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# Strategies for compiling a teaching material for under-college students

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**To cite this article:**

Chi-Min Liu. Strategies for Compiling a Teaching Material for Under-College Students. *Science Journal of Education*.

Vol. 2, No. 1, 2014, pp. 1-3. doi: 10.11648/j.sjedu.20140201.11

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**Abstract:** MEEP (Marine Education Enhancement Project) is a four-year pioneering project (2008 to 2012) supported by Ministry of Education of Taiwan for the sake of spreading and deepening the ocean-related knowledge to the public as well as students at all universities and schools. MEEP covers several sub-projects which include the academic courses for college students either with or without marine background, the career training for students interested in ocean-related industries and shipbuilding, and the teaching material editing for students from 6 to 18 years old. Among these sub-projects, the last one may be the most important because in Taiwan professional books containing ocean knowledge for younger students are quite few in the past. To this end, the author completed teaching materials entitled as "Ocean science, technology and history" suitable for students at pre-college schools in 2010. Different from textbook used in universities and colleges, it requires more delicate strategies and vivid descriptions which are usually beyond a professor's academic ability. Experiences including how a successful editing team was established and how the structure of chapters was chosen are well discussed in this paper.

**Keywords:** MEEP, Ocean Knowledge, Teaching Materials, Pre-College Students

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## 1. Introduction

In Taiwan as well as in many countries, courses related to natural science for those under age 18 are frequently limited. In general, these courses are quite fundamental such as mathematics, physics, chemistry, and biology etc. For those beyond above subjects, for example, engineering and modern technology, textbooks and teaching materials designed for teenagers and children are comparatively few. It consequently results in that students usually acquire the knowledge of these subjects only by reading informal books and surveying the websites. Unfortunately, the most serious problem may be that it is difficult for students, and even their parents, to ensure the accuracy and the precision of science-related information from common media, for example, internet websites, popular magazines, TV programs, etc. It means that editing suitable and reliable teaching materials of popular science is important for the pre-college education.

Taiwan, as an island country of 36000 m<sup>2</sup>, is surrounded by sea. It is logical to suppose that marine education must be a key part of subjects taught in all universities and schools. However, the truth is that ocean-related courses were comparatively few in earlier times. Recently, for the

sake of improving the marine education, the national integrated project, MEEP (Marine Education Enhancement Project), is supported and directed by Ministry of Education of Taiwan. This is a four-year project from August 2008 to July 2012. Main purposes of this national project are to spread and deepen the ocean-related knowledge to the public as well as students at all universities, schools and even kindergartens. Several sub-projects are included in MEEP. First, faculties in either marine- or non-marine-based universities are encouraged to deliver either professional or general courses involving ocean knowledge. It leads to the boom of various kinds of courses which include ocean engineering, ocean science, technology, marine creatures, marine biology, history, law, and even ocean-related art. The second part of MEEP provides a training opportunity for undergraduate student to be a part-time engineer at the shipyard, aquatic farm, or other factories. This makes students to have professional abilities before their graduation and therefore to have more potentials in looking for a job. For more information, a list of numbers of college students enrolled in and graduating from marine-related departments in 2001 and 2005 is provided in Table 1. Numbers of students studying ocean and machinery engineering, marine navigation, ship

management and marine fisheries are obviously more than those enrolled in other departments. Above statistic also reflects the number of job opportunities related to these departments.

The third part of MEEP, which is the core discussed in this paper, is to support and encourage faculties at universities to perform the editing projects of teaching materials. These materials are compiled specially for those who are under age 18. Due to a considerable wide range of ages of students, the teaching materials should be designed to be suitable for several levels. In Taiwan, these levels cover schools from elementary schools, junior high and senior high schools. In the following sections, details of editing the teaching material “Ocean science and technology” will be well discussed.

**Table 1.** Number of students enrolled and graduating from marine-related colleges and universities in Taiwan (2001 and 2005). At the same time, the population of Taiwan is about twenty three million

	Number of College Students		Number of University Students		Number of Graduate Students		Number of Doctoral Students		Total			
	2001	2005	2001	2005	2001	2005	2001	2005	Number of students enrolled		Number of students graduation	
Academic year	2001	2005	2001	2005	2001	2005	2001	2005	2001	2005	2001	2005
1 Ocean Law	0	0	0	0	80	117	0	7	80	124	20	47
2 Marine Biology	0	0	91	185	40	38	7	0	138	223	17	49
3 Marine Geology	0	0	0	0	33	25	5	2	38	27	10	9
4 Oceanography	0	0	276	173	235	259	63	85	574	517	124	114
5 Other Marine-related Sciences	0	0	0	0	7	27	0	0	7	27	0	11
6 Marine Measuring and Engineering	0	0	177	0	43	0	8	0	228	0	64	0
7 Marine Environmental Engineering	351	13	98	413	0	31	0	0	449	457	152	75
8 Marine River and Ocean Engineering	0	0	972	942	386	492	110	165	1468	1599	323	365
9 Marine Machinery Engineering	2095	1166	973	1431	264	197	47	19	3379	2813	839	670
10 Marine Food Science	468	251	199	582	0	23	0	0	667	856	112	207
11 Marine Fisheries	1828	653	1291	1846	287	401	79	78	3485	2978	805	793
12 Marine Navigation Shipping Management	872	586	575	571	74	105	0	0	1521	1262	358	336
14 Marine Tourism	440	240	0	0	0	0	0	0	440	240	0	236
15 Marine Sports	0	0	127	219	0	0	0	0	127	219	0	27
Total	8081	3367	6280	9006	1560	1965	332	381	16481	14719	3858	3980

Source: *White Paper on Marine Educational Policies* (in Chinese), p. 13.

## 2. A Team Work

As mentioned previously, the goal of compiling teaching materials is to convey the ocean-related knowledge to students at elementary schools, junior high schools and senior high schools. Consequently, we need teachers at different levels to join the project together. This team was led by a professor (PI, the author) of ocean knowledge. Other members of the team include teachers coming from schools of three different levels, i.e. elementary schools (age 6 to 12), junior high schools (age 12 to 15) and senior high schools (age 15 to 18). Three sub-leaders (Co-PI) at three levels are chosen to form a so-called “principal learning line”. The remained teachers at each level then constitute a “secondary learning line” led by their sub-leader. Figure 1 indicates that a tree-like structure conveying marine knowledge from the leader to teachers

involved is like the nutrients delivered from the roots of trees to all branches and leaves. Before compiling teaching materials, the leader has to teach and convey marine knowledge to three sub-leaders who will further be seed teachers to educate other teachers belonging to secondary learning line. Each sub-leader plays a key role because he/she has to learn ocean science from the faculty and then convey the knowledge to his/her colleagues at the same level. They are like stems which connect roots and leaves. In this project, the team has twenty five members working together and experiencing a wonderful time. The final results include not only teaching materials but also the successful training of tens of teachers. More importantly, after the project is finished, present team will turn into a sustainable society which continues to discuss, learn and convey ocean knowledge at their schools.

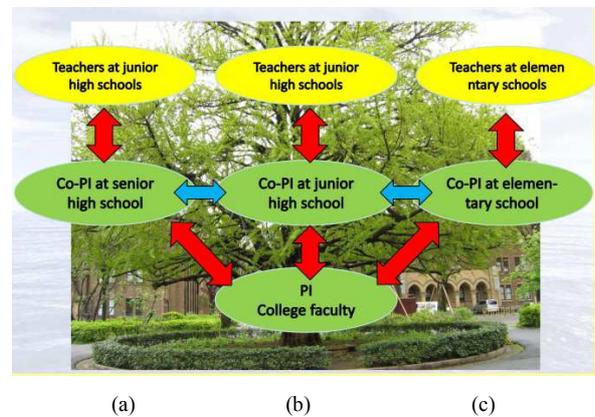


Figure 1. A tree-like structure of our team

## 3. Organization of Teaching Material

Because the knowledge of ocean includes fundamental science, engineering design, fishery and ocean biology, laws, arts and history etc, the important issue is to construct the organization of our teaching material. To focus contents on marine science and technology, eight chapters are organized as Figure 2. The sequence of chapters is the history, fundamental science and then technology. The reason for such an arrangement is that all experiences and development of marine science and technology definitely follow the past paces of history. Therefore, understanding the marine history is quite important to be first introduced (Chapter 1) among all chapters. This chapter contains the history of exploration, some important pioneers of exploration and the progress of ocean science. Next, the knowledge of ocean science forms the Chapters 2 to 4. Fundamental concepts of ocean, marine environment, waves and currents and climate are all contained in this part. Finally, the state-of-the-art technologies based on basic ocean science are the main concerns of Chapters 5 to 8. They include the ways of deep-sea exploration, development of marine resources (for example, energy, fresh water, oil and gas), space utilization (for example, the underwater tunnel) and environmental protection.

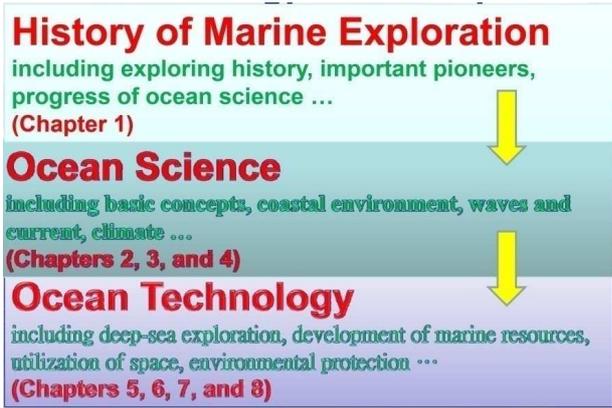


Figure 2. Organization of "Ocean science, technology and history"

### 4. Vivid Expressions: Example Pictures

Since our teaching material is designed for those who are under age 18, the expression and writing style must meet students' understanding capacity instead of the formal style of scientific textbooks used in universities. In this section, some example pictures which are drawn in simple and vivid styles are provided for readers' reference. For more information, please visit the MEEP website: <http://meep.moe.edu.tw>



Figure 3. Warship of Vikings

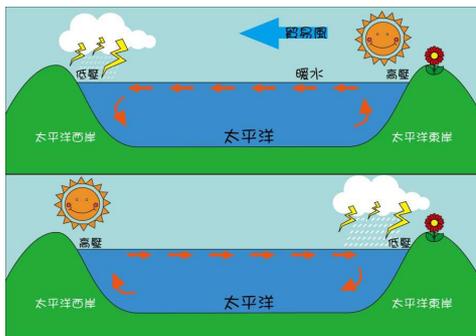


Figure 4. Ocean circulation in the Pacific Ocean without (upper) / with (lower) El Nino effects

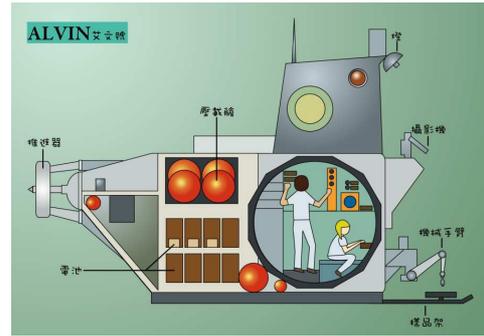


Figure 5. The famous submarine for deep-ocean survey: The Alvin



Figure 6. Design of undersea tunnel

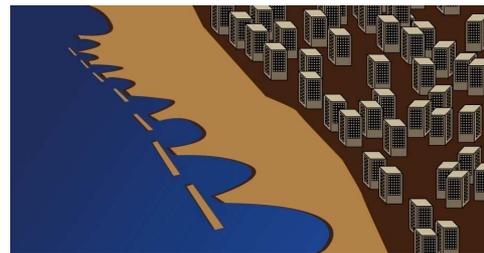


Figure 7. Offshore breakers

### 5. Conclusions

The Experiences of editing teaching materials are demonstrated in this paper. Not only three volumes of materials are completed for schools of different levels, but also we form a learning society constituted by teachers from pre-college schools. It gives a profound impact on the marine education in Taiwan.

### Acknowledgements

The author is indebted to the financial support from National Science Council of Taiwan with grant no. NSC-101-2221-E-270-001, and from Ministry of Education of Taiwan with grant no. MOE-098-05-05-2-23-5-02.

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