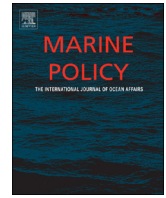




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Youth and the sea: Ocean literacy in Nova Scotia, Canada

Haley Guest^{a,b,*}, Heike K. Lotze^a, Douglas Wallace^b^a Department of Biology, Dalhousie University, 1355 Oxford Street, Halifax, Nova Scotia, Canada B3H 4R2^b Department of Oceanography, Dalhousie University, 1355 Oxford Street, Halifax, Nova Scotia, Canada B3H 4R2

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ABSTRACT

Improving public awareness about the ocean can benefit the environment, economy, and society. However, low levels of ‘ocean literacy’ have been identified in many countries and can be a barrier for citizens to engage in environmentally responsible behavior or consider ocean-related careers. This study assessed the level of ocean valuation, knowledge, interaction and interest of public school students grade 7–12 (ages 12–18) in Nova Scotia, Canada, a region with strong connections with the sea. A survey was used in 11 public schools, with a total of 723 students participating in a quiz and survey. Many quiz questions were aligned with the ‘Ocean Literacy Principles’ established by the Ocean Literacy Campaign in the United States. Although the average quiz score was below 50%, students reported a high valuation of the marine environment and diverse interest in the oceans, including jobs and careers. There was a distinct difference in knowledge of biology-related questions and abiotic-related questions, with students having more knowledge of and interest in topics concerning ocean life. A significant positive correlation between knowledge and value indicated that ocean-literate students might value the marine environment more strongly. Students reporting greater interaction with the ocean also demonstrated higher knowledge levels, and students with higher knowledge levels were more likely to be interested in ocean-related jobs and careers. Participants’ high valuation of the marine environment and interest in ocean jobs and careers suggests important links between ocean literacy and environmental and economic benefit, respectively. Enhancing interactions with the ocean through experiential learning could be the most effective way of improving ocean literacy as well as marine citizen- and stewardship.

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1. Introduction

Although the social, ecological, and economic value of the ocean has been long and widely recognized [33,13], human activities continue to threaten the health and integrity of the marine environment [16,25,39]. To ensure sustainable use of ocean resources there is a need for both top-down and bottom-up approaches; that is, responsible policies, regulations and management strategies [29] as well as individual behavior changes [27]. However, it has become increasingly evident that citizens in many countries have a poor understanding of marine science and ocean issues [36,4,37,35,21,17], which may act as a barrier to individual behavior changes [20]. Furthermore, there is growing awareness that formal education curricula do not adequately communicate ocean science to young people, as low levels of ocean science understanding are evident among students in a number of countries [6,7,15,3,14,35].

Ocean literacy has been defined as “an understanding of the ocean’s influence on you – and your influence on the ocean” by a cooperating group of scientists and educators in the United States [12]. Beyond understanding, an ocean-literate citizen uses ocean knowledge and awareness of ocean issues to communicate about the ocean in a meaningful way and make informed and responsible decisions [12]. This translation of knowledge into action has been recognized as ‘marine citizenship’, and is proposed as a method of ‘bottom-up’ ocean management to reduce negative human impacts on the ocean through collective behavior changes [27]. While not the principal goal of ocean literacy, it is believed that a greater understanding of the marine environment is likely to prompt citizens to feel a responsibility to act as stewards of the ocean [27]. Recognizing that many social, cultural, and economic factors are thought to influence marine citizenship, and that these may ultimately affect an individuals’ likelihood to act as a marine citizen [28], ocean awareness is nonetheless deemed a crucial ‘prerequisite’ to behavioral change [20].

Ocean education therefore emerges as a logical step towards a more ocean-literate public and enhancing marine citizenship, as participation in environmental education has been identified as the most important predictor of environmental behavior [22]. Still,

* Corresponding author at: Department of Biology, Dalhousie University, 1355 Oxford Street, Halifax, Nova Scotia, Canada B3H 4R2.

Tel.: +1 902 494 3406; fax: +1 902 494 3736.

E-mail address: haley.guest@dal.ca (H. Guest).

knowledge is not the sole cause for behavior change but rather one among many essential preconditions leading to action [24]; personal values and attitudes towards an environment are also an integral part of marine and environmental citizenship [5]. This is important to consider in approaching marine education, as students approach learning experiences with their previous knowledge, values, and memories of experiences [2]. On connecting society to the sea, Jefferson et al. [23] recognized the need to “involve multiple audiences, each considering different elements of the marine environment to be most interesting, valuable, or relevant.” Hence, an investigation into students' knowledge of the ocean and attitudes towards the marine environment can aid in designing the most effective learning experiences.

In Canada, individual provinces and territories are responsible for designing and implementing educational curricula. It is important to know if current provincial education strategies encourage youth to value the ocean or develop a strong understanding of ocean science concepts, especially in provinces with strong cultural, social, and economic ties to the sea. Nova Scotia is one such province on the east coast of Canada; with a population of 920,000 and situated near one of the world's largest tides in the Bay of Fundy, its historic natural resources were primarily forestry and fishing [9]. Today, the ocean sector is responsible for over 15% of

GDP and is expected to grow in the future [34], yet the province is facing a foreseen economic and population decline [31]. Understanding young people's knowledge of and interest in the ocean could play a critical role in overcoming these future challenges, as science education has been shown to influence career aspiration of students [38].

While ocean sciences are taught in the grade 8 (age 13–14) provincial curriculum and offered as an optional high school course since the late 1990s, it is unclear whether this is helping produce ocean-literate students. In 1987, a comparison of ocean knowledge between students in Maine, US and Atlantic Canada found that Canadian students demonstrated slightly higher scores on a quiz than their American counterparts, yet generally low scores were evident overall [6]. Still, Nova Scotia students score below the Canadian average on national science assessments [32], indicating a general knowledge gap in sciences.

Looking towards the future of ocean science in Canadian curricula, there is indication that the ocean is not viewed as a relevant topic for Canada's Education Ministers. In a 2014 report that identifies Canada's priorities to be addressed moving beyond the UN Decade of Education for Sustainable Development, oceans were not selected as an issue of importance [11]. The COSEE [12] Ocean Literacy ‘Principles and Concepts’ for grades K-12 (ages 4–18) have

Table 1

List of 11 short-answer questions asked on the ocean quiz and their corresponding ocean literacy principle [12].

Question	Ocean literacy principle
1. Multiple choice: A whale is a... a. fish b. mammal c. both	5
2. Fill in the blank: The surface of the earth is about ____% (percent) covered by oceans.	1
3. Multiple choice: What is plankton? a. Floating wood debris from land. b. Very small plants and animals that drift with ocean currents. c. A messy, slimy substance produced by whales. d. A type of small fishing vessel.	5
4. Multiple choice: Where does the salt in seawater come from? a. Ships dumping salty wastewater into the sea. b. Photosynthesis of coral reefs and ocean plants. c. Decomposition of dead fish and other ocean animals. d. Erosion of rocks on land and sea. e. I don't know.	1, 2
5. Multiple choice: An ‘abyssal plain’ is... a. A large flat area of the ocean floor. b. A special type of submarine used to explore the deep ocean. c. An underwater volcano. d. An aircraft wreck on the seafloor. e. I don't know.	1
6a. Multiple choice: How deep is the deepest part of the ocean? a. 500 m b. 1000 m c. 6000 m d. 11,000 m e. I don't know	1
6b. Open-answer: What is the name of the deepest part of the ocean?	1
7. Multiple choice: How much of the ocean, below the surface, have humans explored? a. Less than 5% b. 15% c. About half d. Humans have explored almost the entire ocean e. I don't know	7
8. True or False: Most rain that falls on land originally evaporated from the ocean.	3, 6
9. Open-answer: The largest animal in the world lives in the ocean. What is this animal?	5
10a. Multiple choice: How much oxygen in the atmosphere (that we breathe) comes from the ocean? a. None b. A little bit (10–25%) c. About half (50–60%) d. Almost all (90–100%) e. I don't know	3, 4
10b. Open-answer: What produces this oxygen?	3, 4
11. True or False: The first life on earth is thought to have evolved in the ocean.	4

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