

Trainer's views of Indicators Comprising Ocean Literacy

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本研究は、海洋リテラシーを評価するための具体的な方法を開発することを目的とする。そのための第1段階として、海洋教育および水産教育の現場で活動する指導者104名を対象に、自由記述により海洋リテラシーを意味する具体的な指標（語句）を427個収集した。それらの語句を97個に精選した後、第2段階として海洋教育の現場で活動する指導者163名を対象に質問紙調査を実施し、海洋リテラシーを構成する指標の構成について多変量解析を用いて分析した。その結果、海洋リテラシーは「説明力」と「理解力」の2つの側面から構成されていると考えられた。さらに「説明力」は中位の指標として「人と海の関わりについて説明する力」と「海での活動に関わる知識と経験」によって構成され、「理解力」は「海についての認識」と「海での活動能力」によって構成されていると考えられた。

Keywords: ocean literacy, indicators, cluster analysis

1. Objectives

The UN Convention on the Law of the Sea (UNCLOS), an international ocean agreement that took effect in 1994, categorized the ocean into various zones with different legal characteristics (including inland waters, territorial waters within 12 nautical miles, contiguous zones, exclusive economic zones (EEZ) and international waters), and delimited continental shelves and the ocean floor.¹⁾ In addition to UNCLOS, other documents of great significance in ocean resource management include the Rio Declaration on Environment and Development, which has become synonymous with the principle of “sustainable development” espoused at the 1992 Earth Summit, and the “Agenda 21” action plan, which was devised to carry out the Rio Declaration. In terms of education and human resources development in the context of ocean management, Agenda 21 called for initiatives promoting the introduction of ocean education curricula, which is a theme of ocean environmental

protection in each country. In Japan, the Basic Act on Ocean Policy took effect in 2007 following the passage of legislation introduced by a Diet member, and the Basic Plan on Ocean Policy took effect in 2008. Through these policies, international treaties and law have obliged the citizens of Japan to appropriately manage the ocean, which is a foundation of their lives, to limit their activities to in accordance with the ocean's capacity, and to practice sustainable development and use of ocean resources.²⁾

Under these circumstances, ocean education has attracted considerable attention. Providing ocean education and raising awareness of issues in ocean resource management have been identified as critical issues in Japan that will be necessary in order to increase people's knowledge and understanding of the ocean and to inspire a proactive interest in coexistence with the ocean, particularly among young people.³⁾

The United States has conducted systematic ocean education in each of its regions since the

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1960s, primarily through the Sea Grant program. One major problem the US faced in ocean education, however, is that elementary school through high school textbooks do not cover ocean science at all. The ocean literacy movement in the US that arose to deal with this situation began by providing a platform for a discussion on defining the contents and message of “ocean literacy” based on suggestions from a web conference of 100 ocean educators and researchers in October 2004. A working group meeting held in Berkeley, California in 2005 defined ocean literacy and ocean concepts and generated a list of ocean science courses for grades K-12. In addition to defining ocean literacy, the group presented basic principles consisting of seven major items (“Essential Principles”) and 44 sub-items (“Fundamental Concepts”).⁴⁾

“Ocean literacy” refers to the ability to acquire and use knowledge concerning the ocean. Ocean literacy has also been defined as an understanding of the influence of the ocean on human beings and the influence of human beings on the ocean.⁵⁾

There is concern that the lack of ocean-related content in elementary through high school education in Japan will have a negative impact on diverse areas such as the day-to-day lives of Japanese people, industrial activities, scholarship and intellectual production, diplomacy, and policymaking targeting environmental problems now and in the future; in order to avoid these problems, it is necessary to increase the ocean literacy—i.e., basic knowledge about the ocean—of Japanese citizens.⁶⁾

Furthermore, students educated within the scope of government curriculum guidelines, not counting the approximately 7% of students who complete high school earth science (special) or earth science (supervision), have been shown to receive fewer than 20 hours of education in topics related to fisheries and the ocean.⁷⁾

In order to increase ocean literacy, school educa-

tion and ocean education leaders need to establish a clear, concrete image of ocean literacy and reflect this in their classroom educational methods while at the same time avoiding abstract concepts and expressions. It will also be necessary to set clear evaluation standards for ocean literacy so that educational effectiveness can be analyzed and projects and lessons can be evaluated.

The objective of this research was to examine indicators constituting ocean literacy that have not previously been adequately examined in Japan and to propose a framework for the development of concrete methods for evaluating ocean literacy.

2. Methods

2.1. Written survey

2.1.1. Collecting survey items

Specific phrases constituting ocean literacy were collected using a written survey administered to leaders involved in seashore experience activities and teachers in fisheries vocational high schools, who are involved in ocean education every day and are therefore considered to have a deep understanding of the subject. The survey of experts in ocean education, such as leaders involved in seashore experience activities, was administered to 23 participants in the Council for Nature Activity along the Coast (CNAC) in June 2009 and to 29 fisheries vocational high school teachers and assistants in August 2009, each time surveying the subjects in groups. In addition, 130 individuals were mailed survey forms directly by post; data from 52 respondents who returned the survey (40% response rate) were included in the analysis. The subjects of investigation comprised persons with at least 10 years of training employed at fisheries high schools, and the average number of years of instruction on topics related to the ocean was 14.4 years. Postal surveys were sent between October and December 2009. A total of 427 phrases were extracted from a total of

104 surveys.

2.1.2. Narrowing down survey items

Phrases were eliminated if they were abstract or difficult to understand, or if they were ambiguous, and phrases with similar meanings were consolidated. The comprehensibility of the extracted phrases was checked by testing them on five university students majoring in marine science and technology. As a result, 97 specific terms concerning ocean literacy were selected and included in the final analysis.

2.2. Questionnaire survey

2.2.1. Survey content

The 97 terms were classed into six grades, from “very good fit” to “not a fit at all”, with respect to four different types of people: males who probably have high ocean literacy (I), males who probably do not have high ocean literacy (II), females who probably have high ocean literacy (III) and females who probably do not have high ocean literacy (IV). Evaluators responded concerning one designated type among these.

2.2.2. Survey subjects

The questionnaire survey was sent by post to 255 experts in ocean education, such as fisheries vocational high school teaching staff and leaders involved in ocean education projects. Data from 163 respondents who returned the survey forms were included in the analysis (response rate 63.9%). The surveys were sent between October and December 2010. Groups I, II, III, and IV included 43, 33, 47 and 40 respondents, respectively.

2.2.3. Examination of survey item validity and capacity to discriminate between levels of ocean literacy

First, to check whether each of the 97 items could discriminate between people who have high ocean literacy and people who do not have high ocean literacy, a t-test was used to determine the

difference in the average score of each item between groups I and III (males and females who probably have high ocean literacy) and groups II and IV (males and females who probably do not have high ocean literacy). The results showed a significant difference of the 0.1% level for all items, so it was judged that all items have the capacity to discriminate between levels of ocean literacy.

Next, exploratory factor analysis was conducted on the 97 items. To investigate the validity for conducting factor analysis, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was calculated and found to be $KMO = .968$, thus ensuring validity. When performing factor analysis, after factors were extracted by the maximum likelihood method, the promax method was used to rotate the factor axis, with the result that nine factors were extracted. One item did not belong to any of these nine factors: No. 91, “Able to explain a tsunami.”

To clarify the deeper relationships among items after the factor space had been narrowed, the items belonging to each of these nine factors underwent factor analysis again. As a result, four lower-order factors were extracted from Factor No.1, two lower-order factors from Factor No.2, and two lower-order factors from Factor No.3. Factors No.4 and beyond were single factors.

Five items did not belong to any lower-order factor: No.9, “Able to explain the ocean and the carbon cycle”; No.21, “Able to explain actions for a sustainable ocean”; No.31, “Able to explain marine bioresources”; No.93, “Able to explain how to use ocean water”; and No.94, “Has had the experience of playing sports on the beach.”

2.2.4. Cluster analysis

After excluding the six items above, cluster analysis was conducted to clarify the neighboring relationship of the 91 items that have the capacity to discriminate between levels of ocean literacy and have validity.

3. Results and discussion

The result of cluster analysis was the clusters shown in Fig. 1. The authors named each cluster; care was taken to use the content of each item to name each lower-level indicator as far as possible. When the upper-level indicators were named, the relationship to other upper-level indicators was taken into consideration.

Based on the results of cluster analysis, ocean literacy can be considered to comprise two aspects: "ability to explain" and "ability to understand." The examination of item validity yielded nine factors, but "ability to explain" was thought to correspond to Factor No.1, "ability to act" to Factor No.2, and "awareness and emotions relating to the ocean" to Factor No.3. "Ability to understand" is thought to comprise Factors No.2 and 3 as derived from factor analysis. "Ability to explain" comprises "ability to explain the relationship between people and the ocean" and "knowledge and experience relating to ocean activities" as intermediate indicators, whereas "ability to understand" comprises "ocean awareness" and "ability to be active at the ocean."

"Ability to explain the relationship between people and the ocean" comprises the lower-level indicators "ability to explain resources and social background," "ability to explain relationships with the ocean" and "ability to explain the environment and ecosystems"; "knowledge and experience relating to ocean activities" comprises the indicators "experience in ocean activities," "knowledge and skills relating to boats" and "ability to explain ocean phenomena and dangers"; and "awareness of the ocean" comprises "emotions toward the ocean" and "understanding of the necessity of the ocean."

Sasaki defined ocean literacy among Japanese people by adapting the learning cycle as follows:

a) Invitation: investigation of the aquatic marine environment; b) Exploration: thinking about envi-

ronmental issues; c) Concept Invention: understanding ocean literacy; d) Application: deciding and acting in a responsible manner; and e) Reflection: informing others of one's intentions. The awareness and emotions relating to the ocean, the ability to understand, the ability to act, and the ability to explain ocean concepts identified in the present research correspond to a), c), d) and e) of this definition, respectively.⁹⁾

Ocean literacy, as advocated in the US, is an understanding of the ocean's influence on individuals, as well as individuals' influence on the ocean, and an ocean-literate person a) understands the essential principles and fundamental concepts about the ocean; b) can communicate about the ocean in a meaningful way; and c) is able to make informed and responsible decisions regarding the ocean and its resources.⁸⁾ The ability to understand and the ability to explain ocean concepts identified in the present research correspond to a) and b) of this definition, respectively.

However, the present results do not necessarily correspond to the seven major items and 44 sub-items indicated as basic principles of ocean literacy in the US. Sasaki conducted a consciousness survey of marine educators in Japan and the US and found that marine educators in the US have a strong consciousness of environmental education and consider the ocean to be valuable for both scientific and leisure activities. On the other hand, Japanese marine educators consider the ocean to be primarily a resource for seafood production. Thus, marine educators in Japan and the US have different ways of thinking about the ocean.¹⁰⁾ As the survey subjects in the present study included individuals who use seashore experience activities as an educational resource as well as fisheries vocational high school teachers, it is possible that the present results emphasize not only intellectual aspects but also practical ability. In addition, the fact that the results

指導者から見た海洋リテラシーを構成する指標

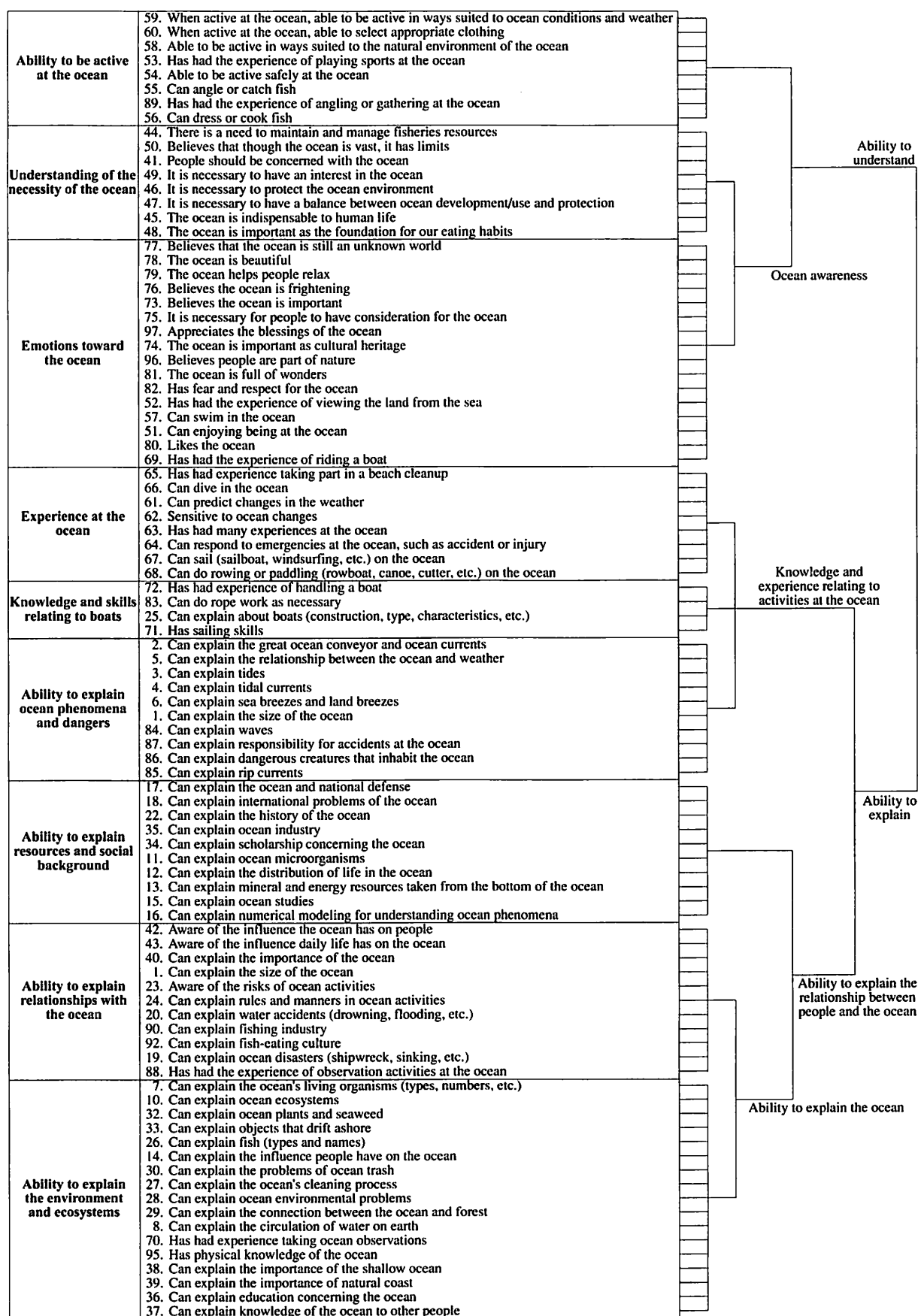


Fig.-1. Clusters of indicators comprising ocean literacy

included emotions toward the ocean in addition to knowledge suggests that appropriate results were obtained in terms of expressing Japanese citizens' understanding of the ocean.

In the future, the development of questionnaires to evaluate ocean literacy based on the concepts identified in this research will allow researchers to evaluate seashore activity programs and analyze their effectiveness.

4. Conclusion

In order to clarify indicators constituting ocean literacy, this research took phrases collected from leaders in seashore experience activities and fisheries vocational high school teachers, had the phrases evaluated by 163 leaders in seashore experience activities and fisheries vocational high school teachers, and then conducted cluster analysis to show the neighboring relationship of the items. Based on the results, ocean literacy can be considered to comprise two aspects: "ability to explain" and "ability to understand." "Ability to explain," furthermore, comprises "ability to explain the relationship between people and the ocean" and "knowledge and experience relating to ocean activities" as intermediate indicators, whereas "ability to understand" comprises "ocean awareness" and "ability to be active at the ocean."

"Ability to explain the relationship between people and the ocean" comprises the lower-level indicators "ability to explain resources and social background," "ability to explain relationships with the ocean" and "ability to explain the environment and ecosystems"; "knowledge and experience relating to ocean activities" comprises the indicators "experience in ocean activities," "knowledge and skills relating to boats" and "ability to explain ocean phenomena and dangers"; and "awareness of the ocean" comprises "emotions toward the ocean" and "understanding of the necessity of the ocean."

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Additional remark

*This research was supported by a Grant-in-Aid for Scientific Research (C) General (21500554: Basic research concerning the acquisition and eval-

uation of ocean literacy from seashore experience activities).

(平成24年4月12日)

野外教育研究

第15巻第2号（通巻第29号）

2012年 7月

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