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Teaching Scheme Research on Issues of Marine Environment Education: Taking the Interdisciplinary Integration of Biology, Chinese, and Information into Marine Biology as an Example

Chia-Mei Lu[1], Su-Mei Wu[2], Mei-Shih Tsai[3], Ming-Cheng Wang[4], Pai-Lu Wu[5*]

[1]Department of Digital Multimedia Design, Cheng-Shiu University,
No.840, Chengcing Rd., Niaosong Dist., Kaohsiung City 83347, Taiwan
[2]Kaohsiung Municipal Wunshan Senior High School,
No.31, Da-pi Rd., Niao-song District, Kaohsiung City 83341, Taiwan
[3]Kaohsiung Municipal Wunshan Senior High School,
No.31, Da-pi Rd., Niao-song District, Kaohsiung City 83341, Taiwan
[4]Kaohsiung Municipal Wunshan Senior High School,
No.31, Da-pi Rd., Niao-song District, Kaohsiung City 83341, Taiwan
[5]Center for Teacher Education, Cheng-Shiu University,
No.840, Chengcing Rd., Niaosong Dist., Kaohsiung City 83347, Taiwan

Abstract:
In order to meet the spirit of interdisciplinary teaching, this study combined the existing teaching materials with students' life experience using the existing resources in the community to train their ability to achieve mastery in any area of their life. Focusing on the ecological teaching in the Museum of Marine Biology and Aquarium, teachers in the subjects of biology, Chinese, and information discussed the teaching direction and designed a series of teaching programs in a comprehensive way. The course ran for one year with a total of 72 classes and two classes a week. The teachers in the three subjects carried out collaborative teaching according to the contents they had prepared together. The objects of this study were 33 high school students who participated in the biology curriculum. It was hoped that they would be provided with a more comprehensive and integrated education and their interest in learning would be cultivated through integrating interdisciplinary teaching into marine education. The research conclusions are: 1) through the systematic and cross-curricular courses prepared together and curriculum activities, students were able to learn more fully and effectively integrate the content of those subjects; and 2) through the strategy of outdoor teaching at Ocean Fantasy Museum, the interest and learning attitude of high school students were effectively promoted and students' knowledge on marine organisms was enhanced. Therefore, the design and implementation of a cross-curriculum teaching plan in this course can contribute to the expansion of marine education.

Keywords: Teaching Scheme Research, Marine Environment Education, Interdisciplinary Integration, Marine Biology

1. Research Motives

According to the findings of Tu (2011), the pro-sea behaviors of junior high school students are helpful to promote their attitudes and behaviors towards marine ecological conservation (Tu, 2011). The more time that is spent on visiting an exhibition related to oceans, the more knowledge about the marine environment can be obtained by the students, whose attitudes also can be further improved (Lee, 2007). Marine education in primary and secondary schools is for cultivating students' ocean literacy so as to lay the foundation for developing Taiwan as a marine country in the future; thus, it is necessary to mold the educational environment of "being close to the sea, loving the sea and knowing the sea" (Chou, 2017). Providing students with appropriate marine related learning environments will help to enhance their marine consciousness.

The relevant research on integrating marine education into teaching showed that diversified curriculum designs such as cyber source, video teaching, reading, teaching bulletins, and outdoor teaching courses in primary and secondary schools could impress students, increase their awareness of the oceans, and improve their attitudes toward the

oceans (Huang, 2012). However, most research subjects were pupils, and few of them were high school students; fewer people even teach marine ecology through an interdisciplinary approach. Therefore, researchers want to design multiple elective courses with the integration of teaching across multiple subjects and explore the impact of the implementation methods and processes of the courses on marine ecological interpretation.

The researchers hope to develop an ecological teaching method in Ocean Fantasy Museum and enhance students' interest in learning by combining with the curriculum of high schools, thus conforming to the principle that "the learning plan for marine education should be based on the experience on the sea (water)" in the White Paper on the Policy of Marine Education of Taiwan's Ministry of Education (Ministry of Education, 2007). Ocean Fantasy Museum is a small marine biology museum and aquarium in Kaohsiung. Many strange sea creatures are raised in the museum, which makes it suitable for the development of marine education, but the explanation data are not complete, and so our teaching and research team hoped to provide students with a more comprehensive and integrated education through integrating interdisciplinary teaching into marine education. Through marine education, we should not only make students obtain marine related knowledge, but also establish the correct value on the ocean, such as how to use marine resources and protect the marine environment, and all the aspects should be based on sustainable development (Huang, 2006), so that everyone can understand the "symbiosis with the ocean" (Tsai, 2008), which helps highlight that the marine education must achieve the purpose of "sustainable development for man and the ocean" (Wu, 2008).

The research team took Ocean Fantasy Museum as the research site and marine biology as the center of learning. Through the interaction of marine biology and other subjects, an interdisciplinary curriculum was formed. Teachers in this team prepared interdisciplinary courses together, used them in multiple elective courses at the high school, and discussed the influence of the curriculum on students' learning.

"Curriculum integration" is a kind of curriculum design form. It organizes relevant knowledge and experience so that students can easily learn the meaning of knowledge, achieve better learning results, and apply what they have learned to daily life for adapting to social life (Yu, 2000). In order to meet the spirit of interdisciplinary teaching, the existing teaching materials were combined with the students' life experience using the existing resources in the community to train their ability to achieve mastery in any area of their life. The integrated curriculum on ecological interpretation of marine organisms was designed in this study, which was based on the marine organisms in the Ocean Fantasy Museum; thus, the study content is meaningful and the teaching profession is brought into full play. Within this design, the biology teacher takes pictures and shoots videos of organisms at Ocean Fantasy Museum and then integrates the data. After that, the Chinese, biology, and information teachers prepare the lessons together in order to discuss the direction of teaching and design a series of teaching plans.

The whole course ran for one year, and there were two classes, which were allocated in the fifth and sixth class of every Tuesday. Excluding holidays, there were classes lasting 18 weeks in each semester, for a total of about 72 classes in a year. According to the content that the three teachers prepared together, the teacher appropriately allocates the classes and organizes the key points that students needed to learn in series. Through this course, the researchers wanted to let students go to the Ocean World Park to learn how to observe organisms and understand the classification and ecological habits of marine organisms. They also hoped that the students could complete the biological explanation of marine organisms by using the Mandala thinking method to sort out biological information, with a large number of reading and methods of metaphors, associations and oral expressions in Chinese. The teachers then use the information software PowerDirector to clip out a complete introduction for organisms, make the biological data produced by students into AR video using ENTiTi, make the data into an e-book, and take them to participate in a relevant e-book game.

2. Research Purpose

The research purposes are as follows: 1) the feasibility of integrating interdisciplinary teaching into the ecological interpretation of Ocean Fantasy Museum; 2) difficulties and solutions in teaching during the course of implementation; 3) the promoting process of interdisciplinary lesson plans through action research, integrating the interdisciplinary lesson plans designed by the teachers all together into teaching; 4) influence on

students' learning attitude to marine biological environment; and 5) the effective improvement of students' learning motivation and interest.

3. Research Method and Procedures

3.1 Research content

Multiple elective courses in the high school were designed through the interdisciplinary method in this study. In the process of practice, students' learning attitudes were observed and data were systematically collected, so as to find out the problems in teaching, analyze the causes of the problems, put forward an improvement scheme, and analyze the feasibility of integrating the interdisciplinary teaching plans into the marine ecological interpretation in high schools.

3.2 Research subjects and sites

Research subjects: Senior high school grade-2 students studying biology curriculum in Wenshan High School in Kaohsiung (33 in total; 13 boys and 20 girls); the students selected the classes freely. Research sites: Wenshan High School in Kaohsiung, and Ocean Fantasy Museum.

3.3 Research process

Research time: September 2016 to June 2017; the whole curriculum ran for one year.

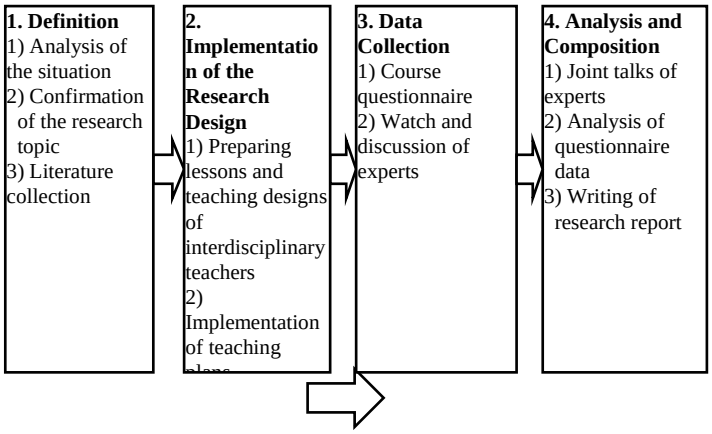
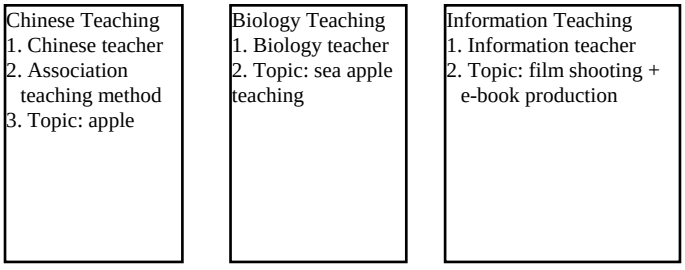


Figure 1: Research Framework

3.4 Designs of teaching plans and teaching implementation – integrating Chinese into biology; the explanation is as follows



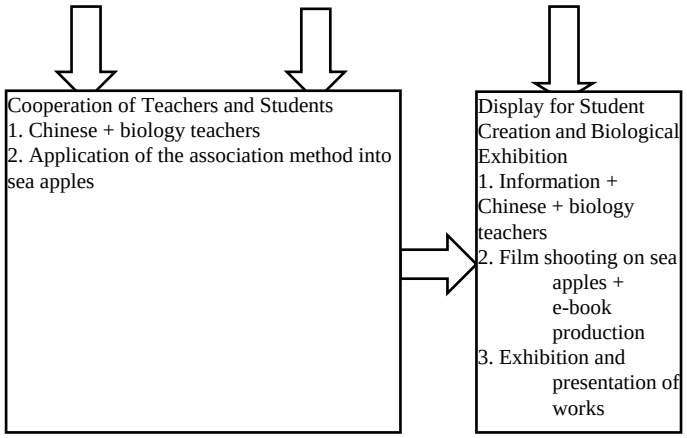


Figure 2: Designs of Interdisciplinary Lesson Plans and Teaching Implementation

1. Chinese teaching

(1)Teaching and demonstration of association method used by teachers: the operation of association method is to let the students learn to think from many angles and apply these data in series. First, teachers used apples as the teaching material and let students think: are they imported apples or local apples? What is the classification status of those apples? The teacher then told students that her/his favorite apple was the honey apple of Taiwan, thus letting students associate the apple tree king grafted by most kinds of apples of Fushoushan in Taiwan. Again, the students associated that the most famous apple tree should be the apple tree related to Newton, because Newton discovered gravity due to that tree. However, what everybody wanted most should be an apple with a bite, thus introducing apples.

(2)Exercises for association method: let students associate Snow White's consequence for eating poisonous apples. Where did the poisonous apple come from? There is a saying that it is related to the sea apple, thus introducing the sea apple in the sea.

2. Biology teaching

In biology class, the teacher introduced the sea apple: sea apple is a kind of poisonous sea cucumber; there are lovely creatures in Ocean Fantasy Museum.

3.Information teaching

Used shooting + e-book production technology as lead-in.

4. Research Results

1. Discussion on the promotion of the interdisciplinary teaching plans

(1) This study found that the students had the ability to collect information, but lacked the abilities of

judgment and summary. After the guidance of teachers, using the strategy application, and practicing data arrangement and biological data collection, the students could find the key points for introduction and arrange them respectively.

(2) In the teaching scheme of interdisciplinary teaching, teachers combined Chinese with marine ecology and made students' biological interpretation not limited to the collection of general network data. They used the exercises of analogy in the Chinese lesson and let students appreciate the works by the writer of ocean literature, Liao Hong-ji. There is a special introduction of literary works of Guidaotou and Ding Wan (Makaira Indica) in textbooks of high schools. Teachers should instruct students to learn the biological analogy to vividly depict the characteristics or features of biology, so as to stimulate the student to use biological metaphors to describe the appearance or characteristics of marine organisms they know. As a result, what the students wrote was beyond what the researchers expected (the exercise results of analogy are shown in Attachment 2). It is thus clear that students' imagination and learning ability can be aroused after they truly contact and understand marine organisms.

2. The influence on students' learning attitudes towards marine biological environment

The statistics of the end-of-term questionnaires: 100% of students believed that their biological abilities had improved a lot after a semester of biology learning. Among them, 24 students believed that their overall biological abilities had improved, 23 of them thought that their interests and abilities to learn biology had been developed, 11 of them thought that learning biology would be helpful for the future career, and there were 32 students who passed the course and received credit. Moreover, 100% students believed that they would still learn the knowledge related to biology after the end of this semester to improve their biological knowledge.

3. Is it effective in improving students' motivation and interest?

The statistics of the end-of-term questionnaires: the most helpful teaching activities to improve biology knowledge according to students are successively ranked as follows: 31 teachers provided biological photos and description, 30 teachers provided biological data, 30 teachers provided biological film and description, 25 teachers asked students to cooperatively discuss the questions he/her raised, 23 teachers assigned topics and asked students to collect related data, 21 teachers asked students to discuss the topics, 16 teachers asked students to make a report on the topic, 19 teachers asked students to take notes, 12 teachers assigned a topic and asked students to write articles according to the topic, and 13 teachers selected topics freely and asked students to cooperatively edit e-books and reports.

The statistics of the end-of-term questionnaires: the most helpful teaching activities to improve the learning interest and attitude towards biology are successively ranked as follows: 29 teachers provided biological data, 29 provided biological photos and description, 29 teachers provided biological film and description, 23 teachers asked students to cooperatively discuss and solve the questions he/her raised, 19 teachers asked students to discuss the topics, 19 teachers asked students to take notes, 17 asked students to make a report on the topic,17 teachers assigned a topic and asked students to collect data, 13 teachers selected topics freely and asked students to cooperatively edit e-books and reports, and 12 teachers assigned a topic and asked students to write articles according to the topic.

5. Research Conclusion and Suggestions

1. Through the multiple selective courses systematically prepared by the interdisciplinary teachers together, students can really learn more comprehensively and integrate the learning content effectively.

2. In the interdisciplinary teaching scheme, it is necessary to create new styles for the introduction of marine biology and ecology, dip into reading data by students, and use the association method and application of the teaching plans to connect all the information of students. From the films made by students, it could be seen that the marine organisms that students wanted to introduce were organized carefully. Through the practice of oral expression, the students could completely describe the ecological status and characteristics of the marine organisms. From the qualitative comparison before and after the course, students' oral expression ability improved. It could be found from the results of the post-class questionnaire of students that 80% of them did think that the arrangement of the teaching plans of this course could really improve their interest in learning.

3. Curriculum activities: Teachers provided biological photos and descriptions; teachers provided biological data; teachers provided biological film and

descriptions; teachers asked students to cooperatively discuss the questions he/her raised; teachers assigned topics and asked students to collect related data; teachers asked students to discuss the topics; teachers asked students to make a report on the topic; teachers asked students to take notes; teachers assigned a topic and asked students to write articles according to the topic; 13 teachers selected topics freely and asked students to cooperatively edit e-books and reports and other activities. Students believed that all these activities are most helpful to promote their biological knowledge and to enhance their learning interests and attitudes toward biology.

4. The result of the classroom observation and discussion of experts: the experts affirmed the feasibility of interdisciplinary teaching plans in teaching; in addition, the experts suggested that the application of mind map could be added in teaching, so as to let the students fully learn the explanation content of biology and ecology.

5. Through the outdoor teaching at Ocean Fantasy Museum, students' interest in learning could be effectively enhanced and the awareness of marine organisms could be improved. The teaching plans developed from Ocean Fantasy Museum could also contribute to the expansion of marine education.

6. Acknowledgment

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