussions into the curriculum, and their views on the impact of such education on students' behaviour and awareness.

The findings of this study uncover different levels of understanding of the ocean literacy concepts among teachers, mainly at the Junior High School level, and further emphasise the significance of increasing ocean literacy through environmental education as well as including elements of plastic pollution within the current curriculum.

The insights offered by teachers' recommendations are helpful in various aspects of education, including curriculum development, teacher training, experiential/ practical learning approaches, and community involvement. These ideas could establish the foundation for future endeavours to incorporate ocean literacy and plastic pollution education into Ghana's educational system.

KEYWORDS: Plastic Pollution, Ocean literacy, Marine litter, awareness, teachers, Knowledge, Perceptions.

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List of Abbreviations

| | |
|--------|---|
| GPAP | Global Plastic Action Partnership |
| KAP | Knowledge Attitude and Practices |
| MESTI | Ministry of Environment Science technology and Innovation |
| NACCA | National Council for Curriculum and Assessment |
| NPAP | National Plastic Action Partnership |
| NPMP | National Plastics Management Policy |
| OL | Ocean Literacy |
| UNESCO | United Nations Educational, Scientific and Cultural Organization |
| UN | United Nations |
| UNEP | United Nations Environment Programme |
| WMU | World Maritime University |

1. INTRODUCTION

1.0. Background

The ocean, which covers more than 70% of the earth's surface, is essential to human well-being because it provides essential ecosystem functions like regulating the climate, food, energy, genetic and mineral resources, as well as recreational and cultural amenities. (Rodrigues et al., 2017; Valdés et al., 2017; De La Cruz, 2021). The health of the ocean is directly related to the health and well-being of humanity (Sandifer and Sutton-Grier, 2014).

Despite the many benefits derived from the ocean, it is increasingly being threatened by a list of threats. These threats range from climate change (IPCC 2019), the overexploitation of fisheries resources (Rousseau et al. 2019), and marine litter (Vince and Hardesty 2019). The cumulative impacts of these threats have adverse effects on the marine environment and can cause a loss of biodiversity and habitat destruction (Baker et al., 2019); there is, therefore the need for urgent global action on sustainable ocean governance and increasing awareness of the impact that humans and society have on oceans (Haas et al., 2021).

In the context of addressing the mounting threats to the ocean, one pivotal avenue for effecting meaningful change lies in understanding the importance of the ocean and how it influences human livelihood (Ashley et al., 2019). The role of awareness creation through ocean literacy in tackling these oceanic stressors cannot be understated; it acts as a catalyst for creating a better understanding of the relationship between the ocean and human life on Earth (Dupont and Fauville, 2017), and constitutes a powerful strategy for inspiring a sense of responsibility, stewardship, and engagement among diverse stakeholders to foster a deeper understanding of a sustainable ocean (Ryabinin et al., 2019). Ocean Literacy is predominantly defined as ‘the understanding of the collective and individual impact of humans on the Ocean and its impact on our lives and well-being’ (Cava et al., 2005). The scope of Ocean Literacy encompasses a wide range of initiatives and endeavours in both formal and informal educational settings, as well as communication initiatives. The primary objectives of

Ocean Literacy extend beyond the mere dissemination of knowledge, emphasising instead the cultivation of an emotional attachment to the Ocean and the promotion of behavioural changes; hence, the comprehension of oceanic matters is an essential tool for augmenting information about the ocean, fostering interpersonal relationships, and motivating individuals and interested parties to engage in sustainable actions for the betterment of our marine environment (McKinley et al., 2023).

This study seeks to evaluate teacher perspectives on the role of an ocean literacy and awareness creation through education towards the mitigation of marine litter from land-based sources.

1.1. Marine litter: a threat to the oceans

UNEP 2009 defines marine litter as *any solid manmade material that is discarded, abandoned or disposed of in the marine environment. Items classified as marine litter are items that have been intentionally disposed into the marine and coastal environment; that have indirectly entered the marine environment through channels such as rivers, sewage systems, stormwater runoff, or wind dispersal. Additionally, marine litter encompasses unintentionally lost materials, including those that have been misplaced at sea during adverse weather conditions, such as fishing gear or cargo. Furthermore, the deliberate abandonment of items by individuals on beaches and shores contributes to the presence of marine litter.* (UNEP 2009).

Marine litter has emerged as a pressing environmental crisis global and is a major stressor of the oceans and biodiversity. Marine litter is endangering to the health and vitality of our oceans and marine ecosystems and poses as a major source of concern globally due to the fact that it affects multiple sections of society such as the environment, economy and culture (Hardesty et al., 2015). Plastics have been identified as the main component of marine litter accounting for approximately 75% of marine litter (Napper & Thompson, 2020), and nearly 95% of the waste that is found on the shoreline, seabed, and sea surface is plastic (Galgani et al., 2015). The primary factor contributing to this phenomenon is the significant demand for plastic products,

resulting in a rapid and exponential growth in production that surpasses other synthetic materials (Geyer et al., 2017).

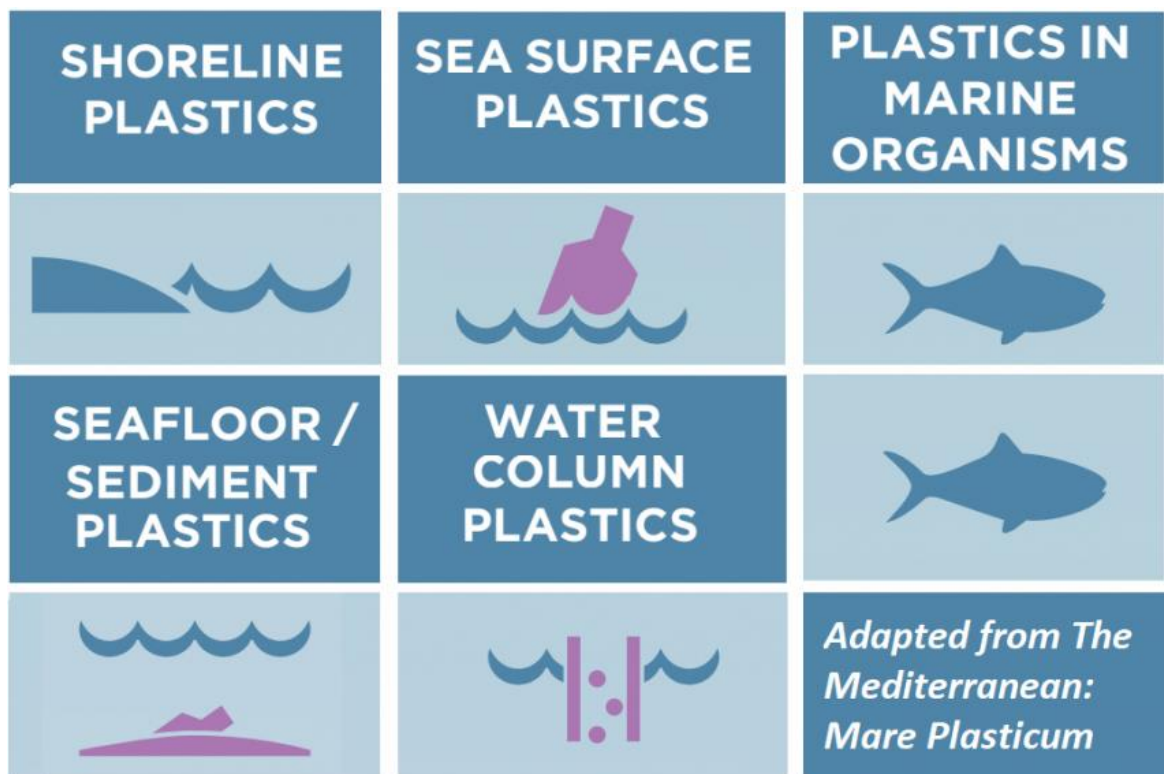
According to research by Gall and Thompson (2015) and Kühn et al., (2015) marine litter poses potentially dangerous effects marine environment. These range from direct health complications in species due to entanglement, often in abandoned, lost or discarded fishing gear otherwise known as ALDFG (Macfadyen et al., 2009), which hinders their ability to move, feed and breathe to ingestion by the marine species when they mistake the marine litter for food which remains undigested in their stomachs. Some other impacts of plastics on marine ecosystems are decreased fisheries catches, the introduction of invasive species and pathogens, as well as loss of ecosystem services (Karbalaie et al., 2018; GESAMP 2015), additionally, plastics in the ocean are also known to leech chemicals into the marine environment, potentially poisoning aquatic life (Luo et al., 2020; Yuan et al., 2022).

The primary source of marine plastic litter can be attributed to land-based sources, from which the waste is transferred into the ocean through channels such as rivers, wind dispersion, effluent discharge, and wastewater runoff (Andrady, 2011; G.G.N. Thushari & J.D.M. Senevirathna, 2020; Chitaka et al., 2022). Other ocean-based economic and recreational anthropogenic activities such as Shipping, Fishing and Tourism also contribute to the presence of plastics in the marine environment (UNEP 2005; Ryan et al., 2009; Anbumani and Kakkar, 2018), however, once in the ocean, the litter is carried further offshore by the wind, currents and tidal movements (Lincoln et al., 2022).

Marine plastic litter originates from a wide range of product sources; which is indicative of the extensive and diverse usage of plastic materials (Rodrigues et al., 2019). Single-use plastics (SUPs) such as plastic bags, bottles, packaging products and cooking utensils represent the majority of the plastic waste discovered in the ocean (Hardesty et al., 2015), along with microplastics from tyres, pellets, textiles, and fishing gear (Hann et al., 2018). Most of these products are made from plastic materials that are by-products of fossil fuels and non-biodegradable (Geyer et al., 2017). Plastics, despite their convenience, adaptability, functionality, and economic

value, require appropriate regulation, reuse, and recycling efforts to prevent negative impacts (Jacobsen et al., 2022). Due to the extensive use and persistence of plastics in the environment, the adverse effects of plastic pollution extend beyond the mere devaluation of the material; it poses significant negative environmental consequences as one of the greatest dangers to the ocean and its biodiversity (Gall and Thompson, 2015; Carbery et al., 2018). Additionally, plastics found in the marine environment (Fig. 1) play a substantial role in causing considerable economic losses for the fisheries, shipping, and tourism industries. (UNEP, 2017).

Figure 1. Areas of the ocean marine litter is found



Source: (IUCN, 2021)

1.2. Marine Plastic Pollution in Ghana

The Ghanaian society is characterised by the prevalence of numerous plastic products, predominant among them are single-use plastic products, that often end up as n waste.

Only a small percentage of this waste is collected, reused, or recycled (Musah et al. 2021).

Figure 2. *Map of Ghana*



Source: Google Maps

Ghana generates approximately 1.1 million tons of plastic waste yearly and about 95% of that waste is unrecycled (GPAP, 2020). According to a study conducted by the World Bank in 2020, it was projected that approximately 86 percent of Ghana's plastic trash is disposed of in an incorrect manner. This improper disposal has led to the obstruction of gutters, stormwater drains, as well as rivers and streams. Additionally, it is estimated that Ghana annually disposes of approximately 250,000 metric tons of plastic waste into the ocean. The current waste disposal method in Ghana is predominantly at landfill sites. There is also the challenge of haphazard littering in the major cities and municipalities in Ghana (Appiah et al., 2017), and due to this, a significant portion of the waste often times end up gutters and unregulated waste sites, ultimately being carried into the ocean and water bodies when it rains and this phenomenon poses a significant threat to aquatic life and has detrimental effects on livelihood, coastal tourism and fishing activities (GEF, 2019; Adam et al., 2020). The prevalence of plastic pollution is also linked to the persistent flooding in Accra and

other coastal communities within Ghana, which poses serious environmental challenges for the country and threats to humans (Musah et al. 2021).

In Ghana, a lot of research has investigated the trends of plastic pollution and its overall effects on the environment and people in Ghana. Musah et al. (2021) and Dasgupta et al., (2022) highlighted the growing threat of marine plastic pollution, particularly in Ghana's coastal areas, and sought to propose potential interventions to help curb this threat and ensure a healthy marine ecosystem. Similarly, various research (Pappoe et al., 2022; Nuamah et al., 2023) have confirmed the discovered presence of microplastics in the gastrointestinal tract and in the gut contents of commercial fish species in local and global communities and in the sediment samples along the coastlines of Ghana. These studies, highlight the widespread contamination of fishes in the Ghana by microplastic debris, demonstrating the grave consequences of improper plastic waste management within the region. Currently, the long-term negative effects of marine litter, especially related to plastic pollution from land-based sources, are intensified by widespread societal unawareness about the scope of the problem, its effects and potential solutions. (Veiga et al., 2016); also, the current state of public comprehension of the fundamental concepts of the ocean and the potential threats resulting from human activities is significantly low. (Gelcich et al., 2014; Fauville, 2019). Accordingly, the effective mitigation of marine litter requires the adoption of comprehensive and intricate strategies that entail the active involvement of a wide range of stakeholders from various sectors. (Rochman, 2016; Ansje Löhrr et al., 2017).

In order to change the course of this ecological crisis presented by plastics found in the marine environment, it is imperative to understand the functioning of the ocean; how humans impact it and vice versa and, in this regard, ocean literacy and environmental education are crucial factors in the promotion of comprehensive understanding and awareness of the significance of the ocean for terrestrial life, its susceptibility to harm, and the necessary measures to safeguard it. (Dupont and Fauville, 2017; Ryabinin et al., 2019)

The educational sector, particularly teachers play a pivotal role in influencing the attitudes, values, and behaviours of the future generation, thus establishing their significance as key participants in this endeavor. Teachers may help to create a generation of environmentally conscious people who are devoted to protecting the oceans by fostering a sense of ocean literacy in their students (Liu et al., 2023). Currently, educational initiatives targeting plastic pollution is mostly carried out by external stakeholders such as individual researchers and activists, NGO's and activist groups who visit schools, give talks and engage in activities centred around the issue of plastic pollution, helping to diversify the curriculum and incorporating information pertaining to real-life situations beyond the confines of the classroom (Mironenko & Mironenko, 2020). One of such initiatives is by Plastic Punch, an NGO in Ghana which occasionally gives talks in schools about marine pollution, its sources and life cycle of plastic products and seeking to inspire behavioural change; these classroom discussions are then complemented with beach clean-ups to have students experience the scale of plastic pollution first-hand.

Currently, existing literature comprehensively explores the global issue of marine plastic pollution, particularly in relation with its environmental consequences, investigating potential solutions and policy implications; there exists a notable research gap concerning the role of ocean literacy especially within the Ghanaian context. Limited scholarly attention has been directed towards understanding the perspectives, knowledge, and practices of Ghanaian teachers in relation to marine plastic pollution and the potential of ocean literacy and environmental education as a mitigation strategy. This study is particularly significant given Ghana's geographical location along the Gulf of Guinea and its susceptibility to the adverse impacts of marine litter. Consequently, this study aims to bridge this gap by providing a teacher focused evaluation which could contribute valuable insights that can be used to develop specific interventions and policy suggestions that are suitable for the educational context in Ghana.

1.3. Current Government Efforts to Address Plastic Pollution

Marine plastic debris has been a persistent issue for years, yet it has recently attracted global attention due to concerns about its detrimental effects on the marine ecosystem. In response, several nations have initiated policies and measures to tackle this concern (UNEP, 2022). In this vein, Ghana's Ministry of Environment, Science, Technology, and Innovation (MESTI) has pioneered a comprehensive National Plastics Management Policy (NPMP). This policy is designed to direct actions along the entire value chain of plastic—from production to disposal—and aims to curtail, if not eradicate, plastic pollution in Ghana. The NPMP serves as a guideline for governmental operations, industries, and other stakeholders involved in various stages of plastic usage, addressing the environmental and health hazards presented by plastics (NPMP, 2020). The NPMP primarily hinges on four pivotal areas to guarantee efficient plastic management and foster socio-economic growth (NPMP, 2020):

- (1) Behavioural change,
- (2) Strategic planning and cross-sectoral collaboration,
- (3) Resource mobilization towards a Circular Economy, and
- (4) Good governance, inclusiveness and shared accountability.

Ghana also marked its place as the first African country to become a part of the Global Plastic Action Partnership (GPAP)—a collaborative platform dedicated to uniting global stakeholders in the fight against plastic pollution, including marine debris (GPAP, 2020). Concurrently, the Ghana National Plastic Action Partnership (NPAP) is set to collaborate with MESTI to create a cohesive national blueprint focused on sustainable plastic management, addressing the nation's pressing plastic waste dilemma.

The first focal area of the NPMP is behavioural change, which is intricately connected to the core objectives of this study. The NPMP's emphasis on behavioural change is aligned with the broader goal of reducing marine plastic pollution from land-based sources through awareness-centred behavioural change, which is the central focus of this research. Specifically, the NPMP recognises that effectively addressing the issue of plastic pollution requires not only the implementation of policy changes and

regulatory frameworks but also a fundamental shift in the behaviours and attitudes of individuals and communities.

In the context of this study, which examines teacher perspectives on the significance of ocean literacy and awareness in mitigating the issue of marine plastic pollution, teachers play an essential role in influencing the behaviours and mindsets of young learners. Consequently, the behavioural change focus of the NPMP not only aligns with but reinforces the significance of this study. It underscores the importance of educating future generations about responsible plastic use and waste management, which can contribute significantly to mitigating marine plastic pollution in Ghana and beyond.

1.4. Research Aims and Objectives

This research conducts a comprehensive analysis to evaluate the importance of ocean literacy in addressing the issue of marine plastic pollution in Ghana, particularly its origins from land-based sources and specifically focuses on the role of teachers in this context. Due to the scarcity of studies in the field of ocean literacy in the Ghanaian perspective, the objective of this study is to provide insight into the potential impact of integrating elements of ocean literacy and plastic pollution into the educational curriculum as a means to address this urgent environmental concern. This will be achieved by examining the viewpoints, challenges, and strategies employed by teachers in their efforts to incorporate plastic pollution into their teaching practices.

The significance of this study lies in its ability to provide valuable insights for environmental education and conservation initiatives in Ghana. Through an examination of the viewpoints held by teachers on the issue of marine plastic pollution and the concept of ocean literacy, it becomes possible to discern areas of deficiency as well as potential avenues for leveraging in order to develop educational interventions that are impactful and successful. In addition, examining the challenges teachers experience in integrating concepts of plastic pollution into their curricula will enable

us to develop specialized solutions and support systems to strengthen environmental education initiatives.

1.4.1. Research Objectives:

The objectives below have been set out in accordance with the aims of the research paper;

1. To assess the level of ocean literacy among high School teachers in Ghana.
2. To investigate the strategies and approaches employed by teachers in addressing plastic pollution in the classroom
3. To provide recommendations for a robust ocean literacy strategy /curriculum to help mitigate the number of plastics entering the oceans from land-based sources.

1.4.2. Research Questions:

The study is guided by the following research questions in support of the research objectives;

1. What is the level of ocean literacy among high school teachers in Ghana?
2. What strategies and approaches do teachers employ to address marine plastic pollution in the classroom?
3. What are the main elements needed for a robust ocean literacy strategy /curriculum?






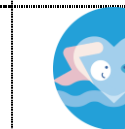
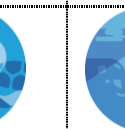
2. OCEAN LITERACY

Ocean Literacy is defined as a person’s ability to understand the ocean’s influence on them and their influence on the ocean (Cava et al., 2005). This concept of Ocean Literacy originated in the United States during the early 2000s, as a result of a collaborative effort by scientists, teachers, curriculum developers, and other invested parties seeking to incorporate ocean-related subjects into educational curricula at schools. (Ocean Literacy Network, 2020).

An ocean literate person is someone who possesses the ability to understand the concepts that are fundamental to the ocean and how it functions, can meaningfully communicate about the ocean and has the ability to make responsible and informed decisions about the ocean and its resources. (Cava et al., 2005; Ocean Literacy Network, 2020).

The ocean literacy framework identifies seven (7) critical principles underpinned by 45 core concepts that are essential for students to be ocean literate. The seven principles are hereby summarised as follows;

Figure 3. Ocean literacy Principles

| | | | | | | |
|---|---|---|---|---|---|---|
|  |  |  |  |  |  |  |
| <i>The Earth has one big ocean with many features.</i> | <i>The ocean and life in the ocean shape the features of Earth.</i> | <i>The ocean is a major influence on weather and climate.</i> | <i>The ocean made the Earth habitable.</i> | <i>The ocean supports a great diversity of life and ecosystems.</i> | <i>The ocean and humans are inextricably interconnected.</i> | <i>The ocean is largely unexplored.</i> |

Source: Santoro et al., 2022

The fundamental principles of ocean literacy underpin the concept of environmental education and marine citizenship. (Hawthorne and Alabaster, 1999). According to (Fletcher and Potts, 2007), individuals with an extensive knowledge of the ocean are capable of making informed choices concerning their lifestyle, with the aim of minimising adverse impacts on the ocean's health. Through such actions, individuals

actively engage in the process of tackling substantial global concerns that may seem complicated and difficult to resolve.

Evidently, the ocean is significantly impacted by various activities in our daily lives. These activities range from the extraction of marine resources such as energy and fisheries, to the generation of anthropogenic waste from human settlements such as plastics that ends up polluting and degrading the marine environment. (Santoro et al. 2018). Several studies examined the individuals' attitudes, knowledge, and behaviours towards ocean related issues, prior to the commencement of the Ocean Literacy (OL) movement. Researches like The Ocean Project (2009) and Gelcich et al. (2014), which were carried out in the United States and 11 countries in Europe respectively, found that there was a general concern about marine pollution, overfishing, and industrial hazardous waste. Their research highlighted that, despite a favourable attitude towards behavioural changes that help the marine environment, there was little understanding and knowledge of critical marine issues, such as ocean acidification, and a lack of confidence in individual efforts.

The significance of environmental education has been acknowledged globally since the 1970s, when the UN Belgrade Charter was published in 1975 where Environmental education was proposed as a strategy to address global environmental challenges. This was subsequently followed by the establishment of the International Environmental Education Programme, a joint effort by United Nations Educational, Scientific and Cultural Organization (UNESCO) and United Nations Environment Programme (UNEP) in 1976 with the aim of fostering awareness about societal independence with the environment and to equip individuals with the right values and skills to interact responsibly with the environment. (Mokos et al., 2020)

Even though Environmental education is included in many curricula across the globe (Khademi-Vidra, 2017), Ocean Literacy among individuals is still low and has not been successfully achieved (Fauville et al., 2019).

There has been a concerted effort to develop pioneering interdisciplinary initiatives that establish connections between different academic disciplines, as well as foster collaborations with local communities, corporations, and other entities. Two examples

of educational initiatives are the Portuguese Blue School network and the Japanese Ocean Education Pioneer School Programme. (UNESCO-IOC, 2022).

Considerable scholarly research has been conducted to examine the extent which ocean-related courses are incorporated into the educational curricula of various countries in order to foster ocean literacy (Mogias et al., 2019; Tsai et al., 2023). Mercer et al., (2017) also offered a critical assessment of the secondary school system, highlighting its deficiencies in providing comprehensive teaching on climate change and sustainability subjects, these teachers indicated sentiments of inadequacy in their ability to instruct intricate and multidisciplinary topics, perceiving them as difficult and challenging. Most of the studies in ocean literacy are concentrated in Europe, USA and Asia as observed in the existing literature, studies about ocean literacy and its inclusion in educational curriculum in the African perspective are however lacking.

2.0. Ocean Literacy as a tool to combat marine litter

Many solutions have been proffered to address marine litter (Löhr et al., 2017; (J.H. Kandziora et al., 2019; Bellou et al., 2021). These solutions have been categorized as Knowledge, Prevention, Mitigation, Removal and Behavioural Change by Williams & Rangel-Buitrago (2019). Behavioural change is recognised as an essential overarching strategy that should be implemented across all potential solution categories. (Williams & Rangel-Buitrago, 2019). Behavioural change could be achieved through educational initiatives such as Ocean Literacy, which fosters a thorough understanding of the ocean's value to earth and mankind. This educational foundation of the ocean and the deteriorating effects of plastics in the marine environment has the potential to motivate individuals and communities to actively make decisions that help combat the deterioration of marine ecosystems (Plankis & Marrero, 2010; McKinley & Fletcher, 2011) such as promoting environmentally friendly products to adopting suitable waste management strategies. In this vein, Ocean literacy can be identified as a critical element in addressing contemporary oceanic stressors such as marine litter.

2.1. Theoretical Underpinnings

In the context of this research, the Knowledge, Attitudes, and Practices (KAP) model theory serves as a guiding framework to explore how teachers' knowledge, attitudes, and practices influence their contributions to ocean literacy and the reduction of marine plastic pollution from land-based sources in Ghana. This theoretical framework integrates psychological and sociological theories to explain how knowledge, attitudes, and practices intersect to influence behaviour change. The KAP model is adapted and extended to the context of Ocean Literacy and sustainable behaviour. The KAP model's roots in learning theory (Bandura, 1977; Bandura, 1986) and diffusion of innovation theory (Rogers, 1995) are relevant to this study.

Knowledge

Knowledge can be defined as the cognitive comprehension of information, encompassing both conscious awareness and the non-symbolic interpretation of meaning (Wessman, 2006). The Ocean literacy framework is built around the comprehension of ocean systems, plastic pollution, and the interrelated nature of these matters by high school teachers in Ghana. This entails evaluating the level of scientific and local knowledge possessed by teachers regarding marine ecosystems, sources of plastic pollution, and the resulting impacts. The categories of knowledge as established by Hulme (2018), encompasses various kinds of knowledge, namely scientific, local, tacit, and self-reflective. In the context of this study, these categories are utilised to evaluate the level of awareness among teachers regarding ocean-related issues.

Attitudes

Ajzen and Fishbein (2000) define attitude as a positive or negative assessment of an objective. The perspectives of high school teachers towards ocean awareness and the mitigation of plastic pollution are crucial. The study examines the personal beliefs, attitudes, and motivations of teachers surrounding the issue and the perceived impacts of education and awareness creation to illicit behavioural change in order to integrate these aspects into their teaching practices. Their perceptions of the relevance of these issues within the Ghanaian context and the importance of preparing students to become responsible and ocean literate citizens are key components to be examined.

Practices

Bourdieu, 1990 explains practice as regular activities that are influenced by widely shared social norms and beliefs. High school teachers' practices in teaching ocean literacy and promoting plastic pollution reduction are analysed in this dimension. The framework delves into how teachers integrate relevant concepts into the curriculum, classroom activities, and extracurricular initiatives. Factors influencing the translation of knowledge and attitudes into practical teaching strategies are explored.

This study utilises the KAP model to gain a deeper understanding of the role teachers play in promoting ocean literacy and mitigating the issue of marine plastic pollution. The framework functions as a structured approach to assessing teachers' understanding, beliefs, and actions related to these critical issues. In this study, the KAP model offers a systematic approach to understanding how teachers' knowledge, attitudes, and teaching practices intersect to contribute to increasing knowledge about marine plastic pollution from land-based sources in Ghana. This extension of the KAP model to the domain of environmental education enhances its utility in assessing teachers' roles in fostering positive behavioural changes among students and within the broader community.

3. Research Methodology

This section presents a comprehensive overview of the research methodology applied to this study, including a detailed explanation of the research design, the participants involved, the processes used for data collection, the ethical issues considered, and the techniques employed for data analysis. A qualitative research approach was adopted to investigate and understand teachers' perspectives on the role of ocean literacy as a strategy for mitigating marine plastic pollution from land-based sources in Ghana. In-depth interviews were utilised to collect primary data.

3.1 Study Area

The primary goal of this study was to examine the perspectives of high school teachers within the Greater Accra region of Ghana. The rationale for choosing this particular region for the study stems from its status as the capital city of Ghana and its reputation as the most populous region in the country, as reported by the Ghana Statistical Service (2022).

Figure 4

Map of Study Area



Source: Google Maps

Its location along the nation's coastline makes it an appropriate place to research the effects of marine plastic pollution and potential mitigating measures. Moreover, as an urban hub, the region accommodates a diverse range of educational institutions, including both public and private high schools. This provides a pool of potential participants engaged in teaching and can provide valuable insights into the integration of ocean literacy and plastic pollution education.

3.0. Participants

The participants of this research consisted of 12 high school teachers from both public and private educational institutions in Accra, Ghana. A purposive sampling technique (Rai & Thapa, 2015; Naderifar et al., 2017) was employed in recruiting participants who possessed experience in high school teaching, with a particular emphasis on individuals who taught science and subjects related to environmental studies. A total of 21 teachers were initially invited to partake in the study, however due to a slow response, snowball sampling was engaged as a method to locate more potential participants by obtaining referrals from the initial respondents. This approach was employed to enhance the variety of the participants, ensuring the inclusion of individuals with different levels of experience, topic areas, and teaching styles. This approach enabled a thorough examination of the research objectives from several perspectives. The table below illustrates the list of all study participants.

Table 1

Background of Teacher Participants

| Code | Gender | Subject Taught 1 | Subject Taught 2 |
|-------------|---------------|-----------------------------|-------------------------|
| T01 | Male | OWOP (Our World Our People) | History |
| T02 | Female | Literacy | Numeracy |
| T03 | Female | Maths | Science |
| T04 | Male | Science | Maths |
| T05 | Male | Maths | Science |
| T06 | Male | Maths | Science |

| | | | |
|-----|------|----------------|----------------|
| T07 | Male | Maths | Science |
| T08 | Male | Language | Technical |
| T09 | Male | Maths | Science |
| T10 | Male | Social Studies | Science |
| T11 | Male | Science | Maths |
| T12 | Male | English | Social Studies |

3.2 Data Collection

The primary methods of data collection employed in this study involved using in-depth interviews. The utilisation of open-ended questions enabled a flexible approach that allows participants to freely articulate their perspectives on the matter while simultaneously assuring the attainment of the research objectives (Covell et al., 2012). Additionally, using interviews provides the opportunity for participants to elucidate further and delve deeper into the covered subjects (Young et al., 2018). Interview questions ([Appendix A](#)) were designed to investigate the participants' comprehension of marine plastic pollution in Ghana, their perspectives on ocean literacy, and their teaching strategies for environmental education. Interviews were conducted between 19th July and 8th August 2023 and were conducted online via Zoom or WhatsApp based on participants' preferences and logistical considerations. Each interview ranged from 20 to 30 minutes, during which audio recordings were made with the participants' explicit consent. Data was collected in the form of in-depth interviews on the virtual meeting platform Zoom, which were recorded and transcribed with the aid of online transcription applications <https://otter.ai/> and <https://transkriptor.com/>. The data was then analysed using the thematic analysis approach, drawing mainly from Braun and Clark's (2006) thematic analysis approach, organising the data into common themes and patterns using the deductive method.

Figure 5.

Interview questions from the KAP model theoretical framework to explore teachers' knowledge, attitudes, and practice.



3.3 Data Analysis

the data collected was analysed using a thematic analysis approach. To maintain precision in capturing the participants' comments, the interview recordings were transcribed in a verbatim manner. Thematic analysis was employed to identify recurring themes and patterns within the collected data. The process of thematic analysis was conducted iteratively, encompassing multiple stages. These stages included becoming acquainted with the interview transcripts, generating initial codes, identifying recurring patterns and themes, reviewing and refining these themes, and interpreting and reporting the findings (Braun & Clarke, 2006). This approach allowed for the identification of differences and commonalities within the participants' responses (Williamson et al., 2018), therefore facilitating a holistic comprehension of their viewpoints about ocean literacy and the issue of marine plastic pollution in

Ghana. NVivo 14, a qualitative data analysis software, was used to facilitate the organisation and analysis of the data.

3.4. Ethical Considerations

The participants were presented with comprehensive information regarding the research objectives. Before conducting the interview's, informed consent was sought from each participant ([Appendix B](#)). All participants provided informed consent and were aware of their right to withdraw from the study at any point without facing any consequences. The identity of the participants was anonymized using codes as identifiers and strict confidentiality measures were implemented to ensure the security of the data. Accordingly, access to the data was restricted solely to the researcher. The utilisation of personal identifiers, such as names or any other identifying information, was deliberately omitted and replaced with randomly assigned codes to identify participant data within this thesis and in any subsequent presentations or publications arising from the conducted study. The study obtained ethical approval from the Ethical Review Committee of the World Maritime University (WMU). There was no linked reward or incentive provided for participating in the study.

4. RESULTS

This section presents the results and findings of the data collection process to address this study's research questions: to investigate teachers' perspectives on harnessing environmental education, focusing on ocean literacy and its potential role in addressing marine plastic pollution in Ghana. The responses from the teachers provide valuable insights into their awareness, teaching practices, opinions, and suggestions for enhancing curriculum content. The results feature the response rates of participants, as well as the emerging themes derived from the participants' responses to questions posed to them; their voices feature prominently in the description of the themes.

A total of 12 high school teachers participated in the study and shared their reflections, thoughts, and experiences.

4.1. Analysis of Emerging Themes

The following themes were developed based on the interactions with the participants to answer the research questions. The table below shows the themes that emerged from the interviews.

Table 2

Emerging Themes from Interviews

| Themes | Sub- Themes | Participants Contributing |
|-------------------------------------|--|---|
| Understanding of Ocean Literacy and | Awareness of Ocean Literacy Concept | T02, T05 |
| Marine Plastic Pollution | Understanding of the effectiveness of Ocean Literacy/ Awareness creation | T01, T02, T03, T05, T06, T07, T09, T11, T12 |
| Teaching Strategies | In-Class teaching | T06, T11 |
| | Personal teaching initiatives | T02, T06, T09 |
| Challenges | Not included in the Curriculum | T01, T02, T04, T05, T06, T07, T10, T11 |

| | | |
|-----------------|-----------------------|-----------------------------------|
| Recommendations | Teacher training | T02, T03, T04, T06, T07, T08, T10 |
| | Curriculum Inclusion | T01, T02, T06, T07, T09, T10, T11 |
| | Experiential learning | T03, T04, T05, T09, T12 |
| | External Resources | T07, T09, T10 |

4.2. Assessing the level of Ocean Literacy among High school teachers

Familiarity with Ocean Literacy

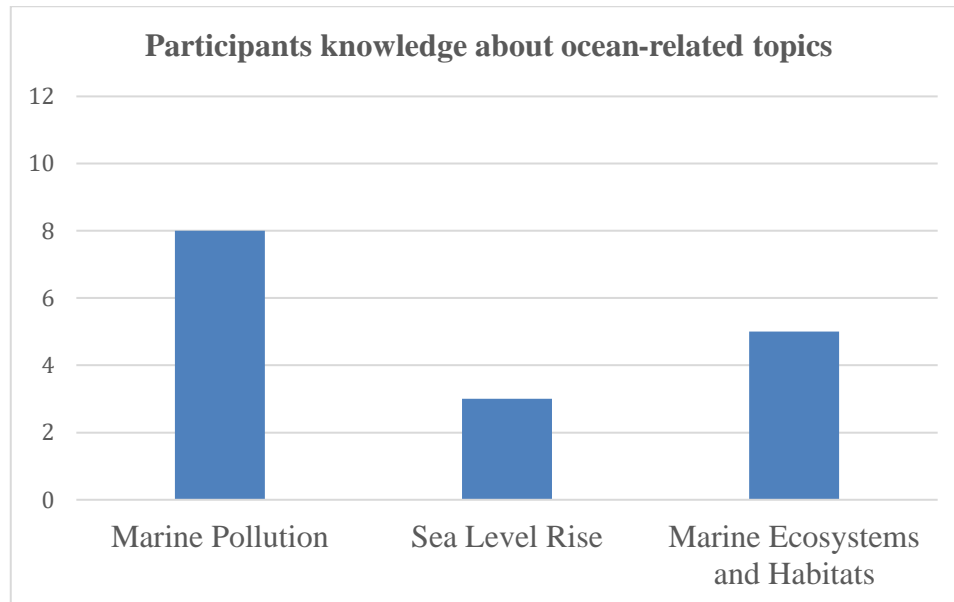
Emerging data revealed a spectrum of unfamiliarity with the term "ocean literacy." Among the 12 teachers interviewed, 10 were unacquainted with the concept, as some admitted they had no knowledge of the concept prior to the interview. Two of the teachers, however, expressed prior knowledge, vaguely associating it with knowledge, understanding and preserving the ocean. In their own words, one of the teachers broadly described ocean literacy as;

“Educating the public or creating awareness of the ocean.”

Knowledge of Ocean-Related Topics

Figure 6.

Participants knowledge about ocean related topics



Teachers exhibited varying levels of understanding of the ocean-related topics presented. Many of the teachers provided concise descriptions for the topic of marine pollution, recognising marine pollution as a result of human activities interfering with marine life in the marine environment, with some describing it as follows;

“Pollution talks about releasing harmful substances into the environment to the environment, so with the attachments of the marine, it talks about the materials or substances that pollute the marine ecosystem, that is the ocean”.

While many recognised marine ecosystems as habitats for sea life, their responses varied in terms of depth and specificity in terms of direct reference to water conditions, physical and chemical properties, and location. Example;

“The lives of living organisms in the sea or in the ocean, and then their homes, their natural homes of our places of abode habitats like that where they live inside the ocean”

However, the general understanding of sea level rise among the participants was low as most admitted to not possessing any knowledge of sea level rise. Of the 12 responses, only three made reference to global warming and melting polar ice.

“Global warming, I do know that the effects of global warming have melted the ice at the north pole, thereby increasing the amount of water thereby raising the sea level.”

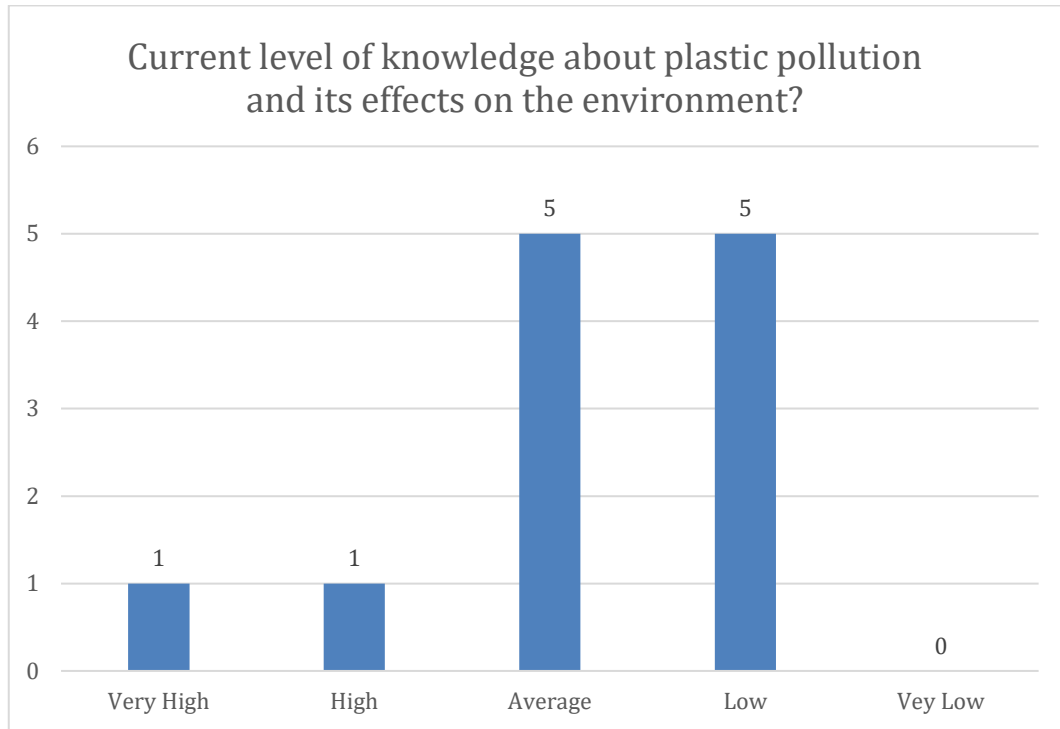
Awareness of the causes and impacts of plastic pollution on the marine environment

Teachers generally demonstrated awareness of the harmful effects of plastics on ocean ecosystems. They generally recognised plastic ingestion as a leading effect of plastic pollution leading to the death of marine creatures and acknowledged that plastic pollution poses a threat due to its non-biodegradable nature. This awareness indicated a baseline understanding of the environmental implications of plastic pollution.

Teachers also self-assessed their knowledge of plastic pollution and its effects, ranking it on a scale of 1 to 5 on a Likert scale. The results were diverse, with teachers rating their knowledge levels at varying points on the scale. This variance suggests that while some teachers possess moderate understanding, others might benefit from further educational initiatives on plastic pollution.

Figure 7.

Current level of knowledge about plastic pollution



4.3. Strategies and approaches employed by teachers employ to address marine plastic pollution in the classroom?

In Class Teaching

Teachers unanimously indicated that they discuss environmental pollution in their teaching; however, this subject does not cover plastic pollution or its effects on the ocean. While teachers generally encouraged responsible disposal and avoidance of plastic littering, they cited a lack of in-depth discussions in the classroom owing to the fact that it has not been integrated into the curriculum and could easily be overlooked. One educator stated;

"I just tell them to pick up these things and how to dispose of them properly."

Personal Practical initiatives

Some teachers highlighted personal initiatives they undertake in order to address plastic pollution. Despite the curriculum constraints, these teachers displayed a commitment to enhancing their students' understanding of these critical issues. One respondent was particularly keen on demonstrating to the children the benefits of waste

separation. Some demonstrated this by giving them talks on practising such behaviours in their household.

Not part of the curriculum

The interviews conducted with teachers also unveiled notable challenges arising from the absence of integration of ocean literacy and plastic pollution subjects within the curriculum. Out of 12 participants, 9 reported that no element relating specifically to plastic pollution is taught within the curriculum. Some teachers highlighted the notable absence of emphasis given to marine pollution and its associated awareness despite the focus on themes such as air, water, and land pollution; this caused their inability to go in-depth and teach on the subject.

4.4. Recommendations on the main elements needed for a robust ocean literacy strategy.

Curriculum Inclusion

Teachers made suggestions on integrating dedicated lessons on plastic pollution in environmental topics into the curriculum. They believed formalising this topic within the curriculum would ensure all students receive structured education on these critical environmental issues. One educator cited that educating the kids extends to their households as they eventually transfer what they have learned to their parents and siblings at home.

Teacher training

Training of teachers emerged as one of the more dominant recommendations provided by teachers to enhance the curriculum's robustness in addressing plastic pollution and ocean literacy. Some teachers emphasised the importance of teacher training through workshops to enable them to have the necessary knowledge needed to impart to their students;

Practical (Hands-on) Learning Initiatives

In addition to the recommendations for curriculum inclusion and training of teachers, some teachers also pointed out the benefits of practical learning strategies. They recommended taking students on field trips to see first-hand the environmental issues caused by plastic pollution. This would help students connect theory with reality and develop a deeper understanding of the problems.

Alternative initiatives

Furthermore, the teachers also shared some additional recommendations for raising awareness on the issue of marine pollution with proposal for external resource persons and experts to be brought in to the classroom to shed mor light on the issue. While this viewpoint was corroborated by other teachers such as T10, another teacher alternatively suggested the involvement of corporate society to support this endeavour by donating items such as dustbins to schools. It worthy of note however that when asked if there has been collaboration with other teaches or institutions to teach about plastic pollution? – question 15 of the interview questions, all respondents answered in the negative.

Table 3

Themes and supporting quotes

| Themes | Quotes |
|----------------------|---|
| In Class Teaching | “When you talk about the environment, certainly you talk about the environmental pollution. You will certainly talk about measures that need to be taken in order to curb that particular environmental pollution. Some of these measures would include plastic management and how to manage the plastics.” |
| Personal Initiatives | “When I got to my new school, I realised that children find it very unconcerned to see something on the ground and pick it.... So, when I got there, I realised that this particular thing must stop. So, I even made the children manage the little resources that they had, and we bought three different dustbins in the classroom. On one of the dustbins, we have plastics on it, then on the other, we have papers on it on the other, we have others on it.” “What I discussed with the students is, like, separation of dumps which are plastics, so when you have a refuse in |

| | |
|-----------------------------------|--|
| | <p>the house, you have to separate your rubbers from the other waste materials, so that at least the rubbers and the waste materials can be Recycle for another product so that you don't combine them and then put them in to refuse dump them."</p> |
| <p>Not part of the curriculum</p> | <p>"Ocean awareness is not part of our syllabus curriculum." "Because it's not part of the curriculum, so you don't get to find it in the textbooks for us even use it in teaching".</p> <p>"Because it isn't part of the curriculum. So, if you are teaching it, it must be indirect."</p> <p>"We are using the CCP and this CCP, they say common core program which starts from basic 7 to basic 10; now from basic 7 to basic 10 there is nowhere where that plastic pollution is mentioned."</p> <p>"It is not in our curriculum; maybe once in a while, you may be talking about how to preserve the ecosystem, and your mind will pop up to how we can preserve our aquatic life and how we can prevent water pollution."</p> |
| <p>Curriculum inclusion</p> | <p>"And if they are well educated about the harmfulness of plastic, they also educate their children also on that, so it's very important for us to educate them and also do when they go home, they can easily educate their parents when they are or their brothers in the house'.</p> <p>"Just as in morality, how children are trained to behave, they are able to decipher between right and wrong from an early tender age. They grow up to become good people in society, or they turn out to be, most of the time, morally upright in society. So, with this knowledge about our aquatic life and marine pollution, if we begin early and</p> |

| | |
|--|---|
| | <p>start teaching them early, I'm sure they will grow up to have a very good idea about the effects and the benefits of how best we can manage. I think if we begin early, then we don't need to wait for them to go to the university or the tertiary before we start teaching them, so the earlier, the better."</p> |
| <p>Teacher Training</p> | <p>"They should organize workshops for the teachers, for them to be endowed with the knowledge before because if the person going to be the facilitator is not even aware of what he or she is going to teach whatever we teach, then it is going to be useless to the children, and they will make they might not even understand what we are saying."</p> <p>"For the teachers, I think workshops will help, and during our professional learning community sessions, we could make these things a topic or one of the things to look at."</p> |
| <p>Practical (Hands-on) Learning Initiatives</p> | <p>"I would just say practical. Just use something in the form. Anything in the form of like practical works is better because even teaching children in a theoretical manner doesn't take much though at that moment or this level. Their mind is quite open than that of an adult, but yes, too, when it's made in a practical way, they get to do things like using hands-on activities, it's better, or you can do it in a form of drama, something like games, just to get this thing instilled in them."</p> <p>"Now, a lot of schools are embracing projects, school-based assessments, which they do projects on. And then most of these things can be put in topics, and then we can practicalise it, you understand, where pupils develop systems, they present on such things to get some marks, which is added to the assessment, they tend to do more, and then understand more. And then once they do</p> |

| | |
|-------------------------|--|
| | understand more, they are able to implement it, the more.” |
| Alternative initiatives | <p>“If you bring in resource persons who work under waste management, and then come to come in to tell us what are some of the wastes recycling those waste materials, what you can use them for.”-T09</p> <p>“Our corporate bodies could also help in like waste management also. They could bring certain things like the dustbins to help the schools in their community also”. - T07</p> |

5. DISCUSSION

This study was conducted to investigate the perceptions of high school teachers in Ghana on the potential of including ocean literacy and plastic pollution-related topics in the educational curriculum as a strategy to deeply increase awareness about the interconnectedness between human life and the ocean as well as environmental issues, especially related to Marine Plastic Pollution. Globally, the inclusion of ocean literacy in educational curricula has been recognised as a vital strategy to help change societal behaviours towards more sustainable ways of living by the United Nations in the UN Decade of Ocean Science for Sustainable Development, which aims to address the ongoing deterioration of ocean health and promote the establishment of more favourable conditions for the sustainable ocean stewardship through a science-policy interface. Prioritisation of Ocean literacy in the educational curriculum has, however, been limited within formal education systems across the globe (Pazoto et al., 2022). The analysis of the findings from this research reveals a general lack of subjects within the high school curriculum in Ghana that specifically create awareness about plastic pollution and its effects on the environment, as well as the ways by which it can be addressed.

5.1. Ocean Literacy of teachers and awareness of ocean-related topics

The results of this study reflect that the knowledge of high school teachers in Ghana about ocean-related topics is moderate, and the findings correlate with some previous studies that assess the knowledge of teachers about the marine environment and marine-related issues (Mogias et al., 2015) and particularly their familiarity with the concept of ocean literacy and Marine Pollution. The Participants were more familiar with the topic of marine pollution and could easily describe it in broad terms. This could be attributed to the fact that marine pollution is a popular phrase and widely discussed; also, their responses were mostly constructed based on the general meaning of the two words “Marine” and “Pollution” for example “*Marine is just talking about waterbodies like the sea, and pollution simply means contaminating the marine with whatever dangerous substances like talking about the plastics.*” - T01

On the other hand, they knew relatively less about the other topics, Marine Ecosystems and Habitats and Sea Level Rise, most likely because these are more specialised terms and require detailed and in-depth descriptions to demonstrate knowledge about them. This type of knowledge is captured within the fundamental principles of the Ocean Literacy Framework and is considered necessary in order to qualify a person ocean literate. Based on the definition of ocean literacy (Cava et al., 2005), the finding of this study demonstrate a low level of ocean literacy among teachers in Ghana. The findings of this study, as it relates to the knowledge of the teachers about plastic pollution and its implications on the marine environment and aquatic life, indicate that even though there is a level of awareness about the situation, teachers would benefit from further education if they are to successfully pass on this knowledge to their students as supported by Nazarenko & Kolesnik 2018. Although the findings indicated moderate levels of awareness for ocean related topics, this did not directly translate to pro-environmental actions and practices on the part of teachers, this relationship is highlighted in a study by Kollmuss & Agyeman (2002) and Tam & Chan (2017) who indicated that pro-environmental behaviours are not a direct function of possessing environmental knowledge. Conversely, the ability of teachers to effectively instruct on contemporary environmental challenges, such as plastic pollution and climate change, is directly linked with their comprehensive understanding of such scientific concepts. This assertion is substantiated by existing evidence from research by Wise (2010), which suggests that teachers commonly perceive their science content education as inadequately equipping them to effectively teach about such subjects. Participants largely recognized the importance of ocean literacy and the need to integrate teaching about plastic pollution in the curriculum. They attested that, teachers play a crucial role in imparting knowledge about the ocean's significance and the harmful effects of its pollution and the consensus was that educating students about the environment, including oceans, can lead to behavioural changes and ultimately contribute to reducing plastic pollution.

5.2. Strategies used to address plastic pollution in the classroom

The study sought to investigate the current strategies and teaching mechanisms that address plastic pollution in the classroom. While the fundamental principles of ocean literacy underpin the concept of environmental education and marine citizenship. (Hawthorne & Alabaster, 1999), the concept of environmental education is considered very important in literature (Lustyantie, 2015; Ardoin et al., 2020) therefore for this study, a special focus was placed on the element of environmental education. The data analysis showed that while environmental topics such as land pollution, air pollution and waste management are discussed in the classroom, to varying degrees, these teachings, do not specifically address plastic pollution and its effects on the marine environment. Although a section of the teachers admitted to teaching students to engage in responsible waste management, these efforts are not widespread enough to make a meaningful impact and cause widespread behavioural change, revealing a consistent theme – the need for more comprehensive and structured content centred on plastic pollution and ocean literacy to aid in the successful transfer of knowledge. The findings also suggest an inadequate implementation of ocean science or marine-based topics in the educational curriculum as well as teacher training programs. A study conducted by Debrah et al. (2021) suggests that the acquisition of information by teachers has a crucial role in fostering the long-term growth and progress of pupils. Furthermore, this knowledge is identified as a pivotal factor in shaping a sustainable future, particularly within the framework of developing nations. The lack of environmental education in the majority of developing countries examined can be attributed to the inadequacy of contemporary environmental curricula which address present-day environmental concerns. With 8 out of the 12 participants citing these as challenges, the teachers called for plastic pollution to be strategically included in the curriculum and for teachers to receive the necessary training required to be able to teach such subjects satisfactorily. Despite the absence in the curriculum, the attitudes of some teachers towards the issues were highlighted by their own initiatives that seek to teach the students sustainable environmental practices, such as initiating waste separation systems for the waste that students generate in the classrooms, providing a practical example of what the students must emulate, considering that practical

education plays a vital role and has been found to generally generate positive attitudes and behaviours by students towards general waste and the natural environment (Hartley et al., 2018). This finding aligns with previous studies that suggest that whilst teachers may be willing to implement environmental education and promote sustainability practices, they lack the knowledge, resources, skills and capacity to do so (Cutter-Mackenzie & Smith, 2003; Evans et al., 2012).

The findings of this study provide validation for the necessity of implementing a comprehensive strategy in the instruction of ocean literacy and, commencing from the early stages of education (Freitas et al., 2023). This approach entails the cultivation of teachers' professional growth, and the enhancement of ocean-related subjects within school curricula. Furthermore, several studies examining the level of marine science knowledge among primary school teachers and student teachers have revealed a notable deficiency in their understanding. These teachers, who are responsible for instructing various courses, appear to lack comprehensive training in ocean literacy.

A constant theme teachers underscored is the significance of equipping teachers with comprehensive and tailored training. They stressed the necessity of offering continuous professional development and providing instructional materials via workshops and training sessions. This suggestion highlights the pivotal role of persistent professional teacher development in advancing environmental education and ocean literacy. It has been documented that having well-prepared teachers who have access to the required knowledge and resources is vital for effective education (Knapp, 2000; Bascopé et al., 2019; Nousheen et al., 2020).

Alternatively, Teachers advocated for the implementation of alternative educational strategies that prioritise practical applications while teaching environmental subjects. It was proposed that pupils be taken on field trips to beaches and within the communities in order to directly observe environmental concerns. These practical experiences were regarded as a viable approach to render the subject matter more concrete and approachable for pupils. This proposal is in accordance with the experiential learning technique. Several scholars have proposed that being in touch

with nature and having first hand experiences have a beneficial effect on learning characteristics. (Leal-Rodríguez & Albort-Morant, 2019) and field trips have been demonstrated to be useful in facilitating a more profound comprehension of intricate topics (Behrendt & Franklin, 2014).

The result of the study showed a broad lack of stakeholder collaboration in terms of establishing relationships with external organizations such as Ngo's that focus on plastic pollution awareness. SDG 17 of the UN sustainable development goals, partnership for the gaols, highlight the importance of partnerships and collaborative approaches to helping solve the contemporary global issues. In this light civil society, Governmental and non-governmental organizations and private entities alike are encouraged to contribute to global efforts that seek to solve these problems. As mentioned earlier, the initiative by the NGO Plastic punch to crate awareness about the issues surrounding marine litter could help effect behavioural change however this is an isolated case and many more of such initiatives could multiply the potential effects. Such initiatives could serve as a boost for the educational curriculum, and further promote students' academic success and effective learning (Mannathoko, 2019).

5.3. Study Implications and recommendations

The findings of the study have important implications for educational policymakers, curriculum writers, and practitioners in Ghana. This section presents a set of recommendations derived from the findings of the present study. The purpose of these proposals is to enhance ocean literacy and address the issue of plastic pollution in the educational system. The initiatives that have been put forth span a range of areas, including teacher training, curriculum development, experiential learning and collaboration with stakeholders. By adopting the aforementioned suggestions, Ghana can make substantial progress in fostering a citizenry that is environmentally aware and conscious of tackling the pressing problem of plastic pollution.

Curriculum Enhancement

The call to revise the national curriculum to include comprehensive content on ocean literacy and plastic pollution, ensuring that teachers have the necessary tools and materials to teach these critical subjects effectively. A proposed modification to the existing curriculum involves the incorporation of comprehensive and developmentally suitable educational material pertaining to marine and ocean literacy, as well as plastic pollution into related subjects within the curriculum. The NPMP acknowledges the pivotal role of behavioural change in achieving sustainable plastic management and curbing issues surrounding the improper disposal of plastics that often find their way into the ocean. The first focal area of the NPMP which is to incite behavioural change can be achieved by introducing elements that cover plastic pollution and ocean literacy into the curriculum by the National Council for Curriculum and Assessment (NaCCA). Additionally, for this to be successful, it is imperative to guarantee that educational materials, such as textbooks and resources, are in accordance with the revised curriculum and easily accessible to instructors.

Experiential learning

Furthermore, to enhance this learning experience, practical and experiential learning opportunities, such as field trips and hands-on activities which exposes the students to the real-world issues should be included into the curriculum. Research has established a positive correlation between marine litter educational interventions targeted at school children to foster deep concern toward the crisis and increasing ocean literacy (Hartley et al., 2015; Severin et al., 2023)

Partnerships and Collaborations

Collaboration and partnership between schools and non-governmental organizations (NGOs) and environmental groups with a focus in plastic pollution awareness and mitigation. These organizations often have educational programs and resources that can be integrated into school curricula or serve as extra curricula learning. Additionally, collaboration with universities and research institutions to access the

latest research on marine plastic pollution can contribute valuable insights and materials for educational purposes.

Teacher Training and Professional Development

Specialized training and continuous professional development programs should be established to equip teachers with the knowledge and skills required to teach ocean literacy and environmental education and to provide ongoing opportunities for teachers whose teaching require it, including workshops, seminars, and online courses, focusing on effective teaching methods for environmental subjects. The development of specialized training programs for teachers to deepen their understanding of ocean literacy and plastic pollution. There is also the need to integrate environmental education modules into pre-service and in-service teacher training programs.

Broader Significance

The findings and recommendations from this study extend beyond the borders of Ghana's, carrying implications for global efforts to combat marine litter. The study emphasizes the crucial role of education in shaping environmentally responsible citizens who can actively participate in sustainably safeguarding the ocean and its biodiversity. As the plastic pollution crisis transcends geographical boundaries, it calls for collective action and knowledge dissemination.

In conclusion, this research contributes to the discourse on ocean literacy and plastic pollution education in Ghana and provides a foundation for future efforts to enhance environmental education within the country's educational system.

Study limitations

The study provided a comprehensive analysis of teachers' viewpoints on ocean literacy and plastic pollution; however, study's participants are primarily educators from only one region in Ghana. It is important to note that the viewpoints may not necessarily represent the diversity of perspectives and practices across the entire country. A significant limitation also lies with the small sample size which may restrict the generalizability of the findings to places beyond the study area the findings might be

more applicable to the sampled region than to other regions with unique educational and environmental contexts.

Summary and Conclusions

The findings of this study indicate the underscore the significance of integrating ocean literacy and environmental education into Ghana's educational system to combat the pervasive issue of plastic pollution through the perspectives of the teachers.

The findings suggest that the incorporation of plastic pollution into the school curriculum has not been effectively accomplished. This study aims to identify major thematic areas pertaining to the understanding and management of plastics pollution that are currently deficient in high school curricula, specifically focusing on preventative and management strategies. Hence, it is imperative to establish and integrate environmental courses that emphasise the presence of emerging pollutants, particularly plastic, into the core curriculum. This study aims to enhance students' comprehension of the intricate interplay between human actions and the natural ecosystem, as well as their awareness of the environmental challenges encountered at both local and global scales.

The recommendations highlighted could collectively represent the foundations for a comprehensive and sustainable framework for enhancing ocean literacy and tackles the issue of plastic pollution within the educational system of Ghana. Ghana could achieve notable progress in promoting environmental education and cultivating a culture of environmental stewardship among its citizens by prioritising ocean literacy with the current curriculum on environmental education and instilling a sense of environmental responsibility among its citizens.

The opportunity for future research in this context includes:

- i. Examine the viewpoints of students regarding the effectiveness of ocean literacy programmes and their impact

- ii. expand the research into other countries and regions to develop a better awareness of the effects of introducing ocean literacy and adding plastic pollution the school curriculum;

It is worthy to note that while educating students is a beneficial measure, future generations alone may not possess the capacity to adequately address these issues within their everyday lives. Consequently, the effort necessitates supplementary comprehensive initiatives and the involvement of all stakeholders in both the private and public sectors. Therefore, it is vital to provide education to all pertinent stakeholders within society, encompassing producers, retailers and consumers, regarding the intricacies involved in pollution-related activity. (Alonso-Almeida et al., 2020; Kazancoglu et al., 2021). This study however, highlights various obstacles and opportunities associated with environmental teaching in schools, specifically in relation to plastics.

References

- Adam, I., Walker, T. R., Bezerra, J. C., & Clayton, A. (2020). Policies to reduce single-use plastic marine pollution in West Africa. *Marine Policy*, 116, 103928. <https://doi.org/10.1016/j.marpol.2020.103928>
- Ardoin, N. M., Bowers, A. W., & Gaillard, E. (2020). Environmental education outcomes for conservation: A systematic review. *Biological Conservation*, 241, 108224–108224. <https://doi.org/10.1016/j.biocon.2019.108224>
- Ajzen, I., & Fishbein, M. (2000). Attitudes and the attitude-behavior relation: Reasoned and automatic processes. *European Review of Social Psychology*, 11(1), 1-33. <https://10.1080/14792779943000116>
- Alonso-Almeida, M. del M., Rodríguez-Antón, J. M., Bagur-Femenías, L., & Perramon, J. (2020). Sustainable development and circular economy: The role of institutional promotion on circular consumption and market competitiveness from a multistakeholder engagement approach. *Business Strategy and the Environment*. doi:10.1002/bse.2544
- Anbumani, S., & Kakkar, P. (2018). Ecotoxicological effects of microplastics on biota: A review. *Environmental Science and Pollution Research*, 25(15), 14373-14396. <https://10.1007/s11356-018-1999-x>
- Andrady, A. L. (2011). Microplastics in the marine environment. *Marine Pollution Bulletin*, 62(8), 1596–1605. <https://doi.org/10.1016/j.marpolbul.2011.05.030>
- Ansje Löhr, Savelli, H., Raoul Beunen, Kalz, M., Ragas, A. M. J., & Frank Van Belleghem. (2017). Solutions for global marine litter pollution. *Current Opinion in Environmental Sustainability*, 28, 90–99. <https://doi.org/10.1016/j.cosust.2017.08.009>
- Appiah, J. K., Berko-Boateng, V. N., & Tagbor, T. A. (2017). Use of waste plastic materials for road construction in Ghana. *Case Studies in Construction Materials*, 6, 1-7. <https://10.1016/j.cscm.2016.11.001>
- Ashley, M., Pahl, S., Glegg, G., & Fletcher, S. (2019). A Change of Mind: Applying Social and Behavioral Research Methods to the Assessment of the Effectiveness of Ocean Literacy Initiatives. *Frontiers in Marine Science*, 6. <https://doi.org/10.3389/fmars.2019.00288>
- Bandura, A. (1977). *Social Learning Theory* (pp. 1–46). General Learning Corporation.
- Bandura, A. (1986). Social foundations of thought and action. *Englewood Cliffs, NJ*, 1986(23-28)

- Baker, E., Harris, P., Mangalagiu, D., Fidelman, P., Gonçalves, L. R., & Hollway, J. (2019). Global Environment Outlook (GEO-6) Chapter 7: Oceans and coasts.
- Bellou, N., Gambardella, C., Karantzalos, K., Monteiro, J. G., Canning-Clode, J., Kemna, S., Arrieta-Giron, C., & Lemmen, C. (2021). Global assessment of innovative solutions to tackle marine litter. *Nature Sustainability*, 4(6), 516-524. <https://10.1038/s41893-021-00726-2>
- Bourdieu, P. (1990). The logic of practice. Stanford university press.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77-101. <https://10.1191/1478088706qp063oa>
- Behrendt, M., & Franklin, T. (2014). A Review of Research on School Field Trips and Their Value in Education. *International Journal of Environmental & Science Education International Journal of Environmental & Science Education*, 9(9), 235–245. <https://doi.org/10.12973/ijese.2014.213a>
- Carbery, M., O'Connor, W., & Palanisami, T. (2018). Trophic transfer of microplastics and mixed contaminants in the marine food web and implications for human health. *Environment International*, 115, 400-409. <https://10.1016/j.envint.2018.03.007>
- Cava, F., Strang, C., Hall, L., & Tuddenham, P. (2005). *Science Content and Standards for Ocean Literacy: A Report on Ocean Literacy*. https://www.coexploration.org/oceanliteracy/documents/OLit2004-05_Final_Report.pdf
- Chitaka, T. Y., Onianwa, P. C., & Nel, H. (2022). Marine Litter Sources and Distribution Pathways. Springer EBooks, 35–89. https://doi.org/10.1007/978-3-031-08626-7_2
- Covell, C. L., Souraya Sidani, & Ritchie, J. A. (2012). Does the sequence of data collection influence participants' responses to closed and open-ended questions? A methodological study. *International Journal of Nursing Studies*, 49(6), 664–671. <https://doi.org/10.1016/j.ijnurstu.2011.12.002>
- Cutter-Mackenzie, A., & Smith, R. (2003). Ecological literacy: The 'missing paradigm' in environmental education (part one). *Environmental Education Research*, 9(4), 497-524. <https://10.1080/1350462032000126131>
- Dasgupta, S., Sarraf, M., & Wheeler, D. (2022). Plastic waste cleanup priorities to reduce marine pollution: A spatiotemporal analysis for Accra and Lagos with satellite data. *Science of the Total Environment*, 839, 156319–156319. <https://doi.org/10.1016/j.scitotenv.2022.156319>
- Debrah, J. K., Vidal, D. G., & Dinis, M. A. (2021). Raising awareness on solid waste management through formal education for sustainability: A developing countries evidence review. *Recycling*, 6(1)<https://10.3390/recycling6010006>

- De La Cruz, C., P., Manuel. (2021). The knowledge status of coastal and marine ecosystem services - challenges, limitations and lessons learned from the application of the ecosystem services approach in management. *Frontiers in Marine Science*, 8 <https://www.frontiersin.org/articles/10.3389/fmars.2021.684770>
- Dupont S., Fauville G. (2017). Ocean Literacy as a Key Towards Sustainable Development and Ocean Governance. Nunes P., Svensson L.E., Markandya A.. In *Handb. Econ. Manage. Sustain. Ocean*.Eds, (Cheltenham:Edward Elgar Publishers), 519–537. doi: 10.4337/9781786430724.00037
- Evans, N. S., Whitehouse, H., & Hickey, R. (2023). Pre-service Teachers' Conceptions of Education for Sustainability. Research Online. <https://ro.ecu.edu.au/ajte/vol37/iss7/1/>
- Fauville, G., Strang, C., Cannady, M. A., & Chen, Y. (2019). Development of the international ocean literacy survey: Measuring knowledge across the world. *Environmental Education Research*, 25(2), 238-263. <https://10.1080/13504622.2018.1440381>
- Fletcher, S., & Potts, J. (2007). Ocean citizenship: An emergent geographical concept. *Coastal Management*, 35(4), 511-524. <https://10.1080/08920750701525818>
- Freitas, C., Francis, P., Bellgrove, A., & Venzo, P. (2023). Adopting Ocean-Themed Picture Books to Promote Ocean Literacy in Primary Education. *Children's Literature in Education*. <https://doi.org/10.1007/s10583-023-09534-y>
- Galgani, F., Hanke, G., & Maes, T. (2015). Global distribution, composition and abundance of marine litter. In M. Bergmann, L. Gutow & M. Klages (Eds.), *Marine anthropogenic litter* (pp. 29-56). Springer International Publishing. https://10.1007/978-3-319-16510-3_2
- Gall, S. C., & Thompson, R. C. (2015). The impact of debris on marine life. *Marine Pollution Bulletin*, 92(1), 170-179. <https://10.1016/j.marpolbul.2014.12.041>
- Gelcich, S., Buckley, P., Pinnegar, J. K., Chilvers, J., Lorenzoni, I., Terry, G., Guerrero, M., Juan Carlos Castilla, Valdebenito, A., & Duarte, C. M. (2014). Public awareness, concerns, and priorities about anthropogenic impacts on marine environments. *Proceedings of the National Academy of Sciences of the United States of America*, 111(42), 15042–15047. <https://doi.org/10.1073/pnas.1417344111>
- GESAMP (2015, IMO/FAO/UNESCO-IOC/UNIDO/WMO/IAEA/UN/UNEP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection); Boelens, R. and Kershaw, P.J., eds, Pollution in the Open Oceans 2009-2013 – A report by a GESAMP Task Team. GESAMP Rep. Stud. No. 91, 87 pp. <http://www.gesamp.org/site/assets/files/1273/pollution-in-the-open-oceans-en.pdf>

- Géraldine Fauville, Craig Strang, Matthew A. Cannady & Ying-Fang Chen (2019) Development of the International Ocean Literacy Survey: measuring knowledge across the world. *Environmental Education Research*, 25:2, 238-263, DOI: [10.1080/13504622.2018.1440381](https://doi.org/10.1080/13504622.2018.1440381)
- Geyer, G., Jambeck, J., & Law, L. (2017). Production, use, and fate of all plastics ever made. *Science Advances*, 3(7), e1700782. <https://doi.org/10.1126/sciadv.1700782>
- G.G.N. Thushari, & J.D.M. Senevirathna. (2020). Plastic pollution in the marine environment. *Heliyon*, 6(8), e04709–e04709. <https://doi.org/10.1016/j.heliyon.2020.e04709>
- Ghana Statistical Service. (2022). Ghana 2021 Population and Housing Census. <https://census2021.statsghana.gov.gh/gssmain/fileUpload/reportthemelist/Volume%203%20Highlights.pdf>
- Global Environment Facility. (2019). Establishing a circular economy framework for the plastics sector in Ghana. https://www.thegef.org/sites/default/files/webdocuments/10401_MFA_PIF_Review.pdf
- Global Plastic Action Partnership (GPAP), 2022. Ghana. <https://www.globalplasticaction.org/ghana>
- Hann, S., Sherrington, C., Jamieson, O., Hickman, M., Kershaw, P., Bapasola, A., & Cole, G. (2018). Investigating options for reducing releases in the aquatic environment of microplastics emitted by (but not intentionally added in) products. *Final Report.London/Bristol*, <https://www.eunomia.co.uk/reports-tools/investigating-options-for-reducing-releases-in-the-aquatic-environment-of-microplastics-emitted-by-products/>
- Haas, B., Mackay, M., Novaglio, C., Liam Fullbrook, Murunga, M., Sbrocchi, C., McDonald, J., McCormack, P. C., Alexander, K., Fudge, M., Goldsworthy, L., Boschetti, F., Dutton, I., Leo X.C. Dutra, McGee, J., Rousseau, Y., Spain, E., Stephenson, R. L., Vince, J., & Wilcox, C. (2021). The future of ocean governance. *Reviews in Fish Biology and Fisheries*, 32(1), 253–270. <https://doi.org/10.1007/s11160-020-09631-x>
- Hardesty, B. D., Good, T. P., & Wilcox, C. (2015). Novel methods, new results and science-based solutions to tackle marine debris impacts on wildlife. *Ocean & Coastal Management*, 115, 4-9. <https://doi.org/10.1016/j.ocecoaman.2015.04.004>
- Hartley, B. L., Thompson, R. C., & Pahl, S. (2015). Marine litter education boosts children’s understanding and self-reported actions. *Marine Pollution Bulletin*, 90(1-2), 209–217. <https://doi.org/10.1016/j.marpolbul.2014.10.049>
- Hartley, B. L., Pahl, S., Holland, M., Iro Alampei, Joana Mira Veiga, & Thompson, R. C. (2018). Turning the tide on trash: Empowering European teachers and school students to tackle marine litter. *Marine Policy*, 96, 227–234. <https://doi.org/10.1016/j.marpol.2018.02.002>

- Hawthorne, M., & T. Alabaster. (1999). Citizen 2000: development of a model of environmental citizenship. *Global Environmental Change-Human and Policy Dimensions*, 9(1), 25–43. [https://doi.org/10.1016/s0959-3780\(98\)00022-3](https://doi.org/10.1016/s0959-3780(98)00022-3)
- Hulme, M. (2018). “Gaps” in Climate Change Knowledge. *Environmental Humanities*, 10(1), 330–337. <https://doi.org/10.1215/22011919-4385599>
- IPCC, 2019: Summary for Policymakers. In: IPCC Special Report on the Ocean and Cryosphere in a Changing Climate [H.-O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, A. Alegría, M. Nicolai, A. Okem, J. Petzold, B. Rama, N.M. Weyer (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 3–35. <https://doi.org/10.1017/9781009157964.001>.
- IUCN. (2021). *Marine plastic pollution*. https://www.iucn.org/sites/default/files/2022-04/marine_plastic_pollution_issues_brief_nov21.pdf
- Jacobsen L. F., Pedersen, S., & Thøgersen, J. (2022). Drivers of and barriers to consumers’ plastic packaging waste avoidance and recycling – A systematic literature review. *Waste Management*, 141, 63–78. <https://doi.org/10.1016/j.wasman.2022.01.021>
- J.H. Kandziora, N. van Toulon, Sobral, P., Taylor, H., Ribbink, A. J., Jambeck, J., & Werner, S. (2019). The important role of marine debris networks to prevent and reduce ocean plastic pollution. *Marine Pollution Bulletin*, 141, 657–662. <https://doi.org/10.1016/j.marpolbul.2019.01.034>
- Jose, S., Patrick, P. G., & Moseley, C. (2017). Experiential learning theory: The importance of outdoor classrooms in environmental education. *International Journal of Science Education, Part B*, 7(3), 269-284. <https://10.1080/21548455.2016.1272144>
- Karbalaei, S., Hanachi, P., Walker, T. R., & Cole, M. (2018). Occurrence, sources, human health impacts and mitigation of microplastic pollution. *Environmental Science and Pollution Research International*, 25(36), 36046-36063. <https://10.1007/s11356-018-3508-7>
- Kazancoglu, Y., Ozkan-Ozen, Y., Sagnak, M., Kazancoglu, I., & Dora, M. (2023). Framework for a sustainable supply chain to overcome risks in transition to a circular economy through industry 4.0. *Production Planning & Control*, 34(10), 902-917. <https://10.1080/09537287.2021.1980910>
- Khademi-Vidra, A. (2017). Curriculum planning of the environmental education. *Journal of Central European Green Innovation*, 5(1063-2018-081), 65-80.

- Kollmuss, A., & Agyeman, J. (2002). Mind the gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research*, 8(3), 239-260. <https://10.1080/13504620220145401>
- Kühn, S., Rebolledo, E., & J.A. van Franeker. (2015). Deleterious Effects of Litter on Marine Life. *Springer EBooks*, 75–116. https://doi.org/10.1007/978-3-319-16510-3_4
- Leal-Rodríguez, A. L., & Albort-Morant, G. (2019a). Promoting innovative experiential learning practices to improve academic performance: Empirical evidence from a Spanish Business School. *Journal of Innovation & Knowledge*, 4(2), 97–103. <https://doi.org/10.1016/j.jik.2017.12.001>
- Lincoln, S., Andrews, B., Silvana N.R. Birchenough, Chowdhury, P., Engelhard, G. H., Harrod, O., Pinnegar, J. K., & Bryony Townhill. (2022). Marine litter and climate change: Inextricably connected threats to the world’s oceans. *Science of the Total Environment*, 837, 155709–155709. <https://doi.org/10.1016/j.scitotenv.2022.155709>
- Liu, J., Hu, Z., Du, F., Tang, W., Zheng, S., Lu, S., An, L., & Ding, J. (2023). Environment education: A first step in solving plastic pollution. *Frontiers in Environmental Science*, 11. <https://doi.org/10.3389/fenvs.2023.1130463>
- Luo, H., Zhao, Y., Li, Y., Xiang, Y., He, D., & Pan, X. (2020). Aging of microplastics affects their surface properties, thermal decomposition, additives leaching and interactions in simulated fluids. *Science of the Total Environment*, 714, 136862–136862. <https://doi.org/10.1016/j.scitotenv.2020.136862>
- Lustyantie, N. (2015). Environmental education in the language and literature learning in elementary education. *International Journal of Research Studies in Education*, 4 <https://10.5861/ijrse.2015.991>
- Mahin Naderifar, Goli, H., & Fereshteh Ghaljaei. (2017, September 30). *Snowball Sampling: A Purposeful Method of Sampling in Qualitative Research*. ResearchGate; Briefland. https://www.researchgate.net/publication/324590206_Snowball_Sampling_A_Purposeful_Method_of_Sampling_in_Qualitative_Research
- Martín Bascopé, Perasso, P., & Reiss, K. (2019). Systematic Review of Education for Sustainable Development at an Early Stage: Cornerstones and Pedagogical Approaches for Teacher Professional Development. *Sustainability*, 11(3), 719–719. <https://doi.org/10.3390/su11030719>
- Mercer, T.G., Kythreotis, A. P., Robinson, Z. P., Stolte, T., George, S. M. and Haywood, S. K. (2017), “The use of educational game design and play in

- higher education to influence sustainable behaviour”, *International Journal of Sustainability in Higher Education*, Vol.18 No. 3, pp. 359-384.
- McKinley, E., Burdon, D., & Shellock, R. (2023). The evolution of ocean literacy: A new framework for the United Nations Ocean Decade and beyond. *Marine Pollution Bulletin*, 186, 114467–114467. <https://doi.org/10.1016/j.marpolbul.2022.114467>
- Macfadyen, G., Huntington, T., & Cappell, R. (2009). *Abandoned, lost or otherwise discarded fishing gear* (No. 523). Food and Agriculture Organization of the United Nations (FAO).
- Mironenko, O., & Mironenko, E. (2020). Education Against Plastic Pollution: Current Approaches and Best Practices. *The Handbook of Environmental Chemistry*, 67–93. https://doi.org/10.1007/698_2020_486
- Mogias, A., Boubonari, T., Realdon, G., Previati, M., Mokos, M., Koulouri, P., & Cheimonopoulou, M. T. (2019). Evaluating ocean literacy of elementary school students: Preliminary results of a cross-cultural study in the mediterranean region. *Frontiers in Marine Science*, 6 <https://www.frontiersin.org/articles/10.3389/fmars.2019.00396>
- Mokos, M., Giulia Realdon, & Ivana Zubak Čizmek. (2020). How to Increase Ocean Literacy for Future Ocean Sustainability? The Influence of Non-Formal Marine Science Education. *Sustainability*, 12(24), 10647–10647. <https://doi.org/10.3390/su122410647>
- Musah, B. I., Peng, L., & Xu, Y. (2021). Plastic waste menace in Ghana, a serious threat to marine ecological diversity. *IOP Conference Series: Earth and Environmental Science*, 725(1), 012006. <https://doi.org/10.1088/1755-1315/725/1/012006>
- Napper, I. E., & Thompson, R. C. (2020). Plastic Debris in the Marine Environment: History and Future Challenges. *Global Challenges*, 4(6). <https://doi.org/10.1002/gch2.201900081>
- Nazarenko, A. V., & Kolesnik, A. I. (2018, July). *Raising Environmental Awareness of Future Teachers*. ResearchGate; Modestum Ltd. https://www.researchgate.net/publication/326149551_Raising_Environmental_Awareness_of_Future_Teachers
- Nousheen, A., Yousuf, A., Waseem, M., & Shafqat Ali Khan. (2020). Education for sustainable development (ESD): Effects of sustainability education on pre-service teachers’ attitude towards sustainable development (SD). *Journal of Cleaner Production*, 250, 119537–119537. <https://doi.org/10.1016/j.jclepro.2019.119537>

- Nuamah, F., Samuel Kofi Tulashie, Joseph Sefah Debrah, & Rodrigue. (2023). Microplastics in the Gulf of Guinea: An analysis of concentrations and distribution in sediments, gills, and guts of fish collected off the coast of Ghana. *Environmental Research*, 234, 116567–116567. <https://doi.org/10.1016/j.envres.2023.116567>
- Ocean Literacy Network (2020). *Ocean literacy: The essential principles and fundamental concepts of ocean sciences for learners of all ages version 3*. https://oceanliteracy.unesco.org/wp-content/uploads/2020/09/OceanLiteracyGuide_V3_2020-8x11-1.pdf.
- Pappoe, C., Maud, L., Dzifa Denutsui, Charles Mario Boateng, Danso-Abbeam, H., & Y. Serfor-Armah. (2022). Occurrence of microplastics in gastrointestinal tract of fish from the Gulf of Guinea, Ghana. *Marine Pollution Bulletin*, 182, 113955–113955. <https://doi.org/10.1016/j.marpolbul.2022.113955>
- Pazoto, C. E., Silva, E., & Michelle Rezende Duarte. (2022). Ocean literacy in Brazilian school curricula: An opportunity to improve coastal management and address coastal risks? *Ocean & Coastal Management*, 219, 106047–106047. <https://doi.org/10.1016/j.ocecoaman.2022.106047>
- Rai, N. and Thapa, B. (2015) *A Study on Purposive Sampling Method in Research*. Kathmandu School of Law, Kathmandu, 5. - References - Scientific Research Publishing. (2015). Scirp.org. [https://www.scirp.org/\(S\(vtj3fa45qm1ean45vffcz55\)\)/reference/referencespapers.aspx?referenceid=3433795](https://www.scirp.org/(S(vtj3fa45qm1ean45vffcz55))/reference/referencespapers.aspx?referenceid=3433795)
- Rochman, C. M. (2016a). Strategies for reducing ocean plastic debris should be diverse and guided by science. *Environmental Research Letters*, 11(4), 041001–041001. <https://doi.org/10.1088/1748-9326/11/4/041001>
- Rodrigues, M., Abrantes, N., Gonçalves, F., Helena, João Carlos Marques, & Ana M.M. Gonçalves. (2019). Impacts of plastic products used in daily life on the environment and human health: What is known? *Environmental Toxicology and Pharmacology*, 72, 103239–103239. <https://doi.org/10.1016/j.etap.2019.103239>
- Rogers, E. M. (1995). Diffusion of Innovations: Modifications of a Model for Telecommunications. *Springer EBooks*, 25–38. https://doi.org/10.1007/978-3-642-79868-9_2
- Rousseau, Y., Watson, R., Blanchard, J. L., & Fulton, E. A. (2019). Evolution of global marine fishing fleets and the response of fished resources. *Proceedings of the National Academy of Sciences of the United States of America*, 116(25), 12238–12243. <https://doi.org/10.1073/pnas.1820344116>

- Ryabinin, V., Barbière, J., Haugan, P., Kullenberg, G., Smith, N., McLean, C., Troisi, A., Fischer, A., Aricò, S., Aarup, T., Pissierssens, P., Visbeck, M., Enevoldsen, H. O., & Rigaud, J. (2019). The UN decade of ocean science for sustainable development. *Frontiers in Marine Science*, 6 <https://www.frontiersin.org/articles/10.3389/fmars.2019.00470>
- Ryan, P. G., Moore, C. J., van Franeker, J. A., & Moloney, C. L. (2009). Monitoring the abundance of plastic debris in the marine environment. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 364(1526), 1999-2012. <https://10.1098/rstb.2008.0207>
- Sandifer, P. A., & Sutton-Grier, A. E. (2014). Connecting stressors, ocean ecosystem services, and human health. *Natural Resources Forum*, 38(3), 157–167. <https://doi.org/10.1111/1477-8947.12047>
- Sandu, C., Takacs, E., Suaria, G., Franco Borgogno, Laforsch, C., M. G. J. Löder, Gijsbert Tweehuysen, & Florea, L. (2020). Society Role in the Reduction of Plastic Pollution. *The Handbook of Environmental Chemistry*, 39–65. https://doi.org/10.1007/698_2020_483
- Santoro, F., Selvaggia, S., Scowcroft, G., Fauville, G., Tuddenham, P., & Europe, U. O. V. R. B. S. C. (2018) Ocean Literacy for All - a toolkit. Paris, France, IOC/UNESCO and UNESCO Venice Office, 136pp. (IOC Manuals and Guides, 80 Revised), (IOC/2017/MG/80rev.). DOI: <http://dx.doi.org/10.25607/OBP-1554>
- Severin, M. I., Akpetou, L. K., Annasawmy, P., Asuquo, F. E., Beckman, F., Benomar, M., Jaya-Ram, A., Malouli, M., Mees, J., Monteiro, I., Ndwiga, J., Neves Silva, P., Nubi, O. A., Sim, Y. K., Sohau, Z., Shau-Hwai, A., Woo, S. P., Zizah, S., Buysse, A., . . . Catarino, A. I. (2023). Impact of the citizen science project COLLECT on ocean literacy and well-being within a north/west african and south-east asian context. *Frontiers in Psychology*, 14 <https://www.frontiersin.org/articles/10.3389/fpsyg.2023.1130596>
- Stoler, J., Weeks, J. R., & Fink, G. (2012). Sachet drinking water in Ghana's Accra-Tema metropolitan area: Past, present, and future. *Journal of Water, Sanitation and Hygiene for Development*, 2(4), 223-240. <https://10.2166/washdev.2012.104>
- The Ocean Project (2009). “America, the Ocean and Climate Change: New Research Insights for Conservation Awareness, and Action, Key Findings”, [http://www.theoceanproject.org/resources/doc/America the Ocean and Climate Change KeyFindings 1Jun09final.pdf](http://www.theoceanproject.org/resources/doc/America%20the%20Ocean%20and%20Climate%20Change%20KeyFindings%201Jun09final.pdf)

- Tsai, L., Sasaki, T., Wu, C., & Chang, C. (2023). Ocean literacy among Taiwanese and Japanese high school students. *Marine Policy*, 150, 105555. <https://10.1016/j.marpol.2023.105555>
- Ugwu, K., Herrera, A., & Gómez, M. (2021). Microplastics in marine biota: A review. *Marine Pollution Bulletin*, 169, 112540–112540. <https://doi.org/10.1016/j.marpolbul.2021.112540>
- UNEP, 2009. Marine Litter: A Global Challenge. Nairobi: UNEP. 232 pp. Retrieved from <https://www.vliz.be/imisdocs/publications/ocrd/151908.pdf>
- UNEP 2005: Marine Litter, an analytical overview. Retrieved from <https://www.unep.org/resources/report/marine-litter-analytical-overview>
- UN Environment, 2017. Combating marine plastic litter and microplastics: An assessment of the effectiveness of relevant international, regional and subregional governance strategies and approaches. https://apps1.unep.org/resolutions/uploads/unep_aheg_2018_inf3_full_assessment_en.pdf
- UNEP. (2021). *UNEP Annual Report 2021*. UNEP - UN Environment Programme. <https://www.unep.org/annualreport/2021/index.php>
- Valdés, L., Mees, J., and Enevoldsen, H. eds (2017). *International Organizations Supporting Ocean Science Global Ocean Science Report - The current status of ocean science around the world*. Paris: UNESCO Publishing.
- Veiga, J. M., Vlachogianni, T., Pahl, S., Thompson, R. C., Kopke, K., Doyle, T. K., Hartley, B. L., Maes, T., Orthodoxou, D. L., Loizidou, X. I., & Alampei, I. (2016). Enhancing public awareness and promoting co-responsibility for marine litter in Europe: The challenge of MARLISCO. *Marine Pollution Bulletin*, 102(2), 309–315. <https://doi.org/10.1016/j.marpolbul.2016.01.031>
- Vince, J., & Britta Denise Hardesty. (2016). Plastic pollution challenges in marine and coastal environments: from local to global governance. *Restoration Ecology*, 25(1), 123–128. <https://doi.org/10.1111/rec.12388>
- Wessman, W. L. (2006). The nature of thought: Maturity of mind.
- Williamson, K., Given, L., & Scifleet, P. (2018). *Qualitative data analysis*. ResearchGate; https://www.researchgate.net/publication/323516751_Qualitative_data_analysis unknown.
- World Bank (2020). Ghana - Country Environmental Analysis.
- Young, J., David Christian Rose, Mumby, H. S., Benitez-Capistros, F., Derrick, C. J., Finch, T., Garcia, C., Home, C., Marwaha, E., Morgans, C., Parkinson, S. T.,

Shah, J., Wilson, K. A., & Mukherjee, N. (2018). A methodological guide to using and reporting on interviews in conservation science research. *Methods in Ecology and Evolution*, 9(1), 10–19. <https://doi.org/10.1111/2041-210x.12828>

Yuan, Z., Nag, R., & Cummins, E. (2022). Human health concerns regarding microplastics in the aquatic environment - From marine to food systems. *Science of the Total Environment*, 823, 153730–153730. <https://doi.org/10.1016/j.scitotenv.2022.153730>

Appendices

Appendix A: Interview Questions

DEMOGRAPHIC INFORMATION

1. Name:
2. Gender:
3. What grade/class do you teach?
4. What subject(s) do you teach?

OBJECTIVE ONE: To assess the level of ocean literacy among high School teachers (teachers) in Ghana.

INTERVIEW QUESTIONS

5. How conversant are you with the term Ocean literacy?
6. Briefly explain in your own words what ocean literacy means.
7. Can you describe the following ocean-related topics?
 - i. Marine ecosystems and habitats?
 - ii. Marine pollution?
 - iii. Sea level rise?
8. Are you familiar with the harmful effects of plastics on land and in the ocean? Can you elaborate?
9. On a scale of 1-5 (1 very low and 5 very high), What is the current level of your knowledge about plastic pollution and its effects on the environment?

| 1 (Very low) | 2 (Low) | 3 (Average) | 4 (High) | 5 (Very High) |
|-----------------|------------|----------------|-------------|------------------|
| | | | | |

10. In your opinion, how important is it for high school teachers to possess this knowledge?

OBJECTIVE TWO: To investigate the strategies employed by teachers in addressing plastic pollution in the classroom

INTERVIEW QUESTIONS

11. Do you discuss subjects relevant to environmental pollution in your teaching?
12. Do any of the subjects specifically address plastic pollution and its effect on the environment?
13. Do you discuss management and prevention measures to prevent plastic pollution?
14. Do you think it is necessary to include plastic pollution or related topics in your teaching?
15. Have you collaborated with other teachers or institutions to teach about plastic pollution?
16. On a scale of 1 – 5 (1 very low and 5 very high), how effective do you think educating the students on the effects of plastic pollution can be in resolving Ghana’s case of plastic pollution? And why?

| 1 (Very low) | 2 (Low) | 3 (Average) | 4 (High) | 5 (Very High) |
|-----------------|------------|----------------|-------------|------------------|
| | | | | |

OBJECTIVE THREE: To provide recommendations for a robust ocean literacy strategy /curriculum to help mitigate the number of plastics entering the oceans from land-based sources.

INTERVIEW QUESTIONS

17. What do you think is needed to make the curriculum more robust in order to address plastic pollution practically?
18. In your experience, what are some effective strategies or approaches that can be adopted by yourself and other teachers to address plastic pollution in the classroom?

Appendix B: Consent Form



Dear Participant,

Thank you for agreeing to participate in this research survey, which is carried out in connection with a Dissertation which will be written by the interviewer in partial fulfilment of the requirements for the degree of Master of Science in Maritime Affairs at the World Maritime University in Malmo, Sweden.

The topic of the Dissertation is ***An Evaluation of The Role of Ocean Literacy in Reducing Ghana's Marine Plastic Pollution from Land-Based Sources: From the Educator's Perspective.***

The information provided by you in this interview will be used for research purposes, and the results will form part of a dissertation, which will later be published online in WMU's digital repository (maritime commons) subject to final approval of the University and made available to the public. Your personal information will not be published. You may withdraw from the research at any time, and your personal data will be immediately deleted.

Anonymised research data will be archived on a secure virtual drive linked to a World Maritime University email address. All the data will be deleted as soon as the degree is awarded.

Your participation in the interview is highly appreciated.

| | |
|----------------|---|
| Student's name | Emelia Akurubire |
| Specialization | Ocean Sustainability, Governance and Management |
| Email address | W1012760@wmu.se |

* * *

I consent to my personal data, as outlined above, being used for this study. I understand that all personal data relating to participants is held and processed in the strictest confidence and will be deleted at the end of the researcher's enrolment.

Name:

Signature:

Date:

Rev August 2021