The Board Game Teaching with the Marine Science Educational Course on Students' Learning Motivation, Interest, and Achievement in Junior High School

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Abstract
Board games are innovative educational tools that may advance learning motivation, interest and enhance learning achievement. And the board-game teaching often offers a variation in the students, comparing with traditional teaching.
This study developed a Marine Science Educational Course for Junior high School Students and designed a board game combining the path of currents in the ocean and marine science concepts and emphasized on the garbage patches problems in the world as the primary educational tool in this course, which was named "M.O.S.". (Marine, Ocean, Sea)

The study used the standard experimental method on the classes, the experimental class and the control class with pre-test & post-test. The experiment class was taught by the board-game teaching while traditional teaching on the control class in this course. The study objects are the 9th students of 2 similar level classes in a junior high school in Taipei City. The experimental class contains 25 students, and the control class provides 26 students.

The purpose of this study was to advance the learning motivation, interest, achievement and further effects in marine science field of students. The expected result is that the board-game teaching has significantly positive impacts on students' motivation, interest, achievement and further effects in marine science field than the traditional teaching.

Keywords: Game-learning, board-game, marine education

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I. Introduction

1.1 General Background Information

Learning, should not be that teachers do one-way indoctrination of knowledge on students. Let students make some observation of environment by themselves, finding solutions of related environment problems, and make students meet what they need to do in actual life. If students can understand how to use the application of knowledge which they learing, they will be willing to learn and regarding as the worth doing.

Teacher's teaching method which can solve the puzzle of students, and increase students ' willingness of learning is the best method. In recent years, many teachers combine their own professional field, instead of the one-way teaching method, their teaching way with many innovatione tools, and take students as the main body. Among these methods, the teaching with the table games is more and more common. According to Taiwan Grade 1-12 Curriculum Guidelines, the marine education is one of four major education issues in Taiwan. Living with the island surround with the ocean, learning basic knowledge of the ocean, training the ocean literacy in life, and the respect for natural environment with the ocean, shaping "Being close to the ocean, Loving the ocean, and knowing the ocean" of education situation, making a silent transforming influence of students in the marine literacy. Therefore, by using the board game teaching method which with the Marine Science Educational Course to enhance the students ' motivation, interest, and achievement become the primary goal of this study.

1.2   Purpose of the Study

The target of this study are ninth-grade students in the Tapei country, planning a series of marine science education courses by using the board game teaching method to investigate students ' learning motive, interest, and achievement. The purposes of this study are below:

1.   Board-game teaching can enhance students ' learning motivation in marine science.
2.   Board-game teaching can enhance students ' learning interest in marine science.
3.   Board-game teaching can enhance student learning achievement in marine science.

II.   Literature review

2.1   Definition of Board-game

This study aims to explore the influence in the board games teaching pattern with marine science of students. Parlett (1999) defines the board game, explaining the word board game: Board originally refers to "flat". In literal meaning, board game is any plane (floor, table or other flat places) to play on.

In this study, we combine the viewpoints of various scholars and the meaning of board game, and define " board game " as follows:
1. Games that can operate accessories on any plane.
2. Activity with interaction and fun, people immerse in it.
3. With the rules, goals, losers and winners.

4. Activity with cooperation and competition.

5. The kind of spontaneous activity, making people emerge intrinsic motivation and learn.

2.2 The Meaning of Marine Science Education

UNESCO (UNESCO) published the report in 1988, seprating marine education into Specialized marine science education and General marine science education. The former is major training the professional marine science people with special skills, the latter is making international citizen of the ocean. Japan, the United States and the Australia pay attention to the marine basic knowledge and literacy. Not only putting the marine culture into the marine education, but also more emphasis on marine-related human resources development. In recent years, the climate changes problems like global warming, making the marine thinking way is more and more recommend between the nations. In October 2005, NOAA, COSEE, and NMEA published a list of 7 Essential Principles and 44 Fundamental Concepts that currently define Ocean Literacy. Ocean Science Literacy serves as a national standard for marine education.

2.3 Learning Motivation, Learning Interest, and Learning Achievement

Zhang Chunxing and Lin Qingshan (1989) interpret the term "interest" as "the inherent tendency of an active subject," and that interest is motive, the difference is only interested in the activities of the direction of the more focused, More specific. Thus, both "interest" and "motivation" can be seen as intrinsic causes of individual behavior. Furthermore, interest can be regarded as motive, but there are still differences between the two: First, interest is the focus of motivation, motivated by the act of special things tend to be called interest. Motivation can produce behavior, but motivation does not necessarily evolve into interest. Second, there are motives in the engine and the outside of the sub-machine, only the internal motivation can be interpreted as an interest. In the application of school education, the study interest is often used to explain the reasons for the success or failure of school children, such as a bad academic factors, usually attributed to "not interested", and that interests and learning motivation between the close relationship. As long as the appropriate motivation in the teaching and maintenance of student motivation, school children of all learning activities within the school, naturally interested.

Zhang Chunxing (1994) pointed out that the meaning of interest refers to the individual to the performance of a person or something to pay attention to the choice of the inner heart. Therefore, interest can be inferred from the explicit behavior, when there are a variety of things present in front of the individual, something in particular caused the attention of the individual, you can infer that he was interested. The second difference is that interest and motivation, the difference between the two is that the goal may not be achieved due to motivation, and interest is due to the motive of the target several times to be met, thus generating interest. Haussler et al. (1998) pointed out that subject-related interest can be divided into two different parts, the first part is the interest in learning the content of the subject, that is, the level of interest in knowledge, the second part for all teaching and learning and performance activities, Interest in arranging activities. Hoffmann (2002)indicted that interest has two levels, can be divided into the first level of personal interest for long-term impact; the second level of interest for the situation, for a short time around the impact. Based on the two-level interest classification, Hoffmann divides the interest into subject-based

learning interest and subject-related learning activity. The former refers to students 'interest in the subject text of the natural science textbook. The latter refers to students' interest in learning activities related to the content of natural science textbooks. Interest and interest in everyday life activities related to scientific topics, distribution of interests under the theme. In addition, Gardner's (1985) three items of interest include:

(1) interest in the subject matter, (2) interest in the subject-related activities of daily living, and (3) engaging in the subject matter of science and the activities of daily living. （Fan,2011;Tuan, Chin., & Shieh,2005；Sansone & Smith,2000；Pintrich & Groot, 1990）
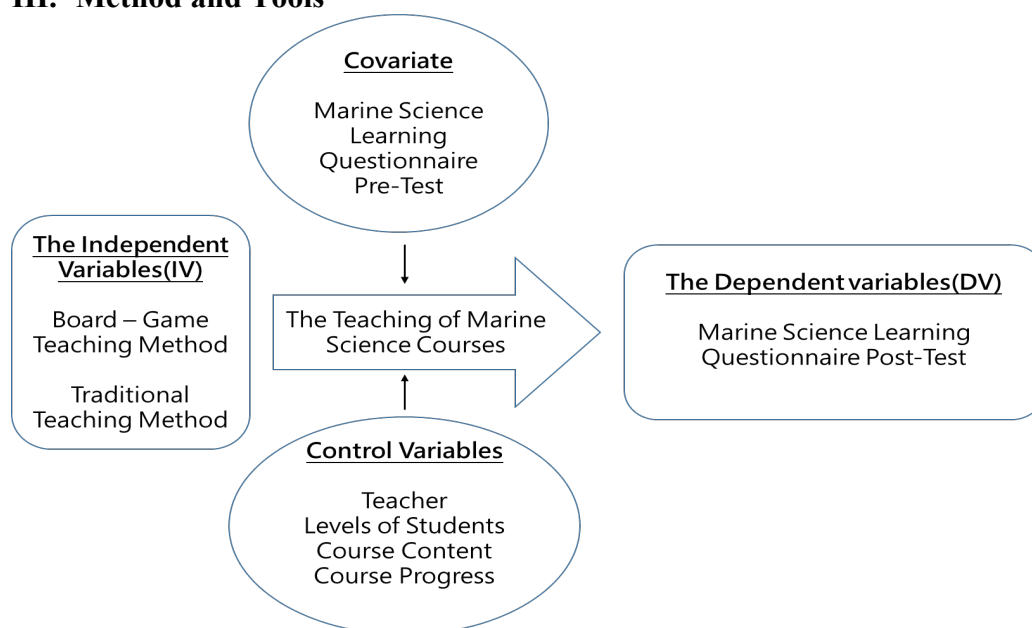
III. Method and Tools

Figure 1 Study framework

This Study made a research in two classes which have similar level in the junior high school in Taipei City through quasi- experiment method .The total subjects are 51 students, there are 25 students in the board game teaching experimental class, while there are 26 students in the traditional teaching control class. The board game "M.O.S." (Marine, Ocean, Sea) is the main auxiliary tools of the board game teaching experimental class , and the traditional teaching control class using direct-introducing teching method. Both teaching methods in classes with multimedia, the projection machine, and the a series worksheet. The research framework shown in figure 1 above.

3.1 Marine Science Learning Motivation Inventory:
The marine science motivation was measured by " Marine Science Learning Motivation Inventory " which includes four dimensions: (1) Attention (2) Relevance (3) Confidence (4) Satisfaction. Participants in the " Marine Science Learning Motivation Inventory " can choose five options, 5 for definitly agree, 4 for agree, 3 for normal, 2 for not agree, and 1 for definitly not agree. Then evaluating the score of the motivation Inventory, with higher score, means the participant had the higher level

of recognition in the dimension.

3.2 Marine Science Learning Interest Inventory:
The marine science interest was measured by " Marine Science Learning Interest Inventory " which includes (1)Feelings about the Ocean (2) Cognition Of the ocean (3) Action Of Marine Science. Participants in the " Marine Science Learning Interest Inventory " can choose five options, 5 for definitly agree, 4 for agree, 3 for normal, 2 for not agree, and 1 for definitly not agree. Then evaluating the score of the motivation Inventory, with higher score, means the participant had the higher level of recognition in the dimension.

3.3 Marine Science Learning Achievement Examination:
On the basis of tidal land published National Museum of maritime science and technology Digest (2014,01), the world fleet by cultures around the world published the ducklings (2013), the higher education publishing (National Taiwan Ocean University Professor series) of the marine education-understanding of teaching and learning (2012), National Geographic published One of the Ocean(2012) guidelines on environmental literacy teaching foreign literature and 95-104 higher secondary school subject logging question, the Marine Science Learning Achievement Examination is designed as the knowledge of marine science multiple choice question.

To improve the content validity of the questionnaire as a whole, prepared the first draft of the questionnaire is completed, 7 experts and scholars to assist in the identification of the questionnaire content representation and appropriateness as an expert according to content validity, confirmation preparation is complete, then pretest. Pretest of the targeted sample of 122 in grade nine students, upon analysis of the project removing inappropriate topics, questionnaire study of variable dimensions of average sampling variance (Average variance extracte) above 0.8, the combination of reliability (Component reliability) amounted to 0.9 per cent, and extracted variance is consistent with greater than 0.5 per cent, the combination of reliability coefficients are in very good (very good) area Combining reliability, 0.6 per cent for the right generally considered acceptable range of 0.5 per cent (Kline, 1998; Hair, 2010; Bogozzi & Yi , 1988; Diamntopoulos and Siguaw, 2000), and marine learning motivation scale and its interest in marine science scale factors, KMO 0.916 and 0.938, respectively, in accordance with this amendment is finalized. Official Qian measuring questionnaire Cronbach's alpha value in sea section learning motivation four frame surface, respectively for (1) Note: 0.876 (2) related: 0.851 (3) confidence: 0.839 (4) meet: 0.921, total table for 0.952; in sea section learning interest three frame surface, respectively (1) on marine of affection feel: 0.882 (2) on marine of cognitive: 0.954 (3) on marine science of action performance: 0.875, total table for 0.932. And in Hou measuring proceeds of Cronbach's alpha value data, haike learning motivation four frame surface, respectively for (1) Note: 0.915 (2) related: 0.823 (3) confidence: 0.815 (4) meet: 0.924, total table for 0.956; in sea section learning interest three frame surface, respectively (1) on marine of affection feel: 0.716 (2) on marine of cognitive: 0.827 (3) on marine science of action performance: 0.863, total table for 0.927. Conclusion this study scale letters school degree expedient, as shown in the following table 1~2.

Table 1　Component reliability of Pre-test

The Study Variables	Dimensions	Cronbach's α (Pre-test)	
Marine Science Learning Motivation	Attention	0.876	0.952
	Relevance	0.851	
	Confidence	0.839	
	Satisfaction	0.921	
Marine Science Learning Interest	Feelings about the ocean	0.882	0.932
	Cognition Of the ocean	0.954	
	Action Of Marine Science	0.875	

Table 2　Component reliability of Post-test

The Study Variables	Dimensions	Cronbach's α (Post-test)	
Marine Science Learning Motivation	Attention	0.915	0.956
	Relevance	0.823	
	Confidence	0.815	
	Satisfaction	0.924	
Marine Science Learning Interest	Feelings about the ocean	0.716	0.927
	Cognition Of the ocean	0.827	
	Action Of Marine Science	0.863	

Before this research in experiment teaching of experimental classes and control classes give junior high students board games teaching marine science education learning motivation, interest and study on the effect of pre-test of the questionnaire and give table games after finishing the experiment teaching marine science education on junior high students learning motivation, interest and effectiveness study of questionnaire survey and open attitudes questionnaire.

3.4 Marine Science Board-Game「M.O.S.」
This research design of teaching aids "M.O.S.", for Marine, Ocean, and Sea three a English word abbreviations, it was designed into the theme for marine garbage patches. The global main wind blow currents and the temperature salt circulation planning background route (as Figure II), and according to marine garbage of status problem and the reference Feller of 110 a marine fans thought combined marine science knowledge design out brand group, is divided into marine garbage brand (168 cards), and marine event brand (40 cards), and marine Miss card(40 cards), During the game, you can become familiar with the world's leading ocean thermohaline circulation and the flow and know what is marine debris marine influence, as well as the knowledge to understand the many myths of the sea, so as to promote ocean awareness and literacy.
"M.O.S." rules of the game are as follows:

1. Take 10 garbage hand cards in each group, select start IN the beginning (the Equatorial countercurrent), each set of starting points for the 80 points.

2. Call for Marine Ocean Sea determines the number of progress before his group (0~3), stay still repeat the action.
3. Plug in box number n: take n. garbage cards
    Stop on the arrow: saving animals animals or not.
    Animal rescue: according to different marine animals (30 points.)
    Whale: plastic bags, plastic bottles, plastic boxes, plastic sheeting
    Turtle: straws, forks, plastic bags
    Seals: fishing net, rope, rubber products
    Seabirds: lighter, canned food, tobacco
    Penguin: plastic caps, plastic particles, plastic debris
    Save animals: (20 points).
4. Park stream: Ocean events, based on the encounters.
    Stop in a cold stream: Miss the ocean, got 30 points, the wrong answer lose 30 points.
5. Yellow stars, you can choose to forward direction.
6. Circulation into delivery via conveyor belts, around to the point after the conveyor belt to another point.
7. meet in the same grid points average.
8. After 10 rounds, calculating points,
    total score= points - (number of hands cards X 3)
    the highest score is winner.

Figure 2   Board-game "M.O.S." background
"M.O.S." activities of the process carried out in groups, led by teachers who teams play, step at a time decided by the teacher called out when Marine Ocean Sea, than members of the group to rise a hand with 0~3 fingers, and total number of fingers presents the next groups step to go forward, increasing more fun to play and

participation.

The research program amounts to 12 courses in marine sciences, mining investment and multimedia about law in the course of the film in the control group; experimental groups were paired with a self-designed marine science teaching aid of table games, so as to promote marine-related knowledge learners ' motivation and interest in learning, curriculum planning, two in the following table.

IV. Results

4.1 Descriptive Statistics

After Experimental group and the control group of the students in marine science curriculum, the results of marine learning motive, marine learning interest and marine learning achievement Test in differences dimensions' descriptive statistics as the following tables, table IV, table V, as shown in table VI.

Table 3   Descriptive Statistics of Learning Motivation

Marine Science Learning **Motivation**	Class	Number of students	Average score	Total points of each Dimensions	Standard deviation
Attention	Experimental Class	25	17.840	25	2.9956
	Control Class	26	16.115	25	5.6237
Relevance	Experimental Class	25	15.320	20	3.3257
	Control Class	26	12.346	20	3.9592
Confidence	Experimental Class	25	12.080	15	2.2716
	Control Class	26	10.000	15	3.6000
Satisfaction	Experimental Class	25	17.920	25	4.5909
	Control Class	26	15.692	25	4.8807
Total score of all Dimensions	Experimental Class	25	63.160	105	1.9780
	Control Class	26	54.154	105	17.0756

Table 4　Descriptive Statistics of Learning Interest

Marine Science Learning **Interest**	Class	Number of students	Average score	Total points of each Dimension	Standard deviation
Feelings about the ocean	Experimental Class	25	11. 600	15	2. 3629
	Control Class	26	8. 885	15	3. 6805
Cognition Of the ocean	Experimental Class	25	15. 720	20	3. 0210
	Control Class	26	12. 154	20	5. 4310
Action Of Marine Science	Experimental Class	25	14. 080	20	3. 9149
	Control Class	26	11. 038	20	5. 3924
Total score of all Dimensions	Experimental Class	25	41. 400	55	8. 9907
	Control Class	26	32. 077	55	14. 1843

Table 5　Descriptive Statistics of Learning Achivement Test

Marine Science Learning **Achievement Test**	Class	Number of students	Average score	Number of questions	Standard deviation
Memory	Experimental Class	25	3. 760	4	0. 4359
	Control Class	26	2. 731	4	1. 6139
Understanding	Experimental Class	25	3. 360	4	0. 9074
	Control Class	26	2. 654	4	1. 2631
High - level thinking	Experimental Class	25	5. 360	7	1. 8000
	Control Class	26	3. 731	7	2. 0111
Total score of all Dimensions	Experimental Class	25	12. 520	15	2. 6000
	Control Class	26	9. 115	15	4. 2926

4.2 One-way analysis of covariance

1.　Experimental group and control group before the students ' learning achievement scores for all variables, variables in teaching law, post-test scores for the dependent variables, covariates of single factor analysis are shown in the following table 7~ 10. In table 7, experiment group and control group in "marine science learning motivation" of "Relevance " (F= 6.852,p=0.012<0.05), and "Confidence " (F= 6.409,p=0.015<0.05) to degrees up significantly differences, so " Board-game teaching can enhance students ' learning motivation in marine science " should to accepted. In table 8, experiment group and control group in "marine science learning

interest" of "Cognition Of the ocean " (F= 4.183,p=0.046< 0.05) to degrees up significantly differences, so " Board-game teaching can enhance students ' learning interest in marine science " should to accepted. Statistics results of experiment group and control group in marine science learning achievements test in "memory" (F= 9.921,p=0.003<0.05), and "understanding" (F= 5.109,p=0.028<0.05), and "high-level thinking" (F= 10.464,p=0.002<0.05) and "total" (F= 158.338,p=0.001<0.05) are significant differences, so " Board-game teaching can enhance student learning achievement in marine science " should be accepted. And in the descriptive part, the experimental group outperformed the control group shows board game teaching method on marine science learning motivation and interest in marine sciences and marine science learning with good results .

Table 7 The Covariance of Marine Science Learning Motivation

Motivation Dimensions		SS	DS	MS	F	P
Attention	Between groups	39. 136	1	39. 136	1. 881	0. 177
	Within groups	998. 752	48	20. 807		
Relevance	Between groups	92. 386	1	92. 386	6. 852*	0. 012
	Within groups	647. 231	48	13. 484		
Confidence	Between groups	59. 082	1	59. 082	6. 409*	0. 015
	Within groups	442. 458	48	9. 218		
Satisfaction	Between groups	65. 552	1	65. 552	3. 007	0. 089
	Within groups	1046. 337	48	21. 799		
Total	Between groups	997. 024	1	997. 024	4. 468*	0. 040
	Within groups	10710. 72	48	223. 140		

*p <.05   **p <.01   ***p <.001

Table 8   The Covariance of Marine Science Learning Interest

Interest Dimensions		SS	DS	MS	F	P
Feelings about the ocean	Between groups	5. 730	1	5. 730	0. 691	0. 410
	Within groups	398. 229	48	8. 296		
Cognition Of the ocean	Between groups	57. 692	1	57. 692	4. 183*	0. 046
	Within groups	662. 096	48	13. 794		
Action Of Marine Science	Between groups	34. 101	1	34. 101	1. 897	0. 175
	Within groups	862. 902	48	17. 977		
Total	Between groups	4. 823	1	4. 823	0. 047	0. 828
	Within groups	4876. 228	48	101. 588		

*p <.05   **p <.01   ***p <.001

Table 9 The Covariance of Marine Science Learning Achievement Test

Achievement Test Dimensions		SS	DS	MS	F	P
Memory	Between groups	14. 144	1	14. 144	9. 921**	0. 003
	Within groups	68. 432	48	1. 426		
Understanding	Between groups	6. 347	1	6. 347	5. 109*	0. 028
	Within groups	59. 635	48	1. 242		
High-level thinking	Between groups	37. 752	1	37. 752	10. 464**	0. 002
	Within groups	173. 168	48	3. 608		
Total	Between groups	158. 338	1	385. 184	158. 338**	0. 001
	Within groups	606. 257	48	12. 630		

*p <.05   **p <.01   ***p <.001

V. Conclusion

Based on the above findings, where you can find board games teaching in marine science learning motivation and interest in marine science and ocean science learning achievements are directly about teaching effect for better than the traditional teaching, the detailed explanation is as follows:

First, in terms of marine science learning motivation, in addition to "Attention, Satisfaction " two dimensions are not significantly different, the other dimensions "Relevance,Confidence and Total" are significant in the board game teaching method.

Second, in terms of marine science learning interest, "Cognition" perspectives presents significant differences, but in "Feelings about the ocean, Action Of Marine Science " and "Total score" the game teaching method has no significant differences. That shows students ' learning interest of game teaching method in "Cognition" in general good.

Third, marine science learning achievement tests in the "memory, understanding, high level thinking and the toal" dimensions are significantly better in the board game teaching.

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