Maritime education and sustainable development in Japan. A Norwegian perspective.

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Abstract

Norway and Japan are leading maritime nations where maritime industries and maritime education are of great importance for the countries' development - historically, economically and culturally. In light of global goals of sustainable development, there is also a great responsibility. The purpose of this article is to contribute knowledge about maritime education and sustainable development in Japan, seen from a Norwegian perspective.

The study is inspired by Grounded Theory (GT) and is based on written, oral and visual sources, as well as participatory observation in schools. In one of the schools, participation also consisted of some teaching in English with all 160 students in the first year.

The results were summarized in two main categories with subcategories: fishing- and maritime technology. One found both similarities and differences with similar Norwegian education. Both countries follow international agreements through the IMO on security and sustainable development, and the STCW on training and certification. However, the way of management is different.

Students sense of belonging and high completion rate are some of the qualities. The content of the education has similarities, but is organized differently than in Norway. In Japan, maritime education takes place in special schools. After 9-year primary school, the student enters integrated 3- or 5-year programs with theory and practice. The schools have their own ships and certify according to STCW class 4 and higher. The 5-year programs are polytechnics that provide an associate bachelor's degree.

In Japan, there are entrance exams for both upper secondary and higher education, and graduates from maritime schools can go on to university. Officers in foreign trade are now more often recruited from universities with subsequent certification through practice on ships in foreign trade.

Like Norway, Japan has two separate ship registers, one national and one international. The latter corresponds to ships in NIS with predominantly foreign crews and their own schools abroad, including in the Philippines, where Norwegian shipping companies also have such training.

Keywords: maritime, education, Japan, sustainable development

1. Introduction

Norway and Japan are leading maritime nations where maritime industries and maritime education are of great importance for the countries' development - historically, economically and culturally. In the light of global goals for sustainable development, there is also a great responsibility, and how is this responsibility expressed in education?

Japan was among the first countries to establish diplomatic relations with Norway, and Tokyo became the first foreign capital with Norwegian representation on November 7, 1905 (Saxe, 1931). The countries have since worked closely together in many areas, including the maritime sector on the management of resources in the sea, measures against pollution, climate and now sustainable development in a broad sense (Aakre, 2021).

In the autumn of 2020, *Yoshihide Suga*, the new Prime Minister of Japan, announced that Japan will reach the goal of zero emissions by 2050 (Nikkei, 2020). One of the latest projects in this connection is about developing sustainable fuel cell systems for ships based on hydrogen. In company with the battery giants Corvus Energy, Equinor and Toyota, the University of Southeast Norway (USN) will deliver knowledge and research in hydrogen safety (USN, 2021). Against this background, it is interesting to study Japanese education in general and maritime education from a Norwegian perspective.

The UN's goals of sustainable development was used as a reference framework for this study (UN, 2015). They were adopted in 2015 with the support of many countries, including Norway and Japan. They consist of a total of 17 sub-goals, which together are very comprehensive. One therefore chose to limit the task to topics such as education, climate and the maritime sector where both Norway and Japan operate within the framework of international agreements. These include the *International Maritime Organization (IMO)* (2020) and the *Convention on Standards of Training, Certification and Watchkeeping for Seafarer* (*STWC*) (2020).

IMO is the UN agency responsible for the safety of shipping and the prevention of marine and atmospheric pollution from ships. The IMO's work also supports the UN's goals for sustainable development. When it comes to training, it is regulated by STWC. Previously, the minimum standards for training, certification and guarding of officers and rankings were established by individual governments, usually without reference to practices in other countries. One consequence was that minimum standards and procedures were interpreted differently in different countries. But now the convention prescribes minimum standards for training, certification and watchkeeping for seafarers, which the countries are obliged to meet. Against this background, the problem was:

What competence does maritime vocational training provide in Japan and how are ideas about sustainable development expressed in the light of today's global challenges in fisheries and shipping?

2. Method

The choice of method in this study is inspired by *Grounded Theory (GT)*. It is a systematic, but flexible research method in which, in addition to describing phenomena, also tries to build theory and possible explanation through constant comparison, densification and structuring of statements and concepts (Glaser and Strauss, 1967; Strauss and Corbin, 1990, p. 23; Charmaz, 2015, p.16). The flexibility depends, among other things, on the types of data used. It gained importance in this study where a combined self-produced and existing data (Corbin and Strauss, 2015, p.42; Charmaz 2015, p. 330). Quantitative data were also used on, among other things, the development of a modern fleet of ships for fishing and shipping, maritime schools, pupils, gender, content of education, length of school year, number of pupils in the class and measures in relation to sustainable development.

The selection includes four maritime schools in Japan, one primary school and three secondary schools. The three secondary schools were included as a reference to ensure representativeness and to capture possible variation within this type of education. In the primary school, teaching was conducted in English with all four classes with approx. 40 students in the class in the first year, a total of approx. 160 students. The school is a 3-years years upper secondary technical school with an extra 2-year program for those like to qualify as officers on ships. This program is also included in this survey.

The survey is based on a combination of own teaching, participatory observation, conversation with students and teachers and analysis of available written sources and statistics. Pictures and video recordings were taken in two schools. Along the way, notes (memos) were taken which were later used in the analysis. Collected data were coded and densified in three steps: open coding, selective coding and theoretical coding (Corbin and Strauss, 2015). In post-production and presentation, there is an element of hermeneutic interpretation in the light of contexts (Kvale and Brinkmann, 2015, p. 190).

Language barriers were a challenge, even with some knowledge of Japanese. Norwegian and Japanese are not only different in word and pronunciation, but also in structure. Expressions and meanings come in a different order. Translation into Norwegian must therefore adapt quotations so that they make sense without becoming a source of misinterpretation. The validity was strengthened by choosing different perspectives and data types, but one cannot generalize the result to, for example, the

national level. Emphasis was placed on research ethics considerations in the use of sources and in ensuring the informants' anonymity.

3. Results

Data from observations, interviews, documents, and notes were first analysed by open coding. In the end, it gave a large number in terms of words and phrases as indicated in Table 1. The result from the open coding was condensed down to 7 codes. Context is an overarching category that is often included in such studies (Corbin et al., 1990, p. 163 and Charmaz, 2014, p. 330). In the last round of theoretical coding, one came to 3 main categories: sustainable development, fisheries and maritime subjects. The process is illustrated in Table 1 and Figure 1. In the analysis further back, the categories are expressed in the form of specific statements and quotations from sources.

Table 1. Results from coding with a few examples

Koding	**Quant.**	**Categories and codes (A selection of samples)**
Theoretical	*3*	*Competence for sustainable development in fisheries and maritime education*
Selective	*7*	*Context ... sustainable development ... students... organization of maritime education ... content and method ... community of practice ... maritime competence*
Open	*210*	*Suisan ... whaling ... sustainable development t... maritime technology... STCW... IMO... safety at sea ... late Monday ... school ships ... fishing nation ... overfishing ips shipping ... international competition ... diving ... ecology ... home knowledge ... instruction ... progression ... activity ... annual testing ... annual exams cooperation ... community ... welding ... farming ... fish and shells ... preserving kelp forests ... school uniforms*

The codes were finally summarized in a theoretical model in the form of an Ishikawa diagram shown in Figure 1 (Ishikawa, 1979). In the model, competence for sustainable development in fisheries and maritime subjects is explained as a process rooted in a historical tradition where today's society and culture constitute prerequisites for education and professional practice. Furthermore, competence is affected by the requirements for sustainable development, by students' learning work, organization, content, method and a professional community of practice between actors in education and professional practice. Knowledge, skills and attitudes are gradually developed within this community until a holistic

competence as certified in accordance with international agreements. The arrow indicates that it happens through action and reflection in the past, present and future.

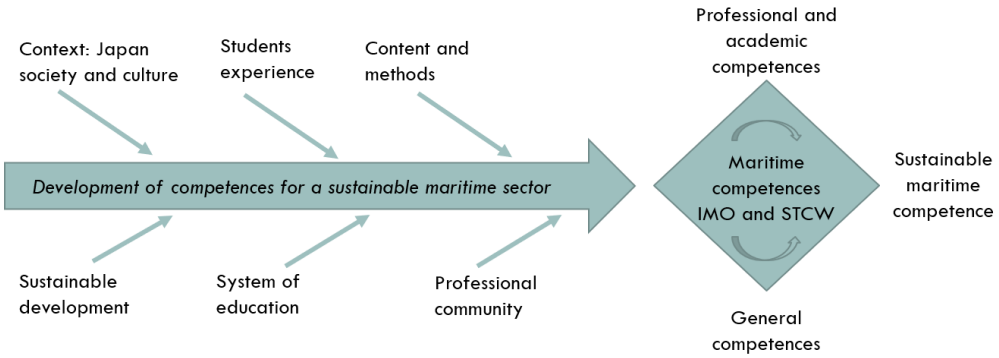


Figure 1. Maritime education explained with Ishikawa diagram (Ishikawa, 1979)

4. Context

Japan consists of large and small islands surrounded by sea. From time immemorial, the sea has therefore been an important source of food, transport and interaction with other cultures and nations. Like Norway, the maritime industry in Japan has had a major influence on the country's history and economic development. In modern times, Japan developed what is today the world's largest shipping nation measured in value, with Norway in 5th place (NR, 2018, Larsen, 2018). This development was made possible through major investments in education, shipbuilding and the development of methods for fishing, processing of seafood, transport, energy and logistics.

(Table 2. Japan's fleet of modern ships 1870-1926. Figures from 2012 over 100 DT (1)

Year	***Number of ships***	***Tonnage (Gross tons)***	***Comment***
1870	*35*	*24.997*	
1900	*859*	*527.239*	
1926	*3.246*	*3.607.038*	
1937-1945	*The Second Sino-Japanese War and World War II. Capitulation.*		
1950	*1.499*	*1.871*	
1970	*8.402*	*27.004*	*402 under foreign flag*
1995	*Japan establishes international ship register equivalent to NIS*		
2017	*5.289*	*25.400 (1)*	*129 Naval ships*

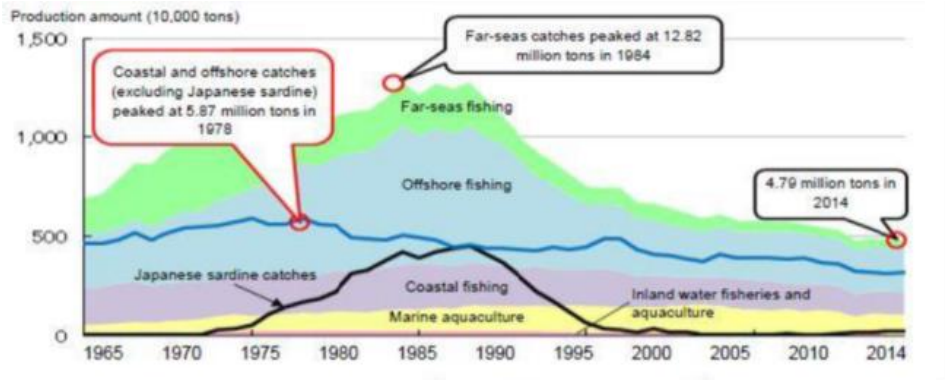
The new regime that took over in Japan at the beginning of the Meiji era in 1868, aimed to become a great power at sea with military and civilian ships that could complement each other. Table 1 provides an overview of this development that made Japan the world's third largest fleet around 1920, following England and the United States (Shindo, 1983, p.123). Today it is the world's largest, but tonnage has decreased somewhat in the period 1995-2017 (Knoema, 2017). Old and new statistics are not directly comparable as ships below 100 DT are not included.

In the 1970s, Japanese shipowners also began to flag ships and the number of flagged-out ships increased until 1995. Then Japan introduced an international ship register much similar to the Norwegian NIS which was introduced in 1986 (Aakre, 2015). Today, the number of Japanese ships and their tonnage are estimated as indicated in the last line (CIA, 2017). The decrease shown in the table is due to the fact that smaller ships are no longer counted. This applies in particular to the number of fishing vessels. Old and new statistics are therefore not directly comparable, but the value is estimated at 108.065 trillion dollars (Shippin, 2020). In the latest overview, Norway is ranked number five and the value of the Norwegian fleet is estimated at 39,484 trillion dollars.

Furthermore, industry was built to produce everything required to operate ships, from engines and propellers to instruments for steering and navigation, as well as necessary port facilities and logistics. This happened through cooperative systems between the state, company groups (keiretsu) and financial groups (zaibatsu) (Habara, 2011). Technology companies like Toshiba and Mitsubishi are still major dominant companies most people have heard of. Nissan has its roots in technology for fishing and trapping where a similar technological development took place.

In parallel with the construction and development of even better ships, electronics were developed and used in communication, command and control systems and navigation on board and in ports. First in the form of telephony and later radio. Nippon Electric Company (NEC) established in 1899 early became a large company in this field. In the early 1930s, Japan began researching the use of radar, which later became important in navigating ships and sonar to search for fish. Furuno, which was established in 1938, we find today on both small and large boats equipped with sonar and or radar. Together with companies like Casio, which technology was later connected to computers and flat screens in colors that make information easily accessible and easy to read. Today, communication also takes place via satellites, which are playing an increasingly important role in monitoring the oceans, in the fight against overfishing and pollution from ships.

The fisheries provide the Japanese with an important part of the food supply, but make up a relatively small part of the country's total. However, the fishing industry contributes to the entire economy through shipbuilding, the food industry and is particularly important for the economies of the many coastal communities Japan has.



Figur 2. Utviklingen av fangster fra havet, lokalt og oversjøisk

Japan and Norway both had progress and adversity in the utilization of the oceans, in fishing as well as in shipping. A recent EU report shows that Japan's total catch and production of seafood has been declining since the late 1980s, as Figure 1 shows (EU, 2019). Over-taxation has long been a problem, but is now being taken more seriously in order to ensure more sustainable harvests in the future. Japan has therefore intensified its monitoring of fish stocks over the past 20 years. Today, Japanese researchers emphasize the importance of sustainable exploitation of marine resources, and that the pollution of the oceans must be stopped on a global basis (Naoya Kakizoe, 2012). Furthermore, we need more and better knowledge about the oceans and their utilization if we are to be able to build sustainable societies that can make a living from harvesting from the oceans also in the future (Sasaki, 2016).

In connection with the maritime industries in Japan, there are specialized educations in the form of upper secondary schools, vocational colleges, colleges and universities (Sasaki, 2016, p. 17). The Japanese Ministry of Education MEXT is responsible for all education and research (MEXT, 2021). But in some areas there is a shared responsibility with other line ministries, for example MAFF which has partial responsibility for fisheries and MLIT which has partial responsibility for transport on ships. Such division of responsibilities was common in Norway even before 1974 (Aakre, 2005).

4.1 System of Maritime Education in Japan

All education in Japan is led by the Ministry of Education, Science and Technology, Sports and Culture abbreviated MEXT (2021). The Education Act was revised in 2006 when it received a supplement in §4 which deals with sustainable development (translated by the author):

"... promoting attitudes that show respect for all life, take care of nature and help to protect the environment" (MEXT, 2006, §4).

Figure 2 provides an overview of the Japanese education system from upper secondary level and higher education.

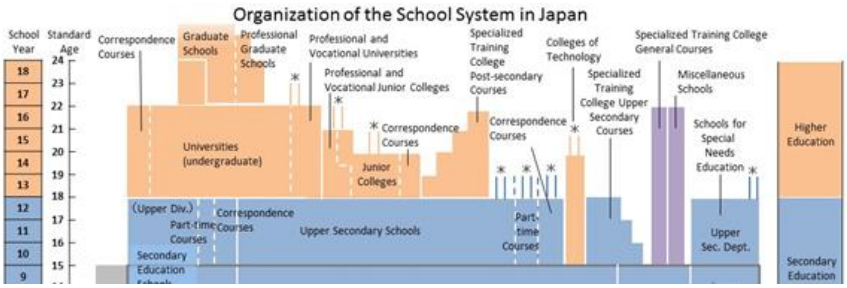


Figure 3. The education system in Japan (MEXT, 2021) Adapted by the author.

Transition to the schools in this survey takes place from 9-year primary school via entrance exams. The schools are located in the middle area in Figure 3 as a 3-year *Upper Secondary Schools* with a 2-year extension in the form of a *Professional and Vocational Junior College*, or as a 5-year *College of Technology*.

As can be seen from the figure, the Japanese education system is somewhat more varied and complicated than the Norwegian one. The relationship of responsibility and ownership is also different in that, among other things, the responsibility for maritime education is shared with other line ministries. This was also the case in Norway before the introduction of the common law on upper secondary education in 1974, with independent seafarers' and vocational schools separated from other schools. The maritime education in Japan is conducted in accordance with international agreements such as IMO and STCW, to which Norway has also acceded. All schools have lines for officers on deck and in machine STCW class 4. Those who also provide specialization in the form of 2- or 3-year college program certify for STCW class 3 and higher. Schools with fishing subjects have the fishing fleet as their primary target group, while those with maritime technology have transport on ships as their primary task. They therefore have a narrower professional circle with a focus on maritime technology. One of the schools mentioned in the survey is such a 3-year upper secondary school with maritime subjects for domestic sea transport.

Fisheries include fishing, farming and processing of seafood. They are often referred to by the term Suisan. This refers to the Japanese word for aqua which is the Latin word for water (Sasaki, 2016, p. 159). They have a dual role in the sense that they provide education in both fisheries and maritime technology that is relevant to all shipping. Two of the schools in this survey are called Suisan.

Universities for maritime technology are not included in this survey, but candidates from the mentioned schools can from the various levels go on to university via entrance exams. The first universities of ship technology in Japan were established in the 1870s, while seamen's schools and fishing schools appeared a few decades later. In comparison, the first maritime schools in Norway, often referred to as seamen's schools, were established in the 1840s. But the first fishing vocational schools did not start until 1938 and the first was in Vardø (Aakre, 2020).

4.2 Presentation of the schools in the selection

This analysis of the organization and content of maritime education is based on data from four schools. They represent a cross-section of this type of education in Japan. The many maritime schools have a lot in common. Therefore, data from one of the schools is presented first with additional data from the other schools where there are interesting differences to notice. The four schools and their main profile is shown in Table 3.

Table 3. Maritime schools included this survey.

Skole	***Secondary (3 year)***	***College (2-4 years)***	***University (4-6 years)***
Fukuoka Kenritsu Suisan HS	*Fishery and Transport*	*Transport (upper)*	*Not included in this survey*
National Karatsu Maritime Polytechnical School	*Transport*	-	
Miya Fishery High School	*Fishery*	-	
Toba National College of Maritime Technology	*Maritime Technology and Logistics. (5 year)*		

Most central in this study is *Fukuoka Kenritsu Suisan HS* (Suisan, 2020). However, to ensure better representativeness, the data from this school are supplemented with data from three other schools. Suisan is located in southern Japan just outside the city of Fukuoka on the southernmost main island of Kyushu. The term kenritsu indicates that it is a public school owned by Fukuoka Ken (county). This is one of Japan's 47 counties. The term Suisan indicates that the main purpose is to provide education in

fisheries and associated maritime technology. But the school also educates for a large number of other tasks that are explained later in the article. The school has six parallel classes with approx. 40 students in each class, a total of approx. 160 students in a joint program the first year. In the second and third year, they can choose to specialize in fishing, navigation, machinery, electrical, aquaculture, fishing industry and special functions such as diving for maintenance and repair underwater. In short, a school with a broad program. In addition, the school provides 2-year additional education at the college level for those who want to qualify for senior positions at level STCW class 3 or higher. These can later be transferred to positions on ships domestically and internationally.

Figur 4. Fukuoka Kenritsu Suisan Maritime HS. Svimming as part of safety training

The school has one of the largest school ships in Japan where students receive practical training and sailing time onboard a ship. Every year, *Kaiyu Maru* has a 2-month cruise in the Pacific Ocean. The catches are processed on board and sold when they are returned.

National Karatsu Maritime Polytechnical School is another, but national 3-year high school with boarding school (Karatsu, 2020). It is also located on Kyushu in Saga Ken which is a neighbouring county to Fukuoka Ken. The main purpose of this school is to train crews on ships, preferably to cover the need for domestic transport. This school therefore does not have fishing subjects, but is otherwise much similar to the previous school. It also has its own school ships, but not a 2-year department at the college level.

Figure 5. Diving and Marine Ecology

Aichi Prefectural Miya Fishery HS is located in central Japan near the city of Nagoya (Miya, 2020). This school has a lot in common with the aforementioned school, including fishing, fishing industry, farming, navigation, machinery and electrical engineering. A specialization that stands out is marine ecology, where students monitor the environment in the sea and the growth of species, among other things. This program is combined with diving and building drones that the students use in the mapping. Within aquaculture, a lot is invested in eel, which is a specialty in Aichi. This school also has its own school ship, the Aichi Maru.

Toba National College of Maritime Technology is, as the name suggests, also a national school (Toba, 2020). It has a boarding school, is 5 years old and the pupils start there straight from upper secondary school after 9th grade. This is the oldest school of its kind in Japan and was established in 1881. The school has four programs in maritime technology and logistics, and a 2-year extension program for officers on ships, or engineers in logistics. This school has a clear environmental profile expressed in the school's purpose in the form of both an overall philosophy and a list of measures that the school and the teaching have committed themselves to. The school is located at Ise Bay, not far from Yukkaichi, where one of the first and most famous environmental scandals in Japan took place (Aakre, 2021, p. 6).

First, the school states that environmental problems are now a global problem, and that there is a need to build a society where the natural environment can be used sustainably and cyclically by coexisting with the natural environment and human activities. Based on this recognition, Toba National College of Maritime Technology seeks to reduce the impact on the environment with a view to coexisting with the natural environment. In addition, we will actively develop education and research with an emphasis on environmental management and contribute to the preservation of the global environment (Toba, 2010). Secondly, the school has committed itself to four specific points (translated by the author):

> *1. We want to reduce pollution of the environment caused by all activities at our school*
>
> *2. We will actively participate in environmental protection activities in close collaboration with the local community*
>
> *3. We will contribute to a sustainable society by promoting education and research related to the use and conservation of the environment and resources in the sea*
>
> *4. We will comply with environmental laws, agreements, and regulations that promote sustainable development*

5. Content and method of teaching and learning

The following sections are based on data from stays at *Fukuoka Kenritsu Suisan Maritime School*, further referred to as Suisan (Suisan, 2021). It is a 3-year high school with a 2-year supplement at the college level for those who want to be certified as officers on ships. Practice at sea takes place on the school's pride, *Kaiyu Maru* (Figure 6)

Figure 6. The pride of the school.
Kaiyu Maru ready for a cruise in the Pacific with students and teachers

Suisan follows a national norm for industrial subjects, but adapted to the maritime industries (MEXT, 2011). The school year is 210 days, which is about 3045 (35x87) hours over three years. The first year is common to all, but from the second year they start choosing specialization within one of seven programs:

1) Navigation, 2) Machine, 3) Electrical, 4) Food, 5) Logistics,
6) Fishing and farming or 7) Special diver

After three years, the students also have general study qualifications which means that they can take higher education. The most common is a 2-year polytechnic combined with practice and experience on a boat. Some also go on to university where they study maritime technology for 4 years with subsequent 6 months of sailing practice to be certified according to STCW.

Figur 7. Skolens nye uniformer etter Reiwa 0

In Japan, students have to pass entrance exams for upper secondary and higher education, and they have to pay tuition fees. For Suisan, the amount is low since it is a priority vocational education, about 100,000 Yen, approx. 10,000 Nkr. It includes school supplies and uniforms. Uniforms are common in most schools, even high school. This school received new uniforms at the transition to a new Emperor and a new time reckoning *Reiwa 0* in 2018. *Reiwa* means harmony, but can also mean peace, and is the new Emperor's chosen language. This corresponds to the Norwegian King's electoral language that King Harald V chose to continue when he took over from his father in 1991.

In Japan, students also spend part of their free time at school with leisure activities for which the school and teachers are responsible. At this school, sailing, diving, baseball, calligraphy and flower decoration are among the most popular.

In Japan, about 25% of students choose vocational subjects after 9 years of primary school. In financial administrative subjects, the majority of students are girls, while the more technical schools such as Suisan have a majority of boys in the ratio 80% / 20% (Aakre, 2019). The relationship between primary and secondary applicants was not certain, but maritime education is not among the most popular in Japan. One can therefore assume that the average result on the entrance exams is somewhat lower there than the more popular schools. Based on the attendance that was posted on a special board each week, the absence seems to be somewhat higher than the official national average for all upper secondary schools in Japan. The completion rate on a national basis is about 96%, which is significantly higher than in Norway.

5.1 General subjects

Students in vocational subjects in Japan have more common subjects and more hours in theory subjects than students in vocational subjects in Norway. They also have theory subjects in all three years, and they have several hours in subjects such as language, social studies. mathematics and science. In addition, they have both art and home knowledge, which is interesting in light of the new goals for sustainable development where emphasis is also placed on health, diet and quality of life in the broadest sense.

Mathematics I is on a par with the subject T1 in Vg1 and R1 in Vg2 in Norway. In addition, they have mathematics II in the 3rd year of school, which means that the scope of the subject mathematics in vocational subjects in Japan is above what is the requirement for general studies in Norway. In addition, they have applied mathematics in the program subjects adapted to, for example, electrical subjects with complex numbers and calculations of strength and stability in mechanical subjects.

Table 4. General subjects in vocational programs. 4 modules can be reallocated between common subjects and program subjects. A module (tani) is 35 hours a / 55 minutes.

Fag	***1.year***	***2.year***	***3.year***	***Total***
Japanese language I and II	*3*	*2*	*2*	*7*
Social science and world history	*2*	*2*	*2*	*6*
Mathematics I and II	*4*	*2*	*2*	*8*
Natural science	*2*	*4*	*1*	*7*
Physical education	*2*	*2*	*3*	*7*
Art	*2*			*2*
English and English communication	*3*	*2*		*5*
Home economics			*3*	*3*
Total modules of 35 hours, 210 days a year	*19*	*15*	*15*	*49*

Science is also more comprehensive than the requirement for general study competence in Norway. There are, among other things, separate subjects in physics and chemistry. In both mathematics and science, both content and forms of learning bear a certain mark of "classical" science with teaching from the board and problem solving.

The scope of physical education is also higher than in Norway since they have three modules in the 3rd year. It is also combined with safety training, including in the form of swimming and lifesaving in the open sea.

Home economics is a practical subject that should promote a good quality of life in the broadest sense. It includes food and health, responsibility in the family, family finances, harmony in social relationships, care and respect for the elderly as well as responsibilities and tasks in the local community. In short, a broad practical subject that will prepare students to become good citizens who take responsibility in the local community. Emphasis is also placed on source sorting, optimal use of resources, cleaning of the school and protection of nature in the local environment. This may be one of the reasons why children and young people in Japan rarely leave rubbish in some places, but keep the environment in good condition without tagging or other destruction. At school, this is expressed in the form of, among other things, a separate bento for lunch and washing of the school at the end of the day.



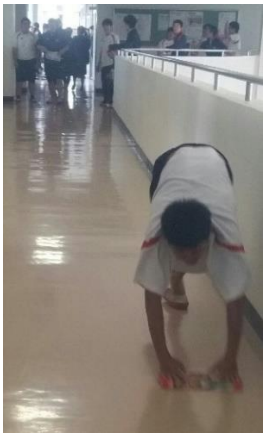


Figure 8. Home economics, art, and cleaning of school

The subject art is somewhat similar to a combination of handicraft and needlework in Norwegian schools before 1969, but is compulsory for both boys and girls. Boys must, among other things, do some work in textiles with sewing and embroidery. One of the works is to make his personal flag with an embroidered logo as shown in figure 5. Flower decoration and calligraphy are other artistic activities that have long traditions in Japan.

5.2 Vocational and technical subjects

This analysis of program subjects at Suisan is based on two specializations: machine and electrical. The other lines are briefly discussed at the end. As in Norway, there is a lot in common in the two program subjects. They make up a total of 37 modules of 35 hours. This amounts to a total of 1235 hours of program subjects over three years.

The content of the program subjects follows the national norm for industrial subjects, but is adapted to machines and equipment on board ships. The first year starts fairly broadly with industrial technology where students learn about various machines and basic techniques such as welding, machining and turning. The basic training also includes simple tasks with operation and maintenance, such as keeping a log, measuring oil pressure, temperature, coolant, operating voltage from units and carrying out lubrication.

Tabell 5. Vocational and technical subjects. Machine (blue) and Electro (yellow). 4 modules can be reallocated between common subjects and program subjects. A module (tani) is 35 hours a / 55 minutes.

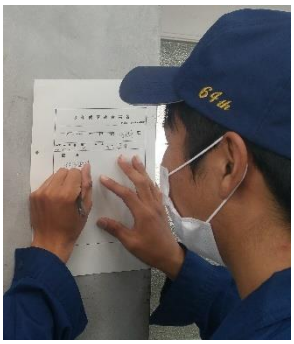
Subject	**1. year**		**2. year**		**3. year**		**Total**	
Industrial technology	*3*	*3*					*3*	*3*
Practice		*4*	*6*	*4*	*3*	*4*	*9*	*8*
Drawing	*2*	*2*		*2*		*2*	*6*	*2*
Mathematics in technology (applied)	*2*	*2*					*2*	*2*
Information technology	*2*	*2*					*2*	*2*
Themes and projects					*2*	*2*	*2*	*2*
Mechanical systems and construction			*2*	*2*			*2*	*2*
Mechanical design	*2*		*2*		*2*		*6*	-
Motor technology					*4*		*4*	-
Electrical technology			*1*				*1*	-
Electronics and electronic systems		*4*		*3*			-	*7*
Electrical machines and tools						*3*	-	*3*
Energy systems (Applied)						*2*	-	*2*
Electronic circuits				*2*			-	*2*
Total modules of 35 hours, 210 days a year	*11*		*13*		*13*		*37*	

The teaching is combined with theory in classrooms and practical exercises in laboratories and in workshops where the teacher first demonstrates and explains with a subsequent session where the students, for example, disassemble and reassemble the same oil pump or the power generator that had been demonstrated and explained.

The same procedure was used in most subjects from simple components to larger and more complex systems. In an electrical class, relays were the theme. Different relays for direct and alternating current were explained on the basis of area of use and capacity with regard to current and voltage given in data books. Furthermore, connections were made from simple to more complex circuits where sensors and regulators could also be included.

Figure 9. Basic training in welding, machine operation and maintenance, and machining

The technology used at the school was of an older type. Exercises on modern electronics with controllers and processors were not observed, but may be in use in classes that were not attended. The school has a nice and large room with a bridge simulator with a great view of the sea. But the technology was from the 1970s or 80s and seemed somewhat unstable. On the roof over the bridge there was radar, but without modern scan converter and automatic generation of plot. On the other hand, the equipment at the school must be seen in the light of the state-of-the-art school ship Kaiyu Maru where students can apply to join a cruise for 2 months and gain experience with modern equipment.



Figur 10. Reflection and reporting

After each session, students wrote down some experiences on a standard sheet. This practice is common both in high school and in higher education. Although most students wrote relatively little on their sheets, they had the opportunity to talk to some fellow students about what they had done, and to reflect on what they had learned. The sheets were collected by a teacher who, through this form of feedback, could stay informed about each individual student and possibly take a guidance interview.

6. Briefly about other programs and activities at the school

Students who specialize in fishing subjects learn to fish with different types of gear such as nets, seines, lines and pots from smaller boats. Catching seaweed for use in food is also included since seaweed is common in the Japanese diet (Figure 11, middle). This fishing takes place from smaller

vessels, of which there are many in the Japanese fleet of local fishing boats. Many of them use, for example, outboard motors.

Those who choose to specialize in aquaculture learn fish, shellfish and shellfish, including oysters (Figure 11, left). Farming takes place in facilities on land in tanks on the school grounds with local species that are not common in Norway, including sharks and eels. Breeding of goldfish is also popular, and sought after by children and families who come to buy these at the school's annual market.

Students who specialize in food learn the processing and sale of seafood through shops, or as fresh produce at fish markets. They also develop and sell processed products that are fried, canned or dried (Figure 11, bottom).

Overfishing and excessive harvesting of kelp forests, especially in coastal areas, have long been a problem in Japan. With an increasing focus on sustainable harvesting, there is now greater awareness of the problem that they seek to solve both through regulations and quotas, but first and foremost through training and knowledge for a new generation of practitioners. Suisan is therefore making efforts to improve damaged kelp forests and the construction of artificial reefs, which can provide protection and better reproduction of fish (Figure 10, right). As individual projects, these attempts may not make much of a difference, but they do contribute to a new awareness among a new generation of practitioners.

Figur 11. Farming of oysters (left), catching seaweed (middle) and building artificial reefs for fish (right). Bottom: Foods that are developed, processed and sold at the school

6.1 Club activities in leisure time

As mentioned earlier, students in Japan also spend much of their free time at school with activities for which the school and teachers are responsible. It creates an affiliation that perhaps explains some of the high completion rate in Japanese schools. At Suisan, sailing, diving, baseball, calligraphy and flower decoration are among the most popular leisure activities. The school also has its own teams that participate in tournaments against other school teams. For the teachers, this is a significant amount of extra work, which was the subject of some discussion among them.

Figur 12. Elev viser oppdrett av hai på skolens marked

Students are also responsible for several events throughout the year. They invite kindergartens that are allowed to fish and eat seafood, and they have information days for students from secondary schools to recruit new students. The biggest event is a separate festival in November with a large attendance where they also sell various products, including fish, seafood and goldfish. They also have various activities for children.

6.2 Counselling, guidance and assessment

The teaching consists of teaching in classrooms or laboratories, demonstration and instruction as well as guidance in practical exercises at school or out in a boat. The students showed some signs of boredom and made some noise when the teacher explained or demonstrated for too long. But the commitment was all the greater when they got to try and do things themselves, similar to students in vocational subjects in Norway.

The student often sought advice from the teacher, both on academic and more personal issues. The school also has its own health station which conducts an annual health check and follows up the students' physical and mental health.

Students are assessed on the basis of attendance, skills and attitudes in practice and written exams in each subject at the end of each school year. Written exams are often based on multiple-choice tests, but where students must reason and make calculations to arrive at the correct answer. The written exams seem relatively easy compared to similar subjects in Norway. On the other hand, the tests function more as approved / not approved since they have little significance for further studies where they have to take new entrance tests.

6.3 Transfer to higher vocational education and universities

After three years and passing the exam at upper secondary level, students have a certificate of competence according to STCW class 4 and can choose between work or further education, immediately, or at a later date. At Suisan, students can become students and take a 2-year polytechnic, get an associate's bachelor's degree and be certified to STCW class 3 and higher, provided they meet the requirements for sailing time.

Figur 13. Students who qualify for a bachelor's degree and STWC class 3 or higher

6.4 Career guidance for work or further education

Suisan, like most educations in Japan, has its own career center where students get help to find work or further education. About 95% of students get a job after graduation. The school has close contact with working life and it arranges meetings between students and employers within the various subject areas. Some also get jobs in the shipping industry or other industrial activities.

For those specializing in navigation, machine or electrical, companies such as Hankyu Ferry Co., Ltd., Seibu Tanker Co., Ltd., Iino Gas Transport Co., Ltd. are mentioned. and Nissui Marine Industry Co., Ltd. Those with specialization in machinery also get jobs in land transport companies such as Nishitetsu M-Tech Co., Engine Division of Tominaga Bussan Co., Ltd., Sankyu Inc. A third area is the construction, operation and maintenance of port facilities. In short: a wide range of companies.

Those who specialize in fishing and aquaculture move either into a profession that fishes on their own or someone else's boat, or into aquaculture companies such as Aqua Farm Co., Ltd., Kurose Fisheries

Co., Ltd. In the food industry, companies include House Foods Co., Ltd. Foods Co., Ltd., Yamazaki Baking Co., Ltd. and Onishi Co., Ltd. These refine maritime products. One of the many fish markets that Fukuoka Fish Market Co., Ltd. and Toyo Refrigerator Co., are also alternatives. Those who specialize in diving also have many job options such as Mikuniya Construction Co., Ltd., Asia Marine Co., Ltd., Nodak Co., Ltd. and Fukada Salvage Construction Co. These are engaged in construction and maintenance underwater. Some also get jobs in the tourism industry, or as instructors on more commercial diving courses.

For those who want to take higher education at university, many possibilities were mentioned, but with no statistics on how many applicants. Among the universities mentioned were Tokyokaiyo, Nagasaki, Hiroshima, Kagoshima, Tokai, Fukuyama and

6.5 The teachers and their work situation

All teachers have common workspaces, each with its own desk with PC. The classes are large with 40 students and the working day is hectic with guidance and facilitation between classes. In addition, they are responsible for activities in the evening a day or two a week, and during the school summer holidays. Therefore, teachers only have a couple of weeks off, which is not infrequently used for any preparation (Aakre, 2018).

The general requirement is a 4-year teacher education from a university with subsequent certification, which must be renewed after ten years. Those who have not approved teacher education, or have not been certified, can teach as an assistant teacher without educational responsibility. The salary is then significantly lower. In vocational subjects, assistant teachers are quite common due to large groups and a lot of organization with practical facilitation and rotation of groups. There was no ratio for the number of teachers versus assistant teachers.

7. Discussion and conclusion

The starting point for this study was Norway and Japan as leading port nations, where maritime industries and maritime education are of great importance for the countries' development - historically, economically and culturally. In light of global goals of sustainable development, it also entails a great deal of responsibility. The study therefore aimed to explore the competence that today's maritime

vocational education in Japan provides to meet these challenges and how ideas about sustainable development are expressed in light of today's global challenges in fisheries and shipping.

Through own teaching, participatory observation and analysis of curricula and public documents, data were collected and condensed into key categories. These describe the maritime competence based on a historical context, education system, pupils and students, content and method as well as qualification and practice within the framework of international agreements such as IMO and STCW. The main impression is that Japan has a very advanced system for maritime education at the upper secondary level and in higher education. They are based on a solid tradition of both experience-based and research-based knowledge. From a Norwegian perspective, there are also some differences and features that can be highlighted.

In Japan, the completion rate on a national basis is about 96%, but somewhat lower in some schools. It is significantly higher than in Norway, where the average is about 70%, and partly even lower in vocational subjects. Close follow-up, responsibility, leisure activities and an experience of belonging can be factors that can explain the high implementation rate in Japan. Students in vocational subjects are also guaranteed three years in the subject without having to apply for an apprenticeship after two years and risk interruption in education.

The content of the education has similarities with similar educations in Norway, but is organized differently. In Japan, education in fishing and shipping takes place in special schools. From 9-year primary school, the student enters integrated programs that are 3- or 5-year-old with theory and practice. The schools have their own school ships and are certified according to STCW. The 5-year programs are polytechnics that provide a bachelor's degree.

In Japan, graduates from maritime schools can continue to university, but there are entrance exams for both high school and higher education. Officers in foreign trade are now more often recruited from universities with subsequent certification through practice on ships in foreign trade.

Like Norway, Japan has two separate ship registers, one national and one international. The latter corresponds to ships in NIS with predominantly foreign crews and their own schools abroad, including in the Philippines, where Norwegian shipping companies also have such training.

Sustainable development is a new requirement that was enshrined in the Japanese Education Act by revision in 2006. Since then, Japan has joined the UN's 17 sustainability goals, and more short-term goals to be achieved by 2030. In the autumn of 2020, the new Prime Minister Yoshihide Suga also announced that Japan will reach the goal of zero emissions by 2050. This is a major challenge, especially for shipping and maritime education. Japan has come a long way with laws and plans, but it remains to be seen to what extent these ambitious goals will be realized.

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