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Literacy Education Program

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# Direction of Aquatic and Marine Environmental Literacy Education Program

Tsuyoshi SASAKI (Graduate School, Tokyo University of Marine Science and Technology)

## 【Abstract】

In Japan, Marine technical education has been strongly conducted, but there have not been systemic and systematic engagement to enhance common ideas for oceans. For that reason, many Japanese people lack knowledge related to the ocean. A lack of knowledge about the ocean and its processes can be expected to cause numerous problems. In Japan, Tokyo University of Marine Science and Technology publishes Aquatic Marine Environmental Literacy (AMEL) Principles. Not only scientific knowledge, but also traditional and ecological knowledge were built in the AMEL. Making AMEL Principles can connect between marine science and national science standards. Such a revolution will be extremely meaningful to conduct marine science education in formal education and informal education.

## 【Key words】

Aquatic Marine Environmental Literacy (AMEL), AMEL Education Program, Tokyo University of Marine Science and Technology

## I Features of Japanese marine education

### (1) Features of Japanese marine education

Japanese marine education is classifiable into two categories of formal school and informal school. Formal school education is engaged systematically at vocational high school such as Suisan<sup>1</sup>(fisheries) high school governed by the Ministry of Education, Culture, Sports, Science, and Technology. Such an education system has supported fisheries industrialization in this country for more than 100 years<sup>1</sup>). Informal education (e.g. Japan 4-H centers, aquariums, and NPOs) have also played a critical role. Nevertheless, the partnership between formal education and informal education has no strong link.

### (2) Role of SUISAN education as vocational education

Marine technical education has contributed to the development of marine science and technology in Japan. This education has been conducted

systematically in formal schools such as Suisan high schools and Universities in respective coastal areas throughout Japan (Figure 1).

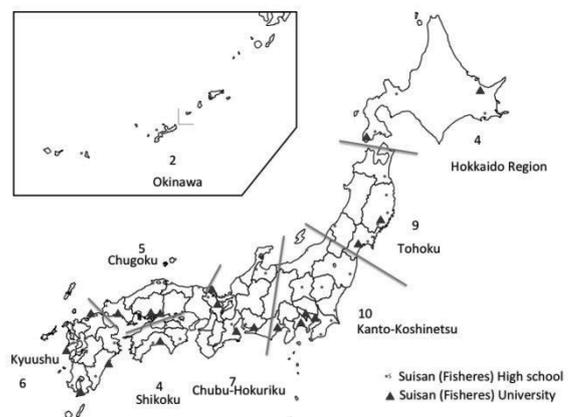


Figure 1 46 Suisan high schools indicated circles, and 21 Department of Fisheries Science in University indicated triangles around country.

For that reason, the development of marine industry in Japan is based on the development of regional industry. Since 1895, 46 Suisan high schools have conducted cultivation of skilled human resources in 47 regional areas to activate local industry (e.g., oil tuna canning, salmon bone canning, oyster aquaculture systems). Through positive engagement in cultivating specialists of Suisan high schools in local areas, high school

<sup>1</sup> Suisan means Japanese original industry which express not only primary industries (i.e. fishery, aquaculture), but also secondary industry (i.e. sea food processing) and third industries (i.e. retail, buffet and sightseeing)

graduates have found excellent job opportunities at firms such as Hanami-oyster, and the Herring revival project<sup>2)</sup>.

It is unquestionable that cultivating specialists in Suisan high schools produce human resources who can support local industry. Of course, local industry is supported by many specialists and facilities, but it is especially fitting that the Suisan high school contribution be recognized.

### (3) Marine education as a specialized system of vocational education

Fisheries and maritime technologies have been supported by these forms of technical formal education in Japan. Nevertheless, few Japanese people have access to such technical marine education.

The especially low number of formal school students means that Suisan high school students are able to study intensively about marine science technology. But, for future marine education to achieve sustainable ocean utilization, we must discuss national standards related to how marine education in formal education is settled.

According to national standards, Suisan education only fulfills a prominent role as marine education in formal schools in national standards. However, Suisan education is aimed at cultivating technical specialists, not students for general education. The number of Suisan high school is only 0.3% of all high schools. The remaining 99.7% of students study in usual high schools. Students of such schools study about ocean science only in geology classes. Geology classes are not conducted very much too.

Actually, Suisan education has played an adequate role for technical marine education facilities. Nevertheless, nothing has existed in terms of systemic formal marine education for K–12 years. Consequently, marine education is designed only for technical education, but it is inadequate for general education.

### (4) National policy related to marine education

There are following educational facilities related to marine education in Japan government agencies<sup>3)</sup> except Suisan high school (Plate 1). National College of Maritime Technology: The governing agency is the Ministry of Education, Culture, Sports, Science and Technology for the university level. National Fisheries University: The governing agency is the Fisheries agency for the university level. Maritime school: The governing agency is Ministry of Land, Infrastructure, Transport and Tourism for the high school level. Maritime Junior College: The governing agency is the Ministry of Land, Infrastructure, Transport and Tourism for the junior college level. Japan Coast Guard Academy: The governing agency is Japan Coast Guard National Defense Academy of Japan: The governing agency is the Ministry of Defense for university level. Almost all education policy in Japan government agencies is technical education.

Table 1 Education policy of Japan government agencies related to marine education except for Suisan high school and University governed by the Ministry of Education, Culture, Sports, Science and Technology

Educational facility	Proper authorities	Education level
National College of Maritime Technology	Ministry of Education, Culture, Sports, Science and Technology	University
National Fisheries University	Fisheries agency	University
Maritime school	Ministry of Land, Infrastructure, Transport and Tourism	High school
Maritime Junior College	Ministry of Land, Infrastructure, Transport and Tourism	Junior College
Japan Coast Guard Academy	Japan Coast Guard	University
National Defense Academy of Japan	Ministry of Defense	University

### (5) Informal education

Informal marine education is conducted at aquariums, Japanese 4-H centers, and NPOs. Especially, aquariums play an important role for marine education for the general public. Japan, the numbers of aquariums per capita in the world is said to be largest aquarium<sup>4)</sup>. More than 200 facilities exist throughout the country. Japanese 4-H centers contribute to informal marine education<sup>5)</sup>. About 250 Japanese 4-H centers exist throughout the country. Furthermore, NPOs play an important role for formal marine education for general public. The law of NPOs was established 1998. About 37000 NPOs exist throughout the country<sup>6)</sup>. These three types of facilities appear to be necessary to solve the following issues such as few educators have sufficient specialized education, and only weak connections exist between each facilities.

### (6) Importance of connecting of formal education and informal education

Regarding the feature of marine education, to engage marine education in formal school as a general education, a better connection between formal education and informal education is necessary. In Japan, no sufficient connection exists between formal education and informal education.

Recently the Ministry of Education, Culture, Sports, Science and Technology began to integrate study and inquiry-based study into the 12-grade curriculum. Formal schools began to engage in such studies connecting with NPOs or Suisan high school or other facilities. For example, NPOs connect to elementary schools to cultivate Nori (seaweed) in Minato-ward in Tokyo<sup>7)</sup>.

However, this engagement has just only started, and is conducted only in a single small local area. Those achievements notwithstanding, there is no platform and reference standard for marine education, school teachers have no idea how to link national standards and marine education. In addition, it is difficult to connect

informal education between different NPOs, aquariums, and 4-H centers. Therefore, we have no reference standard about marine science. For that reason, there remain some problems related to how to conduct systemic engagement for marine education.

## **II Necessity of ocean literacy as common knowledge**

### (1) Ocean literacy program to promote ocean education

Common studies related to marine science have not been conducted in Japan, and there have been few relations between formal school and informal education. Marine education must be conducted in cooperation with formal education and informal education. For formal education, national standards with defined minimum standards are needed. To conduct marine education, a definition of relation between national standards and marine education is required. However, because that has been lacking in the national standards, there have been only insufficient curriculum contents related to studies of the ocean. Actually, it is difficult to carry out marine education.

However, fortunately, marine science includes almost all sciences such as physics, chemistry, biology, geology, and problem-solving study. It is possible to connect those science subjects to study marine education. Marine education is difficult for teachers when they teach in outdoor fields because of a lack of technical knowledge. However, cooperation between formal school and informal education such as aquariums and NPOs makes it possible to use local fields for students and to study science subjects comprehensively. As a matter of course, connecting marine education and national standards must be premised on cooperation

### (2) Organizing the contents of marine science

Interdisciplinary challenges to connect to the formal education and the specialized field are very

intricate because many specialized fields exist, because it is difficult to connect them, and because divisions persist between specialized fields and the general public. It is difficult to produce reference standards related to marine education.

However, producing reference standards might generate the possibility of understanding and studying where the subject is positioned within the framework of marine science or how the subject is applicable to national standards.

### (3) Fostering ocean literacy

All concerned people including marine science researchers, along with educators, NPOs, aquariums, Suisan high school teachers, other school teachers, and education researchers wanted to participate in discussions to produce a reference standard for ocean science in Japan. However, we have no venue or opportunity to exchange information among such people.

But recently, many marine researchers and educators are concerned about the lack of marine education. For example, the Oceanographic Society of Japan, the Japan Society of Fisheries Science, the Japan Society of Marine Architects and Engineers have all engaged in promoting marine education development. The Oceanographic Society of Japan launched a division dedicated to marine science issues research, the Information Board of the Japan Society of Fisheries Science promoted fisheries science education for the general public and K–12.

In addition, it is a fact that few descriptions about marine science exist in the national standard of grades K–9. Almost all science textbooks intended for use in elementary schools include few words referring to oceans, with only 3% of words referring to oceans in all books. Because of the lack of the ocean literacy, we have no reference standard related to marine science, and no idea how to agree upon a national science standard for grades K–12.

Consequently, although each marine

education program is conducted in each area, we have no idea how to teach marine science in relation to school subjects. Almost all participants involved with marine science researchers and educators hope to have consultation criteria for marine science to advance marine education in grades K–12 and the general public. Our university chose preparation of ocean literacy as a consultation criterion.

### (4) Aquatic Marine Environmental Literacy Program in TUMSAT

In Japan, Tokyo University of Marine Science and Technology publishes Aquatic Marine Environmental Literacy Principles based on ocean literacy in the US. Not only scientific knowledge, but also traditional and ecological knowledge were built in AMEL Principles. Making AMEL Principles can connect between marine science and national science standards. Such a revolution will be extremely meaningful to conduct marine science education in formal education and informal education.

### (5) Establishing AMEL Educating Program to make human resources

With these engagements to establish AMEL Principles, TUMSAT had started new program “AMEL Educating Program” since 2007. The major point and purposes of the program is following.

#### *i The major point and purposes of AMEL Educating program*

The program is to develop AMEL Education Leader who promote and understand AMEL Principles as comprehensive science approach building social consensus regarding preservation of bio-diversity or utilization and management to maintain aquatic marine environment. The AMEL Education leader instruct in field work for general public and K-12 and general public based on technical knowledge about aquatic marine environment fostering AMEL Principles built upon education and research of AMEL principles.

#### *ii Establishment of new curriculum*

We established new curriculum to make the AMEL Education Leader have following abilities.

*a. AMEL study...*Enhancing ability to understand aquatic phenomena and to apply comprehensive knowledge in fields such as ocean culture.

The following three points make an important contribution to realization of a sustainable marine environment, 1) general understanding of the various marine phenomena, 2) knowledge and understanding of the symbiotic relationship between the sea and human society, 3) ability to communicate clearly with the general public. For that reason, “AMEL Communicating Study” was established as courses cross subject lines.

Existing related subjects: Ocean science, Maritime science, Ocean and Life, Ocean and culture, Ocean and cultural history, Environmental philosophy, Introduction of Ocean science

*b. AMEL Field Study...*Enhancing ability to enlighten the public about the importance of the aquatic marine environment through aquatic marine activity

The law of environmental education to promote environmental conservation activities mentions, “the importance of deepening awareness and understanding of the environment and evoking a sense of awe for it” and “the need for nature experience fieldwork that evokes those characteristics.” According to the Japanese government’s Education Rebuilding Council, “Enhanced nature experience education for elementary school students will enhance their moral education.” In conducting aquatic nature experiential study, considering about safety of aquatic activities and importance of study contents, nature experiential education leader who have knowledge and experience, ability of interpreter to inform magnificence of nature and culture through experience have an important role. We made new course, “AMEL field studies”.

Existing related subjects: Freshmen’s seminar, Ocean and education, Ocean recreational study, Coastal survey training, Marine biological

field training study, Ocean environmental field training study

*c. AMEL Communicating Field study ...*Enhancing ability to communicate AMEL comprehensively to K–12 students and the general public.

Because Science and Technology (ST) are crucial influence to human life, we not only accept beneficialness of these, but also we must have mental attitude of thinking about what is science and an attitude to make correct judgment as responsible citizen. Actually Science and Technology had supplied useful life style, had been increased expectation, and had been integrated daily life, on the contrary the distance between human and ST become to tend to be far away. In this situation, we have established “AMEL Communicating Field Study” to make students have comprehensive communication abilities to inform Aquatic Marine Environmental Literacy for general public and U-12, and to aim consensus building between human society and ST. Existing related subjects: Communication study, Science education, Student guidance, Integral educational training

*d. AMEL Communicating Field study...*Enhancing ability to promote incorporation and coordination with government, industry, and citizens to build a sustainable aquatic marine environment

It is said that variety actors should work together, make consensus, and play a role to promote environmental education taking advantage of each actors’ features. In the case of aquatic marine environment also there are a lot of different kinds of complicated and multiple actors such as governments, fishermen, shipping trade, marine food processing industries, leisure industries, citizens, and citizens groups. But, integrated management has not been conducted and aquatic marine environment have been deteriorating, have a crisis of healthy ecosystem. To promote sustainable environment we need human resources to promote “Aquatic Marine Environmental Literacy”, and make citizen enhance awareness

about aquatic marine environmental crisis, and have ability to promote cooperation and partnership to live together with aquatic marine environment and human society.

Existing related subjects: Local environmental study, Local policy study, Community partnership study, Ocean policy training study

*e. Existing Each Technical Studies...*Enhancing ability to understand a broad variety of technical knowledge and technologies, consider problems logically, and guide others to solutions to problems with reference to the aquatic environment as an AMEL Education Leader acquiring acquisition of broad specialized knowledge related to the marine environment and the ecosystem, which is composite system of subjects not covered under general environmental studies, and broad-based interdisciplinary study of specialized knowledge regarding the role and function of the marine environment. In order to consider desirable ways of utilizing the marine environment, methods leading to logical and analytical solution of the various problems generated in international and local society by the diverse bodies utilizing the marine environment are indispensable skills.

In TUMSAT, the faculties have not only nature science fields such as marine environment, bio-resources and food science, but also social and humanities science fields such as marine policy and culture, students can study about acquisition of broad specialized knowledge related to the marine environment and the ecosystem.

Existing related subjects: Ichthyology, Invertebrate zoology, Algology, Bio-oceanography, Bio-resource ecology, Bio-Earth Science, Limnology, Plankton Biology, Population Biology, Chemical-oceanography , Marine physics, Environment measurement study, Coastal marine physics, Whale resources, Coastal environmental engineering, Resource environmentology

*f. Utilization of Training Facilities...*The place to conduct experiential learning and the research  
We can undertake marine environment literacy

program though basic field training (i.e. long distance swimming, cutter training, kayaking, rocky seashore investigation, snookering, diving, wearing swimming) using the five marine science fieldwork centers.

And we can make use of University's four training vessels, including the Umitaka-Maru, the Shinyo-Maru, the Seiyo-Maru, and Hiyodori, and also undertake cruising, marine environmental training study, fisheries shipping field study, fisheries science study, and so on.

Cooperative program was made that project members gather from wide-ranging disciplines and symposia, seminars are held by invite lecturers. Training Facilities, Organizations participating in this project are following.

*1 Marine science departments at universities*

*2 Marine science teaching and study centers*

*3 Study centers promoting cooperation with the general public*

*4 Training ships*

*5 Fisheries resources centers*

*6 NPOs, aquariums, marine-product testing facilities, etc.*

*7 ESD regarding upper Tokyo Bay*

*8 Basis for practical education and study related to The Tokyo Bay environment*

(6) Establishing an Ocean Literacy Partnership and role for future

*i. AMEL Education Leader as profession*

The AMEL program was started in 2007 at TUMSAT, producing new AMEL Education Leaders every year since. In what ways do those Leaders play active roles? The Leaders have shown the following five avenues for enhancing aquatic marine environment literacy.

*a. Environmental specialists:* Ability to understand a broad variety of technical knowledge and technologies, consider problems logically, and guide others to solutions to problems with reference to the aquatic environment

*b. Generalists:* Ability to understand aquatic

phenomena and to apply comprehensive knowledge in fields such as ocean culture

- c. *Educators and Communicators*: Ability to communicate AMEL comprehensibly to K–12 students and the general public
- d. *Facilitators*: Ability to promote incorporation and coordination with government, industry, and citizens to build a sustainable aquatic marine environment
- e. *Experiential learning leaders*: ability to enlighten the public about the importance of the aquatic marine environment through aquatic marine activity

Those AMEL Education Leaders who have such excellent abilities are effective as specialists along with those who have high technical knowledge, and generalists who have integrated knowledge related to "AMEL Principles" and communicators who can convey information comprehensibly.

For example, a leader will be capable of becoming a specialist who engages in research at a laboratory, or of becoming a curator, educator, or a communicator at an aquarium. A facilitator at the national or local government can work toward consensus building with stakeholders, and might work as a program coordinator or developer in experiential learning program facilities such as 4-H centers and NPOs.

Flourishing the Leaders in formal education and informal education will forge partnerships. Our country also aims to establish integrated coastal management for future human resources needed for coastal management. In these cases, AMEL Education Leaders will fulfill an important role.

*ii. Positions of AME Education leaders in TUMSAT*  
In fact, TUMSAT is the only university that engages in fostering the Leaders who have those five special abilities in Japan. Such human resource development is the first trial since our University opened in 1875. The Nation Science and technology basic plan also emphasizes the importance of interface roles connecting technical

knowledge and the general public as communicators or educators.

This qualification of the Leaders is expected to increase. Other Universities have also conducted communication building. For example, the Science and Training Unit existing at Hokkaido University, and the Communication Design Center operated at Osaka University. These efforts at human resource development will enhance involvement in various disciplines.

Creation and development of new industries (i.e. environmental education-oriented tourism) or creation of new value-added jobs based on local communities such as human resources (i.e. communicator, educator, and facilitator) will be necessary in various aspects. Japan, as a technology-oriented nation, has a high level of technology, but the implementation of science and technology generalization and enlightenment is lagging. In Japan, we must engage in producing an active environment for professions such as communicators, facilitators, and educators.

*iii. Established ocean literacy partnership to produce AMEL Education leaders*

We have examined and presented the case of University of Florida. That university has conducted outreach and education activities based on academic studies at the Sea Grant College Extension. Those activities have produced various ripple effects in each community. The "Ocean Literacy Partnership (OLP)" was established in April 2010 with the aim of offensive generalization and enlightenment of AMEL Principles at the TUMSAT Liaison Center.

The OLP will contribute to education of the nation's people to have AMEL connected with other educational programs. In the future, we plan to establish satellite centers of OLP in each area. The OLP will connect formal education and informal education facilities such as aquariums, museums, NPOs, research institutes, local government, and local universities. Through these

connections, the OLP will also establish organizations and systems to enhance AME literacy throughout the country. Furthermore, we will continue to strive to make international connections.

The following items will be developed in future studies.

*a. Marine science will be implemented in formal schools.*

*b. Formal education and informal education will forge a partnership through AMEL Principles.*

*c. An AME-literate society will connect ocean educational activists in many communities.*

*d. Through this Ocean Literacy Partnership (OLP), we can inform and maintain our understanding of nature.*

*e. Through this OLP, we can not only understand our own culture and history in our own living area, but also extend them to countries overseas.*

*f. Proper research in preparation of these articles will support responsible action.*

AMEL action is in an early phase: time and effort are necessary to establish an ocean-literate society. That literacy will fulfill an important role of promoting AMEL Education.

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