Article

Impact of the Slow Fish Movement Curriculum on Students' Awareness of Marine Environment Conservation and Marine Resource Sustainability

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Abstract: This study aims to measure the impact of the Slow Fish Movement (SFM) curriculum regarding the awareness of marine environment conservation (MEC) and marine resource sustainability (MRC). The SFM curriculum was designed for 1007 junior high school students in a seaside city. The UN SDG 14, Taiwan Seafood Guide and the Nine Principles of Consuming Seafood in Taiwan for Ocean Sustainability formed the core of three questionnaires. The results show that students in the seaside city lack an understanding of the marine ecosystem and that SFM lessons can significantly encourage personal responsibility and impact students' judgments regarding consuming sustainable seafood. These lessons also increase the awareness of MEC and MRS and the self-restoration of organisms in marine ecosystems. These factors could help us to achieve sustainable development for our ocean.

Keywords: slow fish movement; marine environment conservation; marine resource sustainability; Taiwan seafood guide; sustainable development goals

1. Introduction

The ocean is the largest life-sustaining system on the planet. It produces a wide variety of marine life, providing for human needs in terms of food, energy, medicine and marine recreation, and it contributes to local economies and international trade. The ocean is incalculably significant to us. However, in the past 20 years, human over-exploitation has resulted in a severe decline of resources and the extinction of species. The primary causes of biodiversity damage are habitat destruction, introduction of invasive species, pollution, overpopulation and overexploitation as a result of human activities [1]. Moreover, global warming has caused the seawater temperature to rise, and the environment of the ocean has changed. Severe overfishing in specific areas has been recently confirmed to directly and indirectly affect human multi-food chains, marine environments and ocean ecosystems overall [2,3].

The Ocean Health Index (OHI) is used to measure 10 indicators of ocean health [4]. In 2018, Taiwan's overall OHI ranking was 126, and its marine health index was 65. Of the 10 internal indicators, the food provision seafood sustainability/food supply indicator was 42 (the global average score is 51 out of 100). This shows that Taiwan in particular needs to improve its sustainable use of marine resources [5].

The 2018 annual report of the Food and Agriculture Organization of the United Nations (FAO) showed that about 88% (over 151 million tons) of the total fish production in 2016 was directly utilized for human consumption, while 12% (20 million tons) was used for non-food purposes. Asia is the largest fish-consuming region globally. The usage of marine products is closely related to the growth and development of the human body and the

regulation of its physiological functions [6]. Fish are also significant sources of nutritious protein for humans. The FAO report also showed that one-third of the food produced for human consumption is lost or wasted globally. In addition to the waste of production resources, the increase in greenhouse gas emissions due to food loss also represents an invisible harm to the environment [7]. The world's marine fisheries overfished 33.1% of stocks in 2015. In Asia, both ADM capital foundation (ADMCF) and the Qingdao Marine Conservation Society (QMCS) continue to tackle the issue of marine conservation [8,9].

In Taiwan, there is an idiom, "food first," which means that people catch up with their family and friends while eating. This represents the society's respect for food and appreciation for the food that nature has provided. Chen related the issue of overfishing to consumer seafood consumption behavior [10]. As the marine ecosystem has been collapsing due to human overfishing, habitat destruction, pollution and invasive species, as well as global climate change, fishery resources are decreasing. The next generation will not have the chance to enjoy the same delicacies if we do not change course.

Following the Slow Food movement in Italy in the early 21st century, Slow Fish is the most popular form of marine food awareness. Its principal aim is to draw people's attention to the impact of sustainable seafood consumption. All decisions made by people in markets and restaurants directly influence marine biodiversity. Accordingly, many countries have developed a seafood guide for their country to promote consumer awareness of sustainable seafood to preserve limited marine resources [11]. Voinea et al. showed how a Slow Food-type menu could be a balanced food option [12] and make youth aware of the economic and environmental need to create a sustainable food system. Through the transmission of the story behind the dishes, people can understand the local characteristics of their culture [13].

The Slow Fish Movement (SFM) curriculum is designed to enhance students' awareness of the protection of the marine environment and thus achieve marine environment conservation and resource sustainability for the next generation, as per UN Sustainable Development Goal 14 (SDG 14), the Taiwan Seafood Guide, and the Nine Principles of Consuming Seafood in Taiwan for Ocean Sustainability. The SFM curriculum aims to pay attention to seafood consumption, to set up connections between people, food and nature, and to promote the awareness of the sustainability of marine resources. Developing a broad understanding of sustainability is critical to understanding the relationship between the ocean and people and ensuring a future healthy ocean and abundant marine resources [14].

2. The Ocean and Humans

2.1. Sustainable Development Goals (SDGs)

Sustainable development refers to the balanced development of the economy, society and the environment to meet the needs of contemporary people without compromising the development of the next generation [15,16]. The United Nations announced 17 sustainable development goals (SDGs) and 169 targets in 2016. The subject of SDG14 is life underwater: to conserve and sustainably use the oceans, seas and marine resources for sustainable development.

The ocean covers three-quarters of the Earth's surface and contains 97% of the Earth's water. Fish provide about 3.2 billion people with almost 20% of their average per capita intake of animal protein. However, overfishing is contributing to the rapid depletion of marine life species. Water quality is deteriorating due to pollution, eutrophication and ocean acidification, damaging the balance of marine ecologies and leading to the extinction of species. Furthermore, it directly and indirectly affects human multi-food chains, marine environments and overall ocean ecosystems [17,18].

2.2. Misconceptions about the Marine Environment

In 2012, the International Marine Conservation Conference (IMCC) announced 71 critical questions for marine biodiversity conservation, grouped into eight subject categories: fisheries, climate change, other anthropogenic threats, ecosystems, marine citizenship,

policy, societal and cultural considerations and scientific enterprise. Advances in fishing gear and technology have enabled humans to deplete marine resources endlessly but have also caused rapid changes in marine ecology that will eventually affect humanity. Marine resources will be no longer available for the next generation if people do not increase their awareness of sustainability [19–21]. In Taiwan, high school students have misconceptions of marine ecology. Therefore, marine science concepts and students' understanding of the relationship between living resources and the environment must be strengthened [22]. Students often have misconceptions about marine ecosystems; for example, the relationship between marine food chains is not clear. Furthermore, students believe incorrectly that the whale is a type of fish, not a mammal; that coral is a plant, not an animal; that plankton only lives in the intertidal zone, etc. Chen and Lu pointed out that, although marine resources are common property [23], due to the advancement of fishing technology and the increasing number of fishing boats, the destruction of marine ecology and the exhaustion of marine resources is inevitable. Norazah Mohd showed that knowledge impacted consumers' intent to purchase green products [24]. A balance needs to be struck between supply and demand.

2.3. Overview of Marine Resource Production

In 2018, the FAO report showed that the 2016 global capture from fishery production was 2 million tons lower than 2015 [25]. Mainland China produces the most fish in the world, with a total output of 15.25 million tonnes. Other top marine fishing countries include Indonesia, the United States, Russia, Peru, India, Japan, and Vietnam. Taiwan was ranked 21st on the list. Global fish production peaked at about 170.9 million tonnes in 2016 (Table 1), with aquaculture representing 47% of the total value and capture representing the other 53%. The global population was about 7.4 billion in 2016, and the fish consumption per capita was about 23 kg/year.

Table 1. Global fisheries and aquaculture production (millions of tonnes) [25].

Category/Production	2011	2012	2013	2014	2015	2016
Capture						
Inland	10.7	11.2	11.2	11.3	11.4	11.6
Marine	81.5	78.4	79.4	79.9	81.2	79.3
Total Capture	92.2	89.5	90.6	91.2	92.7	90.9
Aquaculture						
Inland	38.6	42.0	44.8	46.9	48.6	51.4
Marine	23.2	24.4	25.4	26.8	27.5	28.7
Total aquaculture	61.8	66.4	70.2	73.7	76.1	80.0
Total world fisheries and aquaculture	154.0	156.0	160.7	164.9	168.7	170.9

As an island country, Taiwan relies dramatically on marine resources. Fisheries, in particular, are one of its major industries. According to statistics from the Council of Agriculture, Executive Yuan, 51,000 people depend on fisheries. Fishing has contributed significantly to the development of peripheral industries, the economy's stability and the reliability of the food supply. As a report from the Council of Agriculture shows, fish production in 2017 was 103 thousand tons, with a population of 23 million, meaning fish consumption per capita was about 44.88 kg/year—higher than the annual global seafood consumption per capita [25]. The annual fisheries statistics report also showed the total fish production in 2017 to exhibit a small increase compared to 2016 (Table 2). The microstructure of fisheries and marine capture production is decreasing yearly as demand for aquatic products shifts to aquaculture and imported fish.

Table 2. Total fish production over the past 10 years in taiwan (tonnes).

Years	Marine Capture	Aquaculture	Total Grand
2008	1,009,449	332,187	1,341,636
2009	802,531	287,687	1,090,218
2010	854,086	315,737	1,169,824
2011	893,802	328,847	1,222,650
2012	908,082	348,000	1,256,082
2013	925,301	348,981	1,273,282
2014	1,068,375	339,638	1,408,012
2015	985,586	314,150	1,299,736
2016	748,470	255,721	1,004,191
2017	741,762	285,676	1,027,438

The World Wildlife Fund (WWF) 2018 Living Planet Report revealed that fish populations have decreased by more than half in less than 50 years. We should re-examine the concepts that emphasize the economy and ignore sustainability [18,26]. Fisheries-related guidelines have begun to be developed and implemented globally, but the exhaustion of fishery resources is ultimately attributed to the endless consumption of ocean resources. Due to its increased demand on marine ecosystems, the explosion of human consumption is the driving force for unprecedented changes in global fisheries production [27].

Most fishery resources can be sustainable if the catch does not exceed the ability of the organisms to self-restore.

2.4. Awareness of the Slow Fish Movement

- Slow Food

Slow Food, organized by Calo Petrini in the 1980s, was a movement against fast food that aimed to defend regional traditions and promote a slower lifestyle. Concerned by the abandonment of local gastronomic traditions, the movement is characterized by an approach that recognizes the close relationship between humans, the planet and culture. Slow Food recommends a holistic approach to food issues that links economic, sociocultural and environmental aspects to an overall strategy. To protect biodiversity, Slow Food promotes a positive interaction between producers and consumers through a series of events around the nation and the globe, such as the Slow Fish exhibition [12].

- Slow Fish

The Slow Fish exhibition is an international exhibition that promotes environmentally friendly fishing [28]. Every two years, Slow Fish convenes food producers, farmers, fishers, cooks and academics in Genoa, Italy to increase public awareness of sustainable seafood and promote good, clean and fair fish (Table 3).

Table 3. The core and definitions of Slow Fish [28].

The Core	Definition
Good	Fresh, delicious and seasonal, satisfying the senses and connected to our culture and local identity.
Clean	Produced using methods that respect the environment and human health.
Fair	Accessible prices for consumers, but also fair earnings that can guarantee decent working and living conditions for small-scale producers and workers.

- Slow Fishing

Over the course of history, fishing technology has developed to maximize fish catches. As the number of fish caught continues to increase, however, fishery resources are becoming depleted. Thus, the term "Slow Fishing" refers to the effort to catch fish more slowly

and reduce the number of fishing boats on the ocean [10]. The value of Fast-Moving Consumer Goods (FMCGs) is usually commensurate with their rarity. FMCGs, also known as consumer packaged goods (CPGs), are products that are sold quickly and at a relatively low cost. Aquatic products are no exception. If we catch fish without restraint, the increased catch of fish could negatively affect fish market sales. Ultimately, fisheries would have no chance to develop a better livelihood for their workers.

- Slow Fish Movement (SFM)

Studies have shown that knowledge can influence consumers' green product purchase intentions [24]. With this principle in mind, we define the aims of the Slow Fish Movement below, incorporating previous work published by Ya-Yin Liao:

1. To help consumers understand the impact of different fishing equipment and methods on marine environmental ecology.
2. To encourage consumers to buy sustainable seafood with a Seafood Guide and consume seasonal and moderate amounts of fish, giving marine resources enough time to replenish.
3. To influence upstream fishermen to uphold environmentally friendly fishing methods by "Slow Fishing" to catch the appropriate size and quantity of fish.
4. To enjoy the delicacies of the ocean with gratitude.

2.5. Conserving the Environment by Connecting Production and Consumption

Countries have now begun to create seafood guides to help preserve the marine environment through consumer actions and achieve marine environment conservation (MEC) and marine resource sustainability (MRC). At present, there are about 26 countries around the world that have developed their own seafood guides. In order to resolve the challenge of SDG14—to avoid overfishing and food losses—these guides instruct consumers to consider environmentally friendly fishing methods and focus on maintaining a smaller carbon footprint when purchasing aquatic products. In doing so, countries hope this will encourage producers to be responsible for their fishing activities, thereby prioritizing preservation from the beginning to the end of the fish production process [18].

- The United State

Seafood Watch defines sustainable seafood as seafood from sources, whether fished or farmed, that can maintain or increase production without endangering the structure and function of affected ecosystems [29]. The group has also developed a smartphone app that allows consumers to check their data when buying seafood. It divides fish into Green (Best Choice), Yellow (Good Alternatives) and Red (Avoid). Additionally, the U.S. Food and Drug Administration (FDA) and the U.S. Environmental Protection Agency (EPA) have issued advice regarding eating fish. They classify 62 species of fish based on mercury levels (Best Choice, eat 2 to 3 servings a week; Good Choices, eat one serving a week; Choices to Avoid, highest mercury levels) [30,31].

According to a study conducted in 2011, consumers have recently begun to pay more attention to food quality, especially as it pertains to its environmental sustainability [13]. Hospitality seafood sources have also evolved: from local seafood to imported seafood and the traditional market to the supermarket [32]. The Seafood Guide helps people make better seafood choices for health and marine sustainability via education.

- Taiwan

To connect production and consumption, researchers compiled the first edition of the Taiwan Seafood Guide in 2015. The Guide measures the sufficiency of wild resources, trophic levels, migratory or sedentary status and environmentally friendly fishing equipment and methods. The latest Taiwan Seafood Guide was published in 2018. There are 84 common market seafood listed and divided into three categories, with the color green representing a "Good Choice," yellow showing "Eat Less," and red corresponding to

"Say No" [3]. The Taiwan Seafood Guide lists 10 recommended principles for seafood consumers:

1. Common species are better than rare species;
2. Silver species are better than colorful species;
3. Migratory are better than sedentary species;
4. Sand species are better than reef rock habitat species;
5. Avoid seafood transported from long distances (energy-consuming);
6. Farm-raised species better than wild-caught species;
7. Avoid long-lived, large predator species (high heavy metal accumulation);
8. Species farmed with plant protein instead of farmed with wild fish;
9. Choose lower trophic level species;
10. Avoid seafood caught with unsustainable fishing methods.

In 2017, a list titled the "Nine Principles of Consuming Seafood in Taiwan for Ocean Sustainability" was published by the Sustainable Seafood and Fishery Development Association (SSFDA) [33]. The SSFDA is a non-government organization and brings together academics, industry representatives, local fisher associations and fishers. It advocates for better choices, reductions and refusals (Table 4). Compared with the Taiwan Seafood Guide, SSFDA specifically mentions seasonal fish selection, reducing juvenile fish and adult fish consumption, and the importance of fisheries management. Wang et al. [34] found that juvenile and adult fish have higher fertility elasticity. Furthermore, Fujiwara [35] showed that long-lived iteroparous adult fish have a low compensatory capacity. Therefore, for marine fish populations, it is suggested to reduce the consumption of wild-caught juvenile and adult fish.

Table 4. The Nine Principles of Consuming Seafood in Taiwan for Ocean Sustainability [33].

Category	Characteristics
Choice	Choose to refrain from seafood during peak periods of breeding and consume less wild seafood with eggs or reproductive glands. Choose seafood caught using environmentally friendly fishery methods or using sustainable resources. Choose farmed seafood with fast-growing, high feed-conversion-rates that do not burden the environment and require low amounts of animal protein.
Reduce	Reduce consumption of wild-caught juvenile and older adult fish and choose only marketable fish. Reduce consumption of processed seafood with stable shelf lives from wild-caught resources in Taiwan. Reduce consumption of large seafood species, species with long life-expectancies or slow- recovering species.
Refuse	Refuse to buy controversial seafood, especially those on wild conservations or those that are nearly extinct. Refuse to buy relatively cheaper imported seafood. Refuse to buy small fish with spots or stripes (distinguish at least two colors in combination, including yellow, green, blue and white.

The Seafood Guide helps consumers to make informed decisions and choose sustainable seafood based on several characteristics: first is the marine capture species, including (1) species stock status, (2) fishing methods, (3) ecological impacts and (4) the management of fisheries; second is aquaculture, including (1) feed, (2) farming methods, (3) ecological impacts, and (4) the management of aquaculture. The United States seems to be paying increased attention to mercury exposure in consumption seafood. The United States Department of Agriculture (USDA) announced the Dietary Guidelines [6], with a recommendation to consume 8 ounces or more of seafood per week (less for young children), including its EPA and DHA content. The three types of omega-3 fatty acids involved in human physiology are α-linolenic acid (ALA), found in plant oils, and eicosapentaenoic

acid (EPA) and docosahexaenoic acid (DHA), both commonly found in marine oils. Yan and Zeng argue that choosing the right food for health and ecological balance is of utmost importance [36]. Some other countries have developed seafood guidelines and established fish advisories to manage fish consumption and minimize methylmercury exposure [30]. The consumption of many kinds of seafood results in public health problems. Norazah found the correction of knowledge to be the most critical factor influencing consumers' intention to purchase the right products [24]. Every country must pay attention to the eating habits of its citizens. Wang and Chen mention that it is necessary to obtain an education on food through practice to achieve a healthy diet [37]. The goals of home economics education are to enhance students' essential ability to improve their quality of life, according to the United Nations Educational Scientific and Culture Organization [38]. Tseng and Li mention that this is also a critical opportunity to cultivate family relationships by promoting parent-child communication, establishing new thinking on food education and enriching food culture inheritance [39]. The study aimed to measure the impacts of an SFM curriculum on students' seafood consumption and levels of comprehension of MEC and MRS. The study adopted a quantitative methodology using questionnaires for data collection. The research process included a quasi-experimental study method for a single-group pre-test–post-test design, establishing the reliability and effectiveness of assessment tools through data collection and statistical analysis. Furthermore, status and predictive analyses were performed, and later recommendations were made based on the results.

3. Methodology

This study's objective was to strengthen the seafood selection ability of students by promoting the "Slow Fish Movement" to increase their awareness of MEC and MRS. Thus, it was necessary to evaluate students' prior knowledge and assess their awareness regarding MEC and MRS before implementing the SFM curriculum. Three questionnaires were used, entitled the "Seafood Consumption Experience Survey", "Conception Sustainable Seafood Questionnaire" and "Awareness of MEC and MRS Questionnaire,", respectively. The above questionnaires were used for both pre-tests and post-tests.

The Conception of Sustainable Seafood survey was divided into two parts. The first part, the Seafood Consumption Principles Questionnaire, was based on the Taiwan Seafood Guide and "Nine Principles of Consuming Seafood in Taiwan for Ocean Sustainability" and contained 13 questions. The second part, Sustainable Seafood Awareness, contained 10 questions asking about fisheries in Taiwan and other marine resource issues, including the purchase and preservation of aquatic products. The Awareness of MEC and MRS questionnaire was divided into three categories: cognitive learning, socio-emotional learning and behavioral learning.

3.1. Research Content

Among the important indicators promoted in food education, a strong understanding of diet (choosing the right food for health and ecological balance) was the most important. The SFM curriculum was the key to the student's entire conception of sustainable marine resources. The content of the lessons covered three objectives: cognitive learning, socio-emotional learning and behavioral learning. The SFM curriculum included an overview of Taiwanese fisheries, the relationship between humans and the ocean, an understanding of fishing equipment and fishing methods, the marine ecosystem, how to buy fresh whole fish, fish culture and seafood sustainability concepts. Finally, questionnaires and contents were drafted, and a group of five experts and scholars were invited to review them.

Research Experiment Implementation Process

The experimental group contained 1007 students and compared their performance through a pre-test and post-test. Before the SFM curriculum, a pre-test was conducted to understand student's existing knowledge, attitudes and behaviors towards marine conservation and sustainability. After the SFM curriculum of three 40-min lessons, a post-test was conducted to understand if students improved regarding their understanding of MEC and MRS. Data analysis included calculating the mean and standard deviation and the use of a paired sample *t*-test.

3.2. Research Instruments, Tools and Data Analysis

3.2.1. Seafood Consumption Experience Survey

The Seafood Consumption Experience Survey asked about seafood preferences among a range of 84 common seafood products from the Taiwan Seafood Guide.The questions were assessed with a single-choice method. There were 28 kinds of species listed in the "Good Choice" category, 30 kinds of species in the "Eat less" category, and 26 kinds of species in the "Say No" category. To gauge the attitude of the respondents toward the seafood, responses were divided into three categories: frequently, sometimes and rarely/never. The 84 types of seafood were listed arbitrarily.

3.2.2. The Conception of Sustainable Seafood Questionnaire

The Conception of Sustainable Seafood Questionnaire has 23 questions and is divided into two parts:

1. Principles of seafood consumption

Combined with the Taiwan Seafood Guide and the Nine Principles of Sustainable Seafood Consumption in Taiwan for Ocean Sustainability, there were 13 questions listed in this section.

2. The conception of Taiwan's fishery, sustainable seafood and preservation

Compiled with information from government agencies and scholars on seafood selection and the current status of Taiwan's fisheries, there were ten questions listed in this section.

The KR20 (Kuder–Richardson reliability) score for the Conception of Sustainable Seafood in the pre-test was 0.71. In post-test, the KR20 score was 0.73. Consequently, the internal consistency was acceptable.

3.2.3. Awareness of Marine Environment Conservation and Marine Resource Sustainability

The aim of building the MEC and MRS questionnaire was for individuals to be encouraged to be responsible actors. The MEC and MRS questionnaire was designed with a four-point Likert scale. The questionnaire includes 12 questions; its contents were based on Ocean Literacy For All and included the following [38]:

1. Cognitive learning objectives;
2. Socio-emotional learning objectives;
3. Behavioral learning objectives.

Questions 2–12 were direct, and the participants could choose from four options: 4 for strongly agree, 3 for agree, 2 for disagree, 1 for strongly disagree. Question 1 was rhetorical and scored in reverse order (Table 5). Evaluating the agreement inventory score, participants with higher scores had a higher recognition level in each dimension.

Table 5. The score description of marine environment conservation (MEC) and marine resource sustainability (MRC).

Items	Question	Average Score	
		Pre-Test	Post-Test
1 *	As Taiwan is surrounded by the ocean, marine resources are now abundant.	2.83	3.11
2	Marine resources are not endless; we must create sustainable marine resources.	3.65	3.67
3	Marine environment ecology is confronted with a crisis.	3.50	3.66
4	Overfishing has affected the marine ecological food chain and unbalanced it.	3.75	3.76
5	I am curious about the marine ecosystem and care about marine ecology.	3.19	3.38
6	I can learn about marine food culture by consuming different aquatic products.	2.98	3.18
7	I enjoy seafood with gratitude.	2.96	3.29
8	I feel sad when I watch a film about how the ocean is full of trash.	3.22	3.40
9	I am willing to support green consumption and promote sustainable seafood to friends and family.	3.31	3.51
10	When consuming seafood, I ask "where do these fish come from?" and "how were they caught?".	2.62	3.12
11	I am willing to participate in some activities for marine conservation and sustainability.	2.93	3.31
12	I will refuse to buy species that are listed as protected or when the resource is endangered.	3.48	3.69

Using a four-point scale from 1 (strongly disagree) to 4 (strongly agree). * rhetorical question, the score is in reverse order.

- Reliability

Cronbach's α is an internal consistency estimate of the reliability of test scores. A Cronbach's α of 0.7 is a reasonable threshold in advanced research projects. The Cronbach's α values in MEC and MRS, which included three learning objects, are shown in Table 6.

Table 6. The reliability scores for marine environment conservation and marine resource sustainability.

Items	Learning Objectives	Cronbach's α	
		Pre-Test	Post-Test
1–4	Cognitive learning objectives	0.4	0.6
5–8	Socio-emotional learning objectives	0.7	0.8
9–12	Behavioral learning objectives	0.7	0.8
1–12	Overall	0.8	0.9

The Cronbach's α of cognitive learning objectives in the pre-test was 0.4. The low-reliability value may be due to the unclear design of the question content, which may need to be revised. There was a significant improvement after teaching the SFM curriculum. Overall, the internal consistency α score was 0.9.

4. Results and Discussion

4.1. Results

4.1.1. Seafood Consumption Experience Survey

Of the 1070 samples distributed in this survey, 63 invalid samples were eliminated, leaving 1007 valid responses. The overall response rate to the survey was 94.11%. The seafood consumption experience questionnaire asked for the background and consumption habits of respondents. Participants were asked to select one of five possible responses,

which were ranked on a point-value scale. "Strongly like" was valued the highest with 5 points, and "strongly dislike" was valued the lowest (Table 7).

Table 7. Seafood consumption preferences.

	Question: Do You Like to Eat Seafood?				
Items	**Strongly Like**	**Like**	**Acceptable**	**Dislike**	**Strongly Dislike**
Point	5	4	3	2	1
Response	240	379	327	39	43
Average score			3.72		

In the 1007 valid questionnaires, the average score was 3.72 (including vegetarians). The average preference toward seafood consumption was between "acceptable" and "like".

The participants could choose four options to show their frequency of seafood consumption (Table 8).

Table 8. The frequency of seafood consumption.

Items	**Almost Everyday**	**1–2 Times per Week**	**3–4 Times per Month**	**Never/Rarely**
Point	4	3	2	1
Response	237	339	331	158
Average score		2.61		

As shown in the table above, most junior high school students usually ate seafood at least two times per week. The average weekly frequency of seafood consumption was 2.61 (including vegetarians).

This study also sought to determine whether the respondents were actually responsible for their decision to consume seafood. Respondents were asked to identify who purchased the seafood at the time of consumption and were given three possible answers to choose from. Each of these answers was assigned a discrete point value from 1 to 3. The results of this survey are shown in Table 9.

Table 9. Who is the person who decides to eat or buy seafood?

Items	**Me**	**Not Me**	**Vegetarian**
Respond	190	837	36

The traditional market was the most popular place for students' families to buy seafood (82% of families bought from the traditional market, 61% from the supermarket, 40% from the harbor and 8% online). This was divided into three levels according to the frequency of past consumption: frequently, sometimes and rarely/never. The score for each seafood is shown in Table 10.

Table 10. Frequency of eating seafood.

Seafood	**How Frequently Do You Eat This Species of Seafood?**	**Score**
Seafood	Frequently	3
	Sometimes	2
	Rarely or Never	1

Overall, clam, salmon, cuttlefish, marine shrimp and oyster were the top five most popular seafood options. Among them, salmon and marine shrimp were recommended to be consumed less; cuttlefish was the third most popular seafood, and this is listed as "Say No". The percentage of seafood consumption is shown in Figure 1.
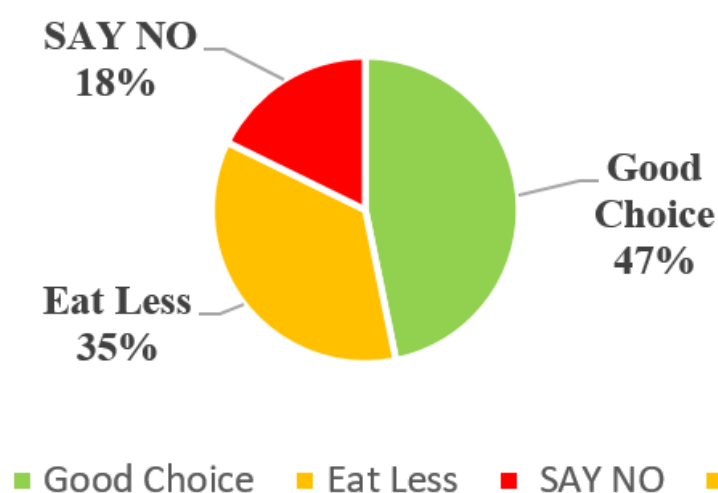

Figure 1. Consumption Ratio of 84 Common Seafood.

The top five most commonly eaten seafood within the Good Choice/Eat Less/Say No criteria were as follows:

1. "Good Choice" criterion: clam, oyster, pacific saury, squid and sakura shrimp;
2. "Eat Less" criterion: salmon, marine shrimp, silver pomfret, tuna and mackerel;
3. "Say No" criterion: cuttlefish, eel, bluefin tuna, shark and wild mullet.

4.1.2. Consumption of Sustainable Seafood Questionnaire Analysis

There were 13 questions in the questionnaire, and the total score was 13 points. The results of this questionnaire are shown in Table 11. The lessons of the SFM curriculum significantly impacted students' judgments on the selection of seafood consumption (pre-test, M = 7.22, SD = 2.45; post-test, M = 10.89, SD = 1.83, t = -46.23, $p < 0.001$).

Table 11. Analysis of Consumption of Sustainable Seafood Questionnaire.

	Number of Participants	**M**	**SD**	**t-Value**
Pre-test	1007	7.22	2.45	-46.23 ***
Post-test	1007	10.89	1.83	

95% confidence interval, M = Mean, SD = Standard Deviation *** $p < 0.001$.

Five principles had a passing rate below 50% in the pretest: principle #4 (14%), principle #8 (29%), principle #3 (31%), principle #7 (34%) and principle #6 (37%). After teaching the SFM curriculum, students showed statistically significant differences in their consumption of seafood principles. The result of this study shows that the passing rate of principle #8 was still below 50% in post-test (Table 12).

Table 13 shows that there were 10 questions on this questionnaire, and the full score was 10 points. Through the SFM curriculum, students were found to have statistically significant differences in understanding the current fishery situation, fish growth background, how to choose seafood and the concepts of sustainable seafood (t = -25.04, $p < 0.001$).

Table 12. The passing rate of the 13 seafood consumption principles.

Item	Consumption of Seafood Varieties	Pre-Test/Post-Test	M	SD	t-Value
1	①Common	Pre-test	0.93	0.25	−7.21 ***
	②Rare species	Post-test	0.99	0.89	
2	①Silver	Pre-test	0.79	0.41	−14.46 ***
	②Colorful species	Post-test	0.97	0.18	
3	①Migratory	Pre-test	0.31	0.46	−22.97 ***
	②Sedentary species	Post-test	0.75	0.44	
4	①Sand habitants	Pre-test	0.14	0.34	−30.97 ***
	②Reef rock habitants	Post-test	0.69	0.49	
5	①Avoid seafood transported from a long distance	Pre-test	0.83	0.38	−12.28 ***
	②Otherwise	Post-test	0.98	0.15	
6	①Farmed-raised	Pre-test	0.37	0.48	−24.50 ***
	②Wild-caught species	Post-test	0.81	0.39	
7	①Avoid long-lived, large predator species	Pre-test	0.34	0.47	−24.90 ***
	②Otherwise	Post-test	0.81	0.39	
8	①Avoid choosing shrimp, salmon and tuna that are farmed (fish meal with animal protein)	Pre-test	0.29	0.45	−4.26 ***
	②Otherwise	Post-test	0.37	0.48	
9	①Choosing farmed Taiwan tilapia and milkfish (fish meal with plant protein)	Pre-test	0.58	0.49	−15.39 ***
	②Otherwise	Post-test	0.85	0.36	
10	①Choosing lower trophic level species	Pre-test	0.52	0.50	−21.96 ***
	②Otherwise	Post-test	0.89	0.31	
11	①Consuming seafood caught by environmentally friendly fishing	Pre-test	0.82	0.38	−9.99 ***
	②Otherwise	Post-test	0.95	0.21	
12	①Choosing species with a fast-growing and high-quality feed conversion rate	Pre-test	0.66	0.48	−17.41 ***
	②Otherwise	Post-test	0.93	0.26	
13	①Avoiding consuming wild seafood with eggs/reproductive glands in their peak period of breeding	Pre-test	0.65	0.48	−19.45 ***
	②Otherwise	Post-test	0.94	0.24	

95% confidence interval, M = Mean, SD = Standard Deviation ① shows a principle of sustainable seafood consumption, based on the Taiwan Seafood Guide and Nine Principles of Sustainable Seafood Consumption in Taiwan for Ocean Sustainability; in contrast, ② shows a kind of consumption that should be avoided for MEC and MRS (①= correct answer, ②= wrong answer). *** $p < 0.001$.

Table 13. Analysis of Sustainable Seafood Awareness Questionnaire.

	Amount of Participants	M	SD	t-Value
Pre-test	1007	7.23	1.58	−25.04 ***
Post-test	1007	8.51	1.29	

95% confidence interval, M = Mean, SD = Standard Deviation *** $p < 0.001$.

4.1.3. Marine Environment Conservation and Marine Resource Sustainability Awareness Questionnaire Analysis

The results show that the SFM curriculum resulted in significantly different cognitive, socio-emotional and behavioral learning objectives in Marine Environment Conservation and Resource Sustainability in Table 14 (cognitive learning objectives: pre-test, M = 13.57, SD = 1.58; post-test, M = 14.06, SD = 1.62, t = −9.09, $p < 0.001$; socio-emotional learning objectives: pre-test, M = 12.61, SD = 2.13; post-test, M = 13.47, SD = 2.09, t = −13.66, $p < 0.001$; behavioral learning objectives pre-test, M = 12.60, SD = 2.11; post-test, M = 13.79, SD = 2.04, t = −18.92, $p < 0.001$).

Table 14. Analysis of awareness of marine environment conservation and marine resource sustainability.

Dimensionality	Items	Pre-Test/Post-Test	M	SD	t-Value
Cognitive learning objectives	1–4	Pre-test	13.57	1.58	−9.09 ***
		Post-test	14.06	1.62	
Socio-emotional learning objectives	5–8	Pre-test	12.61	2.13	−13.66 ***
		Post-test	13.47	2.09	
Behavioral learning objectives	9–12	Pre-test	12.60	2.11	−18.92 ***
		Post-test	13.79	2.04	

95% confidence interval, M = Mean, SD = Standard Deviation. *** $p < 0.001$.

Table 15, the result shows that the SFM curriculum significantly different on overall of Cognitive, Socio-emotional, and Behavioral learning objectives (pre-test, M = 38.79, SD = 4.50; post-test, M = 41.31, SD = 4.66, t = −19.14, $p < 0.001$).

Table 15. Overall analysis of the Marine Environment Conservation and Marine Resource Sustainability Awareness Questionnaire.

	Amount of Participants	M	SD	t-Value
pre-test	1007	38.79	4.50	−19.14 ***
post-test	1007	41.31	4.66	

95% confidence interval, M = Mean, SD = Standard Deviation *** $p < 0.001$. The result shows a significant difference in achievement following the Slow Fish Movement (SFM) curriculum in terms of cognitive, socio-emotional and behavioral learning objectives (pre-test, M = 38.79, SD = 4.50; post-test, M = 41.31, SD = 4.66, t = −19.14, $p < 0.001$).

4.2. Discussion

4.2.1. Sustainable Seafood Consumption

This study shows that most junior high students like to eat seafood (the average score was 3.72) and purchase seafood at least twice a week (the average score was 2.61) at a traditional market, supermarket, fishing harbor and online. Usually, the people who take care of the family decide what food to buy. The result shows that the traditional market is the first choice to buy seafood, in contrast to the work of Chen et al. [32]. That is because Keelung is a harbor city and has a large fish market. The participants and families of this study lived in Keelung and had easy access to various fish species.

The most commonly eaten seafoods were clam, salmon, cuttlefish, marine shrimp and oyster. Imported salmon was the second most popular seafood, which wa sin line with the findings of Chen and Huang [13] that Taiwanese seafood consumption sources have moved from local seafood to imported seafood. The Taiwan Seafood Guide recommends that consumers should consume farmed fish first since the marine resources are insufficient. However, farmed salmon are fed with fishmeal or trash fishes through bycatch; therefore, they are listed under the Eat Less criterion. The other seafood which needs more attention is cuttlefish. Cuttlefish were among the top top-three seafoods but are listed under the "Say No" criterion due to overfishing and catching methods that may destroy habitats or induce bycatch.

Promoting seafood guides is the best way to raise awareness of sustainable seafood consumption. However, there are 84 common seafoods on the list in the Taiwan Seafood Guide. The United States has developed a seafood watch list for all 50 states and a mobile app that provides consumers with the ability to purchase sustainable seafood at any time everywhere. Although the US Seafood Watch only lists 35 species of seafood, it is more cautious about classifying according to origin and fishing methods. In other words, the Taiwan Seafood Guide still has much room for improvement.

Students like to eat seafood, but do not understand marine ecology and habitats. Table 12 shows that principle #8 needs more attention in the future. Students need time to transfer to comprehension from knowledge. Therefore, future researchers can use the results of this study to narrow down the scope of the design curriculum and the microscopic features of #8, #3 and #4 so that students can more clearly understand the principles of Taiwan's Seafood Guide. Knowledge is the foundation for building a person's attitudes and behaviors. The result showed that students lack a concept of the habitats of marine life. Through education, people can consume seafood that is caught with environmentally friendly fishing (principle #11, Table 12). Norazah Mohd showed that knowledge impacted consumers' attitudes toward purchasing green products [24], and Yusah, Shuib, Kunasekaran and Nordin have indicated that, through education, people can exert a significant influence on the use of marine resources to reduce the uses of destructive fishing methods [40].

4.2.2. Marine Environment Conservation and Resource Sustainability Awareness

The data from Tables 14 and 15 convey that as a result of the SFM curriculum, students showed statistically significant differences in the cognitive, socio-emotional and behavioral dimensions of MEC and MRS. Due to unfamiliarity with the fishery situation, marine environmental biology and fish growth background, people could not make sustainable seafood consumption decisions. Although our study showed that the SFM curriculum significantly improved awareness of marine resource sustainability, Wen and Lu [41] have pointed out that students' awareness and attitude towards marine environmental protection have no significant impact on behavior. For cognitive intentions to transfer to actual behavioral performance, further research by future researchers is required. Considering the balance between resource utilization and sustainability, we would sincerely encourage people to adhere to the SFM curriculum.

5. Conclusions and Recommendations

5.1. Conclusions

This study highlights both the lack of awareness among students of the risks of unsustainable seafood consumption and the need to promote public awareness of marine environment conservation and resource sustainability in Taiwan. Most respondents in the survey showed a lack of understanding of the surrounding marine ecosystem. The students' attitudes toward sustainable seafood consumption, however, were significantly impacted by the SFM curriculum. The SFM is not designed to prohibit human consumption of seafood but to teach people to increase their awareness of the marine environment's ecological conservation by understanding the consumption of seafood in their daily diet. The Taiwan Seafood Guide makes recommendations based on the appearance of marine life, the growth environment, breeding feed and sustainable fishing methods. However, the nine principles of consuming seafood in Taiwan also mention that, when purchasing seafood, it is necessary to consider whether it is in season or not, to consume seafood with a high meat exchange rate and to remind consumers to eat in moderation. A different perspective is required to make marine resources sustainable. These findings also correspond to the researchers' second argument regarding the Slow Fish Movement: consumers should be encouraged to buy sustainable seafood with a Seafood Guide and consume seasonal and moderate amounts of fish, giving marine resources enough time to replenish.

Consumer behavior has a significant influence on marine resource conservation and sustainability. Thus, one of the most important ways to protect marine resources is to promote an awareness of sustainable consumption and the purchasing of seafood products. As evidenced by the study, most junior high school students lack a thorough understanding of Taiwan's current over-fishing dilemma and cannot recognize sustainable aquatic products. By influencing the cognitive, socio-emotional and behavioral patterns, the SFM curriculum can educate consumers to protect marine resources by purchasing seafood more responsibly.

5.2. Recommendations

People rely on the ocean for their livelihoods, jobs, food, medication and goods. Exploding levels of human consumption and action are the driving force behind the unprecedented change witnessed in the marine ecological system. Marine resources are not inexhaustible. Facing depleting marine resources, we are now trying to raise awareness of marine resource conservation and sustainability through the Slow Fish Movement curriculum, encouraging positive interactions between producers and consumers to make use of sustainable seafood. Based on the results of this study, we make the following suggestions.

Students should pay more attention to marine resource issues and consult related books, magazines and Internet messages. By consuming seafood responsibly with their family and communicating with people who work in fisheries, students can demonstrate to seafood stakeholders the importance of sustainable seafood in their communities. Educators can develop versions of the SFM curriculum that more closely relate to their respective local cultures.

Governments, museums and schools can promote extracurricular activities that deal with marine ecological habitats and aquaculture. Stakeholders and other consumers can partner with the Taiwan Seafood Guide to help build local, sustainable seafood guides that cater to more specific localities in Taiwan.

Ultimately, there is an urgent need for policies and legislation that regulate harmful fishing practices. Examples of this include enforcing an on-season and an off-season for fishing, standardizing a national aquatic product certification, providing welfare for fishers, and creating a cold-chain for producers, transporters and stakeholders in fishing.

Through the Slow Fish Movement curriculum, we are encouraging the next generation to choose sustainable seafood and develop marine resource sustainability attitudes. The youth will be the leaders of the future. Family members can potentially adapt to conserve and sustain marine sources by educating the youth. Marine resources can continue to propagate if all people consume sustainable seafood. Achieving SDG 12 and SDG14 would be of benefit for the government, fishers and consumers.

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